

Innovation at Canadian Colleges and Institutes

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EXECUTIVE SUMMARY

All of the 157 publicly funded colleges and institutes in Canada, to some extent, conduct innovation activities. These range from project based academic delivery in which senior students address a specific problem for a local industry to colleges/institutes that provide applied research results to the private and public sectors around the world.

This report describes:

- policies, programs, practices and administrative structures that exist to support innovation at colleges and institutes;
- sources of funds to support the college/institute role in innovation;
- human resource issues associated with innovation activities;
- current practices and models used to support innovation;
- benefits associated with the college/institute role in innovation;
- student involvement in innovation activities;
- current challenges and recommendations to support the further develop innovation at colleges/institutes.

Colleges/institutes can be characterized by four models or states of development in relation to innovation. These are:

- those institutions with no formal innovation structure or policies
- novice innovation institutions
- established innovation institutions and
- integrated innovation institutions.

Colleges/institutes in each of these models/states have distinct challenges. The primary challenges that limit college/institute innovation activities and the associated recommendations to funding agencies are as follows:

1. With rare exception colleges/institutes do not receive core funding to cover the expenses associated with innovation activities (most notably salaries). As many funding programs have been developed with the university community in mind where researcher salaries are supported through core funding, research grant programs rarely support researcher salaries. This gap in support is the primary limiting factor for innovation activities at colleges/institutes.

Recommendations:

- Develop college/institute specific programs that fund the salaries or backfill costs of researchers. Build on the model used by the NSERC College Community Pilot that is currently being implemented.
- Expand the NSERC College Community Pilot as soon as possible on the basis of the success of the initial call for proposals and interim results of the funded projects.

- Implement the recommendations of the ACCC report provided to SSHRC. Most significantly reconfigure the SSHRC standard research grant program or provide a separate program to address the need to support salary or backfill costs for researchers in colleges and institutes.
 - Establish a College/Institute Chairs program focused on the application of knowledge rather than the development of new knowledge. This program would ensure that faculty would be at the forefront of research and development and meet the needs of industry. This program would support the salary of the faculty as well as provide funding for capital and operating costs for a significant period of time eg. five years.
 - Include colleges/institutes as eligible partners in industry based innovation grant programs which provide some support for salaries.
2. The measures of capacity and productivity of colleges and institutes used by granting agencies should address the outputs of applied research and development activities rather than focusing on basic research outputs.

Recommendation:

- Rather than measuring productivity on the basis of research publications and formal presentations at scientific conferences, output measures should be associated with disclosures, patents, prototypes or significant improvements to products and processes that are being implemented and used in society.
3. Many colleges/institutes have commenced innovation activities within the last ten years. As such they do not have a long history of productivity in relation to these activities.

Recommendation:

- Implement a funding program based on the value of the project and likelihood of success and reduced emphasis on the history of the researchers involved.
4. Often there is a lack of knowledge concerning the capacities and needs of colleges and institutes in the membership of many funding proposal review and adjudication committees

Recommendation:

- Include members from colleges and institutes on funding proposal peer review and adjudication committees. This will not only increase the collective knowledge of colleges/institutes on these committees but also increase the knowledge of university members concerning the capacity and needs of colleges/institutes.
5. There is ongoing need for support of new and renewal of existing capital infrastructure

Recommendations:

- Continue to support CFI and other granting programs that allow colleges and institutes to gain and renew research infrastructure.

- Strategic grants should require at least one of the partners be a college or institute. This will increase capital resources to colleges/institutes and increase the opportunity for collaboration between these partners
6. Due to a lack of funding and systemic barriers it is difficult for faculty at colleges and institutes to network and develop joint innovation activities with other researchers in their field.

Recommendation:

- Develop or expand existing collaborative research networks to include colleges/institutes and their faculty. Change the eligibility requirements for the National Centers of Excellence program so that colleges/institute may bring their expertise to these centers. This would provide benefits not only to college/institute faculty but university and government researchers as well.
7. A significant limitation particularly in smaller colleges/institutes is the limited resources available to support the administration of innovation activities.

Recommendation:

- Develop college/institute programs that support the salaries of those involved in the administration of innovation activities. This program could be targeted at medium and small institutions.
8. There is a need to increase the knowledge of novice innovation institutions in regards to proposal writing, the development of and management of innovation based partnerships, the administration of research grants, and the management of the technology transfer process including management of intellectual property.

Recommendation:

- Support college/institute participation in the programs that provide professional development and mentorship for research administrators. Support college networks that have applied to the Tricouncil Intellectual Property Mobilization Program.
9. Colleges/Institutes graduate many highly skilled personnel to Canadian society with skills derived through their involvement in innovation activities, particularly those learned through project based delivery. These are rarely supported or even considered by funding agencies when assessing grant proposals.

Recommendation:

- Include the benefits to students in grant adjudication processes as done in the NSERC College Community Pilot Program

The primary challenges to colleges/institutes and the associated recommendations to colleges and institutes are as follows:

1. Novice innovation institutions currently spend much of their time learning how to become involved with and administer innovation activities rather than conduct the actual research and development activities.

Recommendations:

- College/institute associations and individual institutions should share their knowledge with novice innovation colleges/institutes through national and regional workshops and mentoring programs
 - Colleges and institutes should participate in regional clusters and other economic development organizations to improve communication, share knowledge, develop partnerships that support innovation
 - Colleges/institutes should become members of associations that link technology transfer organizations
 - Colleges/institutes should be come involved in networks supported by the Tricouncil Intellectual Property Mobilization program
2. The innovation capacity of colleges and institutes is not well known to many aspects of society including funding agencies and many potential private sector partners.

Recommendations:

- Through associations and as individual institutions publicize innovation successes.
 - Individual colleges/institutes and regional college/institute associations should establish and actively meet to discuss college/institute needs and capacities with the regional administrators of granting agencies eg. Industry Canada regional programs ACOA, FEDQUE, FEDNOR, WED as well as administrators of provincial/territorial programs.
3. NRC-IRAP has historically been a significant partner in the support of innovation activities at colleges and institutes. In recent years this relationship has languished.

Recommendation:

- Individual institutions and college/institute associations should reestablish the relationship with NRC-IRAP through discussions at a local and national level.
4. The federal and provincial/territorial government departments and programs play a key role in the support of innovation activities at colleges/institutes. At the current time many opportunities exist to improve existing programs and to increase the support of innovation at college/institutes. These opportunities cannot be effectively pursued with the current resources within college/institute associations. While association members can provide some support they do not provide the continuity of a permanent employee.

Recommendation:

- Increase the resources associated with innovation in within ACCC and regional societies to support more effective liaison with government departments and programs.

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I. INTRODUCTION

Innovation as used in this study is defined as the process through which commercial concepts are developed into marketable products, services and processes <http://www.innovationstrategy.gc.ca>. Through innovation, knowledge is applied to the development of new products and services or to new ways of designing, producing or marketing an existing product or service. Canada's innovation capacity is near the bottom of world leading economies based on: research and development spending as a percent of gross domestic product; the number of national and external patent applications; and the amount of human capital devoted to research in relation to the size of workforce (Anonymous 2004. Exploring Canada's innovation Character, Benchmarking against global best. The Conference Board of Canada. 49pp.)

Lower innovation capacity results in the production of lower value added products for mature rather than new and growing markets. It also results in an economy with less efficient production, distribution and marketing systems. This, in turn, has resulted in lower competitiveness, a lower gross domestic product, a reduced standard of living and lower productivity in relation to our primary trading partners. <http://www.weforum.org/> Consensus has developed amongst Canadian government, academic institutions and industry that to improve economic performance and productivity Canada must become more innovative.

The Innovation Process

Commercial concepts must be taken through the innovation process (Appendix 1) to be developed into marketable products, services and processes. The focus of Canada's Innovation Strategy has been the generation of commercial concepts developed out of basic research. Applied research is conducted to establish if the commercial concept is viable. If the applied research generates a viable proof of concept and prototype, then production engineering and market studies are necessary to establish how best to produce and market the product. Finally if the product is successful in a small market, production is scaled up into mass production and customization for national and global markets. It is in the final stage where significant economic and social return on the investment in basic research and innovation is realized. This process requires the investment of significant fiscal resources, the availability of a broad range of highly qualified personnel and typically three to ten or more years of work. An extreme example of the resources required is the product development and commercialization of new pharmaceuticals that may require more than \$300 million US and 12 to 15 years.

While much attention and resources have been devoted to the stimulation of basic research (research push) to generate commercial concepts, many commercial products and improved processes arise from the incremental modification of existing products/processes to meet market place demand (market pull). These concepts may develop as a result of the integration of existing technologies to produce new products/processes or modification of an existing product/process to address a new market. These concepts typically arise from the market place itself. The time required from initial development of the commercial concept to market is significantly shorter than new products based on new basic research results. These innovations are in generally incremental in nature rather than new market disruptive technologies. They are often conceived by Small and

Medium sized Enterprises¹ (SME's) that are located throughout Canada in large and small urban centers as well as rural and remote Canada.

College/Institutes and Innovation

The traditional role of colleges and institutes has been to support economic development by providing graduates to the public and private sectors that would support the development, production, sales, delivery and maintenance of products and services <http://www.accc.ca/english/colleges/index.cfm>. These education and training activities have been and will remain the primary role of colleges/institutes in supporting the economic well being of society.

In order to ensure relevant curriculum, colleges/institutes and employers (often SME's) have developed close ties focused on training or retraining participants in the regional workforce. These relationships have often resulted in colleges and institutes responding to regional industry needs by embarking on a variety of innovation activities. These most often have supported business development in general and include the development of a more innovative culture within the corporation. A significant number of colleges and institutes have built upon these relationships and conduct applied research, proof of concept and prototype development to support corporate innovation.

Colleges and institutes have a many characteristics that could be used to facilitate innovation in large and small urban and rural communities on a sustainable basis throughout Canada:

1. The 157 publicly funded colleges and institutes have physical presence in more than 900 urban, rural and remote communities and therefore are in close proximity to SME's throughout Canada.
2. Colleges and institutes have a long history of developing successful partnerships and conducting projects involving both the private and public sectors. This expertise can be used to expedite the flow of ideas and facilitate resolution of inter organizational issues that might otherwise impair the innovation process
3. The focus of college and institutes activities is the practical application of knowledge in response to the needs of the local and regional economy. It is practitioner and industry focused. This has resulted in the attraction and development of faculty/staff expertise that is directly related to local and regional needs.
4. The establishment of degree granting status of colleges and institutes during the last ten years in several provinces has increased the opportunity and support for faculty to conduct scholarship including applied research, proof of concept and prototype development activities.

¹ Small and Medium Sized Enterprises are defined as firms with 500 or fewer employees.

5. Many faculty in colleges and institutes have worked in the private sector and thus have knowledge as to the entrepreneurial culture and expectations of industry.
6. Innovation activities at colleges and institutes have often been conducted in conjunction with academic delivery. This project based academic delivery not only provides the results that industry requires it also further develops the technical and generic skills of graduates from post basic, technologist and degree programs. This is a critical role for colleges/institutes as it not only directly supports innovation it provides potential employees with skills that will carry innovation into the workplace throughout Canada.
7. Colleges and institutes have proven that they are cost effective and productive in support of innovation.
8. Innovation at colleges and institutes has developed based on industry needs, market potential and support of local economic development rather than from the drive to commercialize intellectual property i.e. based on market pull rather than research push.
9. As innovation activities are conducted in partnership with industry intellectual property issues are relatively easily resolved and there is a private sector partner immediately available to take the results of the applied research, proof of concept and/or prototype to market.
10. The close relationships with the private sector results in assessment and development of commercial concepts within the context of industry knowledge of the commercial market. This minimizes the resources expended on concepts that have little commercial viability.
11. Commercial concepts that arise from the new application of existing knowledge, the integration of existing technologies or improvements in product/process development are particularly suited to the interests, role and capacity of colleges and institutes.

Scope

This report will review the current state of innovation at colleges and institutes in Canada. It will describe the conditions that are necessary and sufficient for sustained innovation activities and provide recommendations as to how the untapped potential of colleges and institutes could be used to support innovation throughout Canada. Based on the provisions of my professional development leave and the contract with ACCC it will:

1. describe the policies, programs, practices and administrative structures that exist to support innovation at colleges and institutes;
2. identify sources of funds to support the college/institute role in innovation;
3. discuss human resource issues associated with innovation activities;
4. describe the current practices and models used to support innovation;
5. describe the benefits associated with the college/institute role in innovation;
6. describe student involvement in innovation;
7. identify current challenges facing innovation at colleges/institutes;
8. and provide recommendations to further develop innovation at colleges/institutes.

Due to the wide scope of the report it will not be exhaustive rather it will provide an overview of the above topics in relation to Canada's community colleges and institutes.

This study will not address activities at colleges/institutes that pertain to:

1. research concerning pedagogy and/or institutional effectiveness;
2. sector and market research focused on development or revision of college/institute programs and services;
3. support of business development except where it involves the development of "spin-off" business associated with innovation.

II. PUBLIC POLICY & INVESTMENT

Historically businesses and governments in Canada have invested less than our international competitors in research and development. However since 1997 the federal government has increased public investment in basic research activities through the Canadian Foundation of Innovation, Canadian Institutes of Health Research, Social Sciences and Humanities Research Council, and Natural Science and Engineering Research Council. This has significantly increased basic research and to some extent increased the generation of commercial concepts. Significant time is required between increased investment in basic research and the release of new products in the market. The number of commercial concepts based on the application of existing knowledge to new fields and the integration of existing technologies to produce new or higher value products and services has also increased. This occurs significantly faster than the development of new products based on new basic research. While there have been impressive gains in the development of commercial concepts, the ability to convert these concepts into marketable products and services is lagging.

While investment has increased, Canada remains behind its international competitors in funding research and development. Since 1997 the total investment in research and development from the public and private sectors has increased from 1.68 to 1.94% of gross domestic product in 2001 and 1.85% in 2002. This rate of investment remains significantly lower than that of our primary trading partners eg. United States 2.82% with the average in developed countries of 2.33% <http://oberon.sourceoecd.org/vl=9274964/cl=30/nw=1/rpsv/factbook/06-01-01.htm>. Corporate investment in research and development, especially in the communications sector, was significantly reduced by the burst of the technology bubble in 2001. However more recently there are indications that overall spending has grown and the availability of venture capital has returned to previous levels <http://www.researchinfosource.com/2004-analysis.pdf>. To a major extent this has been stimulated by the introduction of federal tax incentive programs associated with the investment in the development of new products and processes. These programs are described and an evaluation of their effectiveness is presented by the federal government at http://www.fin.gc.ca/toce/1998/resdev_e.html.

As the Canadian investment rate remains low in comparison to international competitors fewer marketable products/services are developed and those that are developed typically require longer to reach the market. Often Canada becomes a market for products rather than the manufacturer or service provider and loses much of the economic benefit of the basic research (Anonymous 1999. Public Investments in University Research: Reaping the Benefits. Report of the Expert Committee on the Commercialization of University Research. 65pp.)

The innovation strategy of Industry Canada suggests that the annual investment in innovation at Canadian Universities and Colleges/Technical Institutes should double and commercialization of research results should triple in order for the Canadian economy to remain competitive <http://www.innovationstrategy.gc.ca>. The current federal government and opposition parties have all shown their commitment to Innovation. The current federal government has proposed significant additional investment in research and development (Anonymous 2005. Interview of David Emerson Industry Minister. The Hill Times, 7-13 March).

Federal Government Policy/Programs

Colleges/institutes in most instances are constituted under the legal jurisdiction of provinces /territories. Thus while the federal government may support innovation in these institutions the provincial/territorial governments govern whether or not colleges and institutes may be involved with formal innovation activities.

In recent years the potential for innovation at colleges/institutes has gained increased recognition by the federal government. The Innovation Strategy developed by Industry Canada <http://www.innovationstrategy.gc.ca/gol/innovation/interface.nsf/engdocBasic/3.html> specifically refers to colleges and institutes as having a significant potential for the support of innovation tailored to local/regional needs. As this is a relatively new role for many colleges/institutes, gaps exist in policies and fiscal resources to support that role. In addition policies and practices that support innovation have often been developed with university or industry needs in mind rather than those of colleges/institutes. While a number of these gaps have been addressed it is evident that many gaps still exist. Specific programs or changes to existing programs so that they support college/institute needs within the context of industry partnerships and clusters are required.

1. Natural Science and Engineering Research Council (NSERC)

NSERC is one of the primary federal government agencies that support research activities at universities. It invests over \$700 million per annum through competitive research grants. While the vast majority of programs support universities to conduct basic research, NSERC programs also supports the management of intellectual property and to a lesser extent the commercialization of research results. Recent increased emphasis on innovation has resulted in a greater expectation of commercialization of products based on the results of basic research. NSERC has become more aware of the untapped capacity at colleges and institutes for innovation. As a result in 1999 NSERC attempted to support research activities at colleges/institutes using university infrastructure and partnerships. Colleges were allowed to be co-applicants with universities. http://www.nserc.ca/professors_e.asp?nav=profnav&lbi=11a1 Unfortunately this initial attempt has had limited success primarily as it did not address specific college/institute needs (primarily the inability to directly support the salaries of researchers).

In 2002 NSERC management visited colleges/institutes across Canada and found them engaged “not in research as NSERC knows it, but a vibrant range of innovation activity contributing to local and regional economic development.” <http://www.nserc.gc.ca/news/2004/p040212.htm> . In 2003 NSERC’s new vision included a commitment to increase innovation at the community level. As a result NSERC worked in conjunction with ACCC to develop a program that would increase the capacity of colleges/institutes to support innovation at the community and/or regional level. The College and Community Innovation Pilot Program is the result. The pilot expands NSERC’s sphere of influence to support innovation at the community level. It complements other NSERC programs that support technology transfer however a number of these programs do not address college needs.

The College and Community Innovation Pilot Program attracted thirty-one applications from throughout Canada. The application and adjudication processes are notably different from those involving universities. The eligible expenditures funded are geared to college/institute needs.

Specifically, the pilot provides teaching release time for faculty; supports student involvement; requires outreach to the public or private sector in the community; supports commercial concept evaluation as well as prototype development. The program supports the building of capacity within the college/institute and contrasts with typical NSERC programs in that the college/institute is the recipient of the grant rather than the individual researcher. Thus the commitment of the college/institution to innovation is critical to the success of the application. The scope of the NSERC college community pilot is limited to six projects. Each project is provided a base level of \$100,000 per year for three years with the possibility of leveraging funding from partners for additional funding of \$100,000 in year two and \$200,000 in year three. This funding formula places significant emphasis on partnership development and the support of local/regional industry, historic strengths of Canadian colleges and institutes

<http://www.nserc.gc.ca/news/2004/p040212.htm>

It is hoped that the number and quality of applications and the success of the funded projects will encourage NSERC to move the program beyond the pilot stage. Presentations at the ACCC Colleges and Institutes Applied Research Symposium held in February 2005 discussed the pilot project, the specific projects funded, provided an overall critique of proposals that were not funded and indicated the future directions of NSERC in relation to the support of innovation activities

<http://www.accc.ca/english/events/reports.cfm>

In January of 2005 the three federal granting councils (Tricouncils) expanded the eligibility requirements associated with the Intellectual Property Mobilization Program so that colleges/institutes may be eligible as partners with a university.

http://www.nserc.gc.ca/professors_e.asp?nav=profnav&lbi=b6 As a result a number of proposals have been made by consortia of colleges and universities from several regions in Canada to access support through this program. The objective of the program is to accelerate the transfer of knowledge and technology residing in Canadian universities, hospitals and colleges for the benefit of Canada. Specifically this program helps institutions gain the knowledge and expertise to manage and commercialize intellectual property. It also has the potential to increase the collaboration among colleges/institutes and universities in regards to intellectual property management and commercialization.

Based on the above, NSERC has taken significant steps to support innovation at colleges and institutes. It is hoped that the existing programs will be expanded and more programs redesigned to support the role of colleges and institutes in innovation. For example colleges and institutes are not currently eligible for the NSERC Idea To Innovation Program

http://www.nserc.ca/professors_e.asp?nav=profnav&lbi=b4. Access to this program would significantly increase resources available to support innovation at colleges and institutes.

2. National Research Council (NRC)-Industrial Research Assistance Program (IRAP)

NRC-IRAP helps build the innovative capabilities of SMEs that are incorporated in Canada. IRAP's Industrial Technology Advisors work with clients, helping them assess their innovation requirements and locate the expertise, technologies and partners they need to make their business grow. IRAP serves more than 12,000 SME's annually - offering firms a mix of advice, referrals, and in some cases, financial assistance. Colleges/institutes have often provided physical space and

services to support IRAP's industrial technology advisors <http://www.nrc.ca/irap>.

Colleges/institutes have typically become involved in IRAP funded projects as partners with or sub contractors of private sector companies who require applied research, prototype development and product/process engineering services. The expertise residing in the college/institute has been used to conduct this work. In some instances new companies have been formed or expanded in direct partnership with colleges/institutes as a result of IRAP programs eg. research and development associated with the commercial breeding and commercial production of Tilapia fish at the Frost Campus of Sir Sandford Fleming College in partnership with Stokes Sea Farms.

3. Canadian Institutes of Health Research (CIHR)

The following extract is from the CIHR website. It provides an overview of the scope of CIHR activities. (www.cihr-irsc.gc.ca)

What is CIHR?

- Canada's premier health research funding agency funds over 8,500 researchers in universities, teaching hospitals, and research institutes across Canada
- Invests in high quality people, excellent science and training the next generation - the backbone of a knowledge-based economy
- \$662 million budget for 2004-2005
- 94 cents of every dollar CIHR receives from the federal government goes directly to Canadian health researchers in every province across the country

CIHR mandate

“To excel, according to internationally accepted standards of scientific excellence, in the creation of new knowledge and its translation into improved health for Canadians, more effective health services and products and a strengthened Canadian health care system.”

Faculty at all post secondary institutions including colleges and institutes are potentially eligible for CIHR funding. However, significant restrictions concerning the use of funds to support researcher salaries have limited the participation of colleges/institutes in CIHR programs. Some have participated in CIHR programs as collaborators with other eligible institutions. Recently CIHR has expressed interest in provided improved support for innovation activities at colleges/institutes particularly in support of technology development and technology transfer activities. More information concerning CIHR programs was presented at the ACCC 2005 College and Institute Applied Research and Development Symposium <http://www.accc.ca/english/events/reports.cfm>

4. Social Sciences and Humanities Research Council (SSHRC)

Faculty at all post-secondary institutions in Canada including colleges/institutes are potentially eligible for SSHRC funding http://www.sshrc.ca/web/home_e.asp. College/institute faculty may act as the applicant, a co-applicant or collaborator. However relatively few colleges/institutes faculty have applied for and been funded by SSHRC. Annually since 1999 less than 0.5% of the

standard research grants awarded by SSHRC have been provided to faculty at colleges/institutes (Appendix II). A primary factor that has limited the number of college/institute faculty from applying to SSHRC is due to the need for the institution to commit to the support of 50% of the backfill costs as outlined in the following extract from the SSHRC web site:

“For applicants successful in the Standard Research Grants competitions, SSHRC will fund a maximum of \$15,000 of release time over the course of a three-year grant for a limited number of highly-ranked applicants who are able to secure one-to-one matched funding from their universities. Therefore, for the [applicant](#) (principal investigator) and for each [co-applicant](#) (co-investigator), you may request a maximum total of \$30,000 over three years, with half that amount to come from the university and half from SSHRC”

http://www.sshrc.ca/web/apply/policies/g_stipends_e.asp

During 2004/05 SSHRC conducted a consultation process to define its future direction. In October of 2004 ACCC provided a submission to that consultation process that outlined a number of issues that impede the participation of colleges/institutes in SSHRC programs including but not limited to the full funding of faculty release time. (Anonymous 2004. Consultation with Canadian Colleges and Institutes Presented to SSHRC; submitted by ACCC. 48 pp) The report on consultations of SSHRC (Anonymous 2005. From Granting Council to Knowledge Council: Renewing the Social Sciences and Humanities in Canada) did not reference the ACCC submission nor did it indicate a change in policy that would increase support for faculty at colleges and institutes.

5. The Canadian Foundation for Innovation (CFI)

The Canadian Foundation of Innovation (CFI) is an independent corporation established by the Government of Canada in 1997. The goal of the foundation is to strengthen the capability of Canadian universities, colleges, research hospitals, and other not-for-profit institutions to carry out world-class research and technology development. In addition, CFI helps to improve Canada's capacity for innovation, attract and retain highly skilled personnel in Canada, strengthen research training, promote networking and ensure the best use of Canada's research infrastructure <http://www.innovation.ca/index.cfm> .

Since 1999 CFI has provided funding to colleges and institutes for the development of research infrastructure through the Innovation Fund and the College Research Development Fund. In total CFI has provided \$2.769 billion to support research infrastructure development to 3,583 projects at Canadian academic institutions and research centers. Approximately \$28 million (10% of total CFI funding) has been provided to 68 projects at 30 colleges and institutes. The web site provides a searchable database that provides information concerning all of the projects funded. CFI provides 40% of the funding necessary for infrastructure. CFI grants are typically matched through provincial government programs with an additional 20% supported by industry, foundations or institutional funds. CFI also provides infrastructure operating grants to aid in the support of the infrastructure.

In the spring of 2005 CFI introduced the Leading Edge Fund that supports the renewal of research infrastructure at universities, research hospitals and colleges/institutes.

CFI has provided critically needed support for research infrastructure. It has been a primary catalyst for much of the innovation activities conducted by colleges/institutes especially those who have entered into innovation activities since 1999.

6. Industry Canada

Industry Canada has recognized the potential for colleges/institutes to support regional economic development for some time. Industry Canada has regional programs (eg. ACOA; FedQ, FedNor, WED) that have directly and indirectly supported college/institute innovation as partners with industry and other levels of government.

Most notably Industry Canada has provided infrastructure support to colleges/institutes to aide in the establishment of offices of research. Industry Canada supports innovation through a number of agencies and programs that may make use of college/institute expertise eg. Precarn

Industry Canada-Precarn

Founded in 1987, Precarn is an independent, not-for-profit corporation that funds, promotes and helps manage collaborative industrial R&D projects in the field of intelligent systems. In 1990, Precarn created, and since then has managed, the Institute for Robotics and Intelligent Systems (IRIS), one of the federally funded Networks of Centers of Excellence. Precarn oversees Canada's intelligent systems network, currently consisting of several hundred executives, entrepreneurs, scientists, engineers, other professionals and students, located in private, academic and public sector organizations across Canada. (<http://www.precarn.ca>)

In discussions of future directions Precarn states that.... "Directed support for university research must therefore continue to be an essential element of a strategy to build innovative intelligent systems companies. Precarn proposes to maintain a University Research element to hold the IRIS network together, and build on it. IRIS is supported until March 31, 2005 through the NCE Program. After that, this evolving element will be expanded and merged into a unified Precarn approach to the support and commercialization of technology, including a proposed role for community colleges. Supported research will be inspired by users in the private sector and will involve companies as participants or in support roles."

<http://innovationstrategy.gc.ca/gol/innovation/interface.nsf/vSSGBasic/in02382e.htm>

As a result of the above Precarn is actively seeking advice as to how to most effectively support colleges/institutes as partners in the innovation process. At the presentation at the ACCC 2004 National Conference in Saskatoon Precarn asked for advice for the most appropriate method of supporting colleges and institutes in the next phase of their program. This program proposal will be submitted in the spring of 2005.

7. The National Centers of Excellence Program (NCE)

Three federal granting agencies — the Canadian Institutes of Health Research, the Natural Sciences and Engineering Research Council of Canada, and the Social Sciences and Humanities Research Council of Canada — combine their efforts with Industry Canada to support and oversee the Networks of Centers of Excellence initiative. The network is built on the funding for research and training in Canadian universities through the agencies' peer-reviewed research programs. The NCE is a partnership among universities, industry, government and non-governmental organizations

aimed at turning Canadian research and entrepreneurial talent into economic and social benefits for all Canadians. (http://www.nce.gc.ca/annualreport2002_2003/Eng/index.asp)

At the current time colleges and institutes are not eligible for direct fiscal support from this program. They may be partners within a Center of Excellence through provision of in kind or fiscal support to research endeavors. At the current time less than five colleges/institutes are listed as being associated with a Center of Excellence under this program. There is discussion that this may increase as there is greater emphasis on support of innovation through industry clusters associated with the National Centers of Excellence. As in other tricouncil programs the primary limitation to the participation of colleges/institutes remains the restrictions concerning funding researcher salaries from grant funds.

8. Canada Research Chairs

The Canadian Research Program is described as follows on its web site:

“The Canada Research Chairs Program stands at the centre of a national strategy to make Canada one of the world’s top five countries for research and development. In 2000 the Government of Canada allocated \$900 million to establish 2,000 research professorships-Canadian research Chairs-in universities across the country. Chair holders advance the frontiers of knowledge in their fields, not only through their own work, but also by teaching and supervising students and coordinating the work of other researchers.”

“By helping Canadian universities and their affiliated research institutes and hospitals become world-class centers of research and research training, the Chairs Program contributes to enhancing Canada’s competitiveness in the global, knowledge-based economy, improving Canadians’ health, and enriching our social and cultural life.

The Chairs Program also seeks to:

- strengthen research excellence in Canada and increase Canada’s research capacity by attracting and retaining the best researchers;
- improve the training of highly qualified personnel through research;
- improve universities’ capacity to generate and apply new knowledge;
- promote the best possible use of research resources through strategic institutional planning, and through collaboration among institutions and between sectors.”

http://www.chairs.gc.ca/web/about/index_e.asp

Colleges/institutes are currently not eligible for this program. It may be of interest to support the development of a parallel program that focuses on applied research with implementation at least in part through colleges/institutes. Elements of such a program would be parallel to those of the “NSERC-Industrial Research Chairs” program http://www.nserc.gc.ca/professors_e.asp?nav=profnav&lbi=c1 and be matched by funding through industry or provincial governments. The government of British Columbia has expressed interest in providing matching support for chairs at colleges/institutes

9. Other Federal Programs

Colleges/institutes may also receive contract funding directly from federal government ministries eg. Fisheries, Agriculture etc. The requirements and eligibility vary between Ministries and programs.

Provincial/territorial government policy/programs

On first examination the provincial/territorial government policies in regards to innovation activities at colleges and institutes appears to differ significantly (Appendix III). While some specifically include innovation (research) and the support of regional economic development as part of the college/institute mandate, eg. Ontario, others are mute on the subject. However, in most instances the absence of innovation in the mandate does not preclude the participation of colleges/institutes in innovation activities eg. British Columbia. Several provinces/territories have recently made changes to their policies so as to include colleges/institutes in innovation activities while others are being reviewed with this in consideration

In general the provincial/territorial policy environment associated with innovation at colleges/institutes is supportive providing the innovation activities support rather than detract from the primary mission of the colleges/institutes. In most instances institutional governance eg. The Board of Governors of the College/Institute, decides through the establishment of appropriate policies whether or not the institution will formally pursue innovation activities.

Typically colleges and institutes are eligible for grants supporting innovation activities provided by provincial granting bodies. In many instances these grants complement those provided by the federal government. They may match federal government funding eg. CFI or “top up” funds provided by a combination of federal and industry partners. Operating funds associated with the development of products or processes typically require significant industry investment where the provincial funding program provides less than 50% of the research project costs.

These programs vary significantly between regions and often change in response to the changing policies of the province/territory. Readers are referred to provincial/territorial web sites for details concerning these funding programs.

III. COLLEGE/INSTITUTE MISSION

Individual college/institute mission statements may or may not refer to innovation as part of their mission. Often larger institutions specifically acknowledge innovation as part of their role in local and regional economic development. While some colleges/institutes have been involved in these activities for many years, acknowledgement of this role within their strategic plans and or mission statement has in most instances been relatively recent. Typically the institution's Board of Governors decides whether or not it will be engaged in formal innovation activities.

In a number of provinces colleges/institutes are using applied research in conjunction with a new mandate to grant degrees to position their institutions as distinct from other colleges/institutes. Conversely some colleges and institutes have specifically indicated that they will not be involved in any formal innovation process or degree granting activities, focusing resources on more traditional activities of the institution. Innovation activities along with degree granting has provided a means for further college/institute differentiation.

While college/institute involvement in innovation is seen to be a relatively recent process some colleges and institutes have been involved in these activities for decades. This is most notable in the agricultural and fisheries sectors where colleges/institutes have had long standing applied research programs and technology transfer outreach to their communities. These colleges/institutes have often been funded through provincial ministries of agriculture or fisheries rather than through ministries associated with other colleges, institutes or universities.

In the province of Quebec twenty-three College Centers for the Transfer of Technologies associated with CEGEPS were developed in 1983. These Centers are focused on innovation activities associated with local and regional enterprise. Faculty are provided partial release time to participate in innovation activities associated with these Centers based on the size of the college/institute and the amount of research activity conducted. Since 1983 several of these have grown into major sites for innovation and business development often closely aligned with the local economy.

IV. COLLEGE/INSTITUTE ADMINISTRATIVE STRUCTURE, POLICY & FISCAL SUPPORT

Administrative structure

In colleges and institutes innovation is often directly associated with academic activities and thus falls under the supervision of the vice president academic. However in a number of instances innovation has been included in portfolio of the vice president responsible for business development and/or contract training. This approach has been used in a number of institutions as innovation activities have many characteristics in common with the entrepreneurial culture associated with and necessary to support contract training and business development.

In most instances an administrative staff member (the director of research) reporting to the vice president has the responsibility of managing the innovation related activities of the institution. This person typically works in a matrix structure with those responsible for specific academic areas (usually deans) to manage: research personnel, physical research resources and research projects. Due to the diversity and volume of innovation activities larger institutions often have a full time director of research and associated office support. In smaller institutions an individual or individuals may manage innovation activities in conjunction with other responsibilities eg. contract training, institutional and market research, or in association with management of academic delivery.

The responsibilities of the director of research are diverse. Often these responsibilities are shared in a matrix organizational structure with other members of the college/institute community and include:

1. development and implementation of research related policies and practices;
2. development and implementation of a college/institute applied research strategy within the context of the institutional strategic direction;
3. outreach and promotion of the college/institute role in local and regional economic development initiatives;
4. external and internal partnership development and management in support of research activities;
5. knowledge and understanding of public and private funding sources including understanding the policies and practices associated with each agency;
6. coordination of the development and/or participate in the preparation of research proposals;
7. monitoring progress and coordination of and/or writing progress reports;
8. participation in the development of research related internal and external communications including web sites and annual reports to institutional leadership;
9. management of intellectual property related issues.

In some colleges/institutes innovation activities are conducted by a subsidiary or stand alone entity associated with the college/institute. These entities have often been developed in response to historical mandate, eligibility requirements for specific funding mechanisms, the requirements of industry for an entrepreneurial approach to innovation; intellectual property management; adherence to collective agreements etc.

College/institute policy

A primary driver in the development of specific innovation related policies and practices has been the requirements of public sector funding agencies. In many instances the generic policies of the institution may be sufficient, however others must be specifically developed. While portions of the research policy/practice infrastructure has existed in many colleges and institutes, the recent NSERC college and community pilot program focused on the college/institute community has provided the impetus for many to develop the detailed policies necessary to be eligible for funding by that body http://www.nserc.com/institution/eligibility_e.htm. While many institutions have had existing policies these have had to be redrafted to be compliant with the NSERC requirements. During this developmental process colleges and institutes have actively shared policy/practice documents and experiences. Generally policies/practice documents in relation to innovation are generally required in the following areas:

- General support of research and development activities
- Research ethics and integrity
- Research involving human subjects
- Animal care and research
- Research involving biohazards and radioactive materials
- Conflict of interest
- Intellectual property ownership, disclosure and management
- Student rights in the conduct of research
- Confidentiality & publication of results
- Compensation & recognition of faculty conducting research activities
- Fiscal accountability and reporting

Fiscal support

Colleges and institutes that have decided to pursue formal innovation activities typically make a commitment to provide ongoing resources to support innovation. This is a critical signal from senior leadership that research is part of the supported core activities of the institution. The expectation that the office of research and/or the director of research can be directly supported through overhead on innovation activities is not viable in most instances. This is particularly true in the early developmental stages of innovation activities. Where colleges/institutes have made a commitment to support research, this office and position is usually supported through core funding. A number of colleges/institutes have received support for the establishment of offices of research through Industry Canada regional programs (eg. Western Economic Diversification) in partnership with provincial economic development programs.

A number of colleges/institutes provide “seed funding” to faculty to support the development of grant proposals or conduct exploratory research activities. This usually involves funding faculty release time from teaching activities to develop grant proposals or less often to conduct research. When faculty are released from teaching responsibilities to conduct research the release time is generally paid for by an external grant or contract. Time to conduct innovation activities may be provided to faculty during the spring/summer period when there is less demand for teaching activities. A few institutions are in the process of developing an internal foundation to support innovation activities. These are generally built from donations from the private sectors served by those innovation activities.

V. PRIVATE SECTOR INVESTMENT IN INNOVATION

The Conference Board of Canada has conducted a number of studies into innovation in Canada's private sector. It concludes that Canada's corporate culture lags behind that of other leading world economies in its support of many facets of innovation including the development of new products and services (Anonymous 2004. Exploring Canada's Innovation Character: Benchmarking Against Global Best. The Conference Board of Canada. 3pp.)

<http://www.conferenceboard.ca/inn/ici/what.htm> . The Conference Board of Canada found that business enterprise expenditure on research and development as a percent of Gross Domestic Product is ranked 8th in comparison to the worlds' eleven leading economies². The private sector particularly SME's are often reluctant to or do not have the resources to invest in the development of a concept until it is well down the innovation path. As a result commercial concepts are often abandoned, are not developed from the basic research at all, or the concept is exported to a multi national corporation in another country that does have resources for further development and commercialization <http://www.innovationstrategy.gc.ca/go/innovation/site.nsf/en/in02189.html>.

In many G7³ countries, innovation is primarily supported and performed by large multinational companies that have the resources to support the innovation process from basic research through to commercialization. This is rarely the case in Canada where there are relatively few large companies with such resources. In Canada, four firms account for 30 percent of all private sector research. The top 100 corporations in Canada based on largest expenditures on research and development are concentrated in the 7 sectors listed below

<http://www.researchinfosource.com/2004-analysis.pdf>

Industry (number of corporations)	R&D Spending (% of total)
Communications and telecommunications equipment (12)	33
Pharmaceuticals and biotechnology (32)	16
Telecommunication services (4)	11
Software and Computer services (12)	8
Aerospace (5)	8
Automotive (1)	6
Primary Energy (5)	4

Canada is more dependent than its international competitors on SME's for innovation and resulting long term economic prosperity. While commercial concepts exist within these enterprises, they often lack the resources required to support the conversion of these ideas into marketable commodities. SME's may require: advice from specialized technical expertise, access to specialized equipment, the results of proof of concept (or applied) research, product/process engineering and specialized training of employees in the preproduction phase of innovation. As a result innovation in these firms often involves private/public sector partnerships to bring commercial concepts to market. Recent examples of successful innovations in Canada are presented in <http://www.innovation.gc.ca/gol/innovation/site.nsf/en/in04262.html> and <http://www.innovation.gc.ca/gol/innovation/site.nsf/en/in05256.html> These successes often

² These countries include the G-7 economies, as well as Finland, Sweden, Spain and Australia

³ Canada, France, Germany, Italy, Japan, United Kingdom, United States

involve private and public sector partners including the participation of the postsecondary education sector. The development of industry lead collaborative research networks that link academic and private sector partners in support of commercialization has been proposed by the Conference Board of Canada <http://www.conferenceboard.ca/> (Guthrie B. and T. Munn-Venn 2005. Six Quick Hits For Canadian Commercialization 14 pp.)

The private sector should be involved early during the development of the commercial concept rather than when proof of concept or prototype development has been completed. Often a commercial concept that has been developed to the prototype stage and then brought to a potential industry partner will not comply with company production standards or market parameters. Involvement at the earlier stage will increase the probability that the resulting prototype or proof of concept will be marketable and compatible with the company's production and process engineering systems and fit into their market strategy. In exchange for this early involvement industry is more likely to consider jointly funding innovation activities. If industry does not wish to participate through fiscal or substantial in kind support, the college/institute should be wary as to the commercial value of the concept. In many instances private sector support may be used to leverage fiscal support from a number of federal and provincial programs.

Availability of venture capital has increased in recent years with more a favorable tax climate in relation to funds invested in innovation activities. Canada provides a very favorable tax structure for those investing in research and development including favorable provisions in corporate, capital gains, as well as personal tax structures. Of special note a research and development tax credit is provided for funds directly invested in research, prototype and process development. The federal and provincial/territorial governments all provide tax incentives to support these activities http://www.fin.gc.ca/toce/1998/resdev_e.html.

Commercial viability

While venture capital is available it is often difficult to access due to the desire of investors to minimize the expenditure of funds on concepts that will not be commercially viable. Once a working prototype or proof of concept is developed from applied research it may still be difficult to access commercialization funds. Both private and public sectors require sufficient evidence of commercial viability, i.e. to "set the bar high" prior to investment in a specific innovation project. This evidence of commercial potential is based on the answers to a series of related questions:

1. What is the value proposition for the commercial concept? i.e. why will customers buy the product?
2. What are the competing technologies? Will this technology be less expensive or provide increased value (quality, increased speed, features) at an acceptable price? Are there multiple price points and markets for different qualities or applications of the technology?
3. Is this a generic technology with multiple applications or are the applications significantly limited?
4. How large is the market? What is the lifespan for the technology, i.e. how long will the technology be relevant? Is there sufficient market (size and duration) to return the investment and provide profit? Will the Innovation process require more time than the lifespan of the technology?
5. Does the concept fit into the company's product line and market segment? Does the company have the expertise to support (sales and maintenance) the product in the market?

6. Does the college/institution have the resources (both human and physical) to support the applied research, proof of concept and prototype development for this commercial concept? Does the commercial concept fit within the ethical policies of the college/institution?
7. Is the intellectual property available? Is it protected or in the public domain? Can license agreements be made for all associated intellectual property?
8. Is there sufficient venture capital available to support the commercial concept through the entire innovation process? i.e. will there be sufficient money committed upfront to support the latter stages of development?
9. What is the current and future regulatory environment associated with this product or sector. Does it restrict or open the market? Are there significant liabilities associated with failure of the technology, i.e. what is the risk associated with the sector and product?

Rarely does a college/institute or SME have the resources to answer all of these questions. In an ideal situation a business plan would be developed by experts in the field that responds to the primary questions listed above. The resulting plan is then used to generate the public/private venture capital on which the innovation process will depend. As the investment requirement increases the detail of the plan and credibility of those who have developed the plan becomes more significant. A number of colleges/institutes have developed the capacity to provide initial assessments of commercial concepts to establish whether or not the development of a full business plan is warranted. This service is often provided through business incubators or accelerators associated with the institution.

The cost of detailed business plans are typically thousands to tens of thousands of dollars. As a result complete business plans that would be acceptable to the venture capital community have not been typically produced by colleges/institutes. As a result the venture capital brought forward from the private sector is significantly less than that required to support the entire innovation process. Public funding has been made available in some instances to support the development of full business plans eg. Fed NOR, Industry Canada.

VI. COLLEGE/INSTITUTE HUMAN RESOURCES

Director of research

Colleges/institutes have minimized the amount of administrative infrastructure associated with innovation activities. While this maximizes the use of resources it often adds additional workload to individuals without additional resources. The director of research requires a significant breadth of knowledge in a field that is rapidly changing (refer to section IV). University commercialization offices (Technology Transfer Offices, Industry Liaison Offices, Business Development Offices, etc.) typically have a narrower focus than college/institute directors of research although there is significant overlap in relation to innovation activities. These offices typically focus on the management of intellectual property and the development of industry partnerships for the purpose of developing marketable products. In 1997, 65% of all Canadian universities had such an office with the number now estimated to exceed 85%. The need for such an office and its support is well accepted both by researchers and industry.

Universities have repeatedly identified that inadequate support of their commercialization offices is a significant limiting factor in innovation. In some colleges/institutes the lack of support for research administrative structure has become a limiting factor for innovation activities. Industry Canada has recognized that the lack of trained technology managers is a significant impediment to Innovation. In response to the difficulty in obtaining this expertise a number of colleges/institutes have reached to industry clusters to support some innovation functions, or are sharing the role of director of research with other colleges/institutes as part of a strategic alliance.

To be successful in innovation colleges/institutes must develop the capacity to develop successful research proposals. This “grantsmanship” is a significant skill that is highly tailored to the requirements of the funding agency. While there is an expectation that the faculty with technical expertise in the field is able to write such proposals this is often not the case without considerable support and development. In colleges/institutes it is typical that the director of research identifies potential funding sources and coordinates the proposal development process that involves faculty technical expert(s), the finance office, the inline academic manager as well as external partners. The director or research is expected to interpret and respond to the wide variety of requirements of granting agencies. As these requirements are often differ significantly in different agencies and significant investments of time are required to develop proposals, colleges/institutes often focus their grant proposals on agencies with which they have had success in the past.

The following professional associations provide opportunities for professional development and networking for those involved in the development of grant proposals, management of intellectual property and management of the technology transfer process at post secondary institutions.

The Canadian based Canadian Association of University Research Administrators (CAURA) <http://www.caura-acaru.ca/login.cfm> offers membership to individuals at Canadian post secondary institutions that are involved in managing research and technology transfer. CAURA provides a national voice for those in the field, supports networking and professional development.

The American based Association of University Technology Managers (AUTM) <http://www.autmnttconline.net/> provides a vehicle for professional development and communication among personnel at universities involved with the administrative aspects (not

directly involved with research) of innovation. This organization supports annual surveys in the United States and Canada that pertain to the management of intellectual property, publishes a journal (The Journal of the Association of University Technology Managers) provides web based courses concerning technology transfer and supports annual conferences.

Westlink Innovation Network is an organization in western Canada that links the private and public sectors involved in technology transfer. It provides courses and mentorship of those involved in technology transfer at universities/colleges and institutes <http://www.westlink.ca/>.

In addition to the above the Association of Canadian Community Colleges delivers an annual workshop that provides professional development support for those involved with innovation activities at colleges and institutes. The program and some of the presentations delivered at the 2005 workshop are available at <http://www.accc.ca/english/events/reports.cfm>

Faculty

Faculty at many colleges/institutes have conducted scholarship in a broad sense for many years. This has been done as part of their professional development activities often with no or minimal support from the institution. In some instances these activities have been conducted in partnership with industry or universities. However these activities have been severely limited, and conducted despite rather than as a result of funding support from most granting agencies.

The development of the innovation strategy and recognition of the potential of role of colleges/institutes in that strategy has increased the potential for faculty at colleges/institutes to engage in research and development. Typically this work provides intellectual challenge, supports industry relationships and exchange of expertise, provides a sense of personal accomplishment and may support an additional mode of academic delivery (project based delivery) that increases the skills of graduates. Where innovation has become a component of the core duties of faculty it may attract new faculty that would previously only be attracted to a university. However, the environment and resources available to support research and development is not the same as that at a university.

The faculty technical expertise must be maintained at a high level to be in demand by industry and recognized by funding agencies. The college/institute must invest in support of professional development activity to have credible faculty to conduct innovation activities. This is often seen by external organizations (universities and industry) as a critical credibility issue for colleges and institutes. As professional publication is not typically expected from faculty, proof of expertise may be difficult to demonstrate. Many innovation related activities do not provide outcomes that are publishable in peer reviewed journals or eligible to be presented at meetings of professional organizations. While results may be published in trade journals these often must be delayed due to intellectual property related issues. Granting agencies do not hold trade journals in as high esteem as traditional scientific journals as articles are usually not peer reviewed. In addition the grant adjudication process expects a significant list of research publications, disclosures and patents as evidence of productivity over multiple years. As most colleges and institutes have not participated in innovation activities for more than a few years, faculty have not had the opportunity to develop this evidence of productivity. As a result it is difficult for faculty to “demonstrate” their expertise through mechanisms traditionally accepted by funding agencies for standard operating grants.

Faculty expertise may be developed through their pursuit of advanced university degrees as graduate students. These activities are often supported through professional development (sabbatical) leave and/or through partial or complete reimbursement for tuition expenses. The graduate research focus may be related to the innovation initiatives of the institution. After graduation it is often difficult for the faculty member to maintain their expertise through an ongoing formal relationship with the university. Due to the time limited basis of typical innovation activities it may be difficult to maintain expertise and professional activity between projects.

Faculty technical expertise may be in demand as consultants with industry outside of the college/institute. While these activities serve to support the skills of the faculty member conflict of interest policies must be clear in how these issues will be resolved so as not to stifle innovation yet not disadvantage the institution.

Cultural conflict

Cultural conflict can occur when innovation activities are introduced into a college/institute which has not previously engaged in these activities. Some members of the institution may see this as a drift in mission of the college/institute away from supporting traditional college/institute values i.e. movement away from the support of access activities. In a number of colleges/institutes the support of innovation activities may be associated with a new degree granting mandate. The question that is generally discussed is “Can the institution deliver degrees and play a greater role in innovation activities and still maintain its traditional role as an access/skills based institution?” Exacerbating this question is that innovation activities are often associated with a relatively small percentage of faculty (less than 3% and often less than 1%) in specific departments eg. technology or engineering departments. It may be perceived that the benefits of innovation will be limited directly to individual faculty or specific departments rather than being of benefit to the entire institution. The results of this cultural debate have often driven decisions for colleges and institutes to opt out of degree granting and/or innovation activities.

For those institutions that have proceeded with innovation activities some members of the college/institute community may actively or passively resist these activities. This resistance may extend from faculty and support staff through to the senior management of the institution. These issues must be addressed and resolved through open forums, discussion and leadership. To be successful innovation activities must be actively supported by the senior leadership within the college. The benefits associated with these activities must be publicly highlighted and shown to be of benefit to the entire institution.

The senior leadership and management of some Canadian colleges/institutions have made a strategic decision to move towards becoming a university or university/college. This has been a result of external drivers such as: unmet demand by prospective students for existing degree programs; the development of new career paths that are not served by existing university programs; the demand for applied education at the degree level that has not been typically delivered by universities; under funding of colleges/institutes in relation to universities; etc. Institutions that have followed this direction have developed a significant number of degrees and expect scholarship including innovation related activities from faculty associated with degree programs. Unfortunately this may generate significant discord in faculty that do not support this strategic direction. The imposition of innovation activities on individual faculty is not desirable or perhaps even possible. Faculty should be invited to participate where sufficient expertise exists and

potential government and industry support exists. In some of these instances it has been necessary to hire new faculty to support innovation and degree granting activities.

Compensation/reward

Often compensation policies for faculty involved in innovation activities do not exist as part of current collective agreements. By the nature of the work it is often difficult to estimate the time required to complete a specific research project. As a consequence compensation is often negotiated on an individual project basis. Time attributed to research activities in formal agreements often does not truly reflect the amount of time required to complete the research. If compensation and recognition for innovation activities is not deemed to be equitable and comparable to that provided for academic delivery faculty will soon opt out of innovation activities.

VII. STUDENT INVOLVEMENT

Project based delivery

Project based delivery has provided the freedom for colleges/institutes to conduct innovation activities supervised by faculty but primarily performed by students in close cooperation with industry. Project based delivery falls under a number of monikers (research report/thesis, independent studies, etc.) the primary commonality being that students address an industry or community problem or develop a product or service in response to market forces.

Project based delivery is often used in the later semesters of a program to apply knowledge learned in earlier semesters and to move those skills to a higher more integrated level. Te more elaborate examples of this type of academic delivery are typically found in post basic technologist and undergraduate degree programs.

Project based delivery:

- 1) develops a new application for an existing product for industry or improves the value of product in relation production costs (typically not a “mission critical” function);
- 2) supports the application and further development of technical and team based skills; communication, negotiation, critical thinking, and innovation;
- 3) places students into an entrepreneurial context in which their work will make a significant contribution to the development of a new product or process;
- 4) improves links to industry that are often the foundation of employment opportunities;
- 5) showcases the capability of students, faculty and college/institute to respond to the needs of local public and private sectors.

In some instances project may be the culminating activity associated with a program with multiple courses and several semesters of study focused towards and integrated through this major project or research semester. The project often involves a multi semester relationship between the student and industry that may include a practicum/coop placement before or after the project. In other instances the project may be relatively discrete addressing with a number of students addressing complementary aspects of an industry challenge. A description of a culminating project course is available at http://www.flemingc.on.ca/Courses/CourseDescription.cfm?Course_Code=APST007

Placement/Internship

Often as a component of college/institute programs students must complete a placement or internship with a potential employer. While these placements/internships often do not involve an innovation related project some do provide the opportunity to address a public or private sector problem. In some instances the project that the student commenced as project based delivery may be completed during placement or internship in the work environment.

Part time employment

Colleges/institutes or their research subsidiaries often employ students on a part time basis during their studies as technical support for innovation activities and may on graduation continue that relationship. While further developing technical and generic skills this also provides the students with income to support their studies.

VIII. THE CURRENT STATE OF INNOVATION AT COLLEGES/INSTITUTES

The 157 publicly funded colleges and institutes and more than 900 campuses are all unique. Each has adapted themselves to the resources and needs of their local and regional communities. As a result there is no single model that has been developed to support innovation activities. The models developed are dependent on:

- 1) significance of innovation in the current institution vision, mission and strategic direction;
- 2) historical mandate and history of innovation at the institution;
- 3) availability and development of the human, physical and fiscal resources used to support innovation;
- 4) credentials offered and models of academic delivery used eg. project based delivery; placement etc.
- 5) nature of relationships with the public and private sector;
- 6) the focus of the local and regional economy.

The discussion below provides four generic models or states that exist at colleges and institutes in support of innovation. These models/states should be viewed as a continuum rather than being discrete in nature.

1. Institutions with no formal innovation policies and structure

Characteristics:

- these institutions may have actively decided not to pursue formal innovation activities or may not have as yet decided to pursue innovation activities
- there are no formal research and development policies as required to be tricouncil (NSERC/SSHRC/CIHR) eligible
- the position of director of research does not exist
- there are no innovation related human resource/staffing policies
- intellectual property policies may exist but usually are limited to the products of pedagogy, eg. books and manuals
- the active support of the innovation activities listed below by senior administration is usually not required

Innovation activities may include:

- project based academic delivery
- student internship/placement with potential employers
- activities that are in addition to the expected academic delivery workload i.e. “side of the desk activities”. These are not tasked nor expected as part of the normal workload.

They are often not supported through release time and are often not sustainable due to inadequate facilities/equipment or insufficient time to sustain projects. They are often conducted as faculty believe that the activities have value to students, the local community or themselves. These may be included in professional development activities.

- research and development associated with graduate studies conducted by faculty/staff

2. Novice Innovation Institutions

Characteristics:

- formal innovation activities have commenced relatively recently
- active support by senior administration is required to sustain formal innovation activities
- a director of research is appointed. The director of research reports to a senior administrative position often the Vice President Academic/Education
- initial research and development policies are developed often to be compliant with the requirements of funding agencies
- ad hoc fiscal and human resource systems are developed to support innovation. These may be local agreements or pilots to establish systems to support innovation. Fiscal systems and reporting capacity especially those that require the carry over of funds to support multiple year research projects are developed
- internal and external community analysis is conducted to establish the potential foci of innovation activities i.e. identification of strengths of the institution and the local community that would support innovation.
- innovation activities are conducted and/or supervised by faculty. Part time support staff may be recruited to support these activities (often former students) or some release time is provided staff to support innovation. These positions or roles are temporary in nature.
- early in this stage institutions are often are capital rich and operating poor. Availability of capital equipment often precedes the availability of operating capital to conduct the project. Since 1999 CFI matched by provincial funding agencies has often acted as the catalyst for the provision of this capital equipment.
- this is a time of significant institutional learning as systems and knowledge to support innovation activities are incomplete. Institutional acceptance of innovation activities as an activity within the college/institute mandate is not wide spread.
- there may be significant cultural conflict between those who believe that this activity will move the college away from its mission (mission drift) and those that see innovation as an opportunity to support academic activities.
- this stage is transitional and usually requires three to seven years. This is a very unstable stage where without active support by administration, faculty and staff formal innovation activities may cease. The time spent in this phase may be reduced by hiring an

experienced director of research or through intensive professional development of those involved in the administration or performance of innovation activities.

Innovation activities include:

- potentially all aspects of the first model/state
- formal innovation activities are usually project based conducted in collaboration with regional community/industry partners. These are often supported by a combination of industry community support (cash or “in kind”) and government funding. These activities are limited in number and scope, are time limited and are often framed as pilot activities as systems and support develop.

3. Established Innovation Institutions

Characteristics:

- comprehensive research and development policies and practices are in place
- human resource policies are stable and innovation positions move from part time or released time to full time longer term positions. There is less turn-over of innovation related personnel.
- fiscal management, human resource and reporting policies and practices are established
- the director of research reports to a senior Vice President. This reporting relationship is dynamic often oscillating between the vice president academic/education and when a separate office exists the vice president that is accountability for contract training/or continuing education. The systems and human resource policies associated with innovation activities have many parallels with those that support contract training.
- facilities and equipment are established but may require renewal
- institutions may be in the situation where they have access to more operational funding than can be managed by the existing innovation administration. This may be a significant limiting factor unless there are additional resources to invest in increased administrative support.
- academic and service divisions support innovation activities as part of the college/institute mandate and mission.

Innovation activities include:

- potentially all aspects of the first model/state
- innovation teams lead by faculty conduct multiple projects that interrelate and are contiguous in time. The faculty and staff involved may seconded and fully funded to conduct innovation activities on a continuing basis.
- innovation activities may support both local and regional needs

- there may be some integration of business supports with research and development
- funding and innovation activities involve multiple public/private sector partnerships
- the longer an institution is in this stage the greater the focus on longer term multi year projects that provide sustainability for innovation activities and greater stability in human resources.

4. Integrated Innovation Institutions

Characteristics:

- these colleges/institutes have integrated innovation and business support systems that provide both business development support integrated with innovation activities
- activities may be regional/national and international in scope
- these colleges/institutes are often relatively large in nature with long standing innovation and business development activities.

Innovation activities include:

- potentially all aspects of the first and third models/states
- these institutions house business incubators, accelerators or business parks that are supported by and provide support to the college or institute Companies on the campus may access research and development resources to conduct their own innovation activities or may sub contract innovation activities to the institution.

Most Canadian colleges/institutes were formed during the past forty years with a mandate that supported the first model, however, there are notable exceptions. These institutions were often formed as institutes, with an initial mandate that supported applied research and development activities. Currently these institutions are in either three or four of the states described above.

IX. THE BENEFITS OF INNOVATION

Measures of Success

Measures of success are necessary to establish whether or not investment in innovation at colleges and institutes is productive and provides significant benefits to the economy and to the institution.

The appropriate measures of success change as the innovation process develops. As many colleges/institutes are in a relatively early stage of developing innovation activities most measures of success will lie in the following category. Initial measures include monitoring the number or amount of:

1. faculty/staff and students directly involved in innovation activities;
2. learning objectives met through increased project based delivery;
3. graduates in the workforce using related skills;
4. industry issues addressed and resolved;
5. private/public sector support (venture capital, in kind support);
6. inventions (product/process) disclosed.

Over time as the innovation process proceeds & activity grows measures would include the number of:

1. patents filed;
2. license agreements executed;
3. number of successful “spin-off” companies formed.

More “mature” or global measures of success would include:

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

On a qualitative basis an expanded role of colleges/institutes in innovation would result in increased local and regional economic growth through:

1. development, production and use of new products and services in an expeditious fashion.
2. improved production processes that would increase product value in relation to the cost of production.
3. increased private sector investment in innovation especially SME’s as a partner with colleges/institutes.
4. increased capacity for ongoing innovation activities tailored to the needs of the local and regional economy.

5. increased generic and technical skills of college/institute graduates (highly qualified personnel) who as industry employees would further support local and regional innovation.

Economic benefits associated with innovation activities

A number of studies have documented the economic benefits to graduates, local communities and society associated with college/institute activities in Canada. A sample of these include: Robinson, M. H. and K. A. Christopherson (2004) The socioeconomic benefits generated by Confederation College 82pp; Christophersen K. A. and M. H. Robinson (2003) The socioeconomic benefits generated by 16 community colleges and technical institutes in Alberta 73pp; Zanasi L. and M. Taggart (2003) Yukon College economic assessment analysis 71pp; Phillips, T. F. 1999) The economic impact of Sir Sandford Fleming College 18 pp (<http://www.acaato.on.ca/home/research/return.html>). These studies show significant rates of return for societal and individual investment in college/institute education and training. However these studies have not specifically addressed the return to innovation activities rather to the overall activities of the college/institute. Qualitative descriptions of benefits associated with college/institute innovation activities included in http://www.aacti.ca/innovation_portal/ <http://www.acaato.on.ca/home/position/primaryInternalContentParagraphs/02/document/ApplydRes+Appendix.pdf>.

While there is the potential of fiscal return to the college/institute based on the licensing of intellectual property and/or equity in “spin-off” companies, it should not be expected that the fiscal return will be significant. At universities the historic royalty revenue in relation to the overall investment in research per annum has been less than 4% in the United States and 1.5% in Canada. The equity position of universities in spin-of companies in Canada has been higher than that in the United States although the return on that equity has yet to be realized in significant measure. In Canada in 2002 only 14.7 licenses were executed and 2 start-up companies created for every \$100 million in research investment at universities.

The annual survey of research activities conducted by the Association of University Technology Managers states that:

“Royalty income, though still less than 3% of total research funding, is now providing a significant source of unrestricted funding for investment in research and education at a relatively small number of institutions that have been fortunate enough to hit a home run. Continuing the analogy in the vast majority of cases though technology transfer remains a game of bunt singles, not grand slams.”

<http://www.autm.net/memberConnect/02%20Abridged%20Survey.pdf>

While the “Grand Slams” are often well publicized they are rare. While it could be expected that there would be greater return to innovation (applied research, proof of concept and prototype development) rather than to overall university research activities, it should not be anticipated that the resulting royalty revenues will provide substantial return to colleges and institutes. Often the royalties from licenses barely cover the costs of managing the patent/license portfolio. For more information concerning the process to obtain and protect Canadian and international patents please refer to

http://strategis.ic.gc.ca/sc_mrksv/cipo/patents/pt_main-e.html)

X. CHALLENGES & RECOMMENDATIONS

Funding Agencies

The challenges and recommendations to funding agencies are as follows:

1. With rare exception colleges/institutes do not receive core funding to cover the expenses associated with innovation activities (most notably salaries). As many funding programs have been developed with the university community in mind, where researcher salaries are supported through core funding, research grant programs rarely support researcher salaries. This gap in support is the primary limiting factor for innovation activities at colleges/institutes.

Recommendation: Develop college/institute specific programs that fund the salaries or backfill costs of researchers. Build on the model used by the NSERC College Community Pilot that is currently being implemented.

Recommendation: Expand the NSERC College Community Pilot as soon as possible on the basis of the success of the initial call for proposals and interim results of the funded projects.

Recommendation: Implement the recommendations of the ACCC report provided to SSHRC. Most significantly reconfigure the SSHRC standard research grant program or provide a separate program to address the need to support salary or backfill costs for researchers in colleges and institutes.

Recommendation: Establish a College/Institute Chairs program focused on the application of knowledge rather than the development of new knowledge. This program would ensure that faculty would be at the forefront of research and development and meet the needs of industry. This program would support the salary of the faculty as well as provide funding for capital and operating costs for a significant period of time eg. five years.

Recommendation: Include colleges/institutes as eligible partners in industry based innovation grant programs which provide some support for salaries.

2. The measures of capacity and productivity of colleges and institutes used by granting agencies should address the outputs of applied research and development activities rather than focusing on basic research outputs

Recommendation: Rather than measuring productivity on the basis of research publications and formal presentations at scientific conferences, output measures should be associated with disclosures, patents, prototypes or significant improvements to products and processes that are actually being implemented and used in society

3. Many colleges/institutes have commenced innovation activities within the last ten years. As such they do not have a long history of productivity in relation to these activities.

Recommendation: Implement a funding program based on the value of the project and likelihood of success and reduced emphasis on the history of the researchers involved.

4. Often there is a lack of knowledge concerning the capacities and needs of colleges and institutes in the membership of many funding proposal review and adjudication committees

Recommendation: Include members from colleges and institutes on funding proposal peer review and adjudication committees. This will not only increase the collective knowledge of colleges/institutes on these committees but also increase the knowledge of university members concerning the capacity and needs of colleges/institutes.

5. There is ongoing need for support of new and renewal of existing capital infrastructure

Recommendation: Continue to support CFI and other granting programs that allow colleges and institutes to gain and renew research infrastructure.

Recommendation: Strategic grants should require at least one of the partners be a college or institute. This will capital increase resources to colleges/institutes and increase the opportunity for collaboration between these partners

6. Due to a lack of funding and systemic barriers it is difficult for faculty at colleges and institutes to network and develop joint innovation activities with other researchers in their field.

Recommendation: Develop or expand existing collaborative research networks to include college/institutes and their faculty. Change the eligibility requirements for the National Centers of Excellence program so that colleges/institute may bring their expertise to these centers. This would provide benefits not only to college/institute faculty but university and government researchers as well.

7. A significant limitation particularly in smaller colleges/institutes is the limited resources available to support the administration of innovation activities.

Recommendation: Develop college/institute programs that support the salaries of those involved in the administration of innovation activities. This program could be targeted at medium and small institutions.

8. There is a need to increase the knowledge of novice innovation institutions in regards to proposal writing, the development and management of innovation based partnerships; the administration of research grants, and the management of the technology transfer process including management of intellectual property.

Recommendation: Support college/institute participation in the programs that provide professional development and mentorship for research administrators. Support college networks that have applied to the tricouncil Intellectual Property Mobilization program.

9. Colleges/Institutes graduate many highly skilled personnel to Canadian society with skills derived through their involvement in innovation activities, particularly those learned through project based delivery. These are rarely supported or even considered by funding agencies when assessing grant proposals.

Recommendation: Include the benefits to students in the grant adjudication process as done in the NSERC College Community Pilot Program

Colleges and Institutes

1. The challenges and recommendations to colleges and institutes are as follows: Novice innovation institutions currently spend much of their time learning how to become involved with and administer innovation activities rather than conduct the actual research and development activities.

Recommendation: College/institute associations and individual institutions should share their knowledge so as to support to novice innovation colleges/institutes through national and regional workshops and mentoring programs.

Recommendation: Colleges/institutes should become members of associations that link technology transfer organizations eg. in western Canada Westlink

2. The innovation capacity of colleges and institutes is not well known to many aspects of society including funding agencies and many potential private sector partners.

Recommendation: Through associations and as individual institutions publicize the innovation successes.

Recommendation: Colleges and institutes should participate in regional clusters and other economic development organizations so as to improve communication, share knowledge, and develop partnerships that support innovation.

Recommendation: Individual colleges/institutes and regional college/institute associations should meet to discuss college/institute needs and capacities with the regional administrators of federal government programs eg. Industry Canada regional programs such as ACOA, FEDQUE, FEDNOR, and WED.

3. NRC-IRAP has historically been a significant partner in the support of innovation activities at colleges and institutes. In recent years this relationship has languished.

Recommendation: Individual institutions and college/institute associations should reestablish the relationship with NRC-IRAP through discussions at a local and national level.

4. The federal and provincial/territorial government departments and programs play a key role in the support of innovation activities at colleges/institutes. At the current time many opportunities exist to improve programs and to increase the support of innovation at college/institutes. These opportunities cannot be effectively pursued with the current resources within college/institute associations. While association members can provide some support they do not provide the continuity of a permanent employee.

Recommendation: Increase the resources associated with innovation within ACCC and regional societies to support more effective liaison with government departments and programs.

APPENDIX I

THE INNOVATION PROCESS:

BASIC RESEARCH → **COMMERCIAL CONCEPT** →

APPLIED RESEARCH → **PROOF OF CONCEPT/
SUCCESSFUL PROTOTYPE** →

**PRODUCTION &
PROCESS ENGINEERING** → **INITIAL PRODUCTION &
MARKET INTRODUCTION** →

MASS PRODUCTION & CUSTOMIZATION → **SOCIETAL
BENEFIT**

APPENDIX II

COLLEGES/INSTITUTES RECEIVING STANDARD RESEARCH GRANTS FROM SSHRC 1999-2005 & TOTAL NUMBER OF SSHRC STANDARD RESEARCH GRANTS (based on information in the SSHRC web site http://www.sshrc.ca/web/home_e.asp)

Year	College (number of grants from SSHRC in that year)
2005-2006:	Algonquin College (1) Grant MacEwan Community College (2) Dawson College (1) College de Maisonneuve (3) Total number of SSHRC standard research grants awarded 2,447
2004-2005:	Dawson College (1) Vanier College (1) Sault College (1) Seneca College (1) Total number of SSHRC standard research grants awarded 2,206
2003-2004:	Dawson College (1) John Abbott (1) Vanier College (1) Camosun College (1) Total number of SSHRC standard research grants awarded 1,884
2002-2003:	Red Deer College (1) Lethbridge College (1) Total number of SSHRC standard research grants awarded 1,802
2001-2002:	Dawson College (1) Marianopolis College (1) Vanier College (2) Valleyfield College (1) Medicine Hat College (1) Total number of SSHRC standard research grants awarded 1,789

Year	College (number of grants from SSHRC in that year)
2000-2001:	Dawson College (1) Marianopolis College (1) Vanier College (1) Mount Royal College (1) Medicine Hat College (1) Capilano College (1) North Island College (1) Total number of SSHRC standard research grants awarded: 1,542
1999-2000:	Dawson College (1) John Abbott College (1) Vanier College (2) Seneca College (1) Grand Prairie College (1) Red Deer College (1) Total number of standard research grants awarded: 1,548

(In addition to the above, grants have been awarded to university-colleges primarily in British Columbia and to private colleges. College/institute faculty may act as collaborators on other SSHRC grants not listed above.)

APPENDIX III

CURRENT STATUS OF PROVINCIAL/TERRITORIAL LEGISLATION REGARDING INNOVATION AT COLLEGES AND INSTITUTES

Newfoundland/Labrador:

The provincial “Act Respecting a Provincial College” (The College of the North Atlantic) is silent in terms of addressing the college’s role in performing research. The Marine Institute has a legislated mandate to contribute to applied research and technology transfer.

Nova Scotia:

The provincial legislation “The Community Colleges Act” (Nova Scotia Community College) is silent on the college’s role in conducting research. The University College of Cape Breton is governed by the “Universities Act” that recognizes the role in research and development.

Prince Edward Island:

The act governing Holland College makes no reference to research.

New Brunswick:

Legislation governing the two (French and English) New Brunswick Community Colleges is silent in terms of conducting research.

Quebec:

The duties of college professors do not include research, however colleges may support college researchers pursuant to the “General and Vocational Colleges Act 1983” when Quebec initiated 23 College Centers of the Transfer of Technologies (CCTT).

Ontario:

The “Colleges of Applied Arts and Technology Act 2002” recognizes that applied research may be performed by colleges/institutes.

Manitoba:

The legislation governing colleges in Manitoba is silent in terms of conducting research at colleges.

Saskatchewan:

The legislation governing SIAST and community colleges is silent in terms of conducting research.

Alberta:

Bill 43 passed in the spring of 2004 allows colleges and technical institutes to conduct applied research and innovation.

British Columbia:

The “College and Institute Act” is silent on the role of university colleges and colleges conducting research. The BC Institute of Technology Act” is also silent in regards to research.

Yukon:

Yukon College houses the Northern Research Institute and thus supports research and development.

Nunavut:

The “Public College Act” provides the authority to create the Nunavut Research Institute and as such recognizes and supports research.

North West Territories:

The “Public Colleges Act” provides the college’s Board of Governors the right to establish a science (research institute) within the college.