Innovation Catalysts and Accelerators

The Impact of Ontario Colleges’ Applied Research

November 2010
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During the research and preparation of the report, The Conference Board of Canada received valuable advice and feedback from an Advisory Committee of leaders in industry, government, universities, and the colleges, as well as experts and other stakeholders. The members of the Advisory Committee are listed in Appendix D.

While the Advisory Board and internal and external reviewers provided input, their participation and the inclusion of their names in this report does not imply their endorsement of the report’s findings and recommendations. The Conference Board of Canada is solely responsible for the contents of this document, including any errors or omissions. The Conference Board of Canada is grateful to the advisory committee, college, university, government, and business leaders and researchers who shared their expertise and insights via interviews that were conducted as part of the research process for this project.

The report was reviewed internally by Michael Burt, Associate Director, Canadian Industrial Outlook; and Vaughan Campbell, Director, Organizational Excellence. It was reviewed externally by David Potter, Director, and Don Pether Chair in Engineering & Management, and Associate Professor Xerox Centre for Engineering Entrepreneurship & Innovation, School of Engineering Practice, McMaster University; and Jacek Warda, President, JPW Innovation Associates Inc.

The report was prepared with financial support from Colleges Ontario.

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Chapter 1

Introduction

Intensifying Applied Research in Ontario’s Colleges

For nearly five decades, Ontario colleges have pursued a number of core objectives, including preparing individuals for the workforce; helping individuals change and enrich their lives; and helping communities to improve their quality of life.¹ For much of that time, some Ontario colleges have engaged in applied research activities in collaboration with local businesses and/or as part of curricula designed to expose students to practical, hands-on problem-solving in their fields of study.

Although applied research was conducted on a very small scale at Ontario colleges during this time, the experience convinced many in the colleges, the Ontario and federal governments, and businesses that college applied research could make an important contribution to economic and social development, and would provide an additional way to better prepare students for employment after graduation. Thus, in its 2002 update of the Ontario Colleges of Applied Arts and Technology Act, the Government of Ontario recognized applied research as one activity that colleges could undertake to carry out its core objectives of offering “a comprehensive program of career-oriented, post-secondary education and training to assist individuals in finding and keeping employment, to meet the needs of employers and the changing work environment and to support the economic and social development of their local and diverse communities.”²

As a result of the enabling mandate and access to some modest research funds from provincial and federal Ministries and granting agencies, many Ontario colleges have accelerated their applied research activities over the past 8 years. Colleges across Ontario are working with businesses—primarily, though not exclusively, small and medium-sized enterprises (SMEs)—and other organizations on research projects designed to address real-world technical problems, adapt new technologies for the marketplace, and develop new and improved products, services, and processes.³

Over a three-year period between 2006-2009, the ten colleges that comprised the Colleges Ontario Network for Industry Innovation (CONII) received 766 requests for research assistance from industry, started 270 applied research projects, and completed 126. Moreover, 187 faculty members and 779 students participated in industry-related applied research projects during that time.⁴ Those

¹ I.D. Clark, et al., Academic Transformation, p. 21.
² The act notes that “in carrying out its objectives, a college may undertake a range of education-related and training-related activities, including but not limited to entering into partnerships with business, industry and other educational institutions; adult vocational education and training; basic skills and literacy training; apprenticeship in-school training; and applied research.” (Emphasis added). Government of Ontario, Ontario Colleges of Applied Arts and Technology Act.
⁴ CONII, “CONII Impact Data Tracking Summary.”

numbers have grown. Over the past year, CONII members report having worked with 415 businesses on 143 projects, and the number of students involved in applied research projects has climbed to over 2000.\(^7\)

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7 Fanshawe College, “CONII2 builds on successful company, faculty, student collaborations,” pp. 4-5. According to data provided to the Conference Board by 14 of Ontario’s colleges, applied research funds administered by colleges amounted to nearly $9.4 million in 2008-09, including grants from provincial and federal government sources, funds from business collaborators, and internal allocations and grants dedicated to research projects and/or research administration. When estimates of company in-kind contributions are included, the resources allocated to Ontario colleges’ applied research activities for that year amount to $11 million. Figures for 2009-2010 are not yet available.

With a multitude of programs and initiatives underway within the province’s colleges, and given the importance of innovation and commercialization to the short- and longer-term development of Ontario’s economy it is time to take stock of the impact and future potential of colleges’ applied research on innovation, productivity, and competitiveness, and develop strategies for maximizing Ontario colleges’ applied research advantage.

Ontario Colleges as Innovation Catalysts and Accelerators

The Conference Board’s research reveals that Ontario colleges are poised to make significant contributions to the country’s innovation performance through their applied research collaborations with businesses and other organizations. While Ontario colleges have only recently intensified their applied research agenda, are focused on building capacity, and are operating on a very limited scale, the early signs are that college applied research is having impressive impacts on firm performance, including the development of new or improved products, services, and processes; increased sales and revenues; job retention and creation; increased business R&D spending; and local economic and social development.

Applied research collaborations between Ontario colleges and businesses are stimulating new R&D activity and spending by businesses that would not have occurred had college expertise and funding not been available. Moreover, in nearly all collaborations that The Conference Board of Canada examined, the college applied research assistance was identified as a key accelerator of innovation, especially in product development and time-to-market.

The collaborations are also contributing to the innovation skills and entrepreneurial ambition of students and employees who participate in collaborations. Given the need for highly qualified personnel (HQPs) to fuel innovation and productivity improvement, training via colleges’ applied research activities will become increasingly important. At the same time, applied research collaborations are providing employers with excellent opportunities to assess the skills of potential recruits, contribute to their improvement, and hire graduates who are familiar with and fit into their industries and workplaces.

Meeting Challenges and Maximizing Potential

As the report reveals, Ontario colleges’ applied research is proving to be a very promising, albeit still developing, mechanism to stimulate innovation and productivity, and to improve education, training, and employment outcomes for students. Indeed, nearly all interviewees in colleges, businesses, and governments who are aware of colleges’ applied research activity were positive and enthusiastic about its potential to contribute to Canada’s social and economic performance and prosperity.

However, awareness and understanding of colleges’ applied research is rather low among potential business clients. Many in government are still unsure about how to measure and assess the outputs and outcomes of the research. And colleges themselves are struggling with faculty release issues, mixed levels of support and skill among faculty and administration, and relative inexperience in managing research projects and partnerships with business.
In fact, while Ontario colleges have accelerated their applied research activities and new funding programs have emerged, many of the findings and recommendations contained in D.J. Madder’s 2005 landmark report, *Innovation at Canadian Colleges and Institutes*, still apply in the Ontario context. This is not to say that progress has not been made in the intervening five years: Ontario colleges have matured their applied research capacities and activities, and governments and funding agencies have become more appreciative of the contribution college applied research makes to economic development, innovation, and the training of HQPs and have become increasingly responsive to colleges’ concerns. Still, many of the fundamental challenges faced five years ago continue to hamper Ontario colleges’ efforts and potential.

If the potential that college applied research has to improve innovation performance, education and training, and economic and social development is to be realized, strategies to address ongoing challenges will need to be identified and pursued. This will require good faith discussions between colleges, governments, and business about steps to take to address the challenges, and ongoing communication among all stakeholders during the implementation, monitoring, and adjustment of those strategies.

Nevertheless, while Ontario colleges’ applied research activities are still developing and maturing, both in terms of scale and sophistication, the track record to date suggests that the college applied research model provides a very promising mechanism to stimulate innovation among firms, contribute to local economic development, and enhance the quality of education and training in Ontario’s colleges, all of which will be essential to future economic prosperity and social well-being.

**Research Objectives and Methodology**

This report presents the findings of a multi-faceted research methodology designed to answer a number of questions related to Ontario colleges’ applied research capacity, performance, and impact. In particular, the research aimed:

- to better understand the contribution that Ontario’s colleges make to economic and social development, firm-level performance, and education, training, and employment outcomes through investments in applied research, innovation, and commercialization activities;
- to identify the key factors that determine college sector success or lack of success in participating in federal and provincial applied research funding programs; and
- to develop recommendations for
  - colleges regarding strategies for improving their effectiveness in securing and undertaking research, innovation and commercialization projects; and
  - federal and provincial governments regarding the design of research, innovation, and commercialization funding programs to better align the program activities with the innovation needs of SMEs and other businesses.

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8 D.J. Madder, *Innovation at Canadian Colleges and Institutes*.
Methodology

To achieve these aims, the following methods were employed:

- a review of relevant literature and available data;
- in-depth interviews with 150 key informants, including representatives from Ontario and other Canadian colleges; officials based in provincial and federal agencies and ministries; senior executives in private and public organizations that have worked with colleges on applied research projects; and representatives of a variety of other associations and stakeholder groups (listed in Appendix E);
- in-depth examinations of college-client collaborations and their outcomes in Ontario (n=29) and other provinces (n=13);
- a survey (n=14) of Ontario colleges on the financial costs of and spending related to applied research;
- an online survey (n=181) of Ontario-based businesses on the importance of and barriers to innovation, and their awareness of and engagement with Ontario colleges’ applied research services;
- an evaluation of the potential economic impact of several possible policy changes and scenarios, particular those that would see an increase in R&D funding directed to Ontario colleges to support expansion of collaborations with businesses; and
- consultation with an Advisory Committee of leaders in industry, government, universities and the colleges, as well as experts and other stakeholders. The members of the committee (listed in Appendix D) provided valuable advice and feedback to The Conference Board of Canada, though the Conference Board produced the report independently and is solely responsible for the contents.9

9 While the Advisory Board provided input, their participation and the inclusion of their names in this report does not imply their endorsement of the report’s findings and recommendations. The Conference Board of Canada is solely responsible for the contents of this document, including any errors or omissions.
Chapter 2

Innovation and Productivity in Canada

Innovation and productivity provide the main, though not the only, lenses through which The Conference Board of Canada assessed Ontario colleges’ applied research activities. As Canada’s performance in these areas has been weak for many years, the search for effective mechanisms and strategies to improve performance has become increasingly urgent.

While Ontario colleges’ applied research activities have many current and potential benefits for individuals, firms, and the economy and society more broadly, one of its key contributions is in stimulating and accelerating research and innovation among firms, especially SMEs. Indeed, Ontario colleges’ applied research activities are emerging as a mechanism that could be harnessed to significantly improve innovation and productivity performance.

Understanding exactly how that mechanism works and how it might be even better supported and exploited to enhance Canadian firms’ competitiveness, requires that we first understand the innovation system in which it operates. What is Canada’s innovation performance record, and what exactly are the barriers and gaps that Ontario’s colleges’ applied research may have the potential to address?

Canada’s Innovation and Productivity Performance

A nation’s current and future prosperity and quality of life depends on how well it innovates—that is, on the ability to extract economic and social value from knowledge using the generation, development, and implementation of ideas to produce new or improved products, services, and processes. Indeed, as a large and growing body of evidence demonstrates, innovation is essential to productivity growth, and increases in productivity lead to long-term economic prosperity and social well-being.10

Unfortunately, Canada’s innovation record is weak. In the Conference Board’s 2010 report, How Canada Performs: A Report Card on Canada, Canada received a grade of “D” grade on innovation performance, ranking 14th out of 17 peer countries.11 Moreover, we have been a consistent “D” performer in innovation since the 1980s. Similar conclusions about Canada’s weak innovation performance have been reached by many other organizations.12


Textbox 2

What is Innovation?

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


Innovation creates value. It can lead to the development of new or improved products or services, which can result in increased sales, expansion into new markets, higher margins and profits, and a range of other benefits for firms and consumers. Innovation may also lead to new or improved processes, which might improve efficiency, productivity, and perhaps lead to lower costs for consumers.

Importantly, much innovation is incremental, not radical or disruptive. Firms can improve their products and performance in small ways with significant benefits. Additionally, innovation should not be confused with invention—new ideas or improved products, processes, and services need not be ‘new to the world’, they need only be new to the sector, firm, or individual and create value to count as innovation.

Why Innovation Matters

“_There is a clear link between levels of innovation at the country and company levels, and economic success. Countries that show more evidence of innovation are richer and grow faster, and companies that do so perform better financially and have higher share prices._” 13 An economy with firms and sectors that innovate often and well will experience productivity growth which, in turn, leads to long-term economic prosperity and social well-being not just for firms, but for consumers and citizens.

Innovation is more important than ever in an era of tight global markets. Countries that are more innovative are passing Canada in productivity and on measures such as income per capita and the quality of social programs.14 There is a persistent and growing income gap between Canada and the United States—$6,400 per person in 2008 (double what it was in 1984).15 Canada’s labour productivity growth throughout the 2000s lagged behind most OECD peers and almost a full percentage point behind the United States.16

To maintain and enhance our quality of life—including quality of education, healthcare, and the environment—Canada will need to improve its innovation performance. Identifying strategies and mechanisms to stimulate more innovation is an ongoing concern of The Conference Board of Canada.


The indicators used to measure Canada’s capacity to innovate (e.g., knowledge production, knowledge transformation, and market share of knowledge-based industries) show that while Canada is supplied with good colleges and technical institutes, universities, and teaching hospitals, we continue to fall short in ensuring that our research and science is successfully commercialized or used as a source of competitive advantage by our companies.17 Even as we outspend our OECD peers on R&D in higher education (HERD) and perform well on rankings of the publication of

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14 The Conference Board of Canada, _How Canada Performs: A Report Card on Canada “Innovation details and analysis.”_
17 The Conference Board of Canada, _How Canada Performs: A Report Card on Canada “Innovation details and analysis.”_

scientific articles, that performance is not being matched by Canada’s spending and ranking on business R&D (BERD) and other indicators of innovation performance.18

To improve Canada’s innovation and productivity performance, strategies and mechanisms that stimulate business R&D activity are urgently required. Until Canadian firms increase attempts to improve products, services, and processes, and make greater investments in research that would improve firm performance and competitiveness, the national innovation situation will stagnate. In the face of increasing global pressures and competition, Canadian firms will need to do more, or simply go out of business.

The Role and Importance of SMEs

Given that improvements in overall economic productivity and competitiveness depend on firm-level innovation and improvements in firm-level productivity it is no surprise that there has been much investigation into, and hand-wringing about, the current state and challenges of business innovation in Canada. But while much attention is paid to the global performance of large, high-profile, Canadian firms—or, for that matter, the relative absence of large Canadian firms—a proper understanding of innovation and productivity in this country requires special examination of the performance of Canada’s SMEs.

Firms with fewer than 100 employees (i.e., “small” enterprises) account for 98 per cent of all businesses in Canada, while firms with less than 500 employers (small and medium enterprises) make up 99.8 per cent of all businesses.19 Moreover, while 48 per cent of the total private sector labour force worked for small enterprises in 2009, approximately 15 per cent worked for medium enterprises. Together, in 2009, SMEs accounted for 63 per cent of private sector employees.20 When the public sector is included, SMEs still employ nearly 55 per cent of all working individuals.21 Ontario alone is home to nearly 400,000 SMEs—a third of all SMEs in the country.22

While it is difficult to quantify the contribution of SMEs to GDP, a method developed by the Government of British Columbia’s statistical service (BC Stats) provides an estimate of the contribution to national and provincial GDP made by small enterprises (defined by BC Stats as firms with fewer than 50 employees).23 In 2008, BC Stats estimated that 29 per cent of Canada’s GDP can be attributed to small firms (compared to 26 per cent in 2000). In Ontario, the

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18 2008 HERD spending in Canada reached $10.3 billion in 2008. We ranked first among G7 countries and fourth among OECD countries, behind only Sweden, Denmark, and Iceland on HERD-to- GDP ratio in 2007. By contrast while BERD spending in Canada reached $16 billion in 2008, and accounted for 54 per cent of all R&D spending in the country, we nevertheless ranked 16th among OECD countries on BERD-to-GDP ratio in 2007 (just over 1 per cent), below the OECD average of about 1.5 per cent, and well-below top performers Japan and Sweden (at about 2.6 per cent). Industry Canada, Science and Technology Data. As the Expert Panel on Business Innovation concluded, Canada’s performance on BERD is not only weak, but getting worse: “expressed as a percentage of GDP, business R&D declined by 20% between 2001 and 2007.” Expert Panel on Business Innovation in Canada, Innovation and Business Strategy, p. 4.
contribution of small firms to provincial GDP in 2008 is estimated at 27 per cent, an increase of 2 per cent since 2000.

Given that the BC Stats method uses a narrower definition of small enterprise (i.e., fewer than 50 employees, rather than fewer than 100) than we employ, and given that medium enterprises (i.e., firms with fewer than 500 employees) are excluded from the estimates altogether, it is certainly the case that total SME contribution to national and provincial GDPs is much higher than suggested by the figures provided here. Whatever the precise contribution of SMEs to employment and GDP, SMEs are central to Canada’s economic performance and thus an analysis of and strategies to improve their innovation performance are essential.

The Innovation and Productivity Performance of SMEs

It is difficult to get a precise picture of the innovation performance of Canadian SMEs, though there are bits of evidence to begin a conversation. Notably, Canadian firms with fewer than 250 employees performed 36 per cent of BERD in 2006 which places Canada first among G7 nations on that metric. Moreover, while Canadian SMEs spend far less on R&D than large firms, “as a percentage of revenue (R&D intensity), spending on innovation by small businesses far outstrips that of larger firms.” Yet, given that firms of that size make up between 98 and 99 per cent of all firms in Canada, and employ more than 50 per cent of workers in the private sector, it is difficult to determine whether SMEs are making a sufficient contribution proportional to their overall weight in the Canadian economy.

It does appear that Canadian SMEs—especially Ontario-based SMEs—lag provincial and international peers in R&D activity. Just over 2 per cent of Ontario-based firms claim to have performed R&D versus approximately 3.3 per cent of Quebec-based firms, and 3.5 per cent U.S. firms. Even if all of those firms were SMEs—an unlikely assumption—then only 8,000 of Ontario’s nearly 400,000 SMEs are involved in research and development. That Ontario-based firms trail their peers by such a large amount indicates that strategies to stimulate more innovation and research activity among the province’s businesses are urgently required.

Another indicator of the weak innovation performance of Canadian SMEs is their low rate of ICT adoption. While the adoption of appropriate ICTs is a recognized way to improve productivity and thereby fuel better performance and growth, SMEs in Canada are less likely than large firms to adopt ICTs.

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25 Statistics Canada, “Key Small Business Statistics – July 2010: Do small businesses innovate as much as large firms?”
Given how much Canada’s economic performance depends on the performance of SMEs, stronger investment and innovation activity by SMEs must be essential elements of a larger strategy to improve innovation, productivity, and competitiveness at the national level.

**Barriers to Innovation**

Despite the demonstrated benefits of innovation for productivity and prosperity, Canadian firms as a whole are not keeping pace with international peers. As David Naylor and Stephen Toope recently observed, “the receptor capacity in the private sector…needs urgent attention.” So why are Canadian firms not innovating and investing in R&D as intensively as one might expect given the benefits and importance of doing so? And what policies and mechanisms are available to stimulate firms to innovate and invest more?

**Recognizing Innovation as Important**

While the innovation performance of Canadian firms may be cause for concern, it is important to note at the outset that leaders and employees of most firms recognize that innovation is important. The Conference Board’s survey of 181 leaders in mainly Ontario-based firms revealed that almost 90 per cent recognize innovation as somewhat or very important to their organization. Specifically, 40 per cent indicated that innovation is very important, 26 per cent said it is more than somewhat important, and 24 per cent said that innovation is somewhat important to their organization. Fewer than 8 per cent of respondents said that innovation is less than somewhat or not important to their organization.

It may be the case, then, that while Canadian businesses see innovation as critical to the performance of both their companies and the country, and may want to do more, they face internal and/or external barriers that prevent them from actually doing more. What are those barriers and how, if at all, can they be addressed?

**Explaining Canada’s Weak Performance**

Though there are many factors that affect the innovation performance of individual firms, sectors, and the country generally, Canada’s weak productivity and innovation performance is “largely due to weak business innovation.” The Council of Canadian Academies’ Expert Panel on Business Innovation asks “if innovation is good for business, why don’t more businesses in Canada choose to compete on the basis of innovation?” To address that question, one needs to consider the a priori “factors that influence the choice of business strategy” including:

- particular characteristics of a firm’s sector;
- the state of competition;
- the climate for new ventures;

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29 D. Naylor and S. Toope, “Don’t swallow these innovation nostrums.”
30 Of course, saying that innovation is important to one’s organization is easier than demonstrating through actions and investments a genuine commitment to innovation. Consequently, these results should not be mistaken for an indicator of commitment to innovation or innovative activity.
iv. public policies that encourage or inhibit innovation; and
v. business ambition (i.e., entrepreneurial aggressiveness and growth orientation)\textsuperscript{32}

In addition to these factors, Conference Board research has revealed that characteristics of the firm itself—especially physical and human capital, availability of funding and expertise for innovation, operational pressures, and size—affect innovation performance.\textsuperscript{33}

As this and many other analyses have concluded, “there is no single cause of the innovation problem in Canada, nor is there any one-size-fits-all remedy.”\textsuperscript{34} Instead, what is needed is a sector-by-sector, and perhaps also firm-by-firm, analysis of the factors that structure the opportunities for and barriers to innovation. In that case, improving Canada’s innovation performance will likely require a mix of targeted policies, tools, and mechanisms that are nimble enough to respond to more than one need or barrier faced by firms looking to innovate.

**Barriers to Innovation According to Businesses**

Business strategy decisions are made by leaders who have specific practical knowledge, dispositions, and beliefs that reflect their understandings of their firms’ positions in the market. Thus, if we want to know why Canadian firms do not innovate more, a useful first step is to speak to decision-makers directly about the barriers they face to becoming more innovative.

Thus, The Conference Board of Canada asked 222 leaders of public and private-sector organizations of varying sizes what barriers they face to becoming more innovative.\textsuperscript{35} (See Chart 1). Among SMEs, the most frequently cited barriers were:

- a lack of R&D funding/capital (53.6 per cent);
- a lack of time (44.8 per cent);
- a lack of in-house expertise (24.5 per cent); and
- insufficient government incentives (24.3 per cent).

Leaders of many SMEs felt that they often lacked the resources and time to pursue more innovation because of the *high demands of daily operations* of their core business. But even in cases where SMEs can find the capital and time, they often lack in-house expertise to conduct research and/or pursue innovation. While turning to external sources for help might not seem difficult, doing so can involve new time demands (e.g., finding and assessing experts, managing relationships), and new risks (e.g., exposure of sensitive information, data, and strategies to external actors; uncertainty about intellectual property (IP) rights; coordinating timelines with unknown collaborators).

\textsuperscript{32} Ibid., p. 5.


\textsuperscript{34} Expert Panel on Business Innovation, *Innovation and Business Strategy*, p. 11.

\textsuperscript{35} The result were collected from 41 in-depth interviews with leaders of organizations who had at some point collaborated with a Canadian college or polytechnic on an applied research project, and from another 181 leaders in primarily Ontario-based businesses (n=181) through an online survey. The 222 respondents and interviewees included both SMEs (n=181) and large businesses (n=41) based primarily in Ontario, 30 per cent of whom at some point had collaborated with a college on a research project.
While “size of organization” was the third most frequently cited barriers by SMEs (28.2 per cent), it barely registered among larger enterprises. Only 1 of 41 representatives of large enterprises cited size as a barrier to innovation. However, despite being cited by more than 1 in 4 SMEs, “size of organization” appears to serve simply as a proxy for other determinants of behaviour (such as presence or lack of expertise and funding/capital).

Among large enterprises, the most frequently cited barriers were:

- a lack of R&D funding/capital (39 per cent);
- a lack of time (31.7 per cent);
- insufficient market incentives (24.4 per cent); and
- excessive regulation and/or onerous application and reporting requirements for government programs (22 per cent).
It is worth noting that while both SMEs and large enterprises point to a lack of R&D funding and a lack of time as key barriers, the frequency with which the barriers are mentioned by SMEs is much higher than their frequency among respondents from large enterprises. Moreover, while many SMEs identify a lack of in-house expertise as one of the major barriers (24.5 per cent), fewer large enterprises seem to face this challenge (17.1 per cent).

There also appear to be some noticeable differences in the kinds of incentives regarded by leaders as necessary to stimulate innovation among firms of different sizes. Thus, while SMEs are more likely than large enterprises to point to the absence of government incentives as a barrier to innovation (24.3 per cent and 17.1 per cent, respectively), large enterprises are more likely than SMEs to cite the absence of market incentives as a barrier to innovation (24.4 per cent and 16 per cent, respectively).

Interestingly, large firms were more likely than SMEs to cite a lack of technology or equipment as a barrier to innovation (19.5 per cent and 8.3 per cent, respectively). The survey and interviews provided very little information to interpret this result; however, it may be that the innovation ambitions of large firms are greater than those of SMEs and thus require more expensive and/or difficult to access technology and equipment. In any case, for those Ontario colleges that have high-demand technology or equipment, there may be opportunities to assist a number of small, medium, and large firms.

**Breaking the Barriers**

In light of the barriers to innovation faced by business and Canada’s generally weak innovation and productivity performance, there is obviously a need for new strategies and approaches. To be sure, addressing the factors that contribute to Canada’s innovation and productivity gaps will require multi-faceted approaches and, as many have concluded, there is unlikely to be a single cure-all for the challenges. Yet, part of that strategy will certainly require attention to the barriers cited by firms themselves and the identification of developed or emerging resources, policies, and institutions that have the potential to bridge the existing gaps. As this report reveals, the applied research activities of Ontario colleges are emerging as a potentially significant piece of provincial and national innovation strategies.
Chapter 3

Bridging the Gaps: Ontario Colleges’ Applied Research Potential

Ontario colleges have developed a set of unique strengths over the past five decades that provide a solid foundation for the successful execution of applied research collaborations with businesses and other organizations. Indeed, Ontario colleges are well-positioned and equipped to understand the needs, challenges, and opportunities of businesses, especially at the local and regional levels, and are using these strengths to further develop and intensify applied research activities.

To be sure, there are areas where additional energy and support could further improve colleges’ unique advantages, and there are some barriers to innovation faced by firms that Ontario colleges may be unable to address on their own. However, taken together, the strengths of Ontario colleges—when used to support applied research, education, and training—will allow them to play an important role in improving the innovation and productivity performance of both the province and the country.

The Ontario College Toolkit

Literature reviews and interviews with 150 representatives of leaders in business, officials in provincial and federal governments, and Ontario colleges reveal that colleges have knowledge, skills, and other resources that are sorely needed by businesses and other organizations facing barriers to innovation and growth. Moreover, applied research collaborations between colleges and businesses, when supported by sufficient resources and policies, are regarded as an ideal mechanism through which colleges can share and exploit their strengths to realize benefits for firms and communities, as well as students and faculty.

In particular, Ontario colleges are widely regarded as having:

**Strong Industry Connections**

As “colleges and institutes are mandated to establish close partnerships with business, industry and community groups and are structured to do so through community access and development departments within institutions,” it is not surprising that they have not only developed strong connections, but also well-tested institutional arrangements for further developing and strengthening those connections.  

Notably, college programs have “advisory committees which are required to have representatives from community or regional employers to ensure that education and training programs are developed and updated in accordance with employers’ needs.” In many cases, colleges strive for advisory committees of ten or more employers and community representatives for each academic program or department. With some colleges boasting well over 100 programs, networks comprised of 1000 or more industry and community representatives tied to a single college may not be uncommon.

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36 ACCC, *Consultation with Canadian Colleges and Institutes*, p. 4.

The networks offer colleges an unmediated way to learn about industry concerns, acquire a familiarity with the language of business, and identify opportunities for collaboration with mutual benefits. As Ontario colleges enhance and expand their applied research activities, these strong industry connections will serve both them, and their business collaborators, very well. Indeed, the challenges of developing mutual understanding and trust—which are often very difficult to achieve in any collaboration—are significantly eased by existing arrangements.

**Industry Relevant Research Expertise**

Given that a quarter of the SMEs surveyed cited “lack of expertise”, and nearly half cited “lack of time”, as barriers to innovation, it is significant that Ontario colleges have a strong supply of student and faculty researchers and problem-solvers whose expertise is directly relevant to industry activities and who have the time and motivation to assist firms with research and innovation needs.  

Education and training in colleges is generally oriented towards employment (rather than knowledge for its own sake). Consequently, both students and faculty have incentives to stay informed about the needs, challenges, and opportunities of industry and to nurture ongoing relationships with employers. As interviewees noted, established college-industry channels of communication (e.g. advisory boards), knowledge exchange (e.g., research collaborations and conferences), and human capital transfer (e.g., recruitment of faculty from industry; internships and career placement for students and graduates) ensure that college researcher attitudes and expertise are “grounded,” “practical,” “connected to the real-world,” and “well-attuned to the needs of business.”

In many cases, both college and business interviewees characterized colleges’ applied research less as conventional research and more as a “problem-solving” activity, and see college-business research collaborations as more “customer-driven” than collaborations between university researchers and businesses. Research questions or problems are identified by firms rather than by the researcher with the result that gaps between what researchers do and what business finds valuable are much narrower.

**Accessibility and Reach**

Ontario colleges are also regarded as being much more accessible than other institutions and organizations that could provide research and problem-solving services to businesses. Nationally, colleges are present “in approximately 1000 communities in every region of Canada” and have a “mandate to support regional economic development.” Consequently, while many businesses will find it difficult to communicate with and receive services from a geographically distant university or consulting firm, the location of colleges in many medium and small communities facilitates easier communication and collaboration.

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38 R. Martin, “What is innovation—really?”
Moreover, the location of colleges in many regions and communities in the province and the country, further contributes to an unmediated understanding of the location-specific and industry-specific challenges and opportunities that local firms face. That is, in virtue of their location, Ontario colleges are not only easier to contact, but also have rich, embedded understandings of economic and social circumstances that firms, especially SMEs, face in their communities.

**Facilities and Equipment**

Another barrier to innovation cited by some firms is their lack of in-house or readily accessible technology and equipment to conduct research, testing, and other innovation and productivity enhancing activities. With research facilities, technology, and equipment of their own, colleges can serve as off-site R&D facilities for firms and thereby help them overcome this barrier.\(^{40}\)

As Polytechnics Canada notes in its recent *Solutions Report*, “[u]nlike large companies with an internal research and development department, most SMEs will need some sort of research support. A smaller enterprise…often cannot afford the advanced machinery and equipment needed to resolve commercial problems.”\(^ {41}\) In that case, colleges may help businesses to conduct research that would otherwise not have been pursued due to a lack of research infrastructure.

Recognizing the advantage that college-based research facilities and equipment can bring both to students and business collaborators, many colleges have been improving their facilities in recent years. In its 2008/2009 *Environmental Scan* the ACCC found that the number of Canadian colleges identifying research centres or specialized labs “increased by 56 per cent over three years” to a total of over 140 centres at 64 Canadian colleges.\(^ {42}\) In Ontario, 14 colleges reported housing 52 specialized labs or research centres in 2008/2009, including facilities focused on work in natural resources and energy; environmental science and technologies; health, medical, and life sciences; manufacturing and building technology; and social innovation.\(^ {43}\) While precise statistics have not yet been aggregated, interviews with Ontario colleges revealed that over the past year, even more new labs and centres have been opened at these and other Ontario colleges.

To be sure, some colleges report that even as they are able to maintain state-of-the-art facilities in some research areas, in other areas they are often well-behind industry in terms of acquiring and using the latest technology and equipment. In that case, the facilities and equipment advantage is not an advantage across the board. Rather, it can be important for some firms in some sectors, but irrelevant to other firms in other sectors. But this situation may improve. The recent announcement by the Canada Foundation for Innovation that $32.5 million in new funding will be made available to colleges, institutes, and polytechnics to acquire and improve research equipment and infrastructure, indicates that the facilities and equipment advantage of colleges is likely to improve in the near future.\(^ {44}\) This will have benefits for both student learning and the success of applied research collaborations with business.

\(^{40}\) ACCC, *Consultation with Canadian Colleges and Institutes*, p. 4.


\(^{42}\) ACCC, *Partnerships for Productivity and Advanced Skill*, p. 10.

\(^{43}\) Ibid., pp. 39-44.

\(^{44}\) Canada Foundation for Innovation, “Canada’s Economic Action Plan Supports New Research at Canada’s Colleges.”

**Funding Application and Reporting Assistance**

The most frequently cited barrier to innovation among both SMEs (54 per cent) and larger organizations (39 per cent) is a lack of R&D funding. While there are government resources available to businesses to initiate and complete R&D projects, many SMEs indicate that accessing those resources can be difficult. In many cases, firms report that the relatively small amounts available often don’t justify the time and effort required to produce and submit funding applications. Additionally, one in five businesses surveyed note that excessive regulation and reporting requirements, often related to funding programs, constitute barriers to innovation. Consequently, a significant proportion of research and innovation activities are not pursued by firms due to challenges related to funding.

While colleges are not a direct source of funding, many do have offices to assist with grant applications and reporting which can greatly reduce the burdens faced by businesses. To the extent that they are able to identify and acquire financial and other resources to support applied research collaborations, Ontario colleges play a key role in increasing the likelihood that businesses may pursue R&D-based innovation and productivity improvements.

As with the facilities and equipment issue, there are limits to what the colleges can achieve given current funding arrangements and reporting requirements. These challenges, and how they limit the potential college contribution to innovation and productivity enhancements, will be addressed more fully in later chapters. However, despite the tight parameters within which colleges must operate, they are playing an important role, along with provincial and federal ministries and granting agencies, in linking businesses with sources of funding for research and innovation.

**Interest in Intellectual Property (IP)**

Finally, although policies and experiences are different across Ontario’s many colleges, a number of interviewees, particularly businesses who have collaborated with colleges, note that colleges’ relative lack of interest in retaining IP related to research projects is an attractive quality to private-sector collaborators. Indeed, a few business interviewees reported that they turned to a college, rather than a university, for research services in large part because they believed that they would not have to engage in lengthy negotiations about IP.

Whether colleges’ current preference that IP is held by clients (to encourage commercialization) is appropriate and good for the colleges in the long-term or not, it does appear to be the case that the current approach constitutes a distinguishing feature of college research services that appeals to business clients.
Barriers to Business Innovation and Ontario College Strengths

<table>
<thead>
<tr>
<th>Innovation Barriers Cited by SMEs and LEs</th>
<th>Ontario College Strengths Cited by Interviewees</th>
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<tbody>
<tr>
<td>• Lack of in-house expertise</td>
<td>• Industry-relevant research expertise</td>
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<tr>
<td>• Lack of time</td>
<td>• Strong industry connections</td>
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<tr>
<td>• Lack of technology/equipment</td>
<td>• Accessibility and reach</td>
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<tr>
<td>• Lack of R&amp;D funding/capital</td>
<td>• Facilities and equipment</td>
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<tr>
<td>• Excessive regulation and/or onerous</td>
<td>• Funding application and reporting</td>
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<tr>
<td>application/reporting requirements</td>
<td>expertise/assistance</td>
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<tr>
<td>• Insufficient market incentives</td>
<td>• Colleges generally prefer that IP is held</td>
</tr>
<tr>
<td>• Insufficient government incentives</td>
<td>by clients (to encourage commercialization)</td>
</tr>
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A Resource for Large Enterprises?

It should be noted that while SMEs are the primary clients for Ontario colleges’ applied research services, and while much of the literature emphasizes SMEs as clients, our research reveals that large enterprises have also been clients.\(^{45}\) About one-quarter of the interviews conducted with firms that had collaborated with a college on an applied research project were with businesses employing 500 or more people. Moreover, given that all but one of the 41 large enterprises who completed the survey or interview cited at least one barrier to research and innovation that could be addressed by one or more of the college strengths described above, there is significant potential for future engagements between Ontario colleges and large enterprises.

As a result, while core strategies for developing and marketing college research services wisely focus on SMEs, there is a population of large enterprises that might benefit from colleges’ research services. It would be to the advantage of both colleges and large enterprises to explore possible collaborations given the benefits that could arise from such collaborations for both parties.

\(^{45}\) Approximately 25 per cent of the in-depth interviews we conducted with businesses and other organizations who have collaborated with colleges reported having 500 or more employees. Excluding public and non-profit organizations, the proportion of large private-sector organizations is approximately 19 per cent (7 of 36). Looking at results from the online survey of organizations, of the 97 organizations that indicated that they are aware that colleges offer research services, 19 (or just under 20 per cent) are large enterprises. Of the 26 organizations that indicated that they had contacted a college regarding research services, 6 (or 23 per cent) are large enterprises. And, of the 22 organizations that indicated that they had received research services from colleges, 10 (or 45 per cent) were large enterprises. While it is difficult to draw strong conclusions from these small numbers, the results provide enough reason to reflect on the strategies that colleges pursue to attract clients to their applied research services. Emphasizing the advantages for SMEs is certainly wise, but neglecting LEs would be an unfortunate omission.
From Potential to Impact

In a 2007 report on the value that college applied research can bring to SMEs in Canada, the Association of Canadian Community Colleges observed that “SMEs need support for research and development activities that are focused on their needs and goals, and the productivity and competitiveness of their businesses” and argues that Canada’s colleges and institutes are well-positioned to meet those needs.46

Our research confirms and extends that observation: SMEs and LEs face opportunities and challenges that Ontario colleges can help them to address in light of the tools and advantages that the colleges have developed over their nearly fifty years of existence.

Still, while it is one thing for Ontario colleges to exhibit great potential, it is another for that potential to be realized and to produce significant benefits for firms, communities, students, and others. Are the college strengths translating into tangible benefits? Is the college applied research potential being realized and maximized? What more can be done to further enhance the contribution that Ontario colleges can make innovation, productivity, and social and economic well-being?

46 ACCC, “Colleges and Institutes and Canada’s SMEs: A Partnership for Innovation,” p. 5.
Chapter 4
Realizing the Potential: The Impact of Ontario Colleges’ Applied Research

While funding for college applied research has been relatively modest to date, and while many Ontario colleges have only recently initiated applied research programs, the results of already completed projects are impressive.

Colleges as Innovation Catalysts and Accelerators

Among the most significant findings from the research is that the applied research activities of Ontario colleges are stimulating new, and accelerating existing, innovation initiatives by the firms with whom they collaborate. Critically, the research reveals that the collaborations are leading to innovations that would not otherwise have emerged had the college services not been available, and Ontario colleges are helping businesses and other organizations create new and improved products, services, and processes much more quickly, and with greater quality, than they otherwise would have been able to achieve without college support.

In light of the many reports and much hand-wringing about Canada’s weak innovation performance, especially the comparatively low R&D spending by Canadian businesses, the recognition that Ontario colleges’ applied research activities constitute a lever to induce businesses to pursue innovation and productivity improvements more intensively is very encouraging.

Innovation Catalysts

The Conference Board of Canada asked business interviewees, “if the college’s research expertise and/or funding contribution were not available, would you still have pursued the initiative?” Of the 28 applied research collaborations between firms and Ontario colleges for which evidence was provided, nearly one-third of the projects (9 out of 28) would have been abandoned had the college research services not been available.

While the college role was critical in only a minority of cases in Ontario, it is nevertheless remarkable that one third of the projects would not have been initiated in the absence of college applied research assistance. It is not possible to quantify precisely the loss or unachieved net gains those firms and the economy generally would have experienced had this subset of projects not been pursued. However, many of the organizations reported that the collaborations with the colleges resulted in new or improved products, services, or processes; increased sales and revenues; identification of new markets and other research opportunities; and the creation of new

47 The Conference Board conducted in-depth interviews with 29 businesses and organizations who had worked with one or more Ontario colleges on applied research projects, and 12 who had worked with colleges outside Ontario. In some cases, the organizations had worked on more than one project with one or more colleges. Of the more than 50 initiatives examined, interviewees provided evidence on and careful assessments of 41 projects.

48 This compares with 6 of 13 projects conducted with colleges in other provinces that would have been abandoned had those colleges not been available to offer applied research services.

jobs (some of which were filled by college graduates who had worked on the projects). These benefits are presented and discussed below in the section “Impact and Benefits for Firms.”

Innovation Accelerators

Although two-thirds of the initiatives would have proceeded even without the college applied research support, nearly all organizations interviewed identified at least one significant negative consequence that they would have faced if college assistance had not been available to them. Specifically:

- more than half the firms would have faced delays in starting and completing their research projects (with some firms reporting that these longer timelines and delays would have resulted in lower sales and revenues);
- half of the firms reported that their projects would have entailed higher costs, in some cases almost to the point of making them financially unfeasible; and
- half of the firms would have had to locate equipment and/or expertise in another partner (e.g., another college, university, private researcher/consultant) with unknown consequences for timelines, costs, and quality;

Some firms also reported that, without the colleges:

- their projects (e.g., products, services, or processes) would have been of lower quality, with unknown consequences for revenues, customer satisfaction, and other metrics; and
- they would have missed out on ideas and opportunities (for future product, service, or process improvements) that emerged from the collaborations with the colleges.

Thus, while colleges were not always essential to the initiation and completion of all the projects investigated, they did play a catalyst role in a sizable minority of initiatives and served an important accelerator function in many of the projects.

On the basis this evidence, it is reasonable to conclude that Ontario colleges are well-positioned to make important contributions to the Ontario and national innovation systems. Indeed, Ontario colleges have the potential to help address a key weakness in Canada’s overall innovation performance—namely, underperformance of Canadian firms, especially SMEs, in R&D spending and innovative activity. That colleges have the potential to play such a critical role in stimulating and

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49 Some organizations that identified the college role as critical observed that “We really needed the college’s expertise and help with funding was critical”; “Without the infrastructure and equipment the college provided, we wouldn’t have been able to do this”; “We probably wouldn’t have completed the initiative. This is a very specialized field and not many entities can do it. It was the college expertise that gave us the idea to even do it”; “[The college] was critical. We wouldn’t have pursued [the project] without them, or any other partners.”

50 Of those firms who indicated that they would have pursued the project even without the college expertise, 24 indicated that doing so would have entailed negative consequences of one sort or another for them. 14 reported that they would have experienced delays; 12 reported that their costs to complete the project would have been higher; 12 reported that they would have had to find another source of expertise or equipment (e.g., another college, university, or consultant); 5 reported that they would have had to purchase additional equipment. In many of these cases, interviewees reported that these consequences would likely have affected sales.

supporting innovation suggests that policies and funding programs ought to be created and/or revised to ensure that the colleges’ innovation catalyst and accelerator potential is expanded and maximized.

Textbox 4

**Incremental Improvements in Manufacturing Processes**

**Conestoga College and COM DEV International Ltd.**

COM DEV International Ltd—one of the world’s leading producers of advanced space hardware—recently partnered with researchers at Conestoga College on a process innovation that has improved the way it does business.

The collaboration involved automating a key manufacturing process—“deburring”—that had previously been performed by hand. After examining alternate tools and techniques, COM DEV and Conestoga College settled on a plan to create a robot with the capacity to fabricate parts with greater efficiency and to integrate the result into COM DEV’s production process. A demonstration of the new process is expected in late 2010 and should provide COM DEV with an improved, more efficient production process.

A COM DEV executive notes that without Conestoga’s assistance, the idea to automate the production process with a robot would not have emerged. Not only did researchers at Conestoga College introduce a new idea to the company, COM DEV executives were also ensured that the idea would be feasible. Moreover, because COM DEV was able to effectively outsource this R&D initiative to Conestoga College, the company was able to stick to its core competencies rather than engage in, what for them would have been, a new and risky activity.

Source: The Conference Board of Canada.

**Impact and Benefits for Firms**

Across a broad range of indicators, the benefits to businesses and other organizations of Ontario colleges’ applied research support is very positive. The applied research activities of Ontario colleges are emerging as an increasingly important means by which they are able to fulfill important parts of their mandate—namely, “to meet the needs of employers and the changing work environment and to support the economic and social development of their local and diverse communities”—and are producing measurable improvements related to production and process; sales, markets, and customers; workforce impacts; and innovation and R&D spending by firms.

**Production and Process**

Nearly all collaborations between firms and Ontario colleges on which data were provided resulted in a new and/or improved product, service, or process and in some cases, more than one

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51 Each firm interviewed was presented with a list of 29 possible outcomes of their research collaborations with Ontario colleges and asked to indicate whether they have “observed” or “anticipate” any of the specific outcomes. Moreover, in an open-ended question, interviewees were invited to describe other positive or negative outcomes not contained in the set list of 29 outcomes. In both cases, when interviewees indicated that specific outcomes have been observed or anticipated, the interviewers asked whether the outcome could be quantified or otherwise appropriately described. While some interviewees were able to provide precise quantitative or qualitative measures of the observed outcomes, most were able to quantify or qualify outcomes in only broad brush strokes. This is not surprising given that the projects were relatively modest in financial terms—e.g., government contributions for most projects tends to be no more than $30,000 and often less—and are often combined with other innovations and initiatives to achieve results.


novel or improved outcome emerged. (See Chart 2). Of the 29 applied research collaborations on which respondents provided outcome assessments, 11 (38 per cent) led to the development of a new good or service, while 9 (31 per cent) are expected to lead to a new good or service in the future. That is, new products or services were observed or are anticipated in 69 per cent of all collaborations we studied.

11 (38 per cent) of the collaborations produced observable improvements to a good or service, and another 5 (17 per cent) are expected to produce future improvements—i.e., improvements were observed or are anticipated in 55 per cent of cases.\(^5\) And, new or improved processes were observed in 9 cases (31 per cent) and anticipated in another 6 (21 per cent)—that is, 52 per cent of collaborations produced observed or anticipated process improvements.

In addition to novel or improved goods, services, and products, firms’ collaborations with Ontario colleges are leading to reductions in the time to market of new/improved products (49 per cent observed or anticipated). One interviewee noted that for his firm, “this was an unexpected benefit” that allowed the firm to gain “six to eight months of development time.”

Other benefits include more effective marketing (31 per cent observed or anticipated), improved decision making (28 per cent), and improved strategic and business planning (27 per cent). The President of one firm that worked with an Ontario college on a wide range of issues related to a single product (including product testing, marketing, and business planning) noted that “deb briefs and conversations with [the college] about project progress and outcomes improved our capacity to plan and make decisions about future directions.” Another entrepreneur remarked that ongoing conversations with college faculty and research staff, during and after the collaboration, have given him a better understanding of risks and opportunities in the market and thus improved his ability to make business decisions.

\(^5\) In some cases, a single “collaboration” resulted in more than one new or improved good or service, or new/improved process. For example, a collaboration that aimed to improve a firm’s existing good may achieve that aim through the development of a new production process. In that case, the firm reported an observed improvement in a good and an observed new process. Consequently, the sum of observed and/or anticipated new or improved goods, services, or processes exceeds the total number of collaborations assessed.
Sales, Markets, and Customers

Research collaborations with Ontario colleges have also led to tangible results with respect to sales, markets, and customers. (See Chart 3). Nearly 80 per cent of the applied research collaborations between firms and colleges have resulted in, or are expected to result in, increased sales and revenues for the firm. Representatives from one firm noted that while the total cost of the collaboration for them was approximately $60-70,000, the ultimate result was return of $2 million over a six month period. Another firm reported that the small applied research project they conducted with an Ontario college led to a sales contract worth $250,000 for the firm. For 5 firms (17 per cent), the increases in sales and revenues is a result of increased exports, while another 9 firms (31 per cent) anticipate increased exports as the results of their applied research collaborations reach market.

Moreover, large majorities of the collaborations have led to, or are expected to lead to, improved market position (79 per cent) and new customers (76 per cent), while others have observed or anticipate new markets (58 per cent) and improved customer satisfaction (59 per cent).
Textbox 5

**Economic and Social Impact**

**Algonquin College and HousAll in Haiti**

Following the earthquake that devastated Haiti in 2010, Ottawa-based firm HousAll contacted the humanitarian organization Save the Children with an offer to provide its patented line of long-term, transitional shelter units to meet the humanitarian need. While interested, Save the Children replied that it required larger shelters than those currently produced by HousAll to serve as schools and clinics. If it was to contribute to the relief effort, HousAll had to find a way to quickly increase the size of its shelters originally designed for single-family use.

A HousAll representative who had once taught at Algonquin College, and who was familiar with the applied research capacity of the college, contacted Algonquin for assistance. The school was receptive to the idea and immediately put HousAll in contact with a suitable department that could undertake the project to find a way to increase the size of the shelters while maintaining their structural integrity.

The total cost of the project was between $60-70,000, which included contributions of cash and in-kind resources from HousAll, and funding from the Ontario Centres of Excellence. The improved shelters were not only sent to Haiti to assist in relief efforts, but also generated $2 million in sales over a six month period for HousAll. Algonquin also benefitted: Two students were hired by HousAll based on their work on the project, and three new research projects between HousAll and Algonquin were initiated in the subsequent year.

Source: The Conference Board of Canada.

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**Chart 3**

**Outcomes for Firms: Sales, Markets, Customers**

n=29

<table>
<thead>
<tr>
<th>Outcome Anticipated by Firm</th>
<th>Outcome Observed by Firm</th>
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<tbody>
<tr>
<td>Increased sales/revenues</td>
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<tr>
<td>Improved market position</td>
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<td>New customers</td>
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<td>Improved customer satisfaction</td>
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<td>New markets</td>
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<td>Increased exports</td>
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<td>Increased profits</td>
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<td>Repeat customers</td>
<td></td>
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<td>Increased margins</td>
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**Workforce Impacts**

Firms that collaborated with Ontario colleges also experienced a variety of workforce-related benefits. (See Chart 4). In over a third of the assessed cases, interviewees reported that the research collaboration was a direct contributing factor to their hiring one or more new employees, while another 28 per cent anticipate hiring in the future as a result of the collaboration.

Of those hired 13 were college students who had worked on the applied research project under assessment. Many firms note that one of the main advantages of the collaborations, beyond the results of the research itself, is the opportunity to observe and assess potential employees over a sustained period of time. When students work on projects that last more than a few weeks or months, employers are able to see how well a potential recruit works, thinks, and fits in with the organization.

While other firms did not hire new employees as a result of the research collaborations, a few reported that the increases in sales and revenues that arose from their applied research collaborations with Ontario college allowed them to retain workers who otherwise may have been laid off, especially during the recent economic downturn. One executive remarked that “the phenomenal success of the project affected everyone’s position.” Had the project not been as successful as it was, a number of employees may have lost their jobs. Instead, the firm became a very profitable exporter of product in great demand in many parts of the world.

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**Textbox 6**

**Health Innovation: Mon Ami**

**Seneca College and Tertec Enterprises**

Markham-based Tertec Enterprises saw an opportunity to develop a product for the baby boomer demographic that increasingly will look for services and technologies to allow them to age at home and thus delay entering retirement or long-term care homes. Tertec used its expertise in developing software and hardware systems to create an interactive device—the Mon Ami. Mon Ami can provide an individual with physical challenges an online connection to a caregiver and provides a number of interactive services in lieu of a flesh and blood care worker—everything from playing music and telling stories, to sending and receiving emails, to recording personal memoirs.

The idea to collaborate with Seneca College emerged through the Markham Synergy Centre—a centre run by the city and NRC’s Industrial Research Assistance Program. With support from the Health Technology Exchange and Communications and Information Technology Ontario, Seneca researchers developed valuable extensions to the device, including a pill dispenser, a microwave, and a communications platform that can be used by clients in case of injury. Tertec received an order for 1,500 Mon Ami units from seniors’ homes in Germany, and home installations began in the Greater Toronto Area in 2007.

According to a Tertec executive, the company looked to Seneca for assistance because of the ability of college students to “hit the ground running” with practical and business-ready skill sets. Two student researchers were eventually hired by Tertec as a result of the collaboration.

Source: The Conference Board of Canada.

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54 Tertec Enterprises. *My Mon Ami.*
55 Seneca Research and Innovation. *Completed Projects.*
In addition to the job creation and retention benefits, many interviewees report that the research collaborations have had significant impacts on the skills, attitudes, and behaviours of both managers and employees. Most notably, over half of the collaborations led to “more ideas being generated in the organization” according to the firms who participated. Because they involve changes in daily routines and broaden the perspectives of participating employees, firms’ applied research collaborations with Ontario colleges are sparking new insights and ways of thinking which are signs of a healthy, innovative organization.

Moreover, some firms report that their work with Ontario colleges has led to an improved capacity to solve problems (45 per cent), an increased belief that innovation leads to competitiveness (38 per cent), and improved teamwork and communications (34 per cent). These are some of the skills and attitudes that make up The Conference Board’s Innovation Skills Profile—a profile of the skills that have been found to be needed by managers and employees to contribute to an organization’s innovation performance. That applied research collaborations between firms and Ontario colleges lead to observed improvements in some of these skills, attitudes, and behaviours is a very interesting finding. It suggests that colleges’ applied research may provide a way to

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57 The Conference Board of Canada, “Innovation Skills Profile.”

improve the entrepreneurial ambition and skills of a nation’s leaders, managers, and workers. (SeeTextbox 7).

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<td><strong>Entrepreneurial Ambition and Innovation Performance</strong></td>
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| While many observers agree that innovation skills and entrepreneurial ambition are key ingredients of competitiveness and innovation success, opinions differ about whether Canadians are sufficiently skilled and ambitious to meet current challenges. Moreover, there is some disagreement about whether Canadians’ weaker entrepreneurial behaviour, when compared with behaviour in the United States, is a consequence of intrinsic differences in ambition and attitudes, or the result of different institutions, policies, and opportunity structures. The Competition Policy Review Panel concludes that Canadian competitiveness is impaired by a “lack of sufficient entrepreneurial culture and ambition….While the entrepreneurial spirit exists in certain companies and industries, Canada needs more aggressive and ambitious business leaders with the global mindset necessary to compete to win in the twenty-first century.”  

While the Expert Panel on Business Innovation agrees that there is a “widespread view” that “Canadian business people lack a sufficiently aggressive and entrepreneurial spirit, at least when compared with their counterparts in the United States,” it could produce no solid evidence to substantiate that belief. Moreover, as the Institute for Competitiveness and Prosperity notes, what evidence is available on the debate suggests that “Canadians do not have a fundamentally different outlook on many aspects of competitiveness than our US counterparts” and that differences in innovation and competitive contexts, rather than intrinsic traits and attitudes of individuals, are better explanations for the behavioural differences we see between Canadian and American business people. 

In short, it may not be deficits in Canadian entrepreneurs’ skills, attitudes, and behaviours as such that explain weaker innovation performance, but instead the lack of a supportive background structure of institutions, policies, and opportunities that support and facilitate innovative behaviour among Canadian business people. |

Source: The Conference Board of Canada. |

**Firm-Level Innovation Benefits**

Two critical innovation-relevant benefits of firms’ applied research collaborations with Ontario colleges are especially worth noting. Together, these benefits provide evidence that collaborations with Ontario colleges are helping SMEs not only to become better innovators, but also helping them to nurture an ongoing innovation orientation in their organizational culture and activities.

**Additional R&D Spending**

It appears that the collaborations have the effect of motivating some firms to increase R&D spending—increases that would not have occurred had they not collaborated with a college on a research project. About one third of the projects led to firms increasing their spending on R&D, while another 10 per cent indicated that they anticipate spending more in the future. One firm noted that it “tended not to invest at all before” the collaboration, but has since increased its R&D spending. Another firm indicated that it “will be spending even more on new collaborations with [the college] in light of the success of the first project.”

60 Institute for Competitiveness and Prosperity, *Beyond the Recovery*, p. 31.
Overall, it is encouraging to find that Ontario colleges provide a mechanism that may be able to stimulate additional R&D in the firm.

Textbox 8

The Three Little Pigs Project
Fanshawe College and the University of Western Ontario

In spring 2006, shortly after Hurricane Katrina struck New Orleans, students at Fanshawe College teamed up with researchers at The Insurance Research Lab for Better Homes at the University of Western Ontario to build and test weather-effects on a specially designed two-story house. The project, dubbed “The Three Little Pigs” aimed to improve the design and construction of dwellings that can sustain hurricane-force winds like those experienced annually in many parts of the world.

More than 90 Fanshawe students participated in designing and constructing the fully-functional brick house on a base with special monitoring equipment in a specially designed facility at the London International Airport. The project is the first of its kind to test the effects of category five hurricanes on a fully-functional house in controlled conditions, in order to learn about many aspects of building durability.

The $6.8 million dollar project, funded in part by the Canada Foundation for Innovation and Ontario Innovation Trust, and a number of private donors, is informing ways of constructing houses are that are more resistant to climactic effects and energy efficient, and offers an example of how colleges and universities can collaborate on mutually beneficial applied research projects.

Source: The Conference Board of Canada.

Networks and Opportunities
Firms also reported that presentations about the results of their work with the colleges at forums and conferences often organized by the colleges, have given them opportunities to expand their business networks. In some cases, this has led to new business opportunities that firms did not expect before the collaboration was initiated.

Other firms have become formally involved in the colleges’ program advisory councils which provide them with a wide range of opportunities to network with others, to keep abreast of developments and opportunities in their sectors and fields, and to nurture their relationships with the colleges which have a variety of mutual benefits.

Repeat Collaborations

Though not a benefit as such, it is worth noting that many of the firms and organizations that worked with Ontario colleges have either collaborated on other projects or plan to do so in the near future. Interviews with firms and other organizations who had worked with Ontario colleges on applied research projects found that in 27 of 29 cases, firms and organizations say that they are “likely to work with this or another Ontario college again on research projects.” 14 of the interviewees reported that they are already collaborating with an Ontario college on one or more new research projects.

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61 Fanshawe College, “Fanshawe and UWP Partner to Make Better Houses.”
62 University of Western Ontario, “The Insurance Research Lab for Better Homes.”
A key reason for repeat collaborations cited by a number of firms is simply the excellent performance of the college in the previous project. One business leader remarked that “too many positive things happened during our collaboration for us not to do it again.”

**Enhancing Technical, Employability, and Innovation Skills and Attitudes**

Ontario colleges’ applied research activities have a variety of benefits for those students who participate in the projects and, consequently, appear to provide a useful way for the colleges to fulfill another part of their mandate—namely “to offer a comprehensive program of career-oriented, post-secondary education and training to assist individuals in finding and keeping employment.”

Indeed, in addition to improving innovation performance of firms in the short term, the applied research activities at Ontario’s colleges also contribute to the development of a highly skilled, innovation-ready, future workforce that should enhance innovation performance in the long-term.

**Educational and Training Benefits**

We asked professors and directors of research at Ontario colleges about the educational and training impacts for students of participation in applied research projects with businesses and other organizations. While unable to precisely measure and quantify the impact of applied research participation on educational and training outcomes, nearly all college representatives report that they have observed improvements and believe that applied research participation has improved the learning experience for students.

Industry exposure and the experience of working on real problems in real workplaces gained through students’ participation in applied research projects, contributes to their training and employability in ways that can’t be replicated in a classroom alone. As one college representative noted, “applied research doesn’t mimic the real world, applied research is the real world. Applied research is the best way for students to put their existing skills to use, and the best way for them to refine and develop new skills.”

In particular, college interviewees report that they have seen improvements in students’ technical and employability skills, including communication and problem-solving skills, adaptability, and ability to work with others. A few college representatives also reported that they are seeing greater self-confidence among students who participate in applied research projects with businesses and other organizations.

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64 Ideally, a study of the impact of applied research participation on students would involve a systematic examination of a large number of students who had, and others who had not, participated in applied research, over a sustained period of time. The scope and timeframe of the current project did not allow us to conduct such a study. However, in completing the work, we have developed a research approach to assessing the educational and other impacts on students using the Conference Board’s General Innovation Skills Aptitude Test (GISAT) and other tools, and we hope to carry out that work in the future.
65 Interviewees’ observations about the improvements in students’ skills and attitudes track closely with what the Conference Board calls “Employability Skills”—the critical skills needed in the workplace, whether one is self-employed or working for others. Employability Skills include communication, problem solving, positive attitudes and behaviours, adaptability, working with others, science, technology and mathematics skills, and others. M. Bloom and K. Kitagawa, *Understanding Employability Skills.*

Additionally, interviewees indicate that participation in applied research projects with businesses or other organizations likely leads to improvements in students’ entrepreneurial ambition and innovation skills—i.e., the skills, attitudes, and behaviours of individuals that contribute to organizations’ innovation performance. According to one college interviewee, “students involved in the projects see the entrepreneurial aspects; they see the light-bulbs go on.” Another remarked that “applied research is the ultimate problem-solving skills training there is”—it shows students “what innovation is really all about.”

“Applied research doesn’t mimic the real world, applied research is the real world. Applied research is the best way for students to put their existing skills to use, and the best way for them to refine and develop new skills.”

Source: College Interviewee

Finally, nearly all college interviewees report that faculty involvement in applied research projects has a variety of indirect benefits all college students, whether they participate in applied research projects or not. Faculty who design and manage applied research collaborations with industry gain new knowledge and skills, and maintain awareness of new developments in the fields in which they teach. This helps to ensure that course offerings and materials provide up-to-date and industry-relevant education and training for students.

**Recruitment and Employment**

Collaborations that involve student researchers provide firms opportunities to rigorously assess the skills and attitudes of potential recruits, while students have parallel opportunities to consider whether the firm with which they are collaborating might be a place they would want to work. In both cases, the relationships that develop over the weeks or months of the research projects reveal much more relevant information to both parties than conventional recruitment processes and job interviews tend to reveal.

Assessments of 29 applied research collaborations between firms and Ontario colleges revealed that 13 students were hired after working on the project, while other firms anticipate hiring students in the future as a consequence of their performance during the collaboration. Even in those cases where students are not hired by the collaborating firm there are important benefits related to students’ employability.

The hands-on experience that students gain can be added to their resumes and many students have received reference letters from the businesses with whom they and their colleges have collaborated. Additionally, students are exposed to contacts in the firm and sector which can be called upon for advice and/or future employment opportunities. In short, students gain experience, contacts, and references that they would not otherwise have acquired through in-class learning alone.
**Future Research**

While early indications are that the educational and employment benefits for students of participation in applied research are positive, a lack of data collection and analysis on many of these outcomes makes it difficult to draw strong conclusions. Moreover, the absence of measured results makes it difficult to offer precise recommendations about how to arrange and manage research collaborations to maximize benefits for students.

In light of the centrality of education and training in Ontario colleges’ mandate and the strong possibility that applied research can make a significant contribution to fulfilling that part of the mandate, future research that aims to collect and analyze data on student-level outcomes, especially employability and innovation skills, attitudes, and behaviours, is highly recommended.

**Enhancing the Impact**

Ontario colleges’ applied research collaborations with businesses, non-profit organizations, and some government agencies are producing excellent outcomes. Yet, the scale on which applied research is being conducted is a mere fraction of what is necessary to stimulate and accelerate innovation performance among Ontario’s businesses, especially SMEs. Indeed, although Ontario colleges have worked with hundreds of businesses, there are nearly 400,000 SMEs in Ontario that constitute the potential client pool. While it would be impossible for Ontario colleges to help all of them, expanding their assistance to more firms would help bring Ontario more in line with Quebec and the U.S. levels of research and innovation intensity.

In short, Ontario colleges’ applied research is emerging as a key lever to stimulate research and innovation in the province. Government and college attention to the three *Foundations of Applied Research Success*—as described in the following chapters—would certainly help to enhance the college contribution.
Chapter 5

Foundations of Applied Research Success I: Funding

As a group, Ontario colleges are beginning to deliver clear benefits from their applied research activities. But not all schools have reached the same level of expertise and sophistication for carrying out successful projects. Moreover, those colleges that have reached greater maturity in applied research capacity and outcomes still face barriers to their full development. In order for Ontario colleges’ applied research activities to deliver significant benefits to firms, students, and the economy, clear understandings of the challenges faced by colleges and their collaborators are required, as are effective strategies to address those challenges.

In the next three chapters, we offer an account of three Foundations of Applied Research Success—namely, funding; physical and human capital; and effective collaborations. To carry out effective applied research projects that produce the kinds of benefits described in this report, colleges require sufficient funding, access to facilities and equipment, research faculty and students with expertise and time to participate, and effective strategies for identifying business partners and managing relationships. As the research reveals, however, colleges face many challenges in securing these preconditions. Moreover, the analysis shows that actions by the colleges and government to overcome the challenges are necessary if the college potential to stimulate innovation and productivity improvements is to be realized and maximized.

Stages of Applied Research at Ontario Colleges

At the outset, it is useful to recognize that Ontario colleges are at different stages of developing their applied research capacity and activity. Recognizing this fact helps in understanding whether the challenges each faces are unnecessary and malleable barriers, or simply the challenges one would normally expect to face at a certain stage of learning and development. Moreover, recognizing the differences in developmental progress allows for the crafting of more strategic and precisely targeted recommendations that can provide a foundation for more effective policy and action on the part of governments and colleges.

Using the continuum of stages of applied research at colleges developed by Madder and refined by the ACCC along with information about Ontario colleges collected through a data request, in-depth interviews with Vice Presidents and Directors of Research, and from the colleges’ websites, we have determined where the colleges would be located on Madder’s continuum. Moreover, given some important developmental differences between colleges within some of Madder’s four stages, we further distinguish between “early to mid” and “late” phases of the three higher stages to create 7 possible phases. (See Textbox 9).

66 Madder, Innovation at Canadian Colleges and Institutes.
67 ACCC, Partnerships for Productivity.
Textbox 9

**Typology of Stages of Applied Research at Colleges**

**Colleges with no Formal Innovation Policies & Structures**

*Characteristics and Activities:*
- Undecided institutional commitment to applied research (AR) and no related policies, structures, human resources allocated or dedicated to AR, and no active support by senior administration.
- Focused on project-based delivery and/or student placements with employers; developed and implemented as “side of desk” activities for faculty, or associated with graduate studies of faculty or staff.

**Novice Innovation College**

*Characteristics and Activities:*
- Recent launch of AR activities with support from senior administration, though institutional acceptance is not widespread and some cultural conflict may be experienced.
- Director of Research appointed and reports to senior VP.
- Initial policies often developed for compliance with funding requirements, including ad hoc and incomplete fiscal and HR systems and policies
- AR activities are done by faculty with some release time or temporary staff allocations and initially more funds are available for capital equipment but less operating capital.
- Often a transitional and unstable stage of 3 to 7 years. Time spent in this stage can be reduced by hiring experienced Director of Research and/or with intensive professional development for AR-related staff.
- Potentially all activities as in the first state.
- Formal AR activities are usually project-based in collaboration with industry partners, with combination of industry support (cash or in-kind), and are limited in number, scope and framed as pilot projects.

**Established Innovation Colleges**

*Characteristics and Activities:*
- Comprehensive policies in place related for AR, including fiscal management, human resources and reporting, and facilities and equipment are established but may require renewal.
- AR human resource policies support more full-time positions and result in less turnover of AR personnel.
- Increased access to operational funding than can be managed by the existing AR administration.
- Academic and service divisions support AR activities as part of the college mandate and mission.
- Potentially all activities of the first and second states.
- AR teams led by faculty conduct multiple projects that interrelate and faculty and staff may be seconded and fully funded to conduct AR activities on a continuing basis.
- AR activities may support both local and regional needs and may be integrated with business support services.
- Funding and AR activities involve multiple public/private sector partnerships.
- As colleges progress through this stage there is greater focus on longer multi-year projects that provide sustainability for AR activities and greater stability in human resources.

**Integrated Innovation Colleges**

*Characteristics and Activities:*
- These colleges, often relatively large, have integrated AR and business support systems that provide business development support integrated with AR activities that may be regional, national, or international in scope.
- Potentially all activities as in the first, second, and third states.
- These colleges house business incubators, accelerators, or business parks supported by and providing support to the college, with many opportunities for companies on campus to access research resources and services.

For those 19 colleges for whom sufficient information was available to make a reasonable assessment, the following distribution emerged:

- 10 colleges exhibit the characteristics of early to middle phase *Novice Innovation Colleges*;
- 5 exhibit the characteristics of late phase *Novice Innovation Colleges*;
- 3 exhibit the characteristics of early to mid phase *Established Innovation Colleges*; and
- 1 exhibits the characteristics of a late phase *Established Innovation College*.

Many of the remaining colleges likely fall into Madder’s “colleges with no formal innovation policies and structures” category, but in the absence of sufficient information about those colleges, it is impossible to make proper assessments.\(^{68}\)

The point of classifying the colleges is not to motivate comparisons and concerns about ranking, but instead to provide a lens through which the performance of colleges can be better understood. Indeed, aware of the different levels of development, we can make better sense of the determinants of funding application attempts and success rates, as well as the determinants of success in applied research collaborations and outcomes. Moreover, the classification can help to ensure that college and government deliberation and planning about what is required to further enhance colleges’ applied research contributions is guided by a clear sense of where the colleges are, what the next steps might be, and what is necessary *and sufficient* to help them get to those next stages.

**Funding**

Historically, the amount of funding available to Ontario and other Canadian colleges to conduct applied research has been low. Relative to the amount of funding available to Canada’s universities, the resources available to colleges is almost imperceptible. Whereas the main source of funding for university-based research derives from the expected allocation of approximately 40 per cent of university professors’ (provincially paid) time to research, the operating grants for Ontario colleges include no explicit allocations for college employees to pursue research. Thus, resources to support Ontario colleges’ applied research activities in this pilot phase of applied research development, have had to be identified and secured from sources other than operating grants.

Indeed, while the Ontario colleges’ mandate allows colleges to pursue applied research as one way to achieve their core objectives, transfers from the Ministry of Training, Colleges, and Universities (MTCU) do not include distinct envelopes for applied research. While colleges may allocate some of the transfer to support applied research, they are not entitled to additional resources and must continue to meet their mandated objectives with the resources they receive. Consequently, much of the funding for colleges’ applied research comes from federal and provincial agencies and departments concerned with research and innovation, including the federal tri-councils.

\(^{68}\) Colleges are not named in the distribution so as not to generate unnecessary conflicts and anxieties about relative positions. The intent is not to rank, but simply to understand how Ontario colleges, as a group, are distributed across the continuum to provide a clear foundation for recommending next steps.
While funding for applied research at Ontario’s 24 colleges is modest, a number of interviewees indicated that such modesty may be appropriate at the present time given the current capacity of Ontario’s colleges to absorb and effectively use applied research funding. Indeed, until recently most colleges have not needed, nor expressed a strong desire to acquire, funds for applied research. It is only in the last five to ten years that colleges have really intensified their applied research activities and started to increase demands for more funding.

At the same time, many colleges are rapidly improving their capacity to absorb and use funds effectively and will likely be ready to apply for, receive, and effectively use more funding than is currently available. Moreover, a number of interviewees noted that funding for infrastructure and capacity-building in particular has been especially thin, even as project-based funding may appear to be adequate.

Further still, many of those who feel that Ontario colleges’ have access to an appropriate level of funding at this stage in the applied research development, nevertheless express concerns about the stability and long-term predictability of funding streams for college applied research. In a context of unstable and unpredictable streams, they hold, colleges’ ability to make long-term investments and rational plans for future applied research activities is hampered.

As the following account and analysis of the funding environment for applied research at Ontario colleges’ reveals, it is as important to discuss the different kinds of funding and their predictability, as it is to discuss the aggregate amounts of funding available. Moreover, even as existing and new sources of funding for college applied research may constitute an appropriate pool of available resources, the actual accessibility of those resources to colleges depends on the nature of eligibility requirements, the composition and knowledge of review committees, and the sorts of performance measures on which colleges and their collaborators are expected to report. (For a more detailed analysis, see page 52: Guidelines and Restrictions on Appropriate Use of Funds).

Ultimately, what we find is a funding environment that increasingly reflects a recognition that Ontario colleges’ applied research activities stimulate research and innovation activity among business, especially SMEs, while contributing to the development of a future labour force with the right mix of technical, employability, and innovation skills and ambition. Indeed, if recent funding announcements are any indication, many in government see the college applied research potential and are searching for ways to further support this vital and underutilized, element of Ontario’s and Canada’s research and innovation system.

**Federal Sources of Funding**

*National Sciences and Engineering Research Council (NSERC)*

The National Sciences and Engineering Research Council (NSERC) is regarded as one of the most important and reliable sources of federal funding for applied research conducted at Ontario, and other provinces’, colleges. Not only is NSERC the administrative headquarters for the tri-council’s College and Community Innovation (CCI) Program—a key applied research funding program—it has also demonstrated a commitment to actively consulting with colleges in the design of programs that are aligned with the nature of applied research, the college context, and the needs of SMEs.
College and Community Innovation (CCI) Program

Colleges have enjoyed a great deal of success through the CCI program which began in 2004 as a pilot collaboration of the tri-council granting agencies—including NSERC, the Social Sciences and Humanities Research Council of Canada (SSHRC), and the Canadian Institutes of Health Research (CIHR)—albeit administered and largely designed by NSERC. Prior to the launch of that $3 million pilot, NSERC consulted with colleges from across Canada and used their input to help shape various aspects of the program, including eligibility requirements. On the basis of the pilot project’s success supporting a handful of applied research programs, CCI become a permanent program and recently had its budget doubled to $30 million for 2010-2011.

CCI seeks to develop college capacity to undertake applied research programs which support innovation, commercialization, and technology transfer activities among local and regional businesses. It does not fund individual projects. CCI grants are awarded on a competitive basis to colleges that demonstrate an ability to contribute to local and regional economic development through collaborations with industry, especially SMEs.69 Colleges submitting applications are expected to have industry partners in place who are committed to the partnerships as evidenced by commitments of cash or in-kind contributions. Moreover, colleges and business are required to report on their activities and show evidence of economic impact to retain funding in future years.

Notably, the 24 performance measures for the CCI program are well-aligned with the nature of applied research and the college context. In addition to asking grantees to report on the total dollars and in-kind contributions invested by SMEs in R&D projects at the college, the CCI program requires colleges to report on, for example, the number of:

- products, technologies, processes, prototypes developed or improved per year;
- principal investigators experienced in working with industry clients on successful innovation projects;
- college professors and staff trained on equipment funded by CCI projects;
- college students participating in applied research and development projects;
- students employed by partner organizations or in local industries after graduation who participated in CCI funded projects; and
- existing college courses revised to include results of CCI funded projects and new courses based on results of CCI funded projects.

These contrast with the more university-centric performance measures of many other tri-council funding programs which include, among other indicators, the number of peer reviewed publications produced and number of graduate students engaged in funded research—important measures for many programs, to be sure, but not appropriate for funding programs intended to stimulate innovation and commercialization among local businesses, especially SMEs.

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69 NSERC. “College and Community Innovation Program.”

A Model for Government-College Understanding:
NSERC’s College and Community Innovation Program

In 2002, senior management from NSERC consulted with 19 community colleges across the country to learn about the nature and scope of college applied research. They discovered that colleges were contributing, in a variety of ways, to local industry needs, and that there was an opportunity to further harness college applied research potential. The College and Community Innovation pilot program soon emerged with an initial budget of $3 million to seize that opportunity.

On the basis of the consultations with colleges, NSERC decided that application evaluation criteria needed to move away from purely performance-based measures at this early stage of colleges’ applied research development. Instead, evaluation criteria were designed to assess institutional policies and practices, and the program aimed to enhance capacity where there already existed basic institutional commitment and local need for college applied research services.

At the time, the CCI program represented a significant departure from conventional university-centric funding programs. Instead of focusing on measures such as number of peer-reviewed publications, and graduate student engagement, CCI evaluation criteria focused on the potential of colleges to contribute to local or regional innovation needs, to facilitate the transfer of technology or skills, and to contribute to the training of students, through collaborations with local businesses.71

By virtue of its adoption of metrics sensitive to the nature of applied research and the college context, and because it developed these in consultation with the colleges themselves, the CCI program provides a good model for the design of other programs that aim to support the contribution of college applied research to innovation and productivity performance and the training of a future innovation-ready workforce. To be sure, not every funding program can be as welcoming to college applied research as CCI, owing to basic differences in program objectives and mandates. However, CCI’s consultation process and program design reveal that unique arrangements may be necessary to ensure that colleges’ contribution to innovation is appropriately supported.


Idea to Innovation (I2I) Program

NSERC’s I2I program provides funding for colleges and universities to help facilitate the development and transfer of promising technologies. Funding is meant to bring ideas to more advanced stages of commercial readiness through applied research activities such as prototyping, benchmarking, and testing of applicability.72

Analysis of I2I as a source of funding for Ontario colleges’ applied research activities produces a mixed conclusion: While the program appears well-aligned with colleges’ strengths in applied, collaborative, research, and those colleges that have received I2I funding have produced benefits for business collaborators and faculty researchers, it presents two significant challenges for potential college applicants:

1. Designed primarily to achieve business and industry objectives in a timely fashion, the program may have the effect of informally excluding students from participating in the projects. I2I’s

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71 See: NSERC, “College and Community Innovation Program.”
72 For objectives and details of the Idea to Innovation Program, see NSERC, “Idea to Innovation Program.”
requirements state that eligible projects are time limited and may not be appropriate for graduate students (saying nothing of college students), and participating personnel are expected to be chosen on the basis of their ability to deliver on objectives. Consequently, a central part of Ontario colleges’ mandate—i.e., education and training—would not obviously be advanced through I2I-funded projects (though there may be in-direct benefits for students if participating faculty revise curricula to include what was learned during the project.

2. The program does not provide money for to release college faculty from teaching while engaged in I2I-funded projects. While NSERC “recognizes that college faculty have heavy teaching loads,” the agency maintain that “as many colleges now have research as part of their mandate from the province where they are located, it is therefore not appropriate that NSERC cover any part of the faculty salaries.” This is problematic for Ontario colleges, for whom applied research is recognized by MTCU as a means of achieving the objectives of their vocational education and training mandate, but who do not have a funding stream explicitly dedicated to releasing faculty from teaching to do research.

For Ontario colleges, I2I may be an important source of applied research funding, but is accessible only to the extent that a college has a strategy and other resources to release faculty from teaching to actually complete the work and, in the end, may provide no direct benefits to college students.

Social Sciences and Humanities Research Council (SSHRC)

SSHRC provides grants and scholarships for social science and humanities research. Although numerous Canadian colleges have sought, and successfully acquired, SSHRC eligibility, the amount of SSHRC funding that has gone to colleges has been small. Since 1999, less than 0.5% of standard SSHRC research grants have gone to colleges, as opposed to universities or other research institutions. This is partly because the number of colleges that apply for SSHRC funding is low.

This situation may reflect the fact that colleges are still predominantly technically focused institutions, and that most collaborations between colleges and businesses are ones that utilize college technical capacities better supported through NSERC or other funding and grant agencies. It also appears to be the case that many colleges do not apply for SSHRC funding due to perceptions that university-centric review and performance measures (such as number of peer-reviewed publications) would exclude colleges from competition, and beliefs that grant review committees may lack understanding of, or have biases against, college applicants.

Nevertheless, many colleges have social science and humanities departments which are interested in pursuing applied research to investigate and offer practical solutions to organizational or social challenges. In that case, ongoing conversations between SSHRC and the colleges should aim to resolve disagreements about funding objectives, eligibility, and perceptions about fairness.

73 NSERC. “Basic Principles for I2I Proposals.”
74 NSERC. “Idea to Innovation Program (I2I) – Frequently Asked Questions.”
75 ACCC, Partnerships for Productivity and Advanced Skills, p.18. Note that this figure excludes grants from the tri-council CCI program administered by NSERC.
Canada Foundation for Innovation (CFI)

CFI was founded in 1997 with a mandate to support world-class research through the creation and improvement of research infrastructure at Canadian universities, colleges, and research hospitals. Colleges have been eligible to compete for funding with these other institutions. Since its founding, CFI has supported over 6000 projects, committing about $5 billion in research infrastructure spending. Colleges have had limited access to infrastructure funding through CFI: Of the $5 billion awarded to date, colleges have received about $50 million.\(^{76}\)

CFI’s programs are designed to enhance research capacity in institutions that demonstrate research excellence, or potential for excellence, as evidenced in institutional missions, research expertise, and research track-record. To win CFI funding, applicants must convince reviewers that infrastructure will facilitate innovative and transformative applications and that sound plans to maintain, and make available to other users, the facilities and equipment funded.


CFI once had a college-only funding envelope—the College Research Development Fund—which invested $15.6 million into college research infrastructure.\(^{77}\) The program was short-lived, with only two competitions offered from 2001-2002. Various explanations exist for why the program disappeared: Some suggest that colleges did not have sufficient capacity to make use of CFI-funded infrastructure at that time so the program may have been viewed as premature. Others noted that colleges had difficulty meeting CFI matching-fund requirements which may have contributed to a view that the program could not meet its objectives. A third explanation offered is that CFI may have terminated the program on the advice of colleges themselves, many of whom allegedly preferred to compete for greater amounts of funding in open envelopes, rather than be limited to the small amounts available in a colleges-specific program.

Whatever the reasons, the cancellation of the College Research Development Fund limited college access to CFI funding. Since then, colleges have not had a great deal of success in CFI competitions. For example, in the last funding competition, no college (out of 13 applicants) won funding as a lead applicant—although three colleges won funding as junior partners with the University of Toronto.

A New CFI College Program

Recognizing the increasing potential for colleges to make significant contributions to Canada’s research and innovation system, CFI recently announced that a new college-only funding initiative has been created and that funding competitions will begin in December 2010. While details about the program are not available at the time of writing, it appears that program requirements are being designed in ways that are aligned with the nature of applied research and the college context.

Indeed, in addition to consulting with colleges directly about program design, staff at CFI have consulting with staff at NSERC about the latter’s own college-specific CCI program.

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\(^{76}\) Ibid. 17

\(^{77}\) Canada Foundation for Innovation, “College Research Development Fund.”

National Research Council – Industrial Research Assistance Program (IRAP)

The National Research Council’s IRAP helps SMEs develop and commercialize promising technologies by directly supporting the costs of technical and business assistance. It also supports agencies and organizations such as the Ottawa Centre for Research and Innovation, and the Innovation Synergy Centre in Markham, which deliver a range of services to businesses to address their innovation needs. Through IRAP’s Research and Technology Development Activities envelope, businesses are eligible to receive funding to support the costs of pre-commercialization activities which in many cases are subcontracted to colleges as applied research activities.

IRAP is notable for the emphasis it places on providing advice and putting businesses in touch with the technical and other expertise they may require through the efforts of its 240 Industrial Technology Advisors (ITAs)—some of whom are located on college campuses. ITAs have in-depth knowledge of specific industries and the characteristics of the communities in which their clients operate, they work to establish long-term relationships with clients, and they serve as impartial brokers of information to help businesses grow and prosper. In addition to the industry experience held by most ITAs, approximately 40 per cent have also been employed by a university or college at some point during their careers and thus understand both sides of business-academic partnerships.

Regional Economic Development Agencies

Regional economic development agencies have supported college applied research in their respective regions. In Ontario, colleges have been supported by two agencies in particular: The Federal Economic Development Agency for Southern Ontario (FedDev Ontario) and Federal Economic Development Initiative for Northern Ontario (FedNor).

FedDev Ontario has recognized the opportunity that exists for colleges to address the gap between research and commercialization and has developed a pilot initiative—the Applied Research and Commercialization (ARC) Initiative—that will provide up to $15 million in funding to support collaborations between SMEs and post-secondary institutions. The program, announced in April 2010, aims to foster economic outputs such as commercialization and productivity improvement. It offers a maximum of $50,000 per project (and a total of $750,000 per institution), provided a partnering SME has been identified, and can be used to support eligible applied research activities, including “product and process applied research; engineering design; technology development; product testing; certification; proof of concept; piloting and demonstration; and problem solving.”

While not exclusively a college-focused program, the ARC Initiative is clearly aligned with the kinds of applied research activities that Ontario colleges conduct. Moreover, the initiative does not give priority to institutions that have prior track records or pre-existing relationships with businesses, so may provide a promising way for colleges just beginning their applied research activities to secure funding.

78 National Research Council Canada, “Industrial Technology Advisors: The human face of innovation.”
79 Ibid.
FedNor is a regional development organization that “works with a variety of partners, as both a facilitator and catalyst, to help create an environment in which communities can thrive, businesses can grow and people can prosper.” Colleges in northern Ontario have had success accessing applied research funding through FedNor given its emphasis on partnerships to stimulate regional economic development. Since 2001, FedNor has provided about $13 million in funding for more than 70 projects conducted with northern Ontario colleges.

**Industry Canada**

In addition to the many permanent funding agencies it houses—including most of those described above—Industry Canada occasionally administers special programs from which colleges have received support that directly or indirectly assists with applied research. For example, as part of Canada’s 2009 Economic Action Plan, Industry Canada created the Knowledge Infrastructure Program—a one-time stimulus of $2 billion to enhance physical infrastructure at Canadian universities and colleges. In Ontario, the program has supported 56 infrastructure projects in colleges and universities. While infrastructure projects are not undertaken with a specific view to enhancing applied research capacity, the construction of new research labs and centres (such as the Centre for the Health Sciences at George Brown College) has the effect of enhancing the applied research capacity of Ontario colleges.

**Provincial Sources of Funding**

**Ontario Innovation Trust (OIT) and the Ontario Research Fund (ORF)**

The OIT was created in 1999 to enhance the research infrastructure in Ontario research institutions, including colleges. OIT funded over $844 million in support of 1,253 projects at 44 Ontario research institutions—including many colleges—before completing its mandate.

The ORF was created in 2005 by the Ministry of Research and Innovation to continue the mandate of OIT to support the creation and improvement of research infrastructure. In particular, the objective of the ORF is to support the creation of new products and services through two funding programs: the Research Excellence Program, which funds the direct and indirect operational costs of research; and the Research Infrastructure Program, which funds the capital costs of research infrastructure. While both programs offer possible means of support for Ontario colleges, they have been focused more on supporting basic or “discovery” research than they are on applied research. It may be worthwhile for the ORF to investigate ways to support colleges’ applied research more substantially, especially to complement the new federal program established by CFI to fund infrastructure at colleges.

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81 Industry Canada, “FedNor.”
83 For more information see Industry Canada, “Knowledge Infrastructure Program.”
84 Ontario Innovation Trust. “The Ontario Innovation Trust.”

Ontario Research Fund—Research Excellence Program (ORF-RE)

According to its program description, ORF-RE supports “transformative, internationally significant research of strategic value to the province.” Minimum funding is generally $1 million, in support of operating costs such as salaries, administration, equipment and facilities, while maximum support the program offers is $8 million, with flexibility for exceptional circumstances. ORF-RE provides 1/3 of the funding, with another 1/3 expected to come from the private sector, and the remaining 1/3 from the institution. Colleges have found it difficult to meet the 1/3 requirement.

Evaluation criteria for applications focus include the quality of the proposed research; broad commercialization potential; the strategic value of the research to Ontario’s economic growth, health, and the environment; opportunities for the development of research talent; and institutional managerial and administrative capacity to carry out the project. While some of these criteria play to Ontario college applied research strengths—namely, commercialization and value of the research to economic growth—as a whole the reviews tend to emphasize institutional reputation and academic credentials of researchers. An interviewee with the Ministry of Research and Innovation noted that the program is designed with a view to supporting Nobel-prize-ready research. Consequently, it may be challenging for colleges to receive much funding from the program.

Ontario Research Fund—Research Infrastructure (ORF-RI) Program

ORF-RI equips Ontario research institutions with the physical infrastructure needed to carry out cutting-edge research and development. ORF-RI funds 40 per cent of the capital costs of research infrastructure through two funding options—the Large Infrastructure Program (LIP) and the Small Infrastructure Program (SIP)—with the remaining 60 per cent of funding to be acquired through CFI, private partners, and/or the institution itself. Colleges are not eligible to apply to the SIP, which requires that an institution be eligible for CFI’s Leaders Opportunity Fund.

Colleges are eligible to apply for the LIP, which supports the capital costs of large infrastructure projects, including the creation or upgrading of facilities and research labs. LIP funding and evaluation criteria are tied closely to CFI’s Leading-Edge/New-Initiative Fund. Applicants to ORF-RI must have already made an application to CFI, though ORF-RI does not necessarily automatically match CFI awards.

Colleges have been successful as co-applicants with universities but have not, to date, been successful as lead applicants to the LIP. In the last funding competition, five colleges submitted applications but none were funded. In light of need to acquire matching funds, possibly from CFI, and the difficulty for colleges in doing so to date, it remains to be seen whether the new CFI program for colleges will improve the chances for college applicants to win funding in future ORF-RI funding competitions.

86 Ibid.
Ontario Centres of Excellence (OCE)

OCE supports industry-relevant research and development with a view to fostering commercialization and other business impacts. While not all OCE programs are designed with colleges in mind, Ontario colleges have been quite successful in receiving funding from OCE programs related to pre-commercialization activities and those that support collaborations with Ontario businesses. OCE offers a suite of funding options for which colleges are eligible and from some of which they have benefited, including the Collaborative Research Program, the Proof of Concept Program, Interact (which colleges have used extensively), Connections, and others. 87

OCE has an especially supportive application process, in which college (and other) applicants work closely with OCE business development staff before applications are sent for review. This guidance ensures that applications are of the highest quality before officially submitted and that only the most competitive applications will reach the stage of review. Not only does this help to reduce wasted effort—because proposals without sufficient potential can be abandoned early—but it also serves to improve the grant-writers’ understanding of what constitutes a strong application which may help them produce successful applications in for other agencies’ competitions. Ultimately, as one representative from OCE remarked, OCE’s goal is to fund the best projects with the greatest potential for good outcomes, not simply to reward the best grantwriters. Applicant mentoring is regarded as a key strategy to achieve that goal.

Colleges Ontario Network for Industry Innovation (CONII)

Initially established in 2006 with ten Ontario-member colleges and a budget of $3.5 million, CONII has since expanded to include 20 member colleges with a further 3-year $10.2 million funding commitment from the Ontario Ministry of Research and Innovation. The mandate of the organization is to support and facilitate applied research collaborations with private-sector partners in need of technical assistance and problem-solving capacity. 88

CONII member institutions receive resources to conduct provide technical assistance and applied research services to Ontario firms, as well as support for capacity building (including assistance in funding research offices and administrative officers). Ontario firms that work with CONII colleges are required to make financial and/or in-kind contributions to projects. Research, technical assistance, and business services supported by CONII often involve work at the pre-commercialization and testing stages of innovation, as well as the marketing stages, and include activities such as:

- Proof of principle projects and testing
- Product, process and prototype development
- Industrial design
- Marketing and communications strategies

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87 For the full suite of OCE programs, see http://www.oce-ontario.org/Pages/Home.aspx.
88 For more, see Colleges Ontario Network for Industry Innovation, “Project Funding.”

• Business planning, market research and other commercialization services.\(^{89}\)

CONII provides colleges and businesses with a readily available source of funds for research and technical assistance, though the amounts for individual project are modest (often about $10,000 per project with some as large as $30,000 per project). Yet, it is noteworthy that the program has been renewed and expanded and is accompanied by efforts of the colleges to mentor and learn from each other about how best to assist companies to perform innovation- and productivity-enhancing research. Additionally, with its central portal for businesses, CONII helps to ensure that businesses are directed to the colleges most suited to meeting their needs and thereby improves the likelihood the network as a whole uses resources efficiently and effectively.

At the same time, with a relatively small pot of funds for an expanded membership, there are limits to what CONII can achieve in terms of supporting innovation among Ontario’s SME. Records from the first 3 years of CONII’s operation indicate that hundreds of businesses who have sought assistance have had to be turned away because the colleges lacked the resources to assist them. Thus, while CONII constitutes an important source of funding and mentoring for Ontario colleges, and an emerging source of expertise and funding for Ontario SMEs, with its current resources it can make only a small-scale contribution to the research and technical needs of Ontario SMEs, and thus produce a small-scale impact on the province’s innovation and productivity performance.

**Other Sources of Funding**

*Institutional Sources/Allocations*

In addition to the funding that they may receive from provincial and federal ministries and agencies, many Ontario colleges have also allocated some of their operating funds to applied research activities and the administrative structures that support these activities.

A handful of federal government officials interviewed noted that the move by some colleges to allocate internal institutional funds to support applied research capacity and projects sends a very good signal to the government about the colleges’ commitment to pursuing applied research. It is regarded as a reassuring sign that the colleges will not only have the necessary administrative structures in place to manage grants and execute successful projects, but also that there is senior level support within the colleges to the long-term development of applied research. At the same time, provincial government officials indicate that allocations of *operating funds* to support college applied research should be done only where applied research serves the college mandate—if applied research is pursued for reasons other than achieving the teaching mandate, then use of operating funds is a concern.

*Private Sector Sources*

Finally, a key component of funding for applied research collaborations between colleges and businesses is the contribution made by the business itself. The nature and amount of the contribution is determined by a number of factors—such as whether government grants require matching contributions, the size and resources available to the firm, and the nature of the project.

\(^{89}\) Colleges Ontario Network for Industry Innovation, “Services Available and Sectors Served.”

itself and its importance to the business, among others—and is often a combination of cash and in-kind resources.

Survey results from the Ontario colleges reveal that applied research dollars spent by the colleges have a leverage effect on the businesses with whom they collaborate. In particular, every dollar contributed by colleges on applied research initiatives (from operating grants and/or specific research grants), leverages an addition 59 cents from collaborating firms.

There are also tax incentive programs—such as the Scientific Research and Experimental Development (SR&ED) Tax Incentive Program—which firms may be able to use to cover eligible R&D expenditures. It is not clear, however, whether many applied research collaborations between colleges and businesses meet the eligibility requirements that would allow businesses to deduct costs or receive refunds.⁹⁰

The Funding Environment: Issues and Challenges

While the funding environment for Ontario colleges’ applied research activities has been improving in recent months and years, there is still a range of outstanding issues and challenges faced by the colleges and their business partners. If colleges are to play the innovation catalyst and accelerator roles for a critical mass of Ontario businesses, changes in the funding environment will be required.

Levels and Kinds of Applied Research Funding

The absolute level of resources available to colleges for applied research—and thus available to potential business collaborators—is still very small. Not only does college research funding pale in comparison to research funds available to the province’s universities, it is insufficient to allow colleges to assist the many SMEs and other businesses in the province with their research, innovation, and technical assistance needs. Ontario colleges currently assist only a few hundred Ontario businesses per year, and turn away hundreds more. With nearly 400,000 SMEs in the province that could benefit from colleges’ applied research services, it is clear that currently levels of funding are inadequate to have a sizable impact on the province’s, let alone the country’s, innovation and productivity performance.

At the same time, many Ontario colleges are still developing their applied research capacity while others are entirely new to the activity. Consequently, while further increases in the resources available would be advisable, those increases should be aligned with the capacity of the colleges to absorb and effectively use those resources. In particular, new resources for infrastructure and capacity should accompany new resources for research projects to ensure that absorptive capacity is allowed to mature.

Recent announcements of new college-specific or college-friendly programs by CFI, NSERC, and FedDev are encouraging. SMEs and colleges would also benefit from assurances that new and future funding will be stable and long-term. As the funding environment over the past

⁹⁰ Canada Revenue Agency, "Scientific Research and Experimental Development (SR&ED) Tax Incentive Program."

decade has included many pilot, cancelled, or sub-optimally designed programs, colleges have faced uncertainty that has affected their ability to make long-term investments and plans to build applied research capacity.

**Accessibility of Funding**

While improvements are being made and granting agencies are increasingly taking care to design programs that reduce artificial barriers to colleges, there still appear to be formal and informal barriers to the accessibility of funds that impairs colleges’ ability to secure resources to assist businesses. Some barriers to colleges may be appropriate for certain funding programs—such as those intended to support graduate student development, and thus require graduate student participation—but other barriers may serve no legitimate purpose—such as those whose objective is to stimulate business R&D, but require strong faculty publication records as a requirement of application.

**Program Barriers**

Both college and some government interviewees observe that many funding programs erect barriers to college eligibility that serve no legitimate purpose given the objectives of the funding programs themselves. Interviewees frequently pointed to requirements of credentials not always held by college applicants (such as PhDs and peer reviewed publications), and requirements of *graduate* student participation as common barriers.

Additionally, application review committees often fail to include college-based members and rarely receive briefings on the nature of applied research and the college context. Consequently, while colleges may be able to contribute to the achievement of many funding programs’ ultimate objectives, they are prevented from doing so by artificial barriers to their eligibility.91

**College Capacity**

Although colleges face some barriers to winning funding that arise from program design, other barriers are a consequence of their own internal challenges. Many of the challenges are simply a consequence of the fact that the colleges are still in a learning and development phase and therefore need more time and resources to perform more effectively in funding competitions.

Interviews with federal and provincial program officials, as well as with Heads of Applied Research at Ontario colleges, uncovered key factors that affect application success rates:

1. **Institutional supports and structures.** Colleges that have already identified or hired a Director of Research, and provide support to his or her office, tend to achieve greater application success than those that do not. Additionally, colleges with clear administrative structures, policies, procedures related to applied research, along with other applied research office staff, perform better than others in funding competitions. Funding programs and agencies want to be sure that the money they are providing colleges is well-managed and accounted for. For example, the presence of a finance office that can provide reliable book-keeping and

91 To reiterate, there are many programs whose objectives cannot be advanced by colleges and therefore formal or informal barriers to their eligibility may be appropriate. But for a number of other programs, barriers to college participation seem unnecessary.
management of applied research money reflects positively on a college’s ability to work smoothly and effectively with government and private-sector partners. Colleges with more haphazard arrangements have more difficulty—such as when a single faculty member attempts to organize the applied research portfolio on his or her own in addition to regular teaching and administrative duties.

2. Proven capability. College success in winning funding is affected by the state of their previous performance in winning funding and completing projects. Researchers with track records of accomplishment and colleges with track records of successfully completed projects tend to do better than others. Consequently, colleges who are new to applied research may have difficulty attracting funding from some government programs, and may be well-advised to make full use of sources more specifically designed for college participation, such as CONII funding.

3. Partnerships. Colleges that have identified industry partners for specific projects and who can provide evidence of long-term, ongoing relationships with firms can be helpful. Some interviewees also note that partnerships with universities can open up new sources of funding and ease review committee concerns about college capacity and expertise.

4. Champions and grantsmanship. Colleges that have superior grant-writing individuals or teams on staff are much more likely to attract funding than those colleges whose grant-writing capacity is weak and/or still developing. Additionally, knowledge of, and ability to navigate, agency and college bureaucracy and structures is a key determinant of success. Thus, having applied research champions on staff is also beneficial.

5. Emphasizing and adhering to evaluation criteria. Applications that explicitly address specific program evaluation criteria and demonstrate how government program objectives will be advanced by the applied research project tend to experience greater success. Funding programs and agencies are outcome-oriented, thus evaluation criteria demand clarity and detail on how an applicant plans to achieve specific goals and objectives. To this end, the primary concern of review panels and evaluation criteria is to determine whether the college is capable of seeing the project or program through to success. A proposal that succeeds on some criteria might nevertheless fail if does not demonstrate a clear fit with government priority areas.

6. Demonstrating faculty research expertise. Finally, there is some indication that highlighting college researchers’ expertise—e.g., PhDs and publication records—may sway some review committees to award funds to colleges. However, there is also evidence that review committees and program managers shun colleges that try to “play the university game” by emphasizing these qualifications. According to some interviewees, this is a “game” that colleges “can never win.”

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92 A number of college respondents have described a boot-strapping dilemma when competing for research grants: In order to win, a college must demonstrate experience and capacity, which it may only be able to acquire through funded applied research collaborations. While this is not the case for all grant opportunities, it is so for many programs—particularly at the federal level. This can make the beginning stages of college applied research very difficult. It requires, as one interviewee noted, that colleges get as much mileage out of their initial successes as possible. It also speaks to the importance of a fundamental institutional commitment to get a college into the applied research game. In the absence of outside support, a college may need to set aside a portion of its own base funding to build capacity and a reputation among local businesses. As one respondent put it, until you grow capacity for five years with full-time applied research staff, you will not be in the game.
Guidelines and Restrictions on Appropriate Use of Funds

Colleges’ ability to attract and use funding—and thus their ability to help firms with their research and innovation needs—is also affected by the nature of guidelines and restrictions on the appropriate use of funds. In particular, colleges’ applied research activities are significantly hampered by the prevalent (though not universal) prohibition on using research funds to release faculty from teaching responsibilities while they perform research. Unlike most university faculty who are not simply allowed, but required, to dedicate approximately 40 per cent of their time to research, Ontario college faculty are paid only to teach. Thus, when opportunities to conduct applied research emerge, colleges face the additional burden of securing resources to hire replacement faculty to teach the vacated courses.

College and other interviewees note that this is the main barrier to expanding college applied research services. In 2008 survey of 2,410 faculty members at Canadian colleges, 81 per cent agreed or strongly agreed that “lack of funding for release time” was the primary barrier to participation in applied research. In the absence of collective agreements that set aside resources for faculty release from teaching, funding applied research depends on programs that allow funds to be used in that manner. Yet, only a handful of programs permit resources to be used in this way thus limited the development and expansion of Ontario colleges’ research assistance to business.

Performance Measures and Reporting Requirements

Finally, colleges’ ability to acquire and effectively use government funding to provide applied research services and technical assistance to business, especially SMEs, depends also on the nature of ultimate program objectives and performance measures. Many funding programs that support research at post-secondary institutions in Canada tend to focus on objective and performance metrics that view research as primarily a curiosity-driven, knowledge-discovery activity. In that case, performance metrics tend to focus on such things as publications, citations, patents, and other discovery-oriented research outputs.

By contrast, those few programs that are explicitly oriented towards tangible improvements in innovation and productivity performance, and economic and social prosperity, are increasingly adopting performance measures and metrics that are more aligned with the nature of applied research and technical assistance. This includes measures such as the number of:

- products, technologies, processes, prototypes developed or improved per year;
- principal investigators experienced in working with industry clients on successful innovation projects;
- professors and staff trained on equipment funded by projects;
- students participating in applied research and development projects;
- students employed by partner organizations or in local industries after graduation who participated in funded projects; and

93 R. Fisher, Faculty Participation in Research at Canadian Colleges, p. 14.
• existing college courses revised to include results of funded projects and new courses based on results of funded projects.94

Yet, movement toward these sorts of measures—i.e., measures that would capture how well research contributes to innovation, productivity, and workforce development—is occurring at a gradual, if not glacial, pace. As a result, government spending on research in post-secondary institutions is still overwhelmingly focused on basic research whose benefits to business and the economy are much more indirect and long-term, if they emerge at all.

To be sure, basic research is a necessary component of an innovative and prosperous society and should receive considerable government support. But applied research and technical assistance—with performance measured in terms of real business- and innovation-relevant outcomes—is also necessary for social and economic prosperity, and these sorts of programs have been relatively scarce in the Ontario, and Canadian, research funding environment.

**Towards an Innovation-Friendly Funding Environment**

Though not unanimous, the prevailing consensus that emerges from interviews with representatives from government, business, and colleges is that while the levels and kinds of funding available to Ontario and other colleges have improved, and may even be adequate at this stage of colleges’ applied research development, there are still formal and informal barriers to the accessibility of the funds, and a need to revise both the guidelines on the appropriate use of funds and performance measures and reporting requirements in directions more sensitive to the college context.

Changes in the funding environment to support more applied research and technical assistance would certainly allow Ontario colleges opportunities to expand their applied research activities. But this is not the reason why the funding environment should be changed. Rather, changes in the funding environment to support more applied research should be made because of the effect that such changes are likely to have on the innovation and productivity performance of firms and thus their contribution to overall economic growth and social well-being. In other words, support for colleges’ applied research is instrumentally, not intrinsically, desirable. College applied research should receive more funding not because it is interesting, but because it stimulates and accelerates innovation at the firm level and improves the training and education of an innovation-ready future workforce.

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94 See the measures used by NSERC’s CCI program, described above.
Chapter 6

Foundations of AR Success II: Human, Physical, and Administrative Capacity

Applied research cannot be undertaken with success unless the right combination of human, physical, and organizational capital is in place. Many colleges have been growing each of these types of resources and expanding the range of their applied research and innovation initiatives. However, many are still new to applied research and have much to do to secure the appropriate human and physical capital. Even those colleges further along the developmental continuum still face deficits that limit the growth and refinement of their applied research capacity and activities.

Human Capital

Applied research is a function of the skills, capacities, and efforts of people. Successful initiatives require faculty and students with the right skills, dispositions, and time to work on projects that involve both technical and professional expertise, as well as relationship management. Ontario colleges appear to have strong pools of motivated faculty and students that could be deployed to pursue applied research and offer technical assistance to business, but face challenges in ensuring that these individuals have the time and resources to achieve success.

Faculty Researchers

A 2008 report prepared by Roger Fisher for the Canadian Council on Learning reveals that a large majority—78 per cent—of Canadian college faculty are interested in participating in various kinds of research. As colleges attempt to expand their applied research activities, these results indicate that there is a “strong receptor capacity for growth” among faculty. Specifically, Fisher’s survey shows that college faculty members are strongly or very strongly interested in applied research, including:

- research related to working with business/community partners (74 per cent);
- research leading to technological advances or processes (66 per cent);
- problem solving for industry (52 per cent); and
- commercialization (38 per cent).

At the same time, a 2004 study conducted by the Association of Colleges of Applied Arts and Technology of Ontario estimated that just 2 per cent of Ontario’s full-time college faculty engaged in applied research, development and commercialization activities. Indications from interviews completed for this project are that this has increased only modestly over the past eight years—and certainly nowhere near the levels of interest discovered by Fisher. In that case, there

95 R. Fisher, Faculty Participation in Research at Canadian Colleges, p. 8.
96 Ibid., p. 30.

is a wide gap between the proportion of college faculty who are interested in pursuing research and the proportion of faculty who have opportunities to do so.

SMEs that have been turned away by Ontario colleges, then, are being turned away not because the colleges and faculty don’t want to help; rather, they are being turned away because colleges simply lack the resources to help.

*Faculty Research Time*

Interviews with college administrators and faculty, as well as individuals in government and business, reveal that the most critical human capital challenge for college applied research relates to faculty and employees having sufficient time to pursue research. As noted above, this is confirmed by Fisher’s survey of faculty members at Canadian colleges—81 per cent agreed or strongly agreed that “lack of funding for release time” was the primary barrier to participation in applied research.98

Reflecting colleges’ mandate to be providers of vocational training and education, Ontario colleges’ operating grants do not include release from instructional duties (which involves time in the classroom as well as lesson preparation, grading, and other teaching-related duties). This limits the scale of applied research to what many instructors are able to conduct on their own time, as many grants and applied research funding programs are not designed to fund release time.

The problem is compounded by the fact that collective agreements and operational requirements make it difficult to coordinate the logistics of teacher release issues. In those colleges that lack a culture of applied research, requests for release time (even if funding is available), may be viewed with scepticism from administration and colleagues. Moreover, uncertainty around funding streams and the nature of funding agency timelines can make release planning very difficult at all colleges.

Thus, if Ontario colleges are to make significant contributions to the innovation performance of firms through applied research and technical assistance, more financial resources must be available to support research time for faculty. Additionally, such resources must be made available in a way and at times that allow colleges to address the logistical demands of finding replacement teachers, making alternate course arrangements, and budgeting instructors’ time for upcoming research activities. It is hard, in other words, for colleges to change their academic structures on a dime, which in turn makes it hard to respond to immediate business needs.

*Faculty Expertise*

Although college faculty members are regarded as having industry-relevant expertise and experience, many colleges report difficulty identifying sufficient faculty expertise to take advantage of applied research opportunities. While many colleges now boast Master’s and PhD-educated faculty among their ranks, not all faculty members have the right combination of technical and managerial skills to ensure successful completion of projects that involve industry collaborators.

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To be sure, Fisher reports that 66 per cent of Canadian college faculty members agree or strongly agree that they have “confidence in their abilities” to pursue research.\(^9\) Yet, given the low participation rates discussed above, many of these self-reported assessments of ability must be from faculty members who have not yet had a chance to put those abilities to the test in actual applied research projects.

Compounding the challenge is the fact that in many cases, a college’s best researchers will also be its best teachers. In that case, department heads and administrators may be reluctant to allow those star teachers to be out of the classroom for the time necessary to pursue an applied research program of any significance.

None of this is to say that colleges lack expert knowledge and industry know-how that could be deployed to assist businesses with research and innovation. Rather, the interviews suggest that what is needed is faculty training in how to use that knowledge and know-how in new ways—i.e., as part of applied research initiatives and programs. In many cases, faculty know how to solve business problems, but may not know how to design and execute a program of applied research with a sound methodology and approaches for verifying and replicating results.

Recognizing the weakness, some colleges are beginning to identify and support research mentors—i.e., faculty members who are expert researchers who can share their knowledge of and experience with the research process with other faculty members who are new to applied research. But as with many other aspects of applied research at Ontario colleges, finding the resources to fund mentors and their activities has been difficult with the result that concerns about college faculty expertise may persist until new funding programs emerge.

**Student Researchers**

While the immediate benefits to firms provide a good reason to support applied research, its contribution to the training and development of an innovation-ready future workforce provides an equally compelling justification for support. Moreover, applied research collaborations also provide businesses with opportunities to have a first look at potential recruits and to make offers to demonstrably capable and skilled students, and they provide students with practical and marketable experience, industry connections, and employment.

Yet, achieving these benefits through applied research is not without challenges. Colleges and business collaborators must recognize that student participants are students—they are not yet fully proficient and professional experts. While they may have developed some classroom-based knowledge and expertise, in many cases student participants in collaborations will be applying their knowledge to real-world problems for the first time and thus will likely make mistakes. Consequently, these junior participants will require careful guidance and management from patient faculty researchers and business collaborators.

Additionally, the applied research collaborations may also constitute the first time many students will be exposed to a professional business environment. College and business interviewees report

\(^9\) Ibid., p. 51.
that students’ ability to adapt and conform to professional environments and expectations is not universally well-developed and that explicit and clear instructions and guidance are required in many cases. At the same time, some business interviewees recognize that students constitute a source of very affordable technical assistance and that enlisting that assistance entails a responsibility on the part of business to contribute to the professional development of those students.

In sum, both colleges and business can achieve great benefits from the participation of students in applied research projects, but appropriate management and direction will be required to ensure that those benefits emerge. Colleges, businesses, and student participants should discuss expectations and responsibilities at the outset of collaborations and ongoing management and mentoring should be a key element.

**Facilities and Equipment**

Human resources are constrained or enabled by the quality and quantity of available *physical resources* at a college, including research infrastructure such as labs or equipment. While colleges have been successfully expanding their physical resources along with their human resources, many colleges still report an infrastructure deficit that is preventing them from undertaking a broader range of applied research and innovation initiatives.

Traditionally, colleges are equipped with a range of facilities and equipment to allow them to achieve their mandate of providing hands-on workforce training. In most cases, pre-existing infrastructure such as machine shops and fabrication facilities support the initial stages of college applied research and innovation. Colleges looking to support a broader or more advanced range of applied research look to expand or enhance their infrastructure—through, for example, the creation of new facilities, research labs, test-beds, or state-of-the-art equipment.

Accessing infrastructure funding has for the most part proven more difficult for colleges than accessing funding for the operating costs of research. The criteria for infrastructure funding tend, regardless of the program, to be high—requiring a convincing plan for how the infrastructure will be used for maximum economic value to the community and/or region. Colleges have not widely benefitted from the major federal source of infrastructure funding—namely, the Canada Foundation for Innovation—though the recent CFI announcement of a college-specific program should ease, however slightly, infrastructure and equipment challenges. Funding from the Ontario Innovation Trust, before it completed its mandate, expanded some college infrastructure, but the program’s replacement—the Ontario Research Fund’s Small and Large Infrastructure Programs—appears unable to meet all colleges’ infrastructure needs.

The infrastructure challenge is particularly pressing in light of the fact that many SMEs value collaborations with colleges because of opportunities to access research facilities and equipment that they are otherwise unable to purchase or maintain themselves. Opportunities for collaboration—and thus colleges’ opportunities to contribute to the innovation and productivity performance of the firms—may be lost if the colleges are unable to provide their research facilities and equipment advantage.
Institutions and Policies

Finally, the effectiveness of colleges applied research services and technical assistance to firms depends on the presence of a sufficient number of qualified support staff—including directors of research, grants-writers, project managers, industry liaisons, financial managers—and procedures and policies on grant applications, human resource logistics, client identification, research process, financial management, and collaboration management. Faculty researchers—who are already pressed to find resources and time to pursue applied research initiatives—require the support of individuals who can facilitate the funding application process, identify and manage student participants, assist with reporting requirements, and assist in managing relationships with business collaborators.

A number of business interviewees noted that they prefer to work with colleges that have sufficient support staff in place because this ensures that projects will be well-managed, that funding application support will be provided, that conflicts can be resolved through established processes and policies, and that faculty researchers will be able to devote more time to the actual research problem than to administrative functions. Some business interviewees indicated that they decided not to pursue collaborations with some colleges due to a lack of professional assistance—especially project and financial management—that they would have to perform themselves and thus face higher costs associated with the collaboration.

While Ontario colleges are at different stages of development in terms of organizational capital and some have achieved greater success than others in getting critical staff and policies in place, all colleges face challenges in identifying and maintaining resources to support applied research administrative capacity. The key challenge is in identifying financial resources. Where it is already difficult to re-allocate existing or find new resources for the research projects themselves, finding resources for AR support staff, however critical, has been especially tough.

Institutional commitment at the highest levels is often needed to see the development of organizational capacity through the “investment horizon”—i.e., the time that must elapse before organizational capital investments (along with human and physical capital investments) begin to pay dividends through self-sustaining applied research programs. Colleges may need to allocate some of their own base funding to support applied research offices, where the necessary administrative and managerial functions can be housed. In the absence of this, colleges can only depend on sources of external funding. Few funding programs, however, recognize and support the indirect costs of applied research.

Although CONII funding includes $2.9 million for college capacity building (specifically, through the creation of College Industry Innovation Centres), it is not clear that this money alone has translated into significantly enhanced organizational capacity at Ontario’s colleges. And although NSERC’s CCI program will support the costs of administrative and supportive functions for specific projects, it will not support the development of overall college applied research organizational capacity. If Ontario colleges’ innovation catalyst and accelerator potential is to bear fruit on large scale, increased resources and effort will be needed to enhance and expand administrative capacity.
Chapter 7

Foundations of AR Success III: Effective Collaborations

As college applied research is intended to stimulate and accelerate firm-level innovation and productivity through collaborations with business, especially SMEs, and other organization, a final element of applied research success is the nature of the collaborations themselves. This includes how they emerge, how expectations and responsibilities are articulated, how projects and relationships are managed, and how conflicts are resolved.

Colleges are well-positioned to contribute to business success. Their industry-oriented and “close-to-the-ground” attitudes and skill-sets have been lauded as well-aligned with business needs and able to contribute in a cost-effective way to business objectives. However, Ontario colleges remain academic institutions with a mandated role to provide vocational training and education and, as such, have developed a different culture than what one finds in the world of business. When institutions with different cultures interact, some challenges are to be expected. While firms that work with Ontario colleges are generally pleased with the final results of their collaborations, many note that challenges do emerge and hope that they will be addressed in future thinking and planning.

Awareness and Initial Contact

A pre-collaboration challenge is that firms are often unaware that Ontario colleges offer applied research services. An online survey of 181 businesses and other organizations reveals that, prior to the survey, nearly half (46.4 per cent) were not aware that colleges offer research services and collaborate with businesses on research and innovation activities. Moreover, despite efforts by colleges to improve awareness through advertising in trade magazines, newspapers, radio, television, and other media, those respondents who are aware (53.6 per cent) were most likely to have become aware through informal mechanisms such as “word of mouth” (49.5 per cent) or “community business networks” (39.2 per cent). (See Table 1).

In one of the in-depth interviews with a firm who had worked with an Ontario college, a senior executive remarked that the colleges and other stakeholders “need to think about how to better engage and inform industry partners of the opportunities available at Ontario colleges. Prior to our self-initiated research into colleges and universities as possible partners, we had no idea that colleges had such great capacity.”

Still, more than 30 per cent of the online survey respondents indicated that they had contacted a college regarding research services in the past, and 13.3 per cent (totalling 24 organizations among the 181 respondents) indicated that a college had provided research services to their business. This suggests that when firms become aware of Ontario colleges’ applied research services and technical assistance, many are interested in using those services and developing partnerships. In that case, if the colleges can improve their marketing strategies, and sufficient funding from government and other sources emerges, there is a vast pool of firms, especially SMEs, ready to take advantage of the colleges’ innovation catalyst and accelerator functions.
Designing and Managing Collaborations

Once colleges and business find each other and begin to set and carry out the objectives of research collaborations, they face a number of challenges that could undermine successful completion of the projects and the potential benefits for firms, students, and others. Interviews with colleges and the businesses with whom they have collaborated uncovered a number of issues including:

- misaligned schedules and deadline expectations;
- preparedness of, and expectations about, student researchers;
- ambiguity around roles, responsibilities, and expectations for deliverables; and
- the extent and quality of administrative support.

A frequently stated concern of businesses is that, although colleges are more business-literate and business-friendly than universities, they nevertheless need a richer understanding of business drivers and constraints. Similarly, while colleges note that many businesses have developed not only an understanding of the challenges of working with students, but also an appreciation for what they can bring to research and innovation. Other leaders, however, still do not seem to understand the importance of involving students in college-industry collaborations.
Aligning Schedules and Timelines

A number of private-sector interviewees identified issues relating to timeliness of activities and deliverables as the most pressing challenge experienced in applied research collaborations with colleges. In particular, many firms noted that the college academic calendar—which for most colleges means a virtual shutdown of activities during the summer—is poorly aligned with their need for access to research services and technical assistance throughout their entire fiscal years. While some businesses indicate that they will adjust their own activities and expectations to overcome the challenges, others experienced delays in completing important work. Some businesses also reported delays related to reporting and accountability activities that colleges and businesses are required to complete as a condition of receiving government funding.

In both instances, a key strategy for dealing with the challenges was ensuring good communication between the collaborators. Where businesses and colleges are aware of the others’ constraints and requirements, potential misunderstandings can be overcome. At the same time, until the colleges have the resources to overcome the faculty release challenge, responsiveness to business timelines will remain problematic.

Working with Student and Faculty Researchers

The success of applied research collaborations between colleges and businesses depend on the skills, attitudes, and behaviours of faculty and student researchers, as well as on the time and resources that those researchers have to work on projects. Finding and working with college faculty and students who have the right mix of skills, attitudes, behaviours, and resources can involve various sorts of challenges for businesses, including:

- **Finding and selecting researchers.** Business interviewees reported a number of issues related to finding and selecting researchers for their applied research projects. In the case of faculty, a business might have a particular person in mind, but that researcher may not be in a position to be released from teaching engagements. With respect to students, businesses tend to want to play a large role in selecting which students participate, while colleges want to ensure opportunities for all students. In some cases, colleges do not provide businesses with a way to be involved in the process of selecting student collaborators at all with the result that some student researchers simply do not fit well with the firm and must be replaced when the project is already underway.

- **Personality conflicts.** As with any relationship between individuals and organizations who have different expectations and ways of doing things, college-business collaborations sometimes experience personality conflicts between key actors. One business interviewee noted that a project was marred by power struggles over various aspects of the work. Another said that personality conflicts resulted in the cancellation of a future project. While there is no perfectly reliable way to resolve personality conflicts, addressing expectations at the outset of projects and involving both the colleges and businesses in the researcher selection process can do much to minimize the likelihood and severity of possible conflicts.

- **Managing students.** A number of business interviewees noted that some students sometimes seemed lost, without proper direction, or lacking in sufficient background
knowledge to effectively carry out their tasks. At the same time, another respondent noted that the students involved in his project were too constrained—that it was challenging trying to deal with them directly without first going through various layers of college control. While joint college-business management procedures and expectations can be designed for applied research collaborations involving students, given that for many students the project will constitute the first time they have ever been formally managed, different responses and behaviours should be expected.

- **Researcher turnover.** Even when the right faculty and student collaborators are found, and good working relationships established, an ongoing problem for businesses is retaining them. As noted, the academic cycle produces regular faculty and student turnover, as short-term faculty are replaced and students graduate. Consequently, long-term collaborations or repeat collaborations must be prepared for new faces and facilitate new orientations.

**Articulating Roles, Responsibilities, and Expectations**

While one of the exciting and attractive features of research is that it can lead to unexpected and unintended results and outcomes, there is a need for clear parameters and expectations in applied research collaborations between college researchers and firms. Indeed, because college applied research not only involves collaboration with businesses—who have ongoing constraints around time and costs, and who are oriented towards creating and exchanging products and services of value—but has improving business as one of its two fundamental objectives, it is necessary to reach an understanding at the outset about how the project will produce value for the business.

Those college and business collaborators who articulate and discuss mutual expectations, roles, responsibilities, and deliverables at the beginning of a relationship are more likely to achieve mutually beneficial outcomes at the completion of the project. Written proposals and contracts that clearly state what is expected from the projects, the nature and deadlines of deliverable, who is to do the work and what their reporting arrangements will be, and what processes should govern the discussion and resolution of conflicts should they emerge would go a long way towards reducing the frequency and severity of misunderstanding and conflicts. And when projects run smoothly, repeat collaborations are much more likely to emerge.

To be sure, in a few cases, businesses may be in a position to allow college researchers much more space and flexibility to pursue interesting results or ideas that might create value much later in the future, or which may fail to produce value for the business at all. But even those businesses that have the resources and inclination to support this kind of research, and the researchers with whom they collaborate, should discuss and define clear roles, responsibilities, and expectations.

**Administrative Support and Business-Readiness**

Business interviewees frequently indicated that they would like to see better administrative support from the colleges on a range of relevant tasks and issues. Indeed, despite satisfaction with ultimate results, there is a general perception among collaborators that most college administrative structures and processes are not business-ready. Improving in this area is important as poor administrative interface between college and business collaborators can result in costly delays, interventions, and/or increased overhead for businesses. Those colleges that
have a reputation for being “business-ready” are more likely to generate repeat collaborations and new relationships than others.

Two support functions in particular were frequently mentioned in interviews with business:

- **Project management capacity.** An absence of adequate project management is associated with ambiguity about key roles, responsibilities, and timeframes which, in turn, can involve increased costs for business. Colleges that have recruited and support project managers who deal with HR issues, facilitate ongoing communication between partners, and attend to policy and reporting requirements are more highly regarded by potential business collaborators.

- **Accounting and procurement.** Colleges that have staff members focused on project accounting and resource procurement ensure that researchers and collaborators can focus on the research rather than the background support functions. Where businesses have to provide their own accounting and procurement support, they will experience higher costs which, given the small scale nature of many projects, especially for SMEs, may cause them to abandon or not initiate projects.

To be sure, having accountants and procurement officers on college payrolls will increase college overhead, but having that capacity already available is likely to attract more SMEs to applied research and innovation activities. Moreover, college-based applied research accountants and procurement officers will have opportunities to improve their specialized expertise and thereby constitute a more efficient and cost-effective resource for the innovation system as a whole. In short, a college-based applied research support staff provides a public good that would likely be under-supplied in the market.

**Towards More Effective Collaborations**

While these represent the main kinds of challenges identified through interviews, they do not exhaust the kinds of issues that might arise in applied research collaborations. Colleges and their business and industry collaborators remain organizations with different structures, and with motivations that are not always identical. While some challenges are the inevitable result of people working together in any sort of relationship, others relate to college processes and structures that can be made more business-friendly with the right strategy and institutional support. Within the parameters of their mandates and funding, there is room for improvement at the college level.
Chapter 8

Estimating the Impact of Applied R&D Funding on the Economy

Colleges Ontario requested that The Conference Board of Canada quantify the impact that applied research and development (R&D) funding at Ontario’s colleges can have on the national and Ontario economies by evaluating the impact of a boost to R&D funding performed within the colleges. At Colleges Ontario’s request, this boost in funding is assumed to come from 3 sources: increased funding of college performed R&D by the federal government, increased funding of college performed R&D by the Ontario government and changes to Scientific Research and Experimental Development (SR&ED) tax credit policy that would make R&D performed by colleges on behalf of businesses eligible for tax credits.

This section considers two scenarios. The first scenario considers the impact of increased funding of college performed R&D by both the federal and Ontario governments. The second scenario builds on the first scenario and considers the additional impact that might result from more liberal SR&ED tax incentives.

The results presented in this section should not be considered recommendations but rather should be viewed as an evaluation of the potential economic impact of several possible policy changes.

The assumptions on increased funding to college performed R&D in Ontario were converted to constant dollars and fed through the Conference Board of Canada’s National forecasting model in order to quantify the impact on the overall economy. This methodology allows for the quantification of the impact of increased funding for college performed R&D on a wide range of economic variables that include gross domestic product (GDP), labour markets and government revenues. Moreover, this methodology allows for the calculation of economic multipliers, which link increased R&D funding to economic activity, that, under not too strict conditions, remain relatively stable under different funding scenarios. In other words, the economic multipliers are valuable for planning because they allow us to link each dollar of increased funding for college performed R&D activity in Ontario to a given dollar value of GDP, job creation or tax revenues.

The scope of this section is limited. While the estimates presented here quantify the direct, indirect and induced impacts of the boosts to funding it does not assess the contribution that R&D performed through colleges have on the productive capacity of the economy. The extent to which R&D in colleges is commercialized, improves productivity or helps lift the competitiveness of Canadian businesses provides additional long-term economic benefits not captured in a typical economic impact analysis. These benefits are difficult to quantify. The appendix contains a literature review which reports findings about the impact that R&D has had on economy-wide productive capacity in Canada and in other countries.

This section is organized as follows: First, a description of historical federal and provincial funding of R&D performed by the higher education funding is presented. Next the methodology, including key assumptions, is discussed. The section concludes with the results of the economic impact analysis. The impact of increased funding for applied R&D at Ontario’s colleges on key
economic indicators – such as employment, GDP and government revenues – along with overall economic multipliers are presented.

**Historical Funding of Higher Education R&D**

Funding of higher education\(^{100}\) by the federal government and the Ontario governments rose sharply between 1979 and 2007. Chart 1 illustrates how this funding has increased, particularly since 1996. In 2007, the federal government spent $2.7 billion dollars on R&D performed by institutions of higher education in Canada, of which $1.1 billion went to Ontario’s institutions of higher education. Ontario’s funding of R&D performed by institutions of higher education in Ontario was $351 million.

![Chart 1: Funding of Higher Education R&D](image)

*Source: Statistics Canada.*

Over the 1982-2007 timeframe, over 38 per cent of all federal funding of higher education R&D has gone toward higher education R&D performed in Ontario. In recent years, however, this share has expanded to 40 per cent.

**Methodology**

**Measuring the economic impacts**

The primary objective of this part of the “Strengthening Ontario Colleges’ Contribution to Economic and Social Development” study is to quantify the impact of additional funding for

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\(^{100}\) Statistics Canada on R&D funding does not disaggregate the higher education sector into universities and colleges.

R&D performed in Ontario’s colleges, on key economic indicators such as GDP, employment, income, and government revenues. This additional funding can come either through direct increases in funding from the federal and Ontario governments and the attendant increases in funding from the colleges’ businesses partners/clients or through the increases in funding from the colleges’ partners/clients as a result of more liberal SR&ED tax credit requirements. The analysis evaluates the combined direct, indirect and induced economic impacts, where:

**Direct impact** measures the value added on the economy of increased spending on capital spending on machinery and equipment and non-residential structures, supplies, salaries, travel associated with the research and spending to disseminate the results of the research by those directly involved with R&D performed by Ontario’s colleges, the colleges and their business partners.

**Indirect impact** measures the value added that “direct impact firms” generate through their demand for intermediate inputs or other support services. For example, R&D might require the purchase of new scientific equipment, which would require inputs, such as glass, from other industries. They may also require inputs that are imported from other countries. This would tend to mute the effect on the Canadian and Ontario economies.

**Induced impacts** are derived when employees of the aforementioned industries (both direct and indirect) spend their earnings and owners spend their profits. These purchases lead to more employment, wages, income and tax revenues, and can be felt across a wide range of industries.

Thus, increased demand for a specific industry will not only have direct impacts on the economy but will spread through the economy through a series of multiplier effects. Indirect effects are first felt on demand for industries that are direct suppliers. Second-round induced effects produce a widespread impact (albeit usually smaller) on all sectors of the economy, largely through a general increase in consumer spending. The overall economic multiplier is calculated as the sum of all value-added impacts (direct, indirect and induced) divided by the initial constant dollar spending spent as a result of increased R&D funding for Ontario’s colleges.

Increased funding of R&D at Ontario’s colleges would be expected to enter into the economy through a variety of spending channels. Spending in each of these areas would be expected to impact the economy differently. Spending generated as a result of increased funding of R&D in Ontario’s colleges was split into five categories. These channels include purchases of machinery and equipment; salaries; construction; travel and accommodations; and dissemination activities. Once the assumed increase in funding was divided into these five spending categories based upon historical spending shares the CBOC’s model was used to capture the sum of direct, indirect and induced economic effects on a wide range of economic indicators over the 2011 to 2014 period.

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101 Value added or net output is the difference between total revenue and the sum of expenses on parts, materials and services used in the production process. Summing the value added across all industries in a region will yield the GDP in that region.
Key assumptions

Some key points and assumptions about the methodology are worth mentioning.

The first set of assumptions is related to the shocks to colleges R&D funding. The assumptions on the boost to funding were provided by Colleges Ontario. They are as follows:

- Canada augments funding of higher education R&D by 5 per cent and directs this additional funding to colleges, with Ontario colleges receiving 2/5 of this.
- Ontario augments funding of higher education R&D by 5 percent and directs this additional funding to Ontario’s colleges.
- Changes to SR&ED tax credit eligibility rules to make R&D performed at colleges on behalf of businesses eligible for SR&ED tax credits.

As noted earlier, the effect of changes to SR&ED tax credit eligibility rules is considered separately from changes to federal and provincial R&D funding. Changes to SR&ED tax credit eligibility rules would be expected to lead to increased spending on applied R&D projects that are performed at Ontario’s colleges and involve spending within Ontario’s colleges as well as in-kind contributions and additional within-organization spending by the colleges’ business clients. In the simulation we assume that R&D expenditures will be 32 per cent higher in the presence of SR&ED tax credits than in the absence of those tax credits. Under the scenario, both current R&D spending as well as the increased business spending as a result of increased federal and provincial funding of R&D at Ontario’s colleges will be augmented as a result of the tax credit.

The second set of assumptions is related to the leverage effect that these initial shocks have on business funding of R&D at Ontario’s colleges. To assess the impact of additional federal and provincial funding of college performed R&D on business spending on R&D a survey was taken of the Heads of Applied Research at Ontario’s colleges. Based upon the responses to the survey a leverage factor was calculated. The calculations suggest that every dollar of additional federal or provincial funding for R&D at Ontario’s colleges nearly 60 cents of business R&D spending is generated. Implicitly assumed in this is that businesses have the funds to make this investment in R&D.

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102 This assumption is based upon a joint Department of Finance Canada and Revenue Canada report "The Federal System of Income Tax Incentives For Scientific Research and Experimental Development: Evaluation Report," (p. 54) which, based upon a survey, estimates that SR&ED expenditures were 32 per cent higher as a result of federal SR&ED tax incentives.

103 This survey requested information on funding for R&D at the colleges for the 2008/2009 fiscal year. Respondents were asked about the value of federal grants for applied R&D projects, provincial grants for applied R&D projects, institutional grants/support for applied R&D projects, company funding support for applied R&D projects and research administration funding not tied to specific projects. In addition, respondents were asked to estimate the value of company in-kind contributions and additional monies spent on research projects performed within the colleges that did not flow through the colleges.

104 This leverage factor was calculated as the ratio of total business spending on R&D to total federal and provincial R&D funding. Total business spending on R&D includes company funding support for applied R&D projects that flows through the colleges' budgets as well as company in-kind contributions to the R&D and additional money spent on those R&D projects that occurred outside the colleges' budgets. Roughly 42 per cent of business spending on college performed R&D flowed through the colleges' budget with the remaining coming as either an in-kind contribution or spending outside the colleges' budgets. Although respondents had a clear understanding of the value of company funding support for applied R&D projects that flows through their budgets and a generally good understanding of the value of company in-kind contributions to the R&D projects, the
The third set of assumptions is related to the share of spending on college performed R&D going to each of the five spending categories: purchases of machinery and equipment; salaries; construction; travel and accommodations; and dissemination activities. Spending shares were constructed using data obtained from the survey of Heads of Applied Research at Ontario’s colleges. The survey asked each respondent to estimate the share of spending going to each of the spending categories. These individual responses were then weighted, using total value of R&D funding in the college as a weight, to create an aggregate measure of the spending shares. These spending shares are illustrated in Chart 2. Over 70 per cent of spending on college performed R&D went towards paying salaries while less than 1 per cent went towards construction. Spending on machinery and equipment accounted for just over 20 per cent of all spending.

<table>
<thead>
<tr>
<th>Category</th>
<th>Share</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total M&amp;E</td>
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</tr>
<tr>
<td>Salaries</td>
<td>70.1%</td>
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<tr>
<td>Construction</td>
<td>0.6%</td>
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<tr>
<td>Travel/Accommodation</td>
<td>5.0%</td>
</tr>
<tr>
<td>Dissemination Activities</td>
<td>3.4%</td>
</tr>
</tbody>
</table>

Source: The Conference Board of Canada.

In producing the simulation, we assume that the additional money necessary for additional funding of college performed R&D by the federal and provincial governments is already available such that there are no direct effects on government accounts. This avoids having to worry about whether the additional funding will come from a budget surplus, is debt financed or results in reduced spending on other government programs. This method is also preferred since it

survey responses suggested that they did not have a good understanding of the additional money spent by businesses on the R&D projects that occurred outside the colleges’ budgets. Consequently, not all respondents were able to provide data on this. In these cases, spending by businesses was assumed to be zero. In one case a college did not provide any information on the business funding of R&D performed by the college either within or outside the college’s budget. This college was excluded from the calculation of the leverage effect.
avoids the complications of allocating the financing, not only at the federal level but also at the regional level. As such, only the beneficial effects of the model simulation are recorded on the government accounts.

The government accounts in the Conference Board’s national model are based on national accounts data and not on public accounts. However, one can assume that the impact of the shock on the national account and public account basis would be very similar. Finally, although a shock of this size only has a very small effect on costs and prices, these variables do move in response to the lift in economic activity and, thus, have a modest dampening effect on the shock results.

Data on government funding of R&D at the provincial level is only available through 2007. Thus, federal and provincial funding to higher education R&D needed to be extended to 2014. This was accomplished by growing nominal spending on higher education R&D out at the rate of growth of nominal GDP adjusted for historical differences between nominal GDP growth and growth of federal and provincial funding of higher education R&D. Funding levels were converted to calendar year estimates to be compatible with the Conference Board’s economic model of the Canadian economy and shared out into the five different spending categories as discussed above.

Potential Economic Impacts of Boosting R&D Funding to Ontario’s Colleges

Scenario 1: Increased Funding of Ontario college-performed R&D by the federal and Ontario governments

The first scenario examined is an increased funding of Ontario performed R&D by the federal and Ontario governments. Under this scenario Canada augments funding of higher education R&D by 5 per cent and directs this additional funding to colleges with 2/5 of this going to Ontario’s colleges and Ontario augments funding of higher education R&D by 5 per cent and directs this additional funding to Ontario’s colleges. In addition, the higher government funding of R&D at Ontario’s colleges is expected to leverage additional business funding for R&D at Ontario’s colleges as the colleges’ capacity for R&D is expanded.

Table 1 presents the annual spending estimates for each category of spending—in current and inflation adjusted terms—that were used to simulate the impacts of a boost in federal and provincial funding of R&D performed by Ontario’s colleges. Over the four year time horizon, increased funding of Ontario college performed R&D by the federal and Ontario governments might be expected to result in an additional $183.2 million in spending. In real terms, an additional $148.7 million would be expected to be injected into the economy over the four year simulation period.

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105 Statistics Canada adjusts government data obtained from the public accounts in an effort to make them compatible with the system of national accounts. Although there are discrepancies in the levels and timing of the two accounting systems, under an impact scenario, the accounts would be expected to move by similar amounts.

106 Over the 1982-2007 period, average growth in federal spending on higher education performed R&D exceeded average growth nominal GDP by 2.7 percentage points while average growth in Ontario provincial spending on higher education performed R&D exceeded average growth in nominal GDP by 4.4 percentage points.
Table 2 presents the results of the simulations on a number of key economic indicators for Canada. The effect of the new spending is positive, lifting economic activity, employment, income, profits and government revenues. The annual shock-minus-control effect is the first indicator, measured in millions of constant 2002 dollars. More specifically, real GDP is lifted by $23.5 million in 2011, with the annual impact rising to a peak of nearly $52 million in 2014. Over the four year horizon, real GDP is augmented by $154 million, in comparison to the $148.7 million (also inflation adjusted) in additional funding provided by the federal and provincial governments as well as the leveraged funding provided by the colleges’ business clients. Thus, for every $1 in additional funding provided by the federal government, provincial government and the colleges’ business clients $1.04 is added to overall real GDP when assessing direct, indirect and induced effects. The small overall effect is largely due to the spending on machinery and equipment which carries a much greater import share than other spending categories. Consequently, leakages out of the economy from machinery and equipment spending are larger than for other spending categories.

However, it is very important to note that 1.04 represents the multiplier for all sources of additional funding – federal, provincial and the leveraged business funding. Since each dollar of federal and provincial funding of R&D at Ontario’s colleges has generated approximately 59

\[107\] In inflation adjusted terms.

cents of business R&D spending at, or in conjunction with, Ontario’s colleges, the overall multiplier for additional funding by the federal and provincial governments is much larger. Here, the appropriate comparison is between the addition of $154 million to real GDP and the real federal and provincial funding of just over $93 million. Thus, for every $1 in additional funding provided by the federal and provincial governments, $1.66 is added to overall real GDP when assessing direct, indirect and induced effects.\footnote{In inflation adjusted terms.}

Table 2

<table>
<thead>
<tr>
<th>Economic Impact Results – Key Statistics</th>
<th>Total over Period</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Boost in Federal and Provincial Funding of R&amp;D Performed by Ontario’s Colleges</strong></td>
<td></td>
</tr>
<tr>
<td><em>Level difference shock minus control except where otherwise indicated</em></td>
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<tr>
<td>Real GDP (millions of 2002 dollars)</td>
<td>154.0</td>
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<tr>
<td>2011</td>
<td>23.5</td>
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<tr>
<td>2012</td>
<td>34.8</td>
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<tr>
<td>2013</td>
<td>44.0</td>
</tr>
<tr>
<td>2014</td>
<td>51.8</td>
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<tr>
<td>GDP (millions of dollars)</td>
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</tr>
<tr>
<td>2011</td>
<td>30.3</td>
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<tr>
<td>2012</td>
<td>48.5</td>
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<tr>
<td>2013</td>
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<tr>
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<tr>
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<tr>
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<td>Labour Income (millions of dollars)</td>
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<td>2012</td>
<td>43.9</td>
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<td>2013</td>
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<td>2014</td>
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<td>Pre-Tax Corporate Profits (millions of dollars)</td>
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<td>2012</td>
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<tr>
<td>2013</td>
<td>8.8</td>
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<tr>
<td>2014</td>
<td>13.3</td>
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</table>

Source: The Conference Board of Canada.

In current dollars, GDP is lifted by $229.5 million, boosted by increases in labour income and profits. These increases generate additional tax revenue and provide a boost to federal and provincial government balances. Personal income tax at the federal and provincial levels is expected to rise by nearly $33.5 million while corporate income tax is lifted by $2.2 million. These taxes produce the lion’s share of the positive effect towards improving federal and aggregate provincial government balances.\footnote{As discussed earlier, the funding by the government is not deducted from the accounts. Only the positive impact of the shock on the fiscal situation is registered.} In current dollar terms, federal and regional governments recover $81 million in their fiscal position from the additional $115 million they contribute towards Ontario college R&D. A larger portion of this accrues to the federal government since its personal and corporate income tax take is larger and it also benefits from slightly reduced spending on employment insurance. Overall, each $1 in additional funding of Ontario college R&D by the federal and provincial governments results in a 43.7-cent improvement in the federal fiscal position and a 26.7-cent improvement in the aggregate provincial fiscal position. These relatively large returns are due to the fact that nearly 70 per cent of funding of college performed R&D is directed towards salaries.
Table 3 presents the impact on GDP by expenditure component. The impact of increased funding of college performed R&D by the federal and provincial governments as well as the leveraged funding provided by the colleges’ business clients is, in this simulation, captured under government spending on goods and services since the funding is largely directed through Ontario’s colleges. In addition, private investment is also augmented by increased business investment (beyond the R&D investment) and residential construction. Total public and private investment (in constant dollars) is thus expected rise by more than $53 million over the 2011 to 2014 period. Increased jobs and labour income will also bolster household spending – boosting real consumer spending by $31.5 million over the 2011 to 2014 time period. The stronger investment and consumer demand in Canada is partly satisfied through increased imports of machinery and equipment, household goods and other items, having an offsetting effect on bottom line GDP gains and eroding the trade balance.
Table 3

Economic Impact Results – Components of Gross Domestic Product
Boost in Federal and Provincial Funding of R&D Performed by Ontario’s Colleges
Level difference shock minus control

<table>
<thead>
<tr>
<th></th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
<th>Total over Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>Millions of 2002 Dollars</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Real GDP</td>
<td>23.5</td>
<td>34.8</td>
<td>44.0</td>
<td>51.8</td>
<td>154.0</td>
</tr>
<tr>
<td>Consumer Spending</td>
<td>3.5</td>
<td>7.2</td>
<td>9.9</td>
<td>10.9</td>
<td>31.5</td>
</tr>
<tr>
<td>Government Spending Goods and Services</td>
<td>17.8</td>
<td>23.8</td>
<td>29.4</td>
<td>34.7</td>
<td>105.7</td>
</tr>
<tr>
<td>Private and Public Investment</td>
<td>6.8</td>
<td>11.7</td>
<td>16.0</td>
<td>19.3</td>
<td>53.7</td>
</tr>
<tr>
<td>Inventory accumulation</td>
<td>1.9</td>
<td>2.6</td>
<td>3.3</td>
<td>4.0</td>
<td>11.9</td>
</tr>
<tr>
<td>Exports</td>
<td>-0.1</td>
<td>-0.2</td>
<td>-0.5</td>
<td>-0.7</td>
<td>-1.4</td>
</tr>
<tr>
<td>Imports</td>
<td>7.8</td>
<td>12.5</td>
<td>16.6</td>
<td>19.7</td>
<td>56.5</td>
</tr>
<tr>
<td>Millions of Current Dollars</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GDP</td>
<td>30.3</td>
<td>48.5</td>
<td>67.0</td>
<td>83.8</td>
<td>229.5</td>
</tr>
<tr>
<td>Consumer Spending</td>
<td>5.4</td>
<td>13.3</td>
<td>21.0</td>
<td>28.3</td>
<td>67.9</td>
</tr>
<tr>
<td>Government Spending Goods and Services</td>
<td>23.0</td>
<td>31.8</td>
<td>40.5</td>
<td>49.3</td>
<td>144.6</td>
</tr>
<tr>
<td>Private and Public Investment</td>
<td>8.4</td>
<td>14.8</td>
<td>20.6</td>
<td>25.3</td>
<td>69.1</td>
</tr>
<tr>
<td>Inventory accumulation</td>
<td>0.0</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
<td>0.3</td>
</tr>
<tr>
<td>Exports</td>
<td>0.0</td>
<td>0.1</td>
<td>0.2</td>
<td>0.4</td>
<td>0.7</td>
</tr>
<tr>
<td>Imports</td>
<td>6.9</td>
<td>11.5</td>
<td>15.6</td>
<td>19.1</td>
<td>53.1</td>
</tr>
</tbody>
</table>

Source: The Conference Board of Canada.

Table 4 shows the simulation results on an industry basis. Over 85 per cent of the impact is captured within the services side of the economy with nearly half of that accruing to the non-commercial services sector – a sector comprised of the health and education subsectors. This is because much of the additional spending on R&D is allocated to paying the salaries of research and support staff.
Employment impacts by industry are summarized in Table 5. For many of the sectors, employment impacts tend to slightly lag the impacts on GDP as employers slowly begin to believe that the boost in demand is not a short-term phenomenon. The exception to this is the non-commercial services sector which experiences a larger and more immediate impact since the direct salary impact from the simulation occurs in this sector. Over the entire 2011 to 2014 time period an additional 2,600 person-years of employment are created with over half of those jobs accruing in the non-commercial services sector. Over the four years of the simulation, the number of unemployed is reduced by roughly 2,300, slightly less than the gains in employment since stronger labour markets generally induce increased participation in the labour force. The impact on unemployment rate, although negative as would be expected, is negligible since the shock to the model is quite small relative to the size of the economy.

| Source: The Conference Board of Canada. |
Scenario 2: Liberalizing SR&ED Tax Incentive Eligibility Rules

The second scenario examined by The Conference Board of Canada looks at changes to SR&ED tax credit eligibility rules to make all R&D performed at colleges on behalf of businesses eligible for SR&ED tax credits. Under this scenario, changes to SR&ED tax credit eligibility rules would be expected to lead to increased spending on applied R&D projects that are performed at Ontario’s colleges and involve spending within Ontario’s colleges as well as in-kind contributions and additional within-organization spending by the colleges’ business clients. In the simulation we assume, as discussed earlier, that R&D expenditures will be 32 per cent higher in the presence of SR&ED tax credits than in the absence of those tax credits. This scenario builds on Scenario 1. Consequently, the liberalization of SR&ED tax credit eligibility rules is assumed to impact current R&D funding as well as additional business spending that might result from the increases in federal and provincial funding assumed in Scenario 1.

Table 6 presents the annual spending estimates for each category of spending, in current and inflation adjusted terms, used to simulate the impacts of more liberal SR&ED tax incentive eligibility rules. Over the four year time horizon, the liberalization of SR&ED tax incentive

Table 5
Economic Impact Results – Labour Market
Boost in Federal and Provincial Funding of R&D Performed by Ontario’s Colleges
Level difference shock minus control

<table>
<thead>
<tr>
<th></th>
<th>2011 (000s)</th>
<th>2012 (000s)</th>
<th>2013 (000s)</th>
<th>2014 (000s)</th>
<th>Total over Period (000s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total employment</td>
<td>0.4</td>
<td>0.6</td>
<td>0.8</td>
<td>0.9</td>
<td>2.6</td>
</tr>
<tr>
<td>Agriculture</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Other Primary</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.1</td>
</tr>
<tr>
<td>Construction</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.1</td>
</tr>
<tr>
<td>Commercial Services</td>
<td>0.1</td>
<td>0.1</td>
<td>0.2</td>
<td>0.2</td>
<td>0.5</td>
</tr>
<tr>
<td>Non-Commercial Services</td>
<td>0.2</td>
<td>0.3</td>
<td>0.4</td>
<td>0.5</td>
<td>1.4</td>
</tr>
<tr>
<td>Public Administration and Defence</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
<td>0.2</td>
<td>0.5</td>
</tr>
</tbody>
</table>

Unemployment -0.3 -0.5 -0.7 -0.8 -2.3
Unemployment Rate 0.0 0.0 0.0 0.0 n/a

Source: The Conference Board of Canada.

110 This scenario does not constitute a recommendation. It is simply a discussion of a scenario that comes from the research project’s technical requirements. Although beyond the scope of this research project, there are other scenarios that could also be considered, including, for example: the provision of a ‘bonus’ SR&ED tax credit given to businesses that collaborate with colleges (e.g., an additional 5 per cent).
eligibility rules might be expected to result in an additional $22.8 million in spending if the tax incentives could be applied to all forms of business R&D conducted through Ontario’s colleges. In real terms, an additional $18.5 million would be expected to be injected into the economy over the four year simulation period.

Table 6

<table>
<thead>
<tr>
<th>Direct Spending Estimates</th>
<th>Liberalizing SR&amp;ED Tax Incentive Eligibility Rules</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2011</td>
</tr>
<tr>
<td><strong>Millions of Current Dollars</strong></td>
<td></td>
</tr>
<tr>
<td>Machinery and Equipment</td>
<td>0.9</td>
</tr>
<tr>
<td>Construction</td>
<td>0.0</td>
</tr>
<tr>
<td>Salaries</td>
<td>3.0</td>
</tr>
<tr>
<td>Travel</td>
<td>0.2</td>
</tr>
<tr>
<td>Dissemination</td>
<td>0.1</td>
</tr>
<tr>
<td><strong>Total Spending in Current Dollars</strong></td>
<td>4.3</td>
</tr>
<tr>
<td><strong>Millions of 2002 Dollars</strong></td>
<td></td>
</tr>
<tr>
<td>Machinery and Equipment</td>
<td>1.1</td>
</tr>
<tr>
<td>Construction</td>
<td>0.0</td>
</tr>
<tr>
<td>Salaries</td>
<td>2.2</td>
</tr>
<tr>
<td>Travel</td>
<td>0.2</td>
</tr>
<tr>
<td>Dissemination</td>
<td>0.1</td>
</tr>
<tr>
<td><strong>Total Spending in Constant Dollars</strong></td>
<td>3.6</td>
</tr>
</tbody>
</table>

Source: The Conference Board of Canada.

Table 7 presents the results of the simulations on a number of key economic indicators. The effect of the new spending is positive, lifting economic activity, employment, income, profits and government revenues. The annual shock-minus-control effect is the first indicator, measured in millions of constant 2002 dollars. More specifically, real GDP is lifted by $3.3 million in 2011, with the annual impact rising to a peak of nearly $6.8 million in 2014. Over the four year horizon, real GDP is augmented by $19.4 million, in comparison to the $18.5 million (also inflation adjusted) in R&D conducted by the colleges’ business clients. Thus, for every $1 in additional R&D spending by colleges’ business clients $1.04 is added to overall real GDP when assessing direct, indirect and induced effects.  

The small overall effect is largely due to the spending on machinery and equipment which carries a much greater import share than other spending categories. Consequently, leakages out

\[111\] In inflation adjusted terms.
of the economy from machinery and equipment spending are larger than for other spending categories. It is important to note that this is not a multiplier for government spending. Rather, a more correct interpretation would be that, when assessing direct, indirect and induced effects, a liberalization of SR&ED tax incentives that would make all forms of business R&D conducted through Ontario's colleges eligible for SR&ED tax credits results in an overall economic boost to the Canadian economy of $19.3 million over the four year simulation horizon.

Table 7

<table>
<thead>
<tr>
<th>Economic Impact Results – Key Statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liberalizing SR&amp;ED Tax Incentive Eligibility Rules</td>
</tr>
<tr>
<td>Level difference shock minus control except where otherwise indicated</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
<th>Total over Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real GDP (millions of 2002 dollars)</td>
<td>3.3</td>
<td>4.0</td>
<td>5.3</td>
<td>6.8</td>
<td>19.3</td>
</tr>
<tr>
<td>GDP (millions of dollars)</td>
<td>4.8</td>
<td>6.3</td>
<td>8.3</td>
<td>10.5</td>
<td>29.8</td>
</tr>
<tr>
<td>GDP Deflator (percentage difference)</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>n/a</td>
</tr>
<tr>
<td>Employment (000s)</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
<td>0.3</td>
</tr>
<tr>
<td>Unemployment rate</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>n/a</td>
</tr>
<tr>
<td>Labour Income (millions of dollars)</td>
<td>4.1</td>
<td>5.4</td>
<td>6.4</td>
<td>8.5</td>
<td>24.5</td>
</tr>
<tr>
<td>Pre-Tax Corporate Profits (millions of dollars)</td>
<td>0.3</td>
<td>0.3</td>
<td>1.0</td>
<td>1.0</td>
<td>2.6</td>
</tr>
<tr>
<td>90 Day Treasury Bill Rate</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>n/a</td>
</tr>
<tr>
<td>Current Account Balance (millions of dollars)</td>
<td>-1.1</td>
<td>-1.4</td>
<td>-2.0</td>
<td>-2.5</td>
<td>-6.9</td>
</tr>
<tr>
<td>Federal Govt. Balance (millions of dollars)</td>
<td>1.0</td>
<td>1.3</td>
<td>1.7</td>
<td>2.2</td>
<td>6.2</td>
</tr>
<tr>
<td>Regional Govt. Balance (millions of dollars)</td>
<td>0.5</td>
<td>0.6</td>
<td>0.9</td>
<td>1.2</td>
<td>3.1</td>
</tr>
</tbody>
</table>

Source: The Conference Board of Canada.

In current dollars, GDP is lifted by $29.8 million, boosted by increases in labour income and profits. These increases generate additional tax revenue and provide a boost to federal and provincial government balances. While the model does not account for the lost tax revenue due to the incentives a portion of those lost revenues will be offset by higher tax revenues due to increased economic activity. Personal income tax at the federal and provincial levels is expected to rise by nearly $4.1 million while corporate income tax is lifted by $0.25 million. A larger portion of this accrues to the federal government since its personal and corporate income tax take is larger and it also benefits from slightly reduced spending on employment insurance.

With the size of the shock being so small, the impact on most individual sectors of the economy will be negligible. A notable exception to this is the services side of the economy and, in particular, the non-commercial services sector. Although the liberalization of eligibility rules for SR&ED tax incentives to make all R&D performed at colleges on behalf of businesses eligible for SR&ED tax credits would be expected to result in an increase of just over 300 person-years of employment.
Summary of Scenario Simulations

The Conference Board of Canada used its economic model of the Canadian economy to estimate the economic impact of two scenarios to increase funding of Ontario college-performed R&D on the economy.

The first scenario involved a 5 per cent increase in federal and provincial funding of higher education R&D that would be directed toward college-performed R&D. Under this scenario additional funding on the order of $93 million (in inflation adjusted terms)—spread out over the 2011 to 2014 time period—would leverage a significant amount of additional business R&D performed by Ontario’s colleges and, ultimately, lift real GDP by $154 million and employment by 2,600 person-years of employment over the 2011 to 2014 period.

The second scenario involved a liberalization of SR&ED tax incentive eligibility rules to make all R&D performed at colleges on behalf of businesses eligible for SR&ED tax credits. Under this scenario, business R&D performed in conjunction with Ontario’s community colleges is expected to increase by $18.5 million (in inflation adjusted terms) over the 2011 to 2014 time period, lifting real GDP by $19.3 million over the period. These estimates quantify the direct, indirect and induced impacts of the boosts to funding but do not include the contribution that R&D performed through colleges have on productivity and the productive capacity of the economy. The extent with which R&D in colleges is commercialized, improves productivity or helps lift the competitiveness of Canadian businesses provides additional long-term economic benefits not captured in this economic impact analysis.
# Chapter 9

## Accelerating Innovation—Recommendations for Action

### Stimulating Business Innovation through Ontario Colleges’ Applied Research

<table>
<thead>
<tr>
<th>Summary of Recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>For Government</strong></td>
</tr>
<tr>
<td>1. In order to increase from 2 per cent the proportion of Ontario firms conducting research and development that leads to innovation, federal and provincial agencies should continue to strengthen and build on college applied research funding programs—including additional and ongoing resources for infrastructure, capacity, and research projects with business.</td>
</tr>
<tr>
<td>2. To ensure that funding programs are geared towards improving business outcomes, especially the benefits of innovation, funding agencies should revise the criteria used to evaluate applied research applications and outcomes to better reflect innovation performance and economic development aims.</td>
</tr>
<tr>
<td>3. To ensure SMEs have access to high quality research experts who can work on business timelines, the federal and Ontario governments should create complementary College Applied Research Leaders program(s).</td>
</tr>
<tr>
<td>4. To ensure that as many SMEs as possible can pursue research and innovation with sufficient support and assistance, the Ontario government should provide base funding enabling colleges to redeploy employees so that they can participate in industry-led applied research as required.</td>
</tr>
<tr>
<td>5. To ensure that an innovation-ready future workforce emerges from the colleges, government funding programs for colleges’ applied research should ensure significant opportunities for college students.</td>
</tr>
<tr>
<td><strong>For Colleges</strong></td>
</tr>
<tr>
<td>1. Ensure that the development and expansion of applied research serves to strengthen economic growth in the community and contribute to the development of highly skilled, innovation-ready graduates.</td>
</tr>
<tr>
<td>2. Take steps to further improve relationships with business clients and the partnership experience.</td>
</tr>
<tr>
<td>3. Improve and expand applied research capacity and activities gradually and learn from colleges further along the development path about the steps to take next.</td>
</tr>
<tr>
<td>4. Increase college-to-college mentoring, sharing, and learning in the planning and activities of the Colleges Ontario Network for Industry Innovation.</td>
</tr>
<tr>
<td>5. Take steps to create and/or improve applied research offices and officers.</td>
</tr>
<tr>
<td><strong>For Business</strong></td>
</tr>
<tr>
<td>1. To improve awareness and to extend the reach of Ontario colleges’ applied research services, industry associations, chambers of commerce, and business advocacy groups should increase efforts to spread the message about and direct their clients to the Colleges Ontario Network for Industry Innovation.</td>
</tr>
<tr>
<td>2. Recognize that Ontario colleges’ applied research services depend critically on the participation of students and may require more guidance than would normally be the case in collaborations with professional consultants and experts.</td>
</tr>
</tbody>
</table>

Source: The Conference Board of Canada.

Ontario and Canada are in urgent need of strategies to improve innovation and productivity performance. Innovation is essential to productivity growth which, in turn, is essential to long-term economic prosperity and social well-being. So long as Canadian businesses lag on innovation, we will face threats to our standard of living, and resources for health, education, and other programs will become increasingly scarce. Stimulating innovation, especially among SMEs, is critical to avert this scenario.

Ontario colleges’ applied research is poised to play a important role in improving business innovation, especially among the provinces’ SMEs. When Ontario colleges have sufficient resources and opportunity, they can serve as dynamic innovation catalysts and accelerators, and contribute to the development of the province’s innovation-ready workforce. But while the applied research lever has produced excellent firm-level results in the pilot phase, it is operating on a very small scale with limited resources. To develop and increase the scale of the contribution that Ontario colleges’ applied research can make to SME innovation performance, action by government and colleges is required.

**Recommendations for Government**

**Recommendation 1:**

In order to increase from 2 per cent the proportion of Ontario firms conducting research and development that leads to innovation, federal and provincial agencies should continue to strengthen and build on college applied research funding programs—including additional and ongoing resources for infrastructure, capacity, and research projects with business.

Ontario colleges have demonstrated, albeit on a small scale, that their applied research services and technical assistance to business can stimulate and accelerate innovation and growth. To increase the proportion of Ontario firms conducting research and development that leads to innovation, federal and provincial governments should increase funding to the college applied research lever.

As Ontario colleges are now moving from a pilot phase to a development phase, resources to support the development and expansion of their applied research contribution should include capacity funding—for applied research support staff and administration—and infrastructure funding—for improvements to college research facilities and equipment deemed an essential resource by Ontario-based SMEs. Resources should also gradually expand to support new research projects and collaborations between firms and Ontario colleges in order to maximize the college contribution to innovation performance. In all three cases, programs should be made permanent in order to reduce the funding uncertainty that has hampered college applied research planning and development.
Recommendation 2:

To ensure that funding programs are geared towards improving business outcomes, especially the benefits of innovation, funding agencies should revise the criteria used to evaluate applied research applications and outcomes to better reflect innovation performance and economic development aims.

Many funding programs that support research at post-secondary institutions in Canada tend to focus on objectives and performance metrics that view research as primarily a curiosity-driven, knowledge-discovery activity. Thus, performance metrics tend to focus on publications, citations, patents, and other discovery-oriented research outputs. Few funding programs employ metrics that reflect a primary and direct concern for innovation and economic development. Consequently, it is no surprise that while Canada’s higher education spending (HERD) ranks highly in the OECD we nevertheless continue to lag international peers on innovation performance.

Greater attention is needed to application criteria and performance measures that are better aligned with the economic benefits of applied research activities. This includes metrics such as the number of:

- products, technologies, processes, prototypes developed or improved per year;
- principal investigators experienced in working with industry clients on successful innovation projects;
- professors and staff trained on equipment funded by projects;
- students participating in applied research and development projects;
- students employed by partner organizations or in local industries after graduation who participated in funded projects; and
- existing college courses revised to include results of funded projects and new courses based on results of funded projects.\(^ {112} \)

Additionally, the composition of review panels and instructions given to members should be more sensitive to the nature of applied research and the college context. Lessons can be learned from NSERC’s CCI program which employs metrics and processes more aligned with applied research.

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\(^ {112} \) This is a selection of measures employed by NSERC’s CCI program.
Recommendation 3:
To ensure SMEs have access to high quality research experts who can work on business timelines, the federal and Ontario governments should create complementary College Applied Research Leaders program(s).

Recommendation 4:
To ensure that as many SMEs as possible can pursue research and innovation with sufficient support and assistance, the Ontario government should provide base funding enabling colleges to redeploy employees so that they can participate in industry-led applied research as required.

One of the greatest barriers to colleges making a greater contribution to SME innovation and performance is the lack of time faculty have available to devote to research as opposed to other duties, such as teaching and administration. Thus, many businesses who contact Ontario colleges for research and technical assistance are turned away because the colleges lack researchers with sufficient time to meet research demand.

To overcome that challenge, and to ensure that Ontario businesses are able to access the research support they need, the federal and Ontario governments should create two programs to provide faculty with more time to conduct research and provide opportunities for the development of their expertise:

- An **Applied Research Leaders** program would fund a **modest number of faculty** to devote a **large proportion of their time** to research, the development of their expertise and industry knowledge, and to mentor other faculty who have potential to collaborate with businesses on applied research projects.

  While using different terminology, this recommendation should be seen as equivalent to the Association of Canadian Community Colleges’ recommendation that a “College Leaders in Research” program be created, and Polytechnics Canada’s recommendation that a “Commercialization Chairs Program” program be created.

  An initial cohort of 200 specialists nationally, including perhaps 50-60 based in Ontario, could be funded to devote 50 to 80 per cent of their time to research. Costs could be shared between the federal and Ontario governments, as well as with industry. A competitive process could be designed and implemented to identify and support college research faculty who demonstrate the greatest potential for developing industry-relevant research programs of excellence.

- Base funding to allow redeployment of college employees to participate in applied research employees would support a **greater number of faculty** to devote a **small proportion of their time** to applied research and technical assistance services to industry partners.

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A gradual implementation could entail funding 5 per cent of faculty to devote 20 per cent of time to research in the first year with a longer-term goal of funding 20 per cent of faculty to devote 20 per cent of time to research, in four phases, within 6 to 8 years. Each phase would cost approx. $10 million per year (or less if teaching replacements are less costly). When fully implemented, the program would cost $40 million per year (excluding inflation and collective bargaining adjustments).115

A review of the cost and outcomes of such funding after each 1-2 year phase should focus on whether the redeployed faculty are successful in attracting research funds (from granting agencies and businesses), engaging students in collaborations, and producing benefits for businesses and other research partners.

If implemented, both programs would help to ensure that businesses and other organizations have access to high quality research experts with the flexibility to respond rapidly to business requests and to work on business, rather than academic, timelines.

**Recommendation 5:**

To ensure that an innovation-ready future workforce emerges from the colleges, government funding programs for colleges’ applied research should ensure significant opportunities for college students.

As the development of a highly skilled innovation-ready workforce is a key element of innovation success, and as colleges’ applied research provides a stellar mechanism to train students to become innovators and innovation assistances, government programs that support applied research should ensure that there are sufficient opportunities for students to participate in applied research collaborations with business.

This is a concern given that many in the colleges and government regard Quebec’s College Centres for Technology Transfer (CCTTs) as a model to emulate. While the CCTTs have produced excellent outcomes for Quebec businesses over three decades, it is not clear that they have engaged college students as often and intensively as would be desirable, given the contribution that they can make to the development of an innovation-ready workforce.

Thus, as agencies move forward with the development of programs to further support applied research, attention should be given to designing them in ways that would maximize college student participation, thereby contributing the development of the future workforce that will be responsible for Canada’s future innovation performance.

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115 Assumes an average of 10,000 Ontario college faculty members with salary and benefits of $100,000 per person, per year.
Recommendations for Colleges

Recommendation 1:

Ensure that the development and expansion of applied research serves to strengthen economic growth in the community and contribute to the development of highly skilled, innovation-ready graduates.

Applied research is identified in the *Ontario Colleges of Applied Arts and Technology Act* as an activity that the colleges may pursue in carrying out its objects—it is not identified as a core objective itself or something that the colleges should pursue *in addition to* their mandated activities. Whatever other benefits Ontario colleges’ applied research might have—and it has many—it should be pursued only insofar as it continues to assist the colleges in fulfilling their core mandate.

If not aligned with the mandate, there is a risk that applied research activities might be pursued *at the expense of* student education and training and economic development rather than *for the benefit of* students and the economy. Where applied research siphons college resources but has little prospect of producing benefits for students and/or the regional economy, it should be abandoned.

Recommendation 2:

Take steps to further improve relationships with business clients and the partnership experience.

While Ontario colleges are regarded as more responsive to, and understanding of, business than other research institutions, interviews with Ontario colleges’ business clients nevertheless reveal that improvements can be made. To ensure that applied research services and technical assistance are tailored to achieve maximum business benefit, colleges should take steps to improve processes and increase support staff to manage collaborations, including:

- expanding and enhancing networks with industry and community;
- recruiting support staff to interact with and support business, including directors of research, project managers, industry liaisons, and finance and procurement officers; and
- creating or revising procedures and policies to guide and govern grant application processes, human resources, client identification, the research process and research ethics, financial management, procurement, collaboration management, and conflict resolution.

Colleges that have appropriate policies and staff in place are more likely to win funding to support applied research and attract business clients.
Recommendation 3:

Improve and expand applied research capacity and activities gradually and learn from colleges further along the development path about the steps to take next.

Building applied research capacity takes time and should be pursued incrementally. While many colleges may want to rapidly increase their applied research activities, it is important to take time to ensure success in, and learn from, initial efforts so that future applications and collaborations have the benefit of a sound track-record on which to rely. Additionally, applied research development and focus should be guided by regional social and economic needs and priorities. Colleges should proceed carefully to identify, exploit, and enhance existing areas of research strength, and take on projects and resources only when they have sufficient capacity and interested collaborators.

Recommendation 4:

Increase college-to-college mentoring, sharing, and learning in the planning and activities of the Colleges Ontario Network for Industry Innovation.

While CONII has been making efforts to contribute to the development of college capacity, there is a great need for more inter-college communication, sharing, mutual mentoring, and networking, all of which could be organized and facilitated by CONII. Colleges who are relatively new to applied research could benefit from advice and mentoring from colleges who are further along the development continuum, while the latter could further enhance their capacity and activities by sharing challenges and lessons with similarly developed peers both in Ontario and nationally.

Specific ideas to maximize the CONII contribution to learning and development include:

- producing case studies and/or organizing workshops that examine the experiences and practices of leading applied research colleges; and
- the organization of national (or even international) study tours of leading jurisdictions/schools.

Recommendation 5:

Take steps to create and/or improve applied research offices and officers.

In addition to the challenges they face managing relationships with business clients (see Recommendation 3), colleges face other challenges in crafting applications, conducting research, and reporting results. To improve their applied research capacity, colleges should aim to build their applied research offices by identifying and supporting some, or all, of the following:

- Director of Research responsible for providing strategic direction and leadership;
• *Research Champions/Mentor(s)* responsible for raising the college’s standard of research by mentoring research faculty; providing methodology training; creating applied research resources/handbooks; and assisting with the development of policies, procedures and practices to support grant-writing and reporting, project management, and conflict resolution;

• *Grant-writing expert or team of experts* to improve application quality and success rates and to assist research faculty with their own applications; and

• *Additional support staff* including accountants, human resource managers, and procurement officers.

**Recommendations for Business**

**Recommendation 1:**

To improve awareness and to extend the reach of Ontario colleges’ applied research services, *industry associations, chambers of commerce, and business advocacy groups should increase efforts to spread the message about and direct their clients to the Colleges Ontario Network for Industry Innovation.*

The Conference Board’s survey of Ontario businesses and other organizations revealed that many are unaware that Ontario colleges offer applied research services and technical assistance. Moreover, few are likely aware of how robust the benefits can be.

Consequently, to ensure that this important innovation lever has maximum reach and impact, industry associations, chambers of commerce, and business advocacy groups should make efforts to increase their members; awareness of Ontario colleges’ applied research. Moreover, they should ensure that members who do express interest in contact a college about receiving assistance are directed either to an appropriate college or to the Colleges Ontario Network for Industry Innovation who can place them with the appropriate school.

**Recommendation 2:**

*Recognize that Ontario colleges’ applied research services depend critically on the participation of students and may require more guidance* than would normally be the case in collaborations with professional consultants and experts.

In light of the fact that business-college collaborations involve participants from different cultures—i.e., business and academic cultures—sensitivity to the needs and constraints of both partners is needed. In particular, just as colleges must make efforts to further adapt to business timelines and objectives, businesses should recognize and adapt to the fact that college applied research services depend critically on the participation of students. In short, working with colleges—and thus college students—may require more patience and guidance than would normally be the case in collaborations with professional consultants and experts. Businesses that adapt to this circumstance will find that they benefit from the often less expensive services of colleges, and will have opportunities to assess and shape potential future employees.
Action for Innovation

In their early efforts in applied research, Ontario colleges have demonstrated that they have great potential to act as innovation catalysts and accelerators for Ontario businesses, especially SMEs. Given the importance of innovation for productivity, economic growth, and overall quality of life, and given Canada’s weak innovation performance, we cannot afford to neglect a key mechanism to improve performance.

Ontario companies—especially SMEs—can get help with their innovation and R&D activities from Ontario colleges’ applied research services. Collaborations can produce new and improved processes, products, and services and can lead to increased sales, reduced costs, and improvements in overall organizational effectiveness. Additionally, the participation of college students in applied research projects, and their exposure to industry, contributes to the development of an innovation-ready future workforce. Supporting the development and expansion of this critical innovation lever should be a provincial and federal priority.
Appendix A

Literature Review: Quantifying the Economic Impact of Applied Research

The Importance of Productivity

Textbox 1

<table>
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<th>Defining Innovation and Productivity</th>
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*Innovation is a process through which economic or social value is extracted from knowledge through the generation, development, and implementation of ideas to produce new or significantly improved products, processes, and services.*


*Innovation is new or better ways of doing valued things. Innovation is not limited to products but includes improved processes like the assembly line, and new business models like web-based commerce. An “invention” is not an innovation until it has been implemented to a meaningful extent. Radical innovations like the steam engine and the transistor create entirely new markets. Much more prevalent is incremental innovation in established markets in which goods and services are continuously improved—a process that is responsible for the majority of labour productivity growth.*


*Many people confuse the concept of productivity with that of work intensity. But improving productivity is not about working longer or harder, it’s about working smarter. It’s about finding more efficient and effective ways to produce goods and services so that more can be produced with the same amount of effort. It’s also about producing higher-value-added products and services that are worth more in the marketplace.*


There is broad consensus among Canadian economists and analysts that productivity is the single most important determinant of a country’s economic prosperity over the longer term and that innovation is the key driver of productivity growth. (See textbox 1).

Low productivity levels and growth present enormous challenges for Canada’s future economic prosperity. Canada’s level of labour productivity was US$35 in 2008, much lower than that of the United States, at US$44. Worse still, Canada’s labour productivity level has fallen to 80 per cent of the U.S. level from a high of 90 per cent in the mid-1980s. (See Chart 1). Despite a broad and growing consensus that Canadian productivity needs to be improved, the gap with the U.S. has widened rather than narrowed.

A gap is also found when comparing labour productivity growth in Canada and the United States. In the 1970s and 1980s, the two countries had roughly similar labour productivity growth rates. (See Chart 2). A gap became noticeable in the 1990s and widened significantly in the 2000s.

**Chart 1**
Canada-U.S. Labour Productivity Ratio  
(ratio of GDP per hour worked, using US$ at constant prices and constant purchasing power parities)

Source: OECD.

**Chart 2**
Labour Productivity Growth  
(average annual growth rate, per cent)

Source: OECD.
The Link Between R&D and Productivity

In order to close the gap, we must first understand why it is happening. While research on the determinants of productivity growth has produced a list of productivity drivers, a report by the Council of Canadian Academies’ (CCA) Expert Panel on Business Innovation concludes that lower R&D intensity is largely to blame.

Among the elements examined, machinery and equipment investment, the quality of labour inputs, and an array of output and outcome measures, it is the almost astonishing under-performance of the business sector with respect to research and development expenditure that is at the heart of the story.116

Canada’s business spending on R&D as a percentage of gross domestic product (GDP) is lower than that of the United States and the OECD average. (See Chart 3).

Thus, in order to understand Canada’s poor productivity and R&D performance, we need to explain the weakness in business R&D. With this in mind, the CCA’s Expert Panel on Business Innovation posed the following pertinent question: “If innovation is good for business, why is Canadian business on the whole apparently less committed to innovation than analysts and policy makers believe it should be?”117

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While the Panel’s 2009 report acknowledged that the reasons for Canada’s low business R&D spending are complex, it concluded that Canadian firms tend not to use R&D as part of their business strategy: “[T]o understand why Canadian business as a whole has not invested more in innovation, one must shift the perspective of analysis from innovation activities themselves—e.g., inputs such as R&D and M&E investment—and focus instead on the factors that influence the choice of business strategy.”118 The report cites five main factors: structural characteristics, competitive intensity, climate for new ventures, public policies, and business ambition.119

In addition to these factors, Conference Board research has revealed that the characteristics of the firm itself—especially physical and human capital, availability of funding and expertise for R&D, operational pressures, and size—affect R&D and innovation performance.120 (See Chapter 2, “Innovation and Productivity in Canada”).

**Ontario R&D Overview**

**Funders of Research in Ontario**

In 2007, R&D expenditures in Ontario were estimated to total $11.7 billion—a 3 per cent decline from the previous year. The business sector funded almost half of the R&D activities. Ontario’s higher education sector funded 15 per cent of the total—worth an estimated $1.7 billion—and constituted the third largest source of R&D funding. (See Charts 4 and 5). The average annual growth in higher education funding between 1981 and 2007 was 9.7 per cent. This growth rate was higher than that of the business and government sectors.

Isolating the more recent period, 2000 to 2007, does not change the story—while the average annual growth in funding by the higher education sector slowed down to 6.6 per cent, it remained higher than the business and government sectors.

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118 Ibid., p. 82.
119 Ibid., p. 85.
Chart 4
R&D by Funding Sector, Ontario
(billions, 2002 constant prices)

Source: Statistics Canada, Cansim Table 358-0001.

Chart 5
Share of Total R&D by Funding and Performing Sectors in Ontario, 2007
(per cent)

* The foreign sector does not perform R&D.
** Performing sector data are not available.
Source: Statistics Canada, Cansim Table 358-0001

Performers of Research in Ontario

In 2007, business was the largest performer of R&D—$6.6 billion, representing 56 per cent of the total. (See Charts 5 and 6). The higher education sector is the second largest R&D performer. In 2007, the higher education sector performed an estimated 32 per cent of R&D in Ontario, worth $3.7 billion. This share is slightly lower than the Canadian average (35 per cent) but is higher than the OECD average, the EU15 average, and many of its competitors. (See Chart 7). Thus, the higher education sector plays a larger role in research and development in Ontario than in comparator countries.

![Chart 6](image_url)

Source: Statistics Canada, Cansim Table 358-0001
Funding of higher education R&D in Ontario comes mostly from internal sources. (See Chart 8). In 2007, the higher education sector internally allocated $1.7 billion to their own R&D, accounting for 46 percent of the total. This share is above what it was in 1981 (28 per cent), but lower than the peak in 1989 (58 per cent). The remaining 54 per cent came from external sources—25 per cent from the federal government, 10 per cent from the business sector, 9 per cent from the not-for-profit sector, 8 per cent from provincial governments, and 1 per cent from foreign sources.
Provincial funding for R&D research by the higher-education sector varies widely by province. (See Chart 9). While the Ontario government provides 8 per cent of its province’s higher-education R&D funding, Alberta funds 23 per cent and Nova Scotia funds 2 per cent. In general, Alberta and B.C. are above the provincial average, Quebec and Saskatchewan are close to the average, Ontario is slightly below the average, and the Atlantic provinces are well below the average.

![Chart 9: Share of Higher Education R&D Financed by Each Province, 2007 (per cent)](image)

Source: Statistics Canada, Cansim Table 358-0001

**Literature on the Link Between R&D and Economic Prosperity**

Literature on the link between R&D undertaken by colleges and economic productivity and growth is scant. There are a few studies that do attempt to evaluate that link and these are discussed below. However, because of the lack of hard data focusing on college and university R&D impacts, we attempt to shed light on the issue indirectly by reviewing general studies on the link between R&D and economic productivity and growth, as well as studies examining specific aspects of the link, such as whether the R&D impact is affected by the source of funding.

The literature review can be categorized as follows:

1. **College and University R&D**—i.e., literature that examines the impact of university or college R&D and economic productivity and growth;
2. **General**—i.e., literature that examines the general link between R&D and economic productivity and growth.
3. **Source of Funding**—i.e., literature that examines whether the nature of the link and its impact differs as a function of whether R&D is publicly-funded or company-financed.
4. **Type of R&D**—i.e., literature that examines whether the nature of the link and its impact differs depending as a function of whether R&D is basic or applied. While recognizing...
that universities perform some applied research, and colleges perform some basic research, we assume that colleges perform more applied R&D than basic R&D.

5. In-House vs. Outsourced—i.e., literature that examines whether the nature of the link and its impact differs as a function of whether R&D is performed in-house or contracted out to an external research organization, such as a university or colleges.

I. Literature on College and University R&D

As previously noted, Canada has the highest ratio of higher education R&D to GDP of its comparator countries. Federal funding of higher-education R&D increased by an average of 11 per cent per year between 2000 and 2007, and provincial funding increased by 6 per cent per year. This public support rests on the assumption that this R&D will help to improve Canada’s productivity performance and prosperity. Yet the linkages between R&D spending by the higher-education sector and business sector productivity are not well understood. This section reviews the few studies that have attempted to quantitatively and qualitatively assess those linkages.

The Effects of College R&D

A Quebec study by the Ministère du Développement économique, de l'Innovation et de l'Exportation evaluated the efficacy of R&D funding given to the province’s Centres Collégiaux de Transfert de Technologie (CCTTs). Data were collected from 28 of the 31 CCTTs and a follow-up telephone survey was conducted.

The number of businesses using CCTTs has been growing—from 1,635 businesses in 1999 to 2,566 businesses in 2006. The ministry target is 3,050 businesses using CCTT services by 2010. Overwhelmingly, users are in the manufacturing sector (62 per cent) and sixty-eight per cent of these businesses in 2006 were SMEs. Clients purchased services from CCTTs worth $21.3 million in 2006, up from $17.7 million in 1999.

The report concluded that the results surpassed expectations (based on 9 evaluation criteria) for 26 of the 28 CCTTs. Only 2 CCTTs underperformed. The study found many positive results from the R&D funding given to CCTTs, including:

- Funding of CCTTs spurred innovation and brought support to Quebec businesses and to students at colleges;
- CCTTs are competing in a niche “innovation” market and are not crowding out other businesses or organizations in the business of innovation;
- CCTTs are focused on getting the know-how down to a practical level for firms—that is, bringing the science to innovation;
- Sixty-five per cent of users of CCTTs stated that they would not have done the research had it not been for the CCTTs;

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The funding helped develop a critical mass in applied research and technical help—creating jobs for 341 scientists and technicians in 2006 and generating $29.1 million in investment in machinery and equipment (M&E) and infrastructure;

- Eight-two per cent of businesses using the services of CCTTs were satisfied;
- The funding helped to establish partnerships between the CCTTs and university researchers;
- Companies using CCTTs increased their capacity and probability of innovating. Ninety-one per cent of firms using CCTTs improved their capacity to innovate; 86 per cent of those reporting increased innovation suggested that the process has made them more effective and 67 per cent report having increased demand for their goods/services;
- CCTTs shared information among themselves, collaborated on projects with other CCTTs or universities, professional associations and, in some cases, with international partners;
- CCTTs were very effective at leveraging funds—for each $1 of public funding (excluding capital funding) the CCTTs leveraged another $3.2 in 2006;
- Other effects include contributing to teaching students and creating jobs in the economy.

The Effects of University R&D

A study by Medda et al. of Italian manufacturing firms concluded that R&D outsourced to universities did not lead to productivity enhancements: “It is noteworthy that among external R&D investments, only expenditures for projects run in collaboration with other firms turn out to be highly significant, while cooperation in R&D with universities does not seem to lead to productivity enhancements.” They even went as far as to note that, among the firms in their sample, external R&D with universities was a “particularly unattractive strategy to acquire a strategic advantage.”

Despite this, firms may engage in collaborative research with universities, according to the authors, when the research outcomes do not have critical strategic consequences: “For instance, firms may delegate to universities the implementation of quality controls that guarantee their products’ compliance with minimum regulatory safety standards.” They may also decide to outsource R&D to universities when appropriability conditions are weak.

Other studies found a positive impact. A report by BJK Associates for the U.S. Small Business Administration attempted “to determine whether university R&D activity affects the local rate of new firm formations and economic growth.” They found that “university R&D expenditures [were] significantly related to new firm formations in the same [labour] market area” and thereby having a positive effect on local economic growth.

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123 Ibid., p. 3.
124 Ibid., p. 3.
125 Medda et al., “University R&D,” p. 199.
The report concluded:

These findings lend strength to the argument that government and private sector R&D expenditures made through research universities contribute to economic growth. Although this argument has traditionally been made with the expectation of long term lags in the R&D to growth relationship, our findings are that this lag is relatively small as little as one year and the effect seems to decrease slowly, but steadily, after the first year but lasts for at least five years. University R&D spending is also associated with localities with higher levels of human capital, which also contributes substantially toward generating new firms. Thus, research universities and investment in R&D at these universities are major factors contributing to economic growth in the labor market areas in which the universities are situated.\textsuperscript{127}

A study by Link and Rees calculated the returns to R&D by firm size. They found that while large firms were more likely to be involved with universities on R&D projects, small firms were more able to leverage their university relationship. In other words, the returns to R&D in small firms active in R&D with universities were larger.\textsuperscript{128} They also asked U.S. manufacturing firms about their perceived success with their university research relationships. The vast majority of firms were satisfied. (See Table 1).

| Firms' Overall Success in University Research Relationships by Size of Firm, per cent |
|---------------------------------|-----------|----------------|----------------|
| Number of employees             | Very satisfied (per cent) | Somewhat satisfied (per cent) | Not satisfied (per cent) |
| < 100                           | 29        | 64             | 7              |
| 100 to 249                      | 38        | 62             | 0              |
| 250 to 499                      | 71        | 29             | 0              |
| 500 to 999                      | 44        | 56             | 0              |
| 1,000 to 9,999                  | 46        | 54             | 0              |
| > 10,000                        | 25        | 75             | 0              |

Source: Link and Rees, “Firm Size,” p. 65.

The Japanese Research Institute of Economy, Trade and Industry conducted a survey on university-industry collaboration activities in 2003. They found that “university-industry collaboration [had] a positive effect on innovation productivity” and “the younger the company, the greater the effects.” They also found that university-industry collaboration also had a positive influence on productivity as measured by the production function, and the effects were greater for younger firms.

\textsuperscript{127} Ibid., p. 1.
\textsuperscript{128} Link and Rees, “Firm Size,” p. 68.
Several studies have highlighted the importance of “spillovers between university research and high-technology innovations.” As noted in a paper by Fischer and Varga, “spillovers occur because the knowledge created by universities has some of the characteristics of public goods, and creates value for firms and other organizations.”

Fischer and Varga found university spillovers that go beyond political boundaries, but decrease as geographical distance increases. A study by Anselin et al. in the U.S. found that there was “strong evidence of local spillovers at the state level.”

A number of studies investigated why firms collaborate with universities. Piga and Vivarelli note that the Italian manufacturing firms they studied that had a public firm or institution as a stakeholder (that is, are owned partly or fully by the state) tended “to be more actively involved in external links only with universities and research labs,” while the “presence of a subsidy may be important in fostering external R&D in general (both with other firms and with universities and research centres).”

While small firms may be more likely to use external R&D facilities, the Link and Rees study of U.S. manufacturing firms found that the probability of being involved with university research centres increases with firm size—just over 50 per cent of the smallest firms were active in a research relationship with a university compared with 90 per cent of large firms. When asked why they had fostered a research relationship with a university, the two main reasons were: product development and identifying potential employees. (See Table 2).

<table>
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<th>Table 2</th>
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<td><strong>Incentives to Engage in University Research Relationships by Size of Firm (per cent)</strong></td>
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<tr>
<td>Number of employees</td>
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<td>&lt; 100</td>
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<td>1,000 to 9,999</td>
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<tr>
<td>&gt; 10,000</td>
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<tr>
<td>Source: Link and Rees, “Firm Size,” p. 65.</td>
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130 Anselin et al., “Local Geographic Spillovers,” p. 422.
132 Ibid., p. 3.
133 Link and Rees, “Firm Size,” p. 64.
The Japanese Research Institute of Economy, Trade and Industry survey findings included:

- Large companies with an abundance of in-house R&D resources were very active in university-industry collaboration five years prior to the survey. Since that time, however, while the effect of business scale remains statistically significant as a determinant for such collaboration, its significance decreased slightly and small and medium sized enterprises (SMEs) were increasingly becoming involved.
- There were only a few cases in which the university-industry relationship took the form of technology and know-how transfer or patent licensing—in most cases it was joint research.
- The younger the firm, the more active it is in university-industry collaboration.
- Firms that do not have their own research facilities are more likely to collaborate. Firms with extensive in-house capability are more apt to handle even comparatively basic research with internal resources.

2. General Literature

Most economists and analysts generally agree that R&D expenditures have a positive effect on productivity. There is, however, no direct, stable, and predictable relationship between R&D expenditures and productivity growth. R&D is a highly unpredictable activity—considerable amounts of time and money can be spent on R&D with no discernible results.

The literature relating to R&D and economic productivity and growth bears this out. The path from R&D expenditures to innovation to productivity to economic growth to improved living standards and quality of life is poorly understood, despite the large number of empirical studies on the subject. Part of the challenge is that the results can vary widely based on such factors as: the methodology used, the country and industry studied, and the time period observed.

Theoretically, R&D can increase productivity by reducing production costs of existing goods, by improving the quality of existing goods, by producing new final goods or intermediate inputs.

A 2009 article by Hall et al. provides a comprehensive listing of the literature that has been published since 1960, disaggregated by methodology (production function versus cost or profit functions), data type (cross-sectional versus time-series), and study focus (firm, industry, or country). After reviewing almost 150 studies, the authors conclude: “In spite of the revealed complexity of the problem, we have learned something about the rates of return to R&D. They are positive in many countries, and usually higher than those to ordinary capital.”

The vast majority of studies reviewed by Hall and her colleagues used a production function methodology and firm-level data. In these studies, the R&D elasticity (i.e., the percentage change in GDP that results from a 1 per cent increase in R&D expenditures) ranged from 0.01 to 0.25, but centred around 0.08. In other words, a 10 per cent increase in R&D would be associated

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134 All findings are taken from Motohashi, “University-Industry Collaboration.”
136 Ibid., p. 22.
with a 0.8 per cent increase in GDP. (See box “Calculating the R&D Elasticity and Rate of Return.”) Using a rate or return equation, the Hall study concluded that “R&D rates of return in developed economies during the past half century have been strongly positive and may be as high as 75% or so, although they are more likely to be in the 20% to 30% range.”

Earlier literature reviews reached similar conclusions. A study conducted by the U.S. Congressional Budget Office found that R&D elasticity tended to be between 0.1 and 0.2. In other words, a 10 per cent increase in R&D would be associated with a 1 to 2 per cent increase in GDP.

A 1999 review by Dilling-Hansen et al. found that elasticity estimates ranged between 0.05 and 0.2. The study notes that while these estimates may be small (and even statistically insignificant in some cases), the estimates in more recent studies were higher than those in earlier studies, particularly those from the 1970s and early 1980s: “Thus, there are indications that the 1970s and the early 1980s were unfavourable for measuring the effect of R&D—mainly because of the stagnation of the OECD economies” and, they note later in the paper, the first and second oil crises. Studies based on data of the 1990s “offer more clear (and positive) evidence of the effects of R&D.”

Regarding the Canadian situation, a report by Baldwin et al. reviewed studies from Canadian business surveys and found a positive relationship between R&D and performance:

SMEs that make significant investments in R&D are more likely to outperform their competitors across a range of performance categories, including growth in market share, productivity and profitability. . . . Among Canadian manufacturing firms, R&D expenditures are highly correlated with the rate at which firms commercialize new products and services.

Other insights emerging from general literature reviews:

* Cross sectional studies had higher returns: Hall and her colleagues found that studies that used cross-sectional data at one point in time had higher elasticity estimates than those that used time-series data for a single firm or industry. The Congressional Budget Office survey also noted that studies using cross-sectional data showed stronger R&D elasticities than those using time-series data.

* Firm or industry studies show higher returns: The Congressional Budget Office literature study noted that the effect of R&D on economic prosperity is larger and more significant in studies that focus at the firm- or industry-level rather than on the economy as a whole.

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137 Ibid., p. 23.
140 Ibid., p. 4.
141 Baldwin et al., “Canada’s Expenditures,” p. 15.
142 Hall et al., “Measuring the Returns,” p. 22.
144 Ibid., p. 14.
• *The R&D effect may be lagged*: A 2006 study by Ali-Yrro and Maliranta analyzed the impact of R&D expenditure on firm-level productivity in Finland and found no statistically significant productivity impact of R&D in the short term, but a statistically significant impact five years out.\(^{145}\)

### Calculating the R&D Elasticity and Rate of Return

#### R&D Elasticity

The theoretical framework of most studies is the Cobb-Douglas production function:

\[
Y = A L^\alpha K^\beta R^\gamma e^\varepsilon
\]  
\[\text{[Equation 1]}\]

Where:

- \(Y\) = output (GDP) or firm revenues [depending on whether the study is economy-wide or firm-level]
- \(A\) = total factor productivity
- \(L\) = labor input
- \(K\) = capital input
- \(R\) = a measure of R&D investment
- \(\alpha\) = output elasticity of labor
- \(\beta\) = output elasticity of capital
- \(\gamma\) = output elasticity of R&D
- \(\varepsilon\) = residual disturbance

Equation 1 can be rewritten in linear form by taking the log of the equation:

\[
\log(Y) = \log(A) + \alpha \log(L) + \beta \log(K) + \gamma \log(R) + \varepsilon
\]  
\[\text{[Equation 2]}\]

#### R&D Rate of Return

Replacing the levels in Equation 2 by growth rates yields the following equation:

\[
d\log(Y) = d\log(A) + \alpha d\log(L) + \beta d\log(K) + \rho(R/Y) + \varepsilon
\]  
\[\text{[Equation 3]}\]

Where:

- \(\rho\) = the rate of return to R&D investment.

Source: The Conference Board of Canada.

3. Literature on the Source of R&D Funding

This literature examines whether the impact of R&D on economic growth differs depending on whether the R&D is publicly-funded or company-financed. A number of studies found higher returns for company-financed research. For example, a 1989 study by Lichtenberg and Siegel of 2000 U.S. firms disaggregated R&D expenditures by source of funds. They found that company-

\(^{145}\) Ali-Yrkkö and Maliranta, “Impact of R&D.”

funded R&D was “a significant determinant of productivity growth, [while] federally-funded R&D investment [was] not.”\textsuperscript{146}

In principle, the effect on productivity should be the same whether it is financed publicly or by the company, since “a dollar is a dollar irrespective of source.”\textsuperscript{147} However, a 1999 study by Dilling-Hansen et al. of Danish manufacturing firms began with the assumption that, “if the firm itself is responsible for the entire financing of its R&D-project, the investment would probably only take place if the expected return is quite high. For that reason we expect that a higher ratio of company financed R&D investments to total R&D investment will raise the average productivity of the firm.”\textsuperscript{148} Conversely, they found that “externally financed R&D capital has the same productivity as company financed R&D capital.”\textsuperscript{149}

The literature review by Hall et al. concluded that most studies found that “public government-funded R&D is less productive than private R&D.” This is, according to the study, “as it should be, given the fact that it [government-funded R&D] targets goals that either do not show up in conventional GDP, or have substantial positive externalities.”\textsuperscript{150}

4. Literature on the Type of R&D

This literature examines whether the nature of the link and its impact differs depending on whether the R&D is basic or applied. The distinction rests on how close the research is to commercial applications.\textsuperscript{151}

Lichtenberg and Siegel found that basic research had a “powerful impact on productivity growth.”\textsuperscript{152} Their estimated rate of return to investment in basic research was 133.8 per cent, rejecting the hypothesis that the rate of return to basic and applied research was the same.\textsuperscript{153}

5. Literature on In-House vs. Outsourced R&D

The decision of whether to outsource or conduct R&D in-house, according to one research report, should not be regarded as “a trivial issue”.\textsuperscript{154} Using 1993 data for U.K. manufacturing firms, Love and Roper conclude that 12 per cent of R&D expenditures were outsourced.\textsuperscript{155} Another U.K. study found that external R&D increased from 5 per cent to 16 per cent of internal R&D expenditures between 1989 and 1995.\textsuperscript{156}

\textsuperscript{146} Lichtenberg and Siegel, “The Impact of R&D Investment,” p. 17.
\textsuperscript{149} Ibid., p. 20.
\textsuperscript{150} Hall et al., “Measuring the Returns,” p. 33.
\textsuperscript{151} Ibid., p. 3.
\textsuperscript{152} Lichtenberg and Siegel, “The Impact of R&D Investment,” p. 17.
\textsuperscript{153} Ibid., p. 17.
\textsuperscript{155} Ibid., p. 240.
\textsuperscript{156} Jones, “Innovation Management.”
Why do firms decide to outsource R&D? Some factors that can influence the decision include the transaction costs of doing R&D internally versus externally, the in-house technological and organizational capabilities of the firm, and the threat that can occur when a firm shares knowledge with an outside partner.

A 1996 study by Audretsch et al. examined why firms in the Netherlands would decide to engage in external R&D. As they note, in a world with perfect information and no knowledge asymmetries, “firms will tend to shun external R&D in favor of internal R&D in order to best appropriate the economic value accruing from investment in new knowledge.” Knowledge is, however, imperfect and uncertain.

Adding to the “imperfect knowledge” reason is the fact that external R&D can be used by firms with limited R&D budgets (for example, who can’t afford specialized research equipment) and that there are technological risks associated with R&D: “Firms can benefit from the scale economies of external research organisations that can achieve a large scale in terms of researchers working on a particular problem and in providing research equipment.”

The financial argument means, according to Audretsch et al., that larger firms are more likely to do R&D in-house. Hertog and Thurik agree, with the following explanations:

- “Internal R&D projects may be more expensive than external R&D projects and can therefore more easily be started off by large firms than by small firms.
- Large firms can use their substantial resources to finance internal R&D projects in an internal fashion, while small firms need to convince commercial banks of the solidity of their prospective innovative projects.
- Large firms can better use the complementarities between internal R&D and their other activities to improve productivity.
- Research projects of large firms are often more risky and complex and, therefore, require specific knowledge that cannot be provided for by organisations not engaged in the firms' production processes. The complex research projects of large firms must form the core of the internal R&D projects.”

The converse of this is that small firms are more likely to outsource their R&D. Hertog and Thurik conclude that “a government policy that aims at stimulating technological progress by offering external research facilities is particularly interesting for smaller, capital-intensive firms operating in less concentrated markets.”

Other conclusions regarding the decision to outsource R&D or do it in-house include:

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161 Ibid., p. 289.

• Firms that are more capital intensive are more likely to engage in external R&D. This is because they generally produce a product that is difficult to copy due to the high barriers to entry.  

• Industries with a high growth rate are likely to be in the early stage of the industry life cycle where no dominant product design has emerged. This means that firms will be more protective of their ideas and have a tendency to keep R&D activities internal to the firm.  

• Market concentration has an effect on a firm’s decision to conduct in-house R&D. Firms operating in concentrated markets will be more likely to conduct in-house R&D in order to prevent rival firms from getting information on research results.  

• Outsourcing R&D is more common among firms that have relatively low levels of skilled labour.  

• Outsourced R&D is complementary to on-house R&D in high-technology industries but not in low-tech industries, where it is a substitute.  

• A firm is more likely to engage in both internal and external R&D the more R&D employees it has.  

• Firms operating in the specialized-suppliers sectors and science-based sectors are more likely to conduct R&D in-house.  

• Firms that have outsourcing relationships with suppliers are more likely to engage in outsourcing R&D.  

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163 Ibid., p. 523.  
166 Ibid., p. 529.  
167 Ibid., p. 528.  
169 Ibid., p. 20.

Appendix B

Colleges’ Applied Research Across Canada: Regional Profiles

As they expand and enhance their applied research activities, Ontario colleges may have some things to learn from colleges in other parts of the country. Some of the country’s leading applied research colleges and polytechnics are located in other provinces and have identified strategies and practices that contribute to success in winning funding and completing collaborations with businesses and other organizations.

British Columbia

Through a range of applied research and innovation activities, British Columbia’s colleges are helping to advance B.C.’s Innovation Strategy, which seeks to make B.C. the most productive Canadian province by 2015. Many have been well-positioned to do this through a variety of funding opportunities offered by programs and organizations such as the BC Knowledge Development Fund (which matches CFI funding), BC Innovation Council, Genome BC (to which colleges can apply with a university partner), Western Economic Diversification, and WestLink Innovation Network. From Camosun’s Centre for Ocean Technology—a consortium tasked with identifying ways of reviving economic potential around Vancouver’s shipping industry—to Selkirk College’s GeoSpatial Research Centre, many colleges have enjoyed a number of notable applied research and innovation successes.

British Columbia Institute of Technology (BCIT)

British Columbia is also home to the British Columbia Institute of Technology (BCIT), which occupies a unique place in the postsecondary landscape of the province. Founded in 1966 as the province’s first permanent trade school, BCIT has since evolved into one of Canada’s leading applied research institutions, through the birth of the BCIT Technology Centre and a series of mergers in the 1990s. In this time it also expanded the range of its applied education to include a Bachelor of Technology degree, first granted in 1996, and is nearing completion of an Applied Master of Technology program. It will soon be applying for a Canada Research Chair.

As a well-established polytechnic, BCIT is in some ways difficult to compare with other colleges at the initial or intermediate stages of applied research capacity. However, BCIT’s evolution serves as an example of the scope that college applied research and innovation can have, given the right combination of government support and college initiative. The BCIT Technology Centre, for example, was first established with the help of a provincial operating grant, from

172 Ibid.
173 See: http://www.bcit.ca/study/credentials/.

which it continues to receive funding. With this ongoing support, BCIT is able to engage in dozens of applied research and innovation collaborations a year, facilitating a range of testing, design, prototyping and commercialization activities. It has also produced 6 patents and 2 spin-off companies. Though it took years to build its reputation for success, the Technology Centre is now very successful in forming partnerships with private and public-sector actors and is a hub for networking and outreach in core areas of specialty.

**BCIT Foundation**

BCIT also connects to potential applied research collaborators through the BCIT Foundation, an organization with registered charity status at arm’s length of the institution and which fundraises for it. The BCIT Foundation maintains a board of directors that includes BCIT alumni, as well as leaders in the private-sector. It was through the BCIT Foundation that Vancouver-based NGrain initially approached BCIT about a new 3D simulation resource centre, called the CUBE, to enhance technical education at BCIT. Along with Lockheed Martin, whose contribution was matched through Industry Canada’s Industrial and Regional Benefits Program, NGrain provided funding for the project which has enhanced the BCIT curriculum by giving students in certain programs the ability to learn through virtual simulations.

**Future Direction**

BCIT seems, like many other polytechnics, to have achieved a “critical mass” of applied research and innovation capacity (infrastructure and established centres of research priority and strength), along with reputation and industry linkage. Despite some familiar challenges (e.g., faculty union agreements have not caught up to applied research potential), it is likely that BCIT’s applied research and innovation activities will become further self-sustaining and self-generating of new opportunities given continued private and public-sector recognition of its economic and social outputs.

**Alberta**

Over the last decade, Alberta’s college system has been positioning itself to play an important role in the province’s innovation and productivity agenda. Alberta is home to two polytechnics and several other colleges that are reaching stages of well-established applied research expertise and capacity. Colleges have benefitted from a 2004 change in provincial legislation that recognized applied research as part of the college mandate, followed by subsequent developments in program funding. This has helped to make Alberta home to number of leading initiatives, including the Alberta Association of Colleges and Technical Institutes (AACTI), founded in 2002 with a $2 million endowment from the postsecondary budget to foster collaborations between industry and colleges.

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As underscored at the recent Alberta Competitiveness Forum, the province’s long-term prosperity cannot rely on its resource-wealth alone. It must also include Alberta’s ability to create a lasting environment conducive to innovation and commercialization—two things that Alberta’s businesses have not maximized, owing perhaps to a culture of complacency, with businesses responding to short-term market opportunities at the expense of investments into R&D and productivity growth. There is recognition of the need for government R&D spending to effect greater business outputs—something that requires strengthening links between academia, industry, and government, “to bring public investments in R&D to market.” As one respondent put it, 80% of the technology that can reach the market is in the hands of people in the private sector. Often it only requires the right initiative and commercialization assistance.

This is assistance that colleges can provide. Colleges across Canada are mandated to be closely connected to local business and community groups, and are structured to do so at the board, program development and program delivery levels. Capturing the local advantage they already enjoy, therefore, is a natural first step in securing initial applied research partnerships, which often happen through personal relationships or other informal channels. As colleges develop their applied research and innovation capacity into established and self-sustaining programs, expanding the reach of these informal community networks can be an effective strategy towards generating more awareness and opportunities.

Central Alberta Regional Innovation Network (CARIN)

The Central Alberta Regional Innovation Network (CARIN) exemplifies how colleges can create wider reaching, sector-focused networks, based out of relevant college programs or centres—in this case, Red Deer College’s Centre for Innovation in Manufacturing. CARIN was formed in 2006 by various partners, including Red County, Alberta Community Futures, the Central Alberta Economic Partnership, and Red Deer College. Under the direction of Mark Burggren (also Senior Advisor to the Central Alberta Rural Manufacturers Association) CARIN expanded from a loose-knit database of contacts to a reputable information network, able to identify opportunities to help companies with their problem-solving and innovation needs—needs that have become all the more pressing in an era of tight global markets and Lean manufacturing standards.

CARIN’s success in fostering numerous collaborations (30-40 last year) between Red Deer College and the manufacturing sector owes in large part to its philosophy and approach, which is grounded in a thorough understanding and appreciation of the sector and its needs. CARIN extends the hand of collaboration not simply as a matter of business, or primarily for the good of the college, but because it wants manufacturers to succeed. Where, according Burggren, the attempts of colleges in other provinces to engage manufacturers have sometimes been a “put-off”

\[175\] Alberta Competitiveness Initiative, “Summary of the Alberta Competitiveness Forum.”
\[176\] Ibid.
\[177\] ACCC, Consultation with Canadian Colleges and Institutes, p. 4.
\[178\] Red Deer College, “Manufacturing.”
to those manufacturers, the success of CARIN exemplifies the need for: the right empathy, the right attitude, and the right approach. CARIN’s success owes to the hard work involved in establishing itself, which first involved developing repors with local manufacturers.

The “CARIN model” is a good one for colleges everywhere to keep in mind. With the right industry-background, skill-sets, and service-oriented mentality, colleges can expand the relatively informal networks they are already parts of into wider networks, able to foster virtuous cycles of new relationships, new collaborations, new experience and expertise.

**Future Direction**

Developing these networks, just like applied research capacity more generally, can take time. The time before benefits are seen—the “investment horizon” of applied research—could be 5-10 years, said one respondent, “and until capacity is grown with full-time staff for 5 years, you won’t be in the game.” And most college instructors are still not involved in applied research—“if even 10 per cent could become involved, that would be a success,” said another respondent.

However, college capacity in the province has been growing over the last few years, owing to the colleges’ efforts and provincial and federal funding opportunities. Many of the province’s colleges are now in positions to leverage their achievements into new opportunities for collaboration and government support. College respondents say that it is still too early to tell how supportive the province’s new funding agency, Alberta Innovates – Technology Futures, will be for colleges. It currently provides about $1 million a year specifically for college research projects.

However, there is recognition of the potential college role in the province’s innovation and productivity mandate. As one respondent said, 80% of the technology that can reach the market is in the hands of people in the private sector. It is likely that Alberta’s R&D funding environment will continue to focus on commercialization and other economic outputs that colleges are well-positioned to support.

**Manitoba and Saskatchewan**

Colleges in Canada’s prairies are on their way to becoming significant regional centres of applied research and innovation. The Saskatchewan Institute of Science and Technology (SIAST) in Regina, and Red River College in Winnipeg, have undertaken many initiatives to date, and continue to grow their capacity. Examination of a sample of the colleges’ research projects and programs reveals the wisdom of targeting applied research and innovation activities to provincial and regional needs and priorities.

**Saskatchewan Institute of Science and Technology (SIAST)**

Though only formally involved in applied research for three years, faculty and students at SIAST have pursued a range of projects that are finding innovative solutions to community and regional
problems. Notable among these is a NSERC CCI-funded project which addresses the province’s need for securing sources of clean fresh-water. Through its Chemical Technology program, under the direction of Dr. Salim Kahlid, SIAST is working with local non-profit groups to develop new ways of treating wastewater to remove harmful contaminants. The new treatment methods will be implemented into municipal sewage and wastewater treatment systems, and are expected to ease growing pressures on water sources as the economy and population develop in the southern part of the province.\textsuperscript{179}

SIAST—which recently won SSHRC eligibility—is also conducting research to adapt its curriculum to address emerging social concerns. An instructor with the college’s Funeral Service program recently completed an investigation into different cultural expectations and practices related to funeral services, in an effort both to update the program’s curriculum, and to enhance relationships between various cultural groups and provincial funeral directors. Additionally, the Nursing Division has investigated expanding its nursing practice education into rural communities. This involved applying innovative new practice methods including triad and co-teaching.\textsuperscript{180}

\textit{Red River College}

Red River College’s \textit{Centre for Applied Research in Sustainable Infrastructure (CARSI)} is a dedicated, state-of-the-art facility designed to house applied research and innovation activities that lead to new developments in construction materials and sustainable infrastructure design. Funded in part by Manitoba Innovation Trust and CFI, CARSI is advancing the province’s strategy towards a green future, for which the province has already been recognized as a world leader.\textsuperscript{181} CARSI has received two awards: the Manitoba Round Table on Sustainability for Green Buildings and Infrastructure, and The Winnipeg Chamber of Commerce Spirit Award for sustainable infrastructure.

Red River College also features the \textit{Centre for Aerospace Technology and Training (CATT)}, located at a campus at Richardson International Airport, where students and faculty utilize their expertise in advanced manufacturing to repair, overhaul, and manufacture aircraft equipment. The aerospace industry is an important part of Manitoba’s economy, generating revenues exceeding $1.6 billion and employing 5100 people (2008 data) in a range of small, medium, and large businesses.\textsuperscript{182} By training the next generation of highly qualified personnel through aerospace diploma and degree programs, CATT is making a valuable economic contribution by helping to address the province’s shortage of qualified personnel in this sector.\textsuperscript{183}

\begin{enumerate}
\item SI\textsc{ast} Office of Applied Research and Innovation, “NSERC grant awarded to SI\textsc{ast} program head,” p. 1.
\item Ibid., p. 2.
\item See: www.gov.mb.ca/greenandgrowing/intro.html.
\item See: www.gov.mb.ca/ctt/profiles/aerospace/index.html.
\item See: www.wd.gc.ca/eng/11699.asp.
\end{enumerate}

**Future Direction**

In these ways and others, colleges in Canada’s prairie region are strategically growing their applied research and innovation capacity in accordance with institutional strengths and regional needs and priorities. Red River College in particular stands out as an established applied research institution, with well-entrenched areas of expertise and experience, capacity, and industry linkage.

Both colleges, however, identify challenges to achieving higher stages of capacity. One is teaching release time—specifically, rules against how grant and award money can be used. Without any program for teacher release time, SIAST finds it difficult to generate interest in applied research activities among some parts of its faculty. Red River College—which does have an internal teacher release program—is also limited in its potential by the amount of staff that are able to pursue applied research activities. The result is unmet economic potential in the region. As one private-sector interviewee noted, cost-sharing applied research collaborations are important to their own ability to innovate—only there is currently not enough capacity out there to meet their needs.

**Québec**

In many respects, Québec has been far ahead of most other provinces in the development of its applied research capacity located in or adjacent to its Cégeps—or Collèges d'enseignement général et professionnel. The development, expansion, and success of the College Centres for the Transfer of Technology (CCTTs) over the past thirty years provides a stellar example of how college applied research can be organized and executed to achieve benefits for local business, especially SMEs.

The CCTTs are research centres affiliated with the colleges and Cégeps in Quebec that, together, employ over 600 experts in a variety of industry-relevant fields, and whose purpose is to support innovation in the provinces’ industries by providing:

- **Technical support**: i.e., assistance and coaching through technological change process; the adaptation of technological solutions; knowledge and know-how transfer; etc.
- **Technological development**: i.e., the creation or improvement of products; the refining and trialling of specialized processes or devices; the development or upgrading of technologies, workshops and tutorials; knowledge transfer; etc.
- **Information and training**: i.e., the development of personalized training programs; technology watch; data searches; post-training follow-up and evaluation; market surveys and feasibility studies; the organization of symposia and colloquia; etc.”

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184 Réseau Trans-tech, “Who we are.”

Like colleges in other provinces, the CCTTs are widely dispersed throughout the province and thereby provide not only industry-relevant expertise, but expertise that is more accessible to SMEs than that provided by research institutions—such as universities—that are not locally embedded.

CCTTs appear to be of two kinds, tracking two kinds of legal status. CCTTs can be

- a service of, or based in a department at, a Cegep; or
- incorporated—i.e., a non-profit organization with its own administrative board that nevertheless maintains close ties to the Cegep from which it developed.

As of 2008, 31 of the 40 CCTTs were incorporated, which marks a sizable shift in status from the mid-1990s when all CCTTs had the former status—i.e., directly based in and under authority of a Cegep. Interviewees note that the move towards incorporated status was driven in large part by challenges and policy changes related to time release for teachers to do research: Up to the mid-1990s, there was a bank of time release for Cegep teachers to do CCTT-based research work. When this time bank was cut, CCTTs began to turn more to external researchers for their expertise—i.e., they hired more researchers who were not teachers and consequently moved to a structure that made that easier for them to conduct research than was possible with tight links to the Cegeps.

**Impact**

Thus far, the innovation and economic impact of Québec’s CCTTs has been very impressive. A study by the Ministère du Développement économique, de l’Innovation et de l’Exportation evaluated the efficacy of R&D funding given to the province’s CCTTs and evaluated data provided by 28 of the 31 CCTTs. The study found that the number of businesses using CCTTs has been growing—from 1,635 businesses in 1999 to 2,566 businesses in 2006. The ministry target is 3,050 businesses using CCTT services by 2010. Overwhelmingly, users are in the manufacturing sector (62 per cent) and sixty-eight per cent of these businesses in 2006 were SMEs. Clients purchased services from CCTTs worth $21.3 million in 2006, up from $17.7 million in 1999.

The report concluded that the results surpassed expectations (based on 9 evaluation criteria) for 26 of the 28 CCTTs. Only 2 CCTTs underperformed. The study found many positive results from the R&D funding given to CCTTs, including\(^\text{185}\):

- Funding of CCTTs spurred innovation and brought support to Québec businesses and to students at colleges;
- CCTTs are competing in a niche “innovation” market and are not crowding out other businesses or organizations in the business of innovation;

• CCTTs are focused on getting the know-how down to a practical level for firms—that is, bringing the science to innovation;

• Sixty-five per cent of users of CCTTs stated that they would not have done the research had it not been for the CCTTs;

• The funding helped develop a critical mass in applied research and technical help—creating jobs for 341 scientists and technicians in 2006 and generating $29.1 million in investment in machinery and equipment (M&E) and infrastructure;

• Eight-two per cent of businesses using the services of CCTTs were satisfied;

• The funding helped to establish partnerships between the CCTTs and university researchers;

• Companies using CCTTs increased their capacity and probability of innovating. Ninety-one per cent of firms using CCTTs improved their capacity to innovate; 86 per cent of those reporting increased innovation suggested that the process has made them more effective and 67 per cent report having increased demand for their goods/services;

• CCTTs shared information among themselves, collaborated on projects with other CCTTs or universities, professional associations and, in some cases, with international partners;

• CCTTs were very effective at leveraging funds—for each $1 of public funding (excluding capital funding) the CCTTs leveraged another $3.2 in 2006;

• Other effects include contributing to teaching students and creating jobs in the economy.

Use as a Model

The success of the CCTTs has prompted industry and college leaders in other provinces to call for efforts to replicate the CCTT model of applied research throughout the country. Indeed, the contribution to innovation performance and economic development of that model provides much to admire.

Yet, views were mixed among interviewees about how well the CCTTs continue to engage students, provide research opportunities for them, and thereby contribute to the long-term development of the future innovation workforce in the province. While some interviewees hold that, especially in the era of incorporation and weaker links to Cegeps, the CCTTs’ track record on student engagement is weak, other believe that student engagement remains both quantitatively and qualitatively impressive.

In light of the uncertainty about the CCTTs’ contribution to student and workforce development, other provinces’ looking to Québec for inspiration will want to ensure that they study the model closely and adapt it to their own needs and context. Ontario colleges in particular will want to
ensure that any move to adopt a CCTT-inspired model in the province ensures that opportunities for students are maximized, especially given the mandate of Ontario colleges.

**Atlantic Provinces**

Colleges in Atlantic Canada can boast of highly successful applied research and innovation endeavours, despite unique regional challenges. Chief among these challenges is a systematic lack of R&D investment by a private sector composed almost entirely of SMEs with limited resources. Interviewees also referred to a general culture of dependency and “disadvantage” in the region, risk-aversion, and a lack of understanding of the value of R&D and innovation, as impediments to finding private-sector partners in applied research activities. Despite these challenges, however, two of the region’s most prominent colleges—Nova Scotia Community College and Holland College—have drawn on community links, research strengths, and provincial and federal funding opportunities to create areas of regional, national—even global—expertise. The following examples of college initiatives demonstrate how, with the right strategy and eye for opportunity, colleges—and the communities they are a part of—can help each other, and their region as a whole.

**Holland College and Canada’s Smartest Kitchen**

Holland College’s *Canada’s Smartest Kitchen* is a $4 million facility opened in 2009. Funded by provincial and federal governments and Cavendish Farms (a processor of frozen potato products), the facility is a natural mesh of the college’s culinary operations, through its Culinary Institute, and the province’s agricultural economy and food-related industries. Atlantic Canada Opportunities Agency (ACOA) and the province of PEI both invested $1.2 million into the *Canada’s Smartest Kitchen* project at Holland College. This investment has resulted in over 10 applied research collaborations between Holland College and businesses in the area of food and bio-food products.

Canada’s Smartest Kitchen facility also demonstrates a unique collaboration between Holland College and Cavendish Farms. Cavendish Farms maintains a lab in the facility for its own use (in exchange for 25 per cent of its operating costs), and uses this as a platform to facilitate collaborations with Holland College chefs and students as needed. Investing in a shared Kitchen, both Cavendish Farms and Holland College were able to expand their R&D capacity in a way that would have otherwise been unaffordable. Cavendish Farms expects its initial investment of $1 million into the facility to be paid back in 6 years, through revenue generated by the new and improved products developed at the Kitchen. The collaboration has been, according to both parties, “win-win”.

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186 Holland College, “Canada’s Smartest Kitchen grand opening.”

**Nova Scotia Community College (NSCC)**

Nova Scotia Community College (NSCC) has been successful in establishing reputations for applied research strength in several areas. Foremost among these is its world-class expertise in geomatics, housed at the Applied Geomatics Research Group at its Middleton campus. Experienced researchers in the group have worked on a variety of projects relating to the gathering and processing of geographical data. Working with Nova Scotia Power, they have mapped biomass—an alternative fuel source already used in some European power plants—in the region, using state-of-the-art LiDar technology. The group has also worked with Green Power Labs on a technology to convert satellite imagery into high-resolution solar resource maps, among other projects with a variety of local businesses. When asked how their research collaborations with the college emerged, private-sector interviewees cited NSCC’s reputation for expertise in this area as a key factor in their decision-making. The college is also developing new community and academic links through its Masters of Science in Applied Geomatics, offered jointly with Acadia University.

**Future Direction**

Applied research and innovation capacity at NSCC and Holland College has, to a large extent, expanded in accordance with the needs and priorities of local industry. The colleges have succeeded at the early stages of capacity-building, having done the hard work of developing both local credibility and experience in areas of specialization. As one college representative noted, colleges and the communities they are a part of share a “co-destiny”—one succeeds along with the other.

But various challenges prevent the colleges from reaching their full potential. In particular, the colleges face hurdles related to:

- **Faculty release time.** Freeing good researchers from teaching responsibilities has been problematic. While replacement instructors can be brought in to allow research faculty to focus on applied research collaborations, there are often time-lags involved which can frustrate private-sector partners, while the colleges themselves face uncertainties around course-planning and faculty contracts.

- **Grant evaluation criteria.** Colleges have found that granting agencies often use evaluation criteria unfriendly to the nature of college applied research activities and outcomes. In particular a focus on publication records puts colleges at a disadvantage relative to universities, while certain economic output measures are “blind” to smaller or less direct social and economic contributions.

- **Limited funding and investment from the public and private sectors.** Despite provincial grant opportunities from various “one-off” funding competitions (such as Innovation PEI’s Discovery and Development Fund), and possible support from ACOA or Nova Scotia Research and Innovation Trust (Nova Scotia’s CFI-matching program), Atlantic
colleges point to a lack of funding and investment possibilities as a major impediment to expanding their applied research and innovation capacity.

 Territories

The country’s northern-most colleges—Yukon College, in Whitehorse, and Aurora College, in Inuvik—face an especially unique set of regional circumstances. Colleges in the remote north find capacity problems compounded by an inability to recruit enough expert faculty, followed by an inability to retain them (with some instructors taking posts for as a little as year to gain northern experience before moving on). In addition, familiar problems of college (mis)perception are aggravated in the northern case. One college representative reported feeling that decision-makers at funding agencies overestimate the colleges’ limitations, perhaps looking down on them as too rural or back-water for serious applied research and innovation.

To make matters worse, northern colleges generally operate alongside a small private sector and large government sector, both of which lack the resources for significant applied research expenditures—as well, perhaps, as an appreciation for the value of innovation. As one interviewee noted, the managerial attitude at his organization, with respect to their infrastructure is “we don’t want anyone touching anything.”

However, there are signs of a cultural shift, and of indications of college success at the initial stages of capacity building. One applied research collaboration between Yukon College and a business, for example, has led to a change in attitude in the organization’s employees, who now report a greater appreciation for the idea that innovation leads to increased productivity and competitiveness.

A Local Advantage

In some ways, colleges in the north are burdened by an aggravated set of challenges owing to their distance from stronger economic centres. Their success in a range of projects demonstrates, with unique clarity, the importance for colleges everywhere to capture the local advantage—to leverage community connections. Specifically:

- College applied research and innovation activities succeed when they respond to the needs of community partners, and colleges are often able to make the difficult but important first-steps into applied research through established community links—including, often, personal relationships between faculty and community.
- Colleges can excel as community problem-solvers. Especially in remote northern communities, colleges are sometimes the only available source of technical expertise, able to identify specific “pain-points” in local industry and business and come up with innovative solutions.
- Colleges do best when they focus on their strengths. Because of aggravated capacity problems in Canada’s north, colleges here are unable to lead a diverse range of projects.

They instead develop focused expertise to meet distinct regional priorities. They test and adapt technologies to the Arctic environment. They help improve generators to power remote communities. They work on projects and programs relating to permafrost.

As one interviewee put it, colleges and the communities they are a part of rise and fall together. Colleges everywhere—from Inuvik to urban Southern Ontario—are well-advised to remember the local advantage when it comes to their applied research and innovation strategies. Plotting applied research programs in accordance with the mid or long-term needs and priorities of the region is a safe bet for a sustainable source of applied research and innovation opportunities—not least of all because many funding opportunities are geared specifically at developing regional economic potential.

However, colleges must capture the local advantage without losing sight of what is happening outside their community. One college respondent in the north described a “silo” mentality among colleges and a need for better communication networks among colleges participating in R&D, to allow for greater sharing of experiences and best-practice ideas. Colleges should maximize their local opportunities by drawing on experiences and insights nationwide.
### Appendix C

## Barriers to Innovation Cited by Firms

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<th>Ontario Interviews (n=29)</th>
<th>Other Prov. Interviews (n=12)</th>
<th>Online Survey</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SMEs (25)</td>
<td>LEs (5)</td>
<td>SMEs (7)</td>
<td>LEs (5)</td>
</tr>
<tr>
<td>Lack of R&amp;D Funding/Money</td>
<td>15 (60%)</td>
<td>1 (20%)</td>
<td>6 (86%)</td>
<td>3 (60%)</td>
</tr>
<tr>
<td>Lack of Time (day-to-day operations are first priority)</td>
<td>6 (24%)</td>
<td>2 (40%)</td>
<td>5 (71%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>Size of Organization</td>
<td>2 (8%)</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>Lack of Expertise</td>
<td>9 (36%)</td>
<td>1 (20%)</td>
<td>2 (29%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>Insufficient Government Incentives (e.g., R&amp;D tax credits)</td>
<td>2 (8%)</td>
<td>1 (20%)</td>
<td>1 (14%)</td>
<td>1 (20%)</td>
</tr>
<tr>
<td>Excessive Regulation/Onerous Application &amp; Reporting Reqs.</td>
<td>6 (24%)</td>
<td>3 (60%)</td>
<td>1 (14%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>Insufficient Market Incentives (e.g., low market potential)*</td>
<td>2 (8%)</td>
<td>1 (20%)</td>
<td>0 (0%)</td>
<td>3 (60%)</td>
</tr>
<tr>
<td>Weak Innovation Skills/Motivation Among Employees</td>
<td>1 (4%)</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>Lack of Technology/Equipment</td>
<td>3 (12%)</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>1 (20%)</td>
</tr>
<tr>
<td>Lack of Ideas</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>Lack of Mandate</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>1 (20%)</td>
</tr>
<tr>
<td>No Barriers</td>
<td>2 (8%)</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>1 (20%)</td>
</tr>
</tbody>
</table>

Appendix D

Advisory Committee

Bruce Anderson
Professor & Coordinator of Graduate Studies
Department of Civil Engineering;
Cross-appointed Professor
School of Urban and Regional Planning
Queen’s University

B.A. (Bruce) Archibald
President
Federal Economic Development Agency for Southern Ontario

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Associate Professor
Director, M. Eng. in Telecommunications Technology Management
Department of Systems and Computer Engineering
Carleton University

Chris Beaver
Executive Vice President
REGEN Energy

John Breakey
Chief Executive Officer
UNIS LUMIN

Paul Charette
Chair of the Board, Bird Construction Company

Len Crispino
President and CEO
Ontario Chamber of Commerce

Bryan Dawson
Chief Executive Officer
Aircraft Appliances & Equipment Limited

Trish Dryden
Associate Vice President
Research and Corporate Planning, Centennial College

William (Terry) D’Silva
President
Tertec Enterprises Inc.

Linda Franklin
President & CEO
Colleges Ontario

Alex Gill
Executive Director
Ontario Environment Industry Association

Barry Goodwin
Executive Director
Industry Canada, Ontario Region

Ian Howcroft
Vice President, Canadian Manufacturers and Exporters

John Keating

James Knight
President and CEO
Association of Canadian Community Colleges

Jeff Nesbitt
Vice President
Government Relations & Strategic Programs
Agfa HealthCare

Craig Richardson
President
Grand River Foods

Nobina Robinson  
Chief Executive Officer  
Polytechnics Canada  

Naill Wallace  
CEO, Infonaut Inc.  

Peter Warrian  
Adjunct Professor, Dept. of Political Science and Munk Centre for International Studies;  
Professional Associate,  
Centre for Industrial Relations and Human Resources  
University of Toronto  

Greg Weiler  
Dean of Applied Research  
Innovation and University Partnerships  
Fanshawe College  

Keith West  
Assistant Deputy Minister  
Small and Medium Enterprise Division  
Ontario Ministry of Economic Development and Trade
Appendix E

Interviewees

The Conference Board of Canada conducted in-depth interviews with 150 key informants, including representatives from Ontario and other Canadian colleges; officials based in provincial and federal agencies and ministries; senior executives in private and public organizations that have worked with colleges on applied research projects; and representatives of a variety of other associations and stakeholder groups. The names and institutional affiliations of 102 of the interviewees are listed below. The remaining 48 interviewees could not be contacted for permission to list their names, or declined to have their names listed.

College Clients: Private and Public Sector

Alain Couturier
Independent Inventor
Durham, ON

Alan Thorpe
Cavendish Farms

Andrew Masse
Technical Services
WindTrans Systems Ltd.
Seaforth, ON

Aydin Mirzaee
chide.it Inc.
Ottawa, ON

Barry Sugden
Property Manager
NorthwesTel Inc.
Whitehorse, YK

Benjamin Strehler
CH-Four Biogas Inc.
Ottawa, ON

Chris Nielsen
Nielsen Systems Inc.
Chelsea, QC

Christine Jones-Harris
Co-Chief Executive Officer
Jones Packaging Inc.
London, ON

Dana Atwell
Director, Environmental Policy & Programs
Nova Scotia Power Inc.
Halifax, NS

Donald G. Simpson, PhD
Chief Explorer
Innovation Expedition Inc.
Toronto, ON

David Ferguson, C.E.T.
Manager, Bylaws, Traffic & Parking Operations
Corporation of the City of Welland
Welland, ON

David Hendrick
President
Hendrick Seeds
Ontario

<table>
<thead>
<tr>
<th>Name</th>
<th>Title</th>
<th>Organization</th>
<th>Location</th>
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</thead>
<tbody>
<tr>
<td>Donna Carmichael</td>
<td>CEO</td>
<td>Mill Pond Cannery and Preserves</td>
<td>Prince Edward County, ON</td>
</tr>
<tr>
<td>Fred Dixon</td>
<td>Chief Executive Officer</td>
<td>Blindside Networks Inc.</td>
<td>Ottawa, ON</td>
</tr>
<tr>
<td>Gamal Mustapha</td>
<td>SMT Research Ltd.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gary Schissler</td>
<td>Director, Systems Engineering</td>
<td>Oasys Healthcare</td>
<td>Uxbridge, ON</td>
</tr>
<tr>
<td>Giuseppe Stanciulescu, P.Eng.</td>
<td>Senior Strategic Technology Professional</td>
<td>Office of the Chief Technology Officer</td>
<td>BC Hydro</td>
</tr>
<tr>
<td>Ihor Petelycky</td>
<td>Spatial View Inc.</td>
<td></td>
<td>Toronto, ON</td>
</tr>
<tr>
<td>Jack Hoang</td>
<td>President</td>
<td>i3 International Inc.</td>
<td></td>
</tr>
<tr>
<td>Dr. Jeremy N. Friedberg</td>
<td>Spongelab Interactive</td>
<td></td>
<td>Toronto, ON</td>
</tr>
<tr>
<td>Jim Higgins, PhD, P.Eng.</td>
<td>Senior Consultant</td>
<td>Stantec Inc.</td>
<td></td>
</tr>
<tr>
<td>Phil Magill, PhD</td>
<td>LANXESS Inc.</td>
<td></td>
<td>London, ON</td>
</tr>
<tr>
<td>John Husnik, PhD</td>
<td>Senior Research Scientist</td>
<td>Phyterra Yeast Inc.</td>
<td>Charlottetown, PE</td>
</tr>
<tr>
<td>Josie d'Avernas</td>
<td>Vice President</td>
<td>Program Development and Innovation</td>
<td>Schlegel Seniors Villages</td>
</tr>
<tr>
<td>Justin St-Maurice</td>
<td>President, Analytics</td>
<td>Guelph Family Health Team</td>
<td>Guelph, ON</td>
</tr>
<tr>
<td>Ken Ono</td>
<td>Vice President, Analytics</td>
<td>NexJ Systems</td>
<td>Toronto, ON</td>
</tr>
<tr>
<td>Klaus Engel</td>
<td>Staff Scientist</td>
<td>COM DEV International Ltd.</td>
<td>Cambridge, ON</td>
</tr>
<tr>
<td>Miles Kennedy</td>
<td>Chairman, Founder and Chief Technology Officer</td>
<td>HousAll Systems Corporation</td>
<td>Ottawa, ON</td>
</tr>
<tr>
<td>Paul Lindahl</td>
<td>Chief Executive Officer</td>
<td>NGrain</td>
<td>Vancouver, BC</td>
</tr>
<tr>
<td>Paula Neves</td>
<td>Director, Health Planning and Research</td>
<td>Ontario Long-Term Care Association</td>
<td>Markham, ON</td>
</tr>
<tr>
<td>Roland Bissell</td>
<td>Convergent Telecom Inc.</td>
<td></td>
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</table>
Tim Poupore  
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Sylvain Poirier, PhD
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