Colleges and Institutes Canada
Collèges et instituts Canada

Applied Research:
Partnered Innovation for Businesses and Communities

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Colleges and Institutes Canada is the national and international voice of Canada's publicly supported colleges, institutes and polytechnics. We work with industry and social sectors to train 1.5 million learners of all ages and backgrounds at campuses serving over 3,000 urban, rural and remote communities in Canada. The Association operates in 29 countries via 13 offices around the world.

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APPLIED RESEARCH:

Partnered Innovation for Businesses and Communities

COLLEGE AND INSTITUTE INNOVATION

Highlights from the 2014-15 Applied Research Survey

Canada's colleges and institutes foster innovation that supports economic growth and social development. They improve the productivity of small and medium-sized enterprises (SMEs) and community partners through the development of new and improved technologies, processes, products and services.

This fact sheet provides a summary of the Colleges and Institutes Canada 2014-15 Survey of Applied Research Activity based on 113 responses from our members.

Partnerships

5,502 PRIVATE SECTOR PARTNERS:
- **78%** SMEs
- **14%** LARGE COMPANIES
- **8%** MICRO-ENTERPRISES

474 COMMUNITY PARTNERS FOR SOCIAL INNOVATION

64 PARTNERSHIPS WITH UNIVERSITIES

28 INTERNATIONAL RESEARCH PROJECTS IN **19** COUNTRIES

Institutional Engagement

2,585 FACULTY AND STAFF, INCLUDING INDUSTRIAL EXPERTS AND TECHNICIANS, ENGAGED IN APPLIED RESEARCH

105 INSTITUTIONS HAVE A DEDICATED APPLIED RESEARCH OFFICE

APPROXIMATELY **5%** OF FACULTY EMPLOYED AT RESPONDENT INSTITUTIONS ARE INVOLVED IN APPLIED RESEARCH

Student Involvement

31,346 STUDENTS ENGAGED IN APPLIED RESEARCH

REPRESENTING APPROXIMATELY **3%** OF STUDENTS AT COLLEGES AND INSTITUTES ACROSS CANADA

10,101 STUDENTS RECEIVED SUPPORT TO PURSUE AN ENTREPRENEURIAL IDEA

84% OF COLLEGES AND INSTITUTES SUPPORTED STUDENT ENTREPRENEURSHIP

1,450 AREAS OF RESEARCH EXPERTISE WERE IDENTIFIED IN THE FOLLOWING SECTORS:

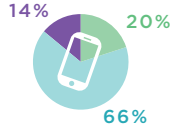
- NATURAL RESOURCES AND ENERGY
- ENVIRONMENT
- HEALTH
- INFORMATION AND COMMUNICATIONS TECHNOLOGIES
- MANUFACTURING
- SOCIAL INNOVATION

763 SPECIALIZED RESEARCH CENTRES AND LABS

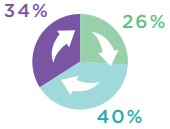
Research Outcomes

IN 2014-15, COLLEGE AND INSTITUTE APPLIED RESEARCH RESULTS INCLUDED:

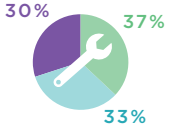
347 PRODUCTS



168 PROCESSES



87 SERVICES



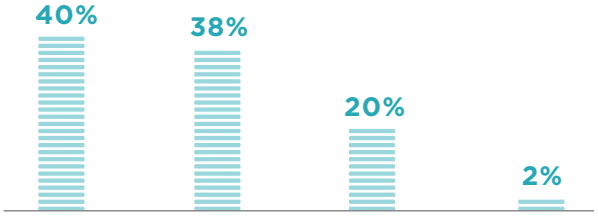
- LESS THAN 6 MONTHS
- 6 MONTHS - 1 YEAR
- MORE THAN 1 YEAR

THE VAST MAJORITY WERE DESIGNED OR IMPROVED IN LESS THAN ONE YEAR

Institutional Investment

COLLEGES AND INSTITUTES INVESTED
$59 MILLION
IN APPLIED RESEARCH ACTIVITIES AND ADMINISTRATION

External Funding



COLLEGES AND INSTITUTES LEVERAGED
$199 MILLION
IN EXTERNAL FUNDING

Key Findings

Investment	**2010-11**	**2011-12**	**2012-13**	**2013-14**	**2014-15**
Private Sector	$50,300,000	$59,400,000	$72,000,000	$78,300,000	$80,000,000
Federal Government[1]	$33,700,000	$72,000,000	$71,400,000	$85,100,000	$74,700,000
Colleges and Institutes	$38,000,000	$38,000,000	$49,200,000	$52,100,000	$59,300,000
Provincial/territorial Governments	$29,700,000	$44,000,000	$36,345,000	$40,000,000	$39,400,000
Foundations	$1,373,000	$730,000	$587,000	$2,100,000	$2,100,000
International	$295,000	$1,533,000	$3,500,000	$865,000	$1,700,000
Community Service Organizations	$319,000	$831,100	$407,000	$792,000	$1,000,000
Municipal	unknown	$533,000	$313,000	$182,000	$300,000
Total Investment[2]	**$153,687,000**	**$217,027,100**	**$233,752,000**	**$259,439,000**	**$258,400,000**
Private Sector Partners	4,444	4,586	5,444	5,633	5,502
Social Innovation Research Partners	289	338	821	693	474
Partnerships with Universities	unknown	unknown	62	89	64
Research Centres	305	387	489	670	763
Areas of Research Expertise	447	524	654	1,083	1,450
Research Networks	137	171	232	306	357
Faculty and Staff Engaged in Applied Research	1,606	1,774	2,298	2,491	2,585
Student Participation	13,585	24,108	29,356	32,093	31,346
NSERC Eligible Institutions[3]	84	92	96	102	108
SSHRC Eligible Institutions[4]	38	55	59	64	88
CIHR Eligible Institutions[5]	0	1	3	3	3

[1]The federal government amount includes data provided by NSERC, SSHRC, CFI and NRC-IRAP.
[2]The numbers given may not match total counts due to rounding procedures.
[3,4,5]The list of eligible institutions is available on the granting agencies' websites.

Introduction

Businesses in Canada urgently need to get more innovative. According to the Science, Technology and Innovation Council, Canada is falling steadily behind its global competitors on key measures of innovation. Most notably, Canada ranks 26th among international competitors for business spending on research and development as a share of gross domestic product, sitting at just over one-third of the threshold amount spent by the top five performing countries.

To overcome Canada's innovation shortfall, it is essential for all players in science, technology and innovation to collaborate for change. Canada's colleges and institutes, well-established in their communities and connected with business, government, health care and community organizations, are fast becoming innovation hotspots. By leveraging their equipment, infrastructure and the expertise of faculty and students, colleges and institutes are responding creatively to the research and development requirements of partners in small business, industry and the community — at the same time, helping students develop innovation skills they can use throughout their work lives.

Partners looking to increase their competitiveness and expand their markets are fast learning the advantages of approaching colleges and institutes for help with R&D. The schools can draw on their in-house technology and expertise of faculty and students to turn an operational problem into a research project — whether that means helping to design or enhance a product, develop a prototype, enhance the use of technology better, or improve processes and services. The place of colleges and institutes in the research, development and commercialization continuum is represented in Figure 1.

REPORT HIGHLIGHTS

This report is a snapshot of applied research, drawn from the CICan Survey of College and Institute Applied Research Activity for 2014-15. It looks at:

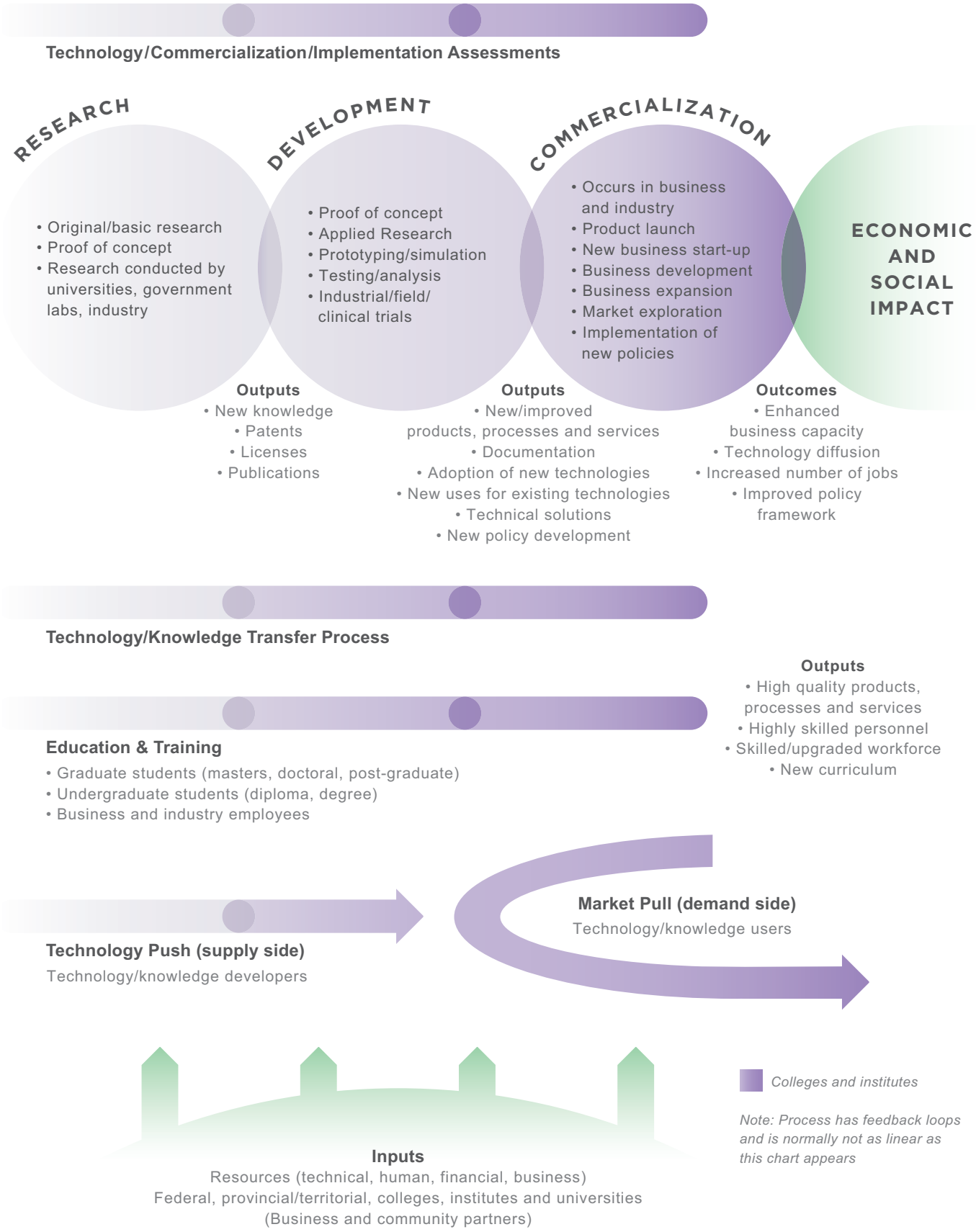
- Partnerships that serve as the foundation for applied research;
- Research resources in colleges and institutes;
- Collaborative investments by community partners, government and the private sector; and
- Outcomes of applied research.

Results since the CICan Survey of College and Institute Applied Research Activity was launched in 2005–06 show colleges and institutes across the country have steadily built their capacity to support business and social innovation. Changes include establishing structures and policies for delivering applied research, engaging faculty and students and getting commitments from governments to fund their applied research partnerships. Those efforts are paying off, as we see growing interest from industry and community players, which are increasingly turning to colleges and institutes for innovation solutions to their problems.

METHODOLOGY

The CICan Survey of College and Institute Applied Research Activity was designed in collaboration with the CICan National Research Advisory Committee. The 2014-15 survey, comprised of qualitative and quantitative questions, was completed by 113 institutions from June - September 2015 and cover all provinces and territories. The list of respondent institutions is provided as Appendix 1.

FIGURE 1: COLLEGES AND INSTITUTES IN CANADA - ROLE IN THE RESEARCH AND DEVELOPMENT CONTINUUM



1. College and Institute Applied Research Partnerships

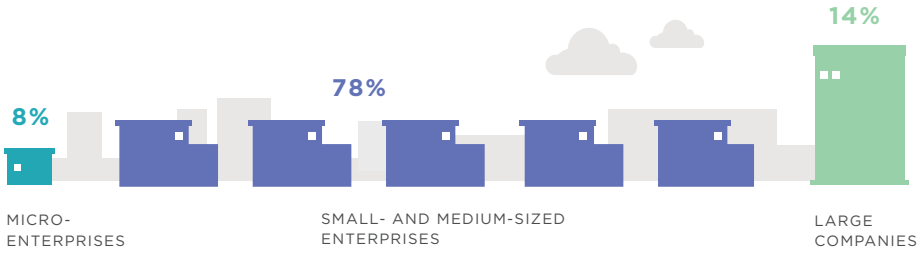
Colleges and institutes collaborate with others – from the private sector, community organizations, other post-secondary institutions and the international community – and focus on finding solutions to the needs their partners define. This section describes these partnerships in more detail.

1.1 PRIVATE SECTOR PARTNERS

Since college and institute research is demand-based, partnerships are largely with the private sector. In 2014-15, colleges and institutes provided research-based solutions to 5,502 companies, 5,403 for business and industrial research, and 99 for social innovation research.

As shown in Figure 2, the majority of partnerships were with small and medium-sized enterprises (SME) defined as having 5 to 500 employees, followed by large companies (over 500 employees) and micro-enterprises (1 to 4 employees).

FIGURE 2: DISTRIBUTION OF BUSINESS AND INDUSTRY PARTNERS BY SIZE OF ENTERPRISES



Canada is fortunate to have an infrastructure in place, through colleges and institutes, to support the innovation needs of SMEs. Considering small businesses make up 98% of companies in Canada, but only 31% invest in R&D,[1] there is much potential to improve their innovation capacity and productivity.

As shown in Table 1, college and institute partnerships answered to the needs of companies in high-skills, high-tech sectors such as manufacturing and information and communications technologies, as well as companies in key economic and growth sectors such as natural resources and energy and environmental science and technology.

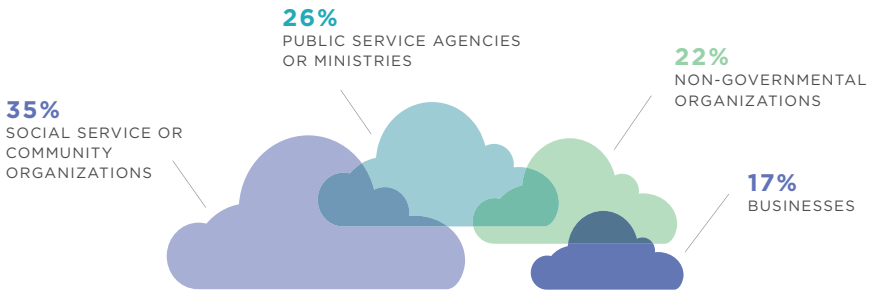
TABLE 1: BREAKDOWN OF PARTNERSHIPS BY SECTOR AND BUSINESS SIZE

	Micro-businesses	Small- and Medium-sized Enterprises	Large Companies
Manufacturing	20%	51%	55%
Information & Communications Technologies	14%	15%	14%
Natural Resources & Energy	15%	12%	15%
Environmental Science & Technology	12%	8%	6%
Health, Medical & Life Sciences	12%	6%	4%
Building Technology	7%	5%	4%
Social Innovation	1%	1%	1%
Others	19%[2]	2%	1%

1.2 SOCIAL INNOVATION PARTNERS

Colleges and institutes identified 583 research partners in social innovation, the greatest proportion in environmental awareness and planning, healthcare, and management and business. The survey results show that 35% of partnerships were with social service or community organizations, 26% with public service agencies or ministries, 22% with non-governmental organizations and 17% with businesses.

FIGURE 3: BREAKDOWN OF RESEARCH PARTNERS FOR SOCIAL INNOVATION BY ORGANIZATION TYPE



[1]Key Small Business Statistics – August 2013. Innovation, Science and Economic Development Canada: http://www.ic.gc.ca/eic/site/061.nsf/eng/02810.html
[2]Eighty-three enterprises were identified under micro-enterprises without specifying a sector. As such, this percentage is very high.

Table 2 shows the social innovation partnerships by area of research. The greatest number of social innovation partnerships was in environmental awareness and planning, followed by healthcare and management and business.

TABLE 2: AREAS OF RESEARCH FOR SOCIAL INNOVATION PARTNERSHIPS

	%
Environmental awareness & planning	20%
Healthcare	17%
Management & Business	15%
Disadvantaged populations	14%
Education	13%
Social Services	6%
Public Safety	5%
Communications & Media	4%
Industrial Relations	2%
Scholarship of Teaching & Learning	2%
Justice	1%
Other	1%
Total	**100%**

1.3 RESEARCH COLLABORATION AMONG COLLEGES AND INSTITUTES

Seventy-seven per cent of respondents reported partnerships with other colleges and institutes across Canada and internationally on research focusing on areas such as: essential skills, literacy, education, entrepreneurship, emerging technologies and renewable energies.

Table 3 provides a breakdown of research collaboration among colleges and institutes. The highest proportion of collaboration was in social innovation (25%), environmental science and technologies (20%) and manufacturing (15%).

TABLE 3: BREAKDOWN FOR RESEARCH COLLABORATION AMONG COLLEGES AND INSTITUTES

Sectors	**%**
Social Innovation	25%
Environmental Science & Technologies	20%
Manufacturing	15%
Health, Medical & Life Sciences	13%
Natural Resources & Energy	11%
Business and Management	5%
Information & Communication Technologies	4%
Other	4%
Transportation	2%
Building Technology	1%
Total	**100%**

1.4 COLLABORATION WITH UNIVERSITIES

Colleges and institutes identified partnerships with 64 universities in Canada and overseas. These partnerships focused on environmental science and technologies (31%), social innovation (20%) and natural resources and energy (15%) as demonstrated in Table 4. The list of partnerships with universities is available on the CICan website.

TABLE 4: AREAS OF RESEARCH FOR COLLABORATION WITH UNIVERSITIES

Sectors	**%**
Environmental Science & Tech	31%
Social Innovation	20%
Natural Resources & Energy	15%
Health, Medical & Life Sciences	14%
ICT	8%
Manufacturing	4%
Building Technology	3%
Other	2%
Business & Management	2%
Transportation	1%
Total	**100%**

1.5 INTERNATIONAL PARTNERSHIPS

Institutions from British Columbia, Alberta, Manitoba, Ontario, Quebec and Northwest Territories reported 28 international projects in 19 countries. The approximate value of funding allocated to these projects in 2014-15 was $1,655,508.

TABLE 5: INTERNATIONAL RESEARCH PARTNERSHIPS

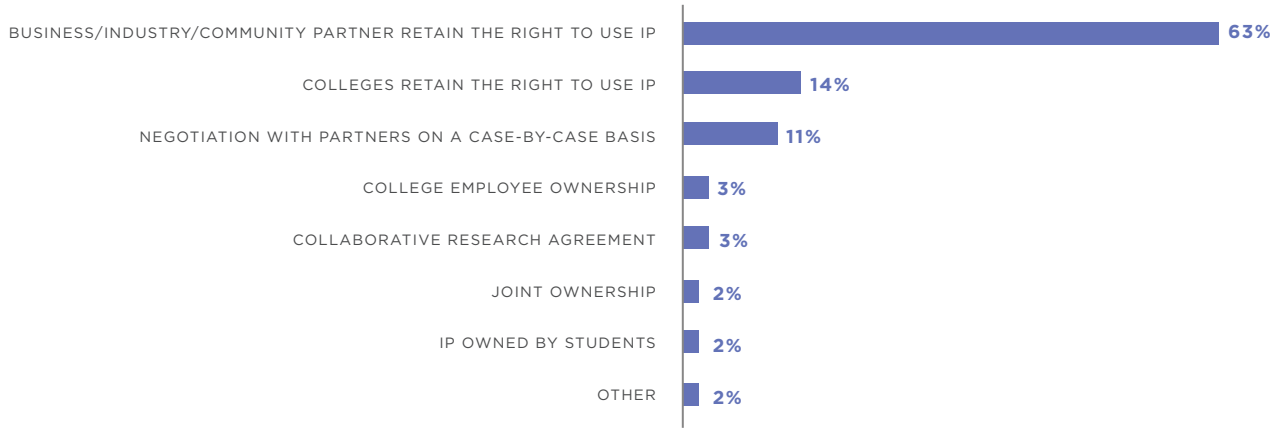
Sectors	**Country**
Building Technology	United Kingdom
Environmental Science & Technologies	Argentina, China, Colombia, Japan, Mexico, Senegal, United States
Health, Medical & Life Sciences	Australia, Ireland, Kenya, Suriname, United States
Information & Communications Technology	Albania, Tanzania, United States,
Manufacturing	Israel, Japan
Natural Resources & Energy	China, Germany, Spain, United States
Social Innovation	Israel, Switzerland
Total	**19 Countries**

1.6 INTELLECTUAL PROPERTY

In 2014-15, 90% of respondent colleges and institutes had an intellectual property (IP) policy setting out IP rights for their applied research partnerships. These policies differ from one institution to another, but most institutions (63%) reported that their partners retain IP. In general, colleges and institutes value applied research activities for the benefits and opportunities they create for students and faculty, rather than financial gain, and prefer to avoid the costs associated with registering and managing IP. This feature also makes it very interesting for business and industry partners who are able to retain IP and hence, better control further developments from the products, processes and services emerging from these applied research services from colleges and institutes.

In the cases of partnerships that involve colleges retaining IP, agreements are negotiated that take each party's contribution into consideration and in some cases, agreements allow institutions to incorporate new knowledge or technologies into their learning methods and curriculum. Students involved in applied research projects have the right to list this experience on their résumé.

FIGURE 4: COLLEGE AND INSTITUTE PRACTICES WITH RESPECT TO INTELLECTUAL PROPERTY OF APPLIED RESEARCH PROJECTS



2. College and Institute Applied Research Expertise and Resources

Colleges and institutes have expanded their expertise and capitalize on their equipment and facilities to serve the innovation needs of their partners. This section highlights college/institute applied research expertise and the range of research centres and laboratories institutions have identified.

2.1 RESEARCH EXPERTISE

Colleges and institutes are identifying a growing number of areas of research specialization – a good indicator of their capacity to adapt and respond to the current and emerging needs of businesses and communities. As of 2014-15, 1,450 areas of research expertise had been identified. It is noteworthy that colleges and institutes in nearly all provinces and territories reported research expertise across the six sectors. Table 6 categorizes the areas of research specialization for respondent institutions from the ten provinces and three territories, across six sectors, and identifies where the expertise is concentrated. For example, areas of research specialization in natural resources and energy are more concentrated in institutions in Ontario and Alberta, and environmental science and technology is concentrated in British Columbia and Ontario, followed by Quebec. Manufacturing research is concentrated heavily in Ontario. For social innovation, there is a high concentration of institutions in British Columbia, followed by Quebec and Ontario. The list of areas of research expertise at colleges and institutes by province/territory is available on the CICan website.

TABLE 6: BREAKDOWN OF AREAS OF RESEARCH SPECIALIZATION – TOTAL 1,450

	Natural Resources and Energy		Environmental Science and Technologies		Health Medical and Life Sciences		Information & Communication Technologies		Manufacturing and Building Technology		Social Innovation	
	#	%	#	%	#	%	#	%	#	%	#	%
Newfoundland and Labrador	9	3%	6	3%	2	1%	3	2%	7	3%	1	0%
Prince Edward Island	4	1%	3	1%	7	3%	1	1%	5	2%	4	1%
Nova Scotia	10	4%	20	9%	1	0%	3	2%	9	4%	0	0%
New Brunswick	11	4%	2	1%	4	2%	4	2%	7	3%	7	2%
Quebec	31	11%	38	17%	11	5%	24	13%	28	12%	59	21%
Ontario	78	28%	49	21%	83	35%	88	46%	102	44%	59	21%
Manitoba	13	5%	8	4%	4	2%	4	2%	2	1%	14	5%
Saskatchewan	6	2%	3	1%	5	2%	1	1%	1	0%	4	1%
Alberta	63	23%	35	15%	40	17%	23	12%	29	12%	48	17%
British Columbia	38	14%	52	23%	71	30%	36	19%	39	17%	87	30%
North West Territories	4	1%	7	3%	8	3%	1	1%	1	0%	0	0%
Nunavut	2	1%	1	0%	1	0%	1	1%		0%	1	0%
Yukon	5	2%	4	2%	1	0%	1	1%	3	1%	3	1%
Total	**274**	**100%**	**228**	**100%**	**238**	**100%**	**190**	**100%**	**233**	**100%**	**287**	**100%**

Highest Concentration of Research Expertise
Second Highest
Third Highest

2.2 RESEARCH CENTRES AND LABORATORIES

The 2014-15 survey results confirm that there are 763 research centres and laboratories at colleges and institutes across the country. Table 7 lists where these centres and laboratories are by province and territory, across the six sectors. Ontario reported the highest number of research facilities in all sectors except social innovation. Quebec reported the highest number of research facilities used for social innovation research, followed closely by British Columbia. There is also a high concentration of research facilities focused on natural resources and energy and environmental technologies in Alberta. The list of research centres and laboratories at colleges and institutes by province/territory is available on the CICan website.

TABLE 7 – BREAKDOWN OF CENTRES AND RESEARCH LABORATORIES – TOTAL 763

	Natural Resources and Energy		Environmental Science and Technologies		Health Medical and Life Sciences		Information & Communication Technologies		Manufacturing and Building Technology		Social Innovation	
	#	%	#	%	#	%	#	%	#	%	#	%
Newfoundland and Labrador	5	3%	0	0%	2	1%	1	1%	2	1%	0	0%
Prince Edward Island	1	1%	1	1%	3	2%	0	0%	3	2%	1	1%
Nova Scotia	5	3%	3	3%	1	1%	2	2%	3	2%	0	0%
New Brunswick	2	1%	0	0%	2	1%	3	3%	4	3%	1	1%
Quebec	21	14%	13	14%	9	6%	15	14%	28	18%	33	30%
Ontario	51	34%	36	38%	78	56%	68	61%	86	55%	31	28%
Manitoba	6	4%	1	1%	4	3%	0	0%	5	3%	1	1%
Saskatchewan	3	2%	0	0%	3	2%	2	2%	0	0%	2	2%
Alberta	37	25%	20	21%	17	12%	11	10%	10	6%	14	13%
British Columbia	10	7%	17	18%	19	14%	7	6%	14	9%	27	24%
North West Territories	3	2%	1	1%	0	0%	0	0%	0	0%	0	0%
Nunavut	4	3%	0	0%	0	0%	1	1%	0	0%	0	0%
Yukon	3	2%	3	3%	1	1%	1	1%	1	1%	1	1%
Total	**151**	**100%**	**95**	**100%**	**139**	**100%**	**111**	**100%**	**156**	**100%**	**111**	**100%**

Highest Concentration of Research Expertise
Second Highest
Third Highest

2.3 RESEARCH NETWORKS

Colleges and institutes identified 357 research networks at the local, regional, provincial and national levels, many of which are sector-specific. A list of the research networks is available on the CICan website.

2.3.1 PROVINCIAL AND TERRITORIAL COLLEGE AND INSTITUTE RESEARCH NETWORKS

The following are provincial and territorial research networks in which colleges and institutes are involved:

The **British Columbia Applied Research and Innovation Network (BCARIN)**, with representatives from colleges in British Columbia and from Yukon College, meets to share information about applied research and innovation activities and to support the development of institutional policies and practices. http://www.bcarin.ca

The **Heartland Applied Research Partners (HARP)**, formerly the Great Plains Applied Research Network, comprises directors of applied research from Red River College and Saskatchewan Polytechnic, and senior officers of academic and research services from University College of the North and Assiniboine Community College. HARP delivers applied research capacity that brings value to students, industry and community partners and the regional economy.

The **Ontario Centres of Excellence (OCE)**. OCEs, with support from the provincial and federal governments, drive the development of Ontario's economy by helping create new jobs, products, services, technologies and businesses. In partnership with industry and universities, OCEs invest in commercializing the innovations coming out of the province's colleges, universities and research hospitals. http://www.oce-ontario.org

Representing the 48 cégeps of Quebec, the **Association pour la recherche au collégial (ARC)** works to develop research in college-level academic institutions by taking a position on relevant and related issues, hosting activities and lectures, setting up support measures for research, and awarding prizes. http://vega.cvm.qc.ca/arc

The **Réseau Trans-tech** groups Quebec's 49 college centres for the transfer of technology (CCTTs). Falling under the college's authority, CCTTs are recognized by Quebec's ministère de l'Éducation, et de l'enseignement supérieur (MELS). The CCTTs' mandate is to conduct applied research activities and provide technical support and information in a particular field to help develop and accomplish technologically and socially innovative projects and implement and disseminate innovation. http://reseautranstech.qc.ca

The **Applied Research Network of the Atlantic Provinces Community College Consortium** is formed of research directors from the College of the North Atlantic, Nova Scotia Community College, Holland College, New Brunswick Community College and the Collège communautaire du Nouveau Brunswick. Its primary mandate is to help applied research progress through collaboration, cooperation and the sharing of best practices. http://www.apccc.ca/research/reference.html

The **Social Economy Research Network of Northern Canada** is part of a national research program funded by the SSHRC. This network is led by Aurora College, Nunavut Arctic College and Yukon College and their respective research institutes. The network links researchers working in the North with students, community organizations and universities for research on the following themes: the social economy in northern Canada; resource regimes and social economy in the north; the impact of public policy on social economic development in the north; and indigenous communities and the social economy. http://yukonresearch.yukoncollege.yk.ca/sern/aboutsernnoca

2.3.2 REGIONAL AND SECTOR-SPECIFIC NETWORKS

To support their research activities, colleges and institutes are also members of regional and sector-specific networks. The following are examples identified by respondent institutions:

The **Resources and Sustainable Development in the Arctic (ReSDA)**, with representatives from Yukon College, Nunavut Artic College and Aurora College is a research network that brings together researchers from a broad range of disciplines and organizations representing communities, government, the private sector, and non-profit organizations. The network conducts research aimed at the sustainable development of Arctic natural resources in a manner that will improve the health and well-being of northern communities while preserving the region's unique environment. http://yukonresearch.yukoncollege.yk.ca/resda

Fleming College is involved in the **Canadian Association on Water Quality**, a non-governmental, non-profit organization for scientists, engineers, technologists, administrators, practitioners and students engaged in or interested in research on water quality or on the control or treatment of water pollution. https://www.cawq.ca/en

The **Alberta Rural Development Network (ARDN)** is a collaborative partnership between Alberta's 21 publicly funded, publicly governed colleges, universities, and technical institutes, working together to support and enhance rural development. Keyano College, Grande Prairie Regional College, Lethbridge College, Medicine Hat College, Northern Lakes College and Portage College represent the college system. http://www.ardn.ca

The **BC-Alberta Social Economy Research Alliance (BALTA)** is a regional research collaboration amongst community based organizations, universities and colleges in Alberta and British Columbia, with an interest in the social economy. http://www.socialeconomy-bcalberta.ca

CCTTs in Quebec are involved in the **Consortium for Research and Innovation in Aerospace in Québec (CRIAQ)** is a non-profit organization established in 2002 with the financial support of the Québec government. Its mission is to increase the competitiveness of the aerospace industry, and enhance the collective knowledge base in aerospace through improved education and training of students. http://www.criaq.aero/

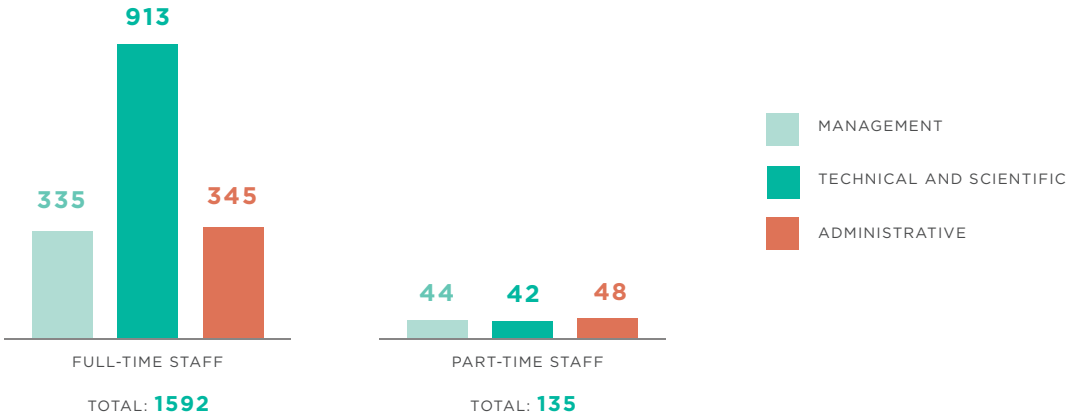
3. Applied Research Staff and Faculty Engagement

Engagement of faculty and non-teaching staff is key to the success of the applied research enterprise in colleges and institutes. This section provides an overview of the staff at applied research offices as well as the level of participation by faculty and non-teaching staff in research projects.

3.1 PROFILE OF APPLIED RESEARCH & DEVELOPMENT STAFF

In 2014-15, 94% of respondent institutions reported having a dedicated research and development office, with a total of 1,727 full and part-time staff across the system. Table 8 shows the profile of staff within research and development offices.

TABLE 8: PROFILE OF STAFF AT RESEARCH AND DEVELOPMENT OFFICES

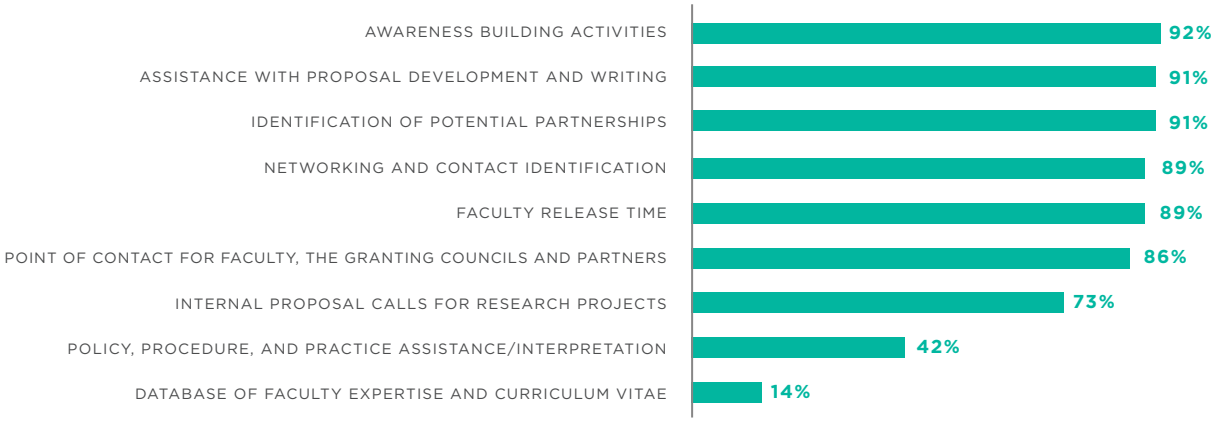


3.2 ENGAGEMENT OF FACULTY AND STAFF

In 2014-15, 2,585 faculty and staff were involved in applied research activities. This represents 5% of the 34,225 faculty members employed at respondent institutions. The majority of faculty and staff is involved in applied research on a part-time basis. They also have an impressive range of credentials: 15% hold a college-level degree, 32% have a bachelor's, 30% hold a master's and 23% have completed a doctorate degree.

Figure 5 highlights the ways colleges and institutes involve faculty and staff in applied research projects. The highest proportion of respondent institutions reported their applied research offices promote and support faculty and staff engagement by building awareness about applied research opportunities, assisting with proposal development, identifying potential partnerships and networking, and providing release time from teaching responsibilities.

FIGURE 5: HOW COLLEGES AND INSTITUTES FOSTER FACULTY AND STAFF ENGAGEMENT IN APPLIED RESEARCH

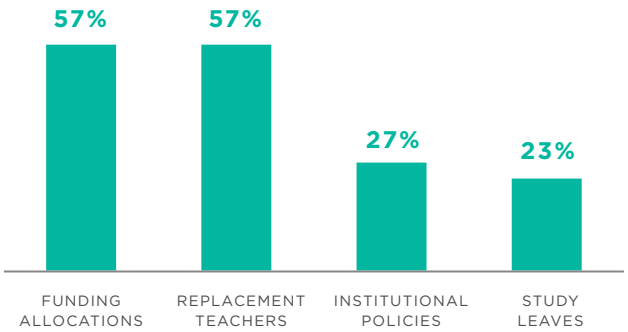


College and institute faculty are typically expected to teach full time. To support growth in applied research activity, more colleges and institutes are allocating resources to offer faculty release time, which enables teachers and professionals to conduct collaborative research and participate in projects as co-researchers, partners or associate scientists. In 2014-15, 89% of respondent institutions offered their faculty release time for research.

Figure 6 identifies how colleges and institutes implement release time. Fifty-seven per cent allocate funds, whether from internal budgets, professional development funds and in some cases external grants to enable professors to take time off their teaching responsibilities. Currently, the Tri-Council College and Community Innovation (CCI) Program is the only federal funding program that recognizes faculty release time as an eligible expense. This program provides up to $7,000 per faculty release to hire a replacement teacher so that faculty can contribute to research through CCI projects.

Respondent institutions also reported they replace their professor-researchers with other teachers (57%) or reorganize their workload allocation. In addition, 23% of colleges and institutes reported that faculty members can obtain study leaves.

FIGURE 6: HOW COLLEGES AND INSTITUTES ENCOURAGE FACULTY RELEASE TIME



4. The Next Generation of Innovators and Entrepreneurs

Integrating innovation and entrepreneurial skills in post-secondary education curricula is a key lever for developing the next generation of innovators and entrepreneurs. This section addresses the level of student engagement in applied research at colleges and institutes and provides an overview of how institutions are fostering entrepreneurship among students.

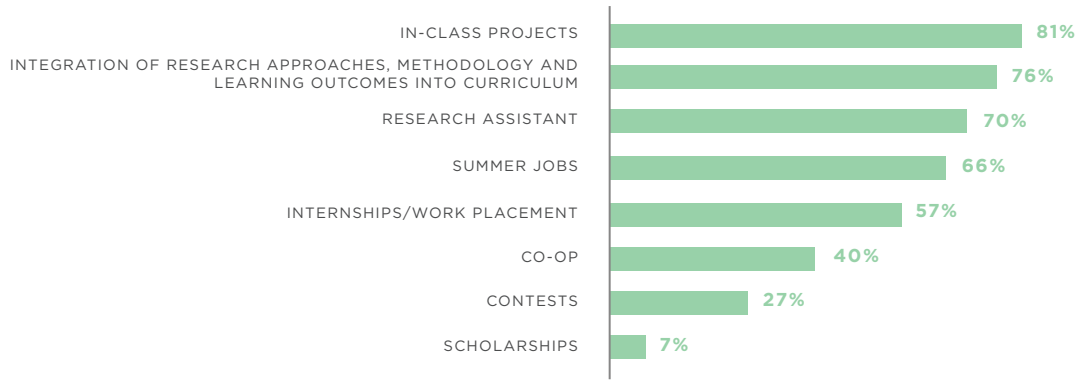
4.1 STUDENTS AT THE CORE OF APPLIED RESEARCH

One of the primary reasons colleges and institutes engage in applied research is to enhance student learning. By being involved in applied research activities, students learn new skills, get practical, hands-on experience and the chance to work with business and communities to solve practical problems, increasing employment opportunities after they graduate.

In 2014-15, 31,346 students were engaged in applied research projects representing approximately 3% of students at colleges and institutes across Canada. The vast majority of students who participated in those projects were not paid (93%), while 2,317 students (7%) were paid by their institution or industry/college partners as part of a part-time job, summer job or internship.

Figure 7 shows how colleges and institutes facilitate student engagement in applied research. The two most common approaches identified were in-class projects (81% of respondents), which provide students with research experience related to their field of study, and the integration of applied research into curriculum (76%). Colleges and institutes are increasingly including capstone projects as a requirement for program completion. These large, intensive research projects are often designed to address specific problems identified by business, industry or community partners. Respondent institutions also confirmed that applied research partnerships provide students with work-integrated learning opportunities, whether through research assistant positions, summer job opportunities or internships and work placements.

FIGURE 7: HOW COLLEGES AND INSTITUTES FACILITATES STUDENT PARTICIPATION IN APPLIED RESEARCH



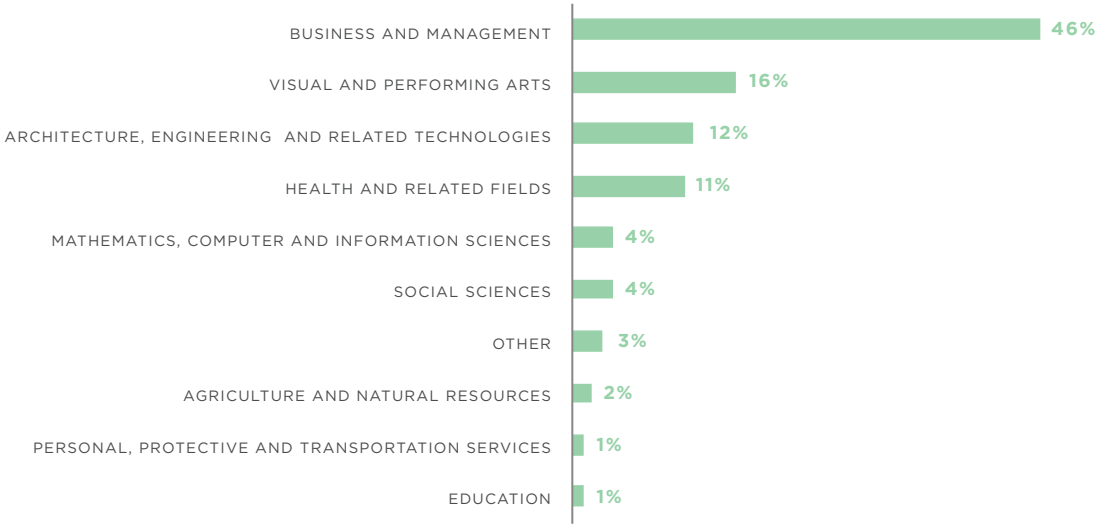
4.2 FOSTERING STUDENT ENTREPRENEURSHIP

Creating an entrepreneurial mindset in youth increases their employability by building the knowledge and skills required to start, grow and manage a small business, develop the skills needed for success as an entrepreneur.

In 2014-15, 84% of respondent institutions supported student entrepreneurship and 10,101 students received funding to pursue an entrepreneurial idea.

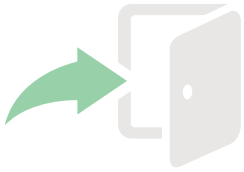
Colleges and institutes create opportunities for students to discover entrepreneurship by integrating its skills into curriculum and facilitating students' interactions with entrepreneurs from the community. The overall goal is to expose students to experiences both in and out of the classroom that will help them see entrepreneurship is a viable career option and entrepreneurial skills enhance any learner's portfolio. In 2014-15, colleges and institutes identified 273 programs that integrated entrepreneurship, with the highest proportion (46%) in business and management-related programs. The other types of programs that integrate entrepreneurship skills are identified in Figure 8.

FIGURE 8 : COLLEGE AND INSTITUTE PROGRAMS THAT INTEGRATE ENTREPRENEURSHIP BY FIELD OF STUDY



4.3 BUSINESS HUBS, INCUBATORS AND ACCELERATORS

Many colleges and institutes have set up entrepreneurship hubs where they promote the development of an entrepreneurial culture and seek to inspire students to see change and uncertainty as a source of opportunity. Some examples are highlighted below:



The **E-Hub at Canadore College** is dedicated to identifying students and young entrepreneurs (between the ages of 18 and 29) both on campus and from the community and provide space for them to share ideas, seek out resources and collaborate on entrepreneurship projects.

The Centre for Innovation and Entrepreneurship at **Dawson College** is a resource for creative people who want to launch their own enterprise. It serves as a portal and central hub for entrepreneurship education, promotion, advancement, support and services.

Students from all programs at **Cégep Garneau** are expected to develop their entrepreneurial spirit through l'Espace Entreprendre. They can work on entrepreneurship projects and acquire the knowledge to start a business. Students are supported and trained by experienced entrepreneurs throughout their journey.

Kinetica Innovation Lab is housed at **Southern Alberta Institute of Technology**. This lab space brings together the strengths of academia, trades and industry representatives to collaborate on helping students and companies accelerate technology development for the energy sector. Kinetica's acceleration services enable emerging science and technologies to be commercialized more rapidly in energy technology sub-sectors. This includes clean technologies, transportation, security systems, greenhouse gas emission reduction, pipeline leak detection, energy service providers, and software development.

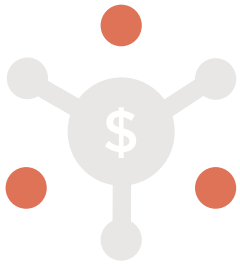
College and institute incubators and accelerators are also community resources for emerging SMEs, providing mentoring, training, networking and funding to bring innovative business ideas to life.

ACCEL is the Accelerator for Centennial Community Entrepreneurs and Leaders at **Centennial College**. It supports more than 50 youth-led startups. These young entrepreneurs include students, alumni, and youth from our community who are commercializing innovative products and services with support from the College and the Ontario Centres of Excellence.
http://accel.centennialcollege.ca

Conestoga College has a specialized accelerator called the Advanced Manufacturing Technology (AMT) Catalyst. The AMT Catalyst supports early stage startups in Waterloo and Guelph-Wellington, providing business training, mentoring, networking, lab space and technical support to post-secondary students and graduates. Half of those who graduated from the inaugural class have started a business.
www.conestogac.on.ca/c4e/amt.jsp

5. Collaborative investment in College and Institute Applied Research

In today's economy, collaborative investment is more important than ever for advancing the applied research and innovation required to increase productivity, economic growth and social development. Colleges and institutes have been proactive with this approach, using their internal resources as stimulus and weaving partnerships for collaborative investment. As a result, over the last five years, colleges and institutes have been receiving increased funding for applied research, particularly from the private sector and the federal government.



5.1 INSTITUTIONAL INVESTMENT

Applied research is an essential part of educational programming at colleges and institutes, and as a result a growing number of institutions are dedicating part of their core budget to fund applied research activities and projects. In 2014-15, colleges and institutes allocated $59,300,000 to their applied research office budgets to support the administration of applied research and associated projects.

5.2 TRENDS IN EXTERNAL INVESTMENT 2014-2015

In 2014-15, colleges and institutes leveraged $199 million in external funding, as shown in Table 9. In 2014-15, 94% of external investment was dedicated to business and industrial innovation and 6% to social innovation.

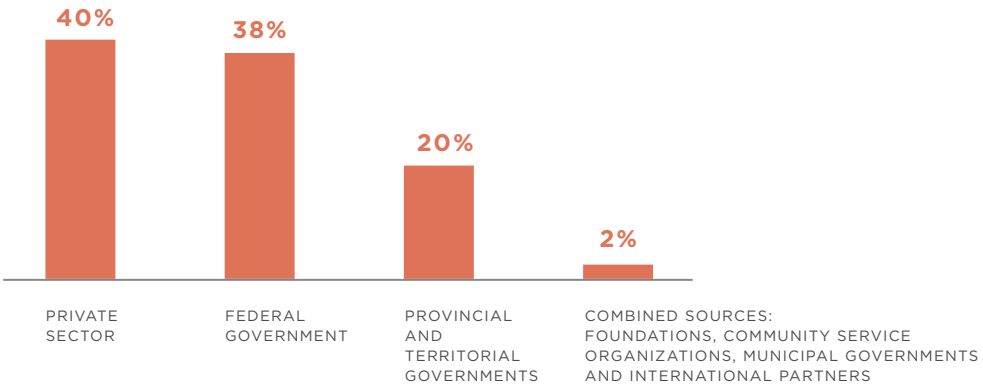
COLLEGES AND INSTITUTES LEVERAGED
$199 MILLION
IN EXTERNAL FUNDING

TABLE 9: 2014-15 EXTERNAL INVESTMENTS IN COLLEGE AND INSTITUTE APPLIED RESEARCH

Source	2014-15
Private Sector	$80,035,734
Federal government	$74,664,891
Provincial/territorial governments	$39,367,814
Foundations	$2,128,986
International	$1,655,008
Community service organizations	$983,620
Municipal	$258,120
Total Investment	**$199,094,173**

In the last five years, private sector investment has increased by 59%. In 2014-15, the private sector was the largest source of investment for college and institute applied research and at $80 million represents 40% of all external investment. This is followed closely by federal government investment which represents 38% for a total of $74.6 million.

FIGURE 9: EXTERNAL FUNDING



5.3 INCREASED OPPORTUNITIES WITH FEDERAL GRANTING COUNCILS

Over the last ten years, there have been substantial increases in the number of colleges and institutes eligible for funding from the Natural Sciences and Engineering Research Council of Canada (NSERC) and the Social Sciences and Humanities Research Council (SSHRC). With the introduction of the Tri-Council College and Community Innovation (CCI) Program administered by NSERC, the number of institutions eligible for NSERC funding has increased from only 13 in 2005-06 to 108 in 2014-15. Eighty-eight colleges and institutes are eligible for grants from SSHRC, compared to 64 last year. Three colleges are eligible for grants from the Canadian Institutes of Health Research (CIHR).

5.4 FEDERAL INVESTMENT FOR APPLIED RESEARCH IN COLLEGES AND INSTITUTES

As shown in Table 10, the granting agencies are the largest source of funding for college and institute applied research totaling $52,606,065, with 91% from the Tri-Council CCI Program, The combined funding from the federal economic development agencies represents the second largest federal source of funding for college applied research after the granting agencies, totaling $11,436,041. The breakdown by agency is provided in Table 11. Table 12 identifies research funding from other federal government sources, most notably the Canada Foundation for Innovation at $4,768,266 from the College Industry Innovation Fund, and the National Research Council, from the Industrial Research Assistance Program and the Business Innovation Access Program.

FEDERAL INVESTMENT FOR APPLIED RESEARCH IN COLLEGE AND INSTITUTES

TABLE 10: FUNDING FROM THE GRANTING AGENCIES[3]

Tri-Council College and Community Innovation Program	$47,929,635
Natural Sciences & Engineering Research Council (Non-CCI)	$2,350,006
Social Sciences & Humanities Research Council	$1,564,909
Canadian Institutes of Health Research	$761,515
Total	**$52,606,065**

TABLE 11: FUNDING FROM THE REGIONAL ECONOMIC DEVELOPMENT AGENCIES

Canada Economic Development for the Regions of Quebec	$5,183,964
Western Economic Diversification	$2,662,760
Federal Economic Development Organization for Northern Ontario	$2,071,500
Atlantic Canada Opportunities Agency	$1,093,505
Canada Northern Economic Development Agency	$334,055
Federal Economic Development Agency for Southern Ontario	$90,257
Total	**$11,436,041**

TABLE 12: FUNDING FROM OTHER GOVERNMENT OF CANADA SOURCES

Canada Foundation for Innovation[4]	$4,768,266
National Research Council - Industrial Research Assistance Program (IRAP)[5]	$1,308,293
Employment and Social Development Canada	$666,403
Department of National Defence	$651,956
Research Support Fund	$622,448
Aboriginal Affairs & Northern Development Canada	$621,948
Citizenship & Immigration Canada	$617,612
Natural Resources Canada	$325,361
Environment Canada	$271,055
Agriculture Agri-Food Canada	$162,168
National Research Council - Business Innovation Access Program	$158,118
Fisheries & Oceans Canada	$135,503
Public Health Agency of Canada	$100,000
Parks Canada	$75,812
Public Safety Canada Policy Development Contribution Program	$36,000
Canada Mortgage and Housing	$35,400
Public Works and Government Services Canada	$25,000
Transports Canada	$21,442
International Development Research Centre	$20,000
Total	**$10,622,785**

[3]This data was provided by NSERC, SSHRC and CIHR.
[4]The amount for the College-Industry Innovation Fund (CIIF) and the Infrastructure Operating Fund were provided by the Canada Foundation for Innovation.
[5]This data was provided by the National Research Council.

5.5 TRI-COUNCIL CCI PROGRAM

The Tri-Council College and Community Innovation Program was established in 2008 and is administered by NSERC in partnership with the SSHRC and CIHR. The CCI Program aims to increase innovation at the community and/or regional level by enabling colleges to increase their capacity to work with local companies, particularly SMEs. It supports applied research partnerships that facilitate commercialization through the adaptation and adoption of new technologies and the improvement or development of new products, processes or services. The program has been instrumental in increasing the research capacity of colleges and institutes and has demonstrated benefits through the increased research partnerships developed between companies and colleges, enhanced curricula and professional growth for faculty and employment opportunities for students.

For 2014-15, colleges and institutes received $47,929,635 from the CCI Program; a breakdown by grant type is provided in Table 13. As in the previous year, the highest proportion (53%) of the funds went to five-year Innovation Enhancement grants. The Engage Grants for colleges, the Industrial Research Chairs for Colleges Grants and the Applied Research and Development Grants account for 15%, 10% and 9%, respectively.

TABLE 13: TRI-COUNCIL CCI FUNDING (2014-15)

Innovation Enhancement (IE) Grants	$25,373,492
Engage Grants for colleges	$7,353,134
Industrial Research Chairs for Colleges Grants	$4,559,749
Applied Research and Development Grants	$4,478,664
College - University Idea to Innovation Grants	$2,664,729
Technology Access Centres Grants	$2,137,800
Applied Research Tools and Instruments Grants	$995,521
Synergy Awards for Innovation	$99,745
Technology Access Centre - Letters of Intent	$90,000
Connect Grants level 3	$79,572
Best Practice Workshops	$63,231
College Special Initiatives	$24,998
Undergraduate Student Research Awards	$9,000
Total	**$47,929,635**

Technology Access Centre (TAC) grants enable colleges and institutes to establish centres affiliated with their applied research office or in the case of cégeps in Quebec, with established CCTTs. The purpose of the TACs is to provide companies, particularly SMEs, with access to college expertise, technology and equipment in order to enhance their ability to become more productive and innovative. TACs serve vital industrial sectors across the country, responding to industry's applied research needs through innovation support services delivered by college faculty, staff and students. TAC grants provide five-year, renewable funding of up to $350,000 per year. Currently, there are 30 TACs that serve the research and innovation needs of specific regional economic clusters representing nine sectors:

- Advanced Manufacturing
- Agriculture
- Construction Technology
- Digital Media and Graphic Communications
- Environmental Technology/Biotechnology
- Food Technology
- Healthcare Technology
- Nanotechnology
- Transportation

In September 2015, the TACs established the TAC-CAT Network to represent TACs to industry and government and promote their ability to support business and industry innovation. For more information regarding the TAC-CAT Network, please visit: http://tac-cat.ca/#welcome

5.6 INVESTMENT FROM THE SOCIAL SCIENCES AND HUMANITIES RESEARCH COUNCIL

While colleges and institutes are eligible to apply for grants across SSHRC's Insight, Connection and Talent programs, the proportion of projects awarded to colleges and institutes has remained small. In 2014-15, SSHRC funds received by colleges and institutes totaled $1,564,909.

The launch of the pilot Community and College Social Innovation Fund (CCSIF) in November 2014 within SSHRC's Partnership Development Grants was welcomed across the country. It is providing $15 million over three years in support of social innovation research projects at colleges and institutes. The fund connects the talent, facilities, and capabilities of Canada's colleges and institutes with the research needs of local community organizations. Together they develop collaborative social innovation research, bringing together researchers, students and partners to address social innovation challenges. CCSIF grants last one to three years, have a value of up to $200,000 plus an additional 20 per cent to offset overhead and administrative costs, reducing course load for full-time faculty and staff to provide some salary support for part-time college faculty staff.

Because of the strong connections between communities and colleges and institutes, and because up to 60% of their programming is in fields related to the social sciences and humanities, the demand for the first two CCSIF competitions was very high. In the first competition, 27 projects at 20 colleges and institutes were selected to work collaboratively with community organizations and businesses. They are addressing a wide range of social innovation issues, including poverty, crime prevention, Indigenous community development, immigrant integration, addressing the needs of youth and adults with disabilities and adapting to climate change.

5.7 INVESTMENT FROM REGIONAL ECONOMIC DEVELOPMENT AGENCIES

Regional economic development agencies invest in college and institute applied research through programs and initiatives that provide businesses with practical solutions and concrete results for improved products, increased commercialization opportunities and expanded markets. As shown in Table 9, colleges and institutes reported a total of $11.4 million in funding from these agencies, with 45% reported from Canada Economic Development for the Regions of Quebec, 23% from Western Economic Diversification (WED) and 18% from the Federal Economic Development Organization for Northern Ontario (FedNor).

In Quebec, the Canada Economic Development for the Regions of Quebec stimulates and encourages innovation by helping industry partners becoming more productive and competitive. For 2014-15, CCTTs reported they received $5,183,964 from this agency.

WED supports the expansion of the applied research and innovation portfolio of colleges and institutes in Western Canada through infrastructure investments. Four institutions received funding from WED in 2014-15 for a total of $2,662,760.

In Ontario, FedNor contributes to economic development in northern Ontario and supports community and industry partners to foster innovation and entrepreneurship and improve productivity. In 2014-15, two Ontario colleges reported they received FedNor funding totalling $2,071,500.

6. Outcomes of College and Institute Applied Research

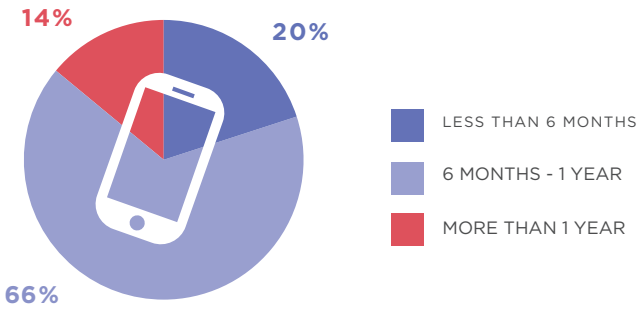
College and institute applied research projects introduce new products, processes or services which increase productivity, create jobs, contribute to the growth of a company, and thus support community and regional development. Colleges and institutes were asked to report on the number of products, processes and services that were created or improved through their applied research activities and the timeframe over which these activities were carried out. In 2014-15, respondent institutions from all provinces and territories with the exception of Quebec, Northwest Territories and Nunavut reported they developed or improved 347 products, 168 processes and 87 services.[6]

6.1 NEW AND IMPROVED PRODUCTS

In 2014-15, respondent institutions identified 347 new or improved products. As shown in Figure 9, 86% of the products were developed in less than one year. Some examples of new products include:

- Wireless sensors prototypes
- Electric vehicle technologies
- Probiotic dental product
- 3D data visualization tool prototype
- Video search optimization
- Energy management application

FIGURE 10: TIMEFRAME FOR THE DEVELOPMENT OF NEW AND IMPROVED PRODUCTS



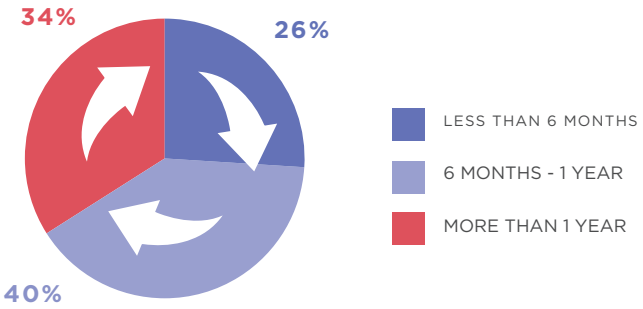
[6]*Quebec's CCTTs information on applied research has been collected differently from this survey, hence does not display details on number of products, processes and services. According to the 2014 KPMG-Secor report on the economic contribution of Cégeps and CCTTs in Québec, 4,000 companies were served by the CCTTs. As such, the missing data from this counterpart has an impact on the overall number reported in this section.*

6.2 NEW AND IMPROVED PROCESSES

Colleges and institutes also improve or design processes through applied research. A process refers to a continuous series of actions or steps taken in order to achieve a particular end. For 2014-15, respondents identified 168 processes, and 66% were designed or improved in less than one year (see Figure 10), including for example:

- Process of patient data delivery
- Prototype Manufacturing Process for organic light-emitting diode (OLED) technology
- Syncing files from browser to server
- Process - Web-Based Marketing
- Mushroom Cultivation
- Analytics for Manufacturing Systems

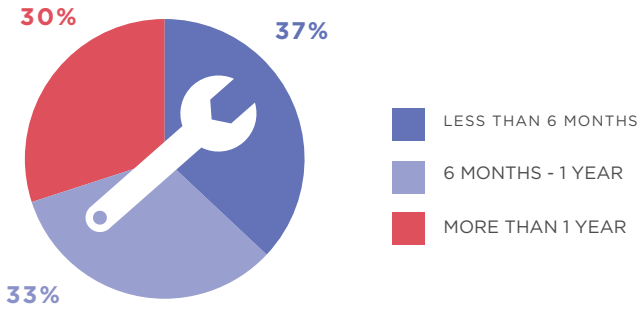
FIGURE 11: TIMEFRAME FOR THE DESIGN / IMPROVEMENT OF PROCESSES



6.3 NEW AND IMPROVED SERVICES

Applied research also develops or improves services, including wholesale and retail sales, culinary management in restaurants, hospitality management, transportation, storage, communications, finance, insurance and community, social or personal services. Colleges and institutes reported 87 new or improved services over the course of 2014-15. Examples include services to vulnerable groups, physical activity programming for Indigenous peoples and training programs.

FIGURE 12: TIMEFRAME FOR THE DEVELOPMENT / IMPROVEMENT OF SERVICES



6.4 EMERGING NEW TECHNOLOGIES

Emerging technologies are key drivers for an innovative economy. Colleges and institutes were asked to report on the number of emerging new technologies resulting from applied research. Seventy-nine per cent of respondent colleges and institutes identified 130 technologies — mainly in manufacturing, information and communications technology, and energy. Some examples include:

- Sensor suite and device integration for Cisco's IP Phone
- Web mapping product and services
- Digital fabrication processes
- Electric vehicle technologies
- Automated harvester
- Small-scale wind turbines
- Underwater wireless communication

Conclusion

Although just a quick snapshot, this report on the 2014-15 Survey of College and Institute Applied Research Activity has captured a strong image of how Canada's colleges and institutes are steadily developing their expertise and gaining status with other researchers, with governments, business, industry and communities.

This year's report is a picture of strong links to the private sector, showing more than 5,000 partnerships with business, especially manufacturing; It shows important activity with social-innovation partners, including more than 500 projects with public service agencies, community organizations and businesses focused on environmental awareness and planning, healthcare services, and education, among other areas.

Canada's colleges and institutes continue to build expertise in applied research. They reported 1,450 areas of specialization and more than 700 dedicated research centres and laboratories; most have offices for promoting research. Faculty and staff bring a wealth of business and community connections and exposing students to real-world experience is one of the main drivers behind much of the research that is done.

Clearly, colleges and institutes are important catalysts of innovation in their communities, across the country and internationally. It is also clear, however, the potential for that work has hardly been tapped: there are more than one million small businesses in Canada, but only a small percentage of them have ever invested in research and development, while social agencies everywhere struggle to meet demands. Colleges and institutes, with their community roots and orientation, expertise, national networks and widespread support, are an excellent vehicle to help those agencies and businesses and the people who depend on them to flourish.

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Canadian Northern Economic Development Agency: http://www.north.gc.ca/index-eng.asp

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Federal Economic Development Agency for Southern Ontario (FedDev Ontario):
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Appendix 1

SURVEY OF 2014–2015 APPLIED RESEARCH ACTIVITY / LIST OF PARTICIPATING INSTITUTIONS

NorthWest Territories
Aurora College

Nunavut
Nunavut Arctic College

Yukon
Yukon College

British Columbia
British Columbia Institute of Technology
Camosun College
Capilano University
Douglas College
Justice Institute of British Columbia
Kwantlen Polytechnic University
Langara College
College of New Caledonia
North Island College
Northwest Community College
College of the Rockies
Selkirk College
University of the Fraser Valley

Alberta
Bow Valley College
Grand Prairie Regional College
Lakeland College
Lethbridge College
Medicine Hat College
Northern Alberta Institute of Technology
NorQuest College
Olds College
Portage College
Red Deer College
SAIT Polytechnic

Quebec
Cégep Gérald-Godin
Collège Montmorency
Cégep de l'Outaouais
Cégep Saint-Jean-sur-Richelieu
Vanier College

Data Provided by Réseau Trans-tech for the 49 College Centres for the Transfer of Technology at the following cégeps:

Cégep de l'Abitibi-Témiscamingue
Cégep André-Laurendeau
Cégep de Baie-Comeau
Cégep Beauce-Appalaches
Cégep de Chicoutimi
Cégep de la Gaspésie et des Îles
Cégep John-Abbott College
Cégep de Jonquière
Cégep de La Pocatière
Cégep de Lévis-Lauzon
Cégep Marie-Victorin
Cégep de Matane
Cégep Régional de Lanaudière
Cégep de Rimouski
Cégep de Saint-Hyacinthe
Cégep de Saint-Jérôme
Cégep de Saint Laurent
Cégep de Sainte-Foy
Cégep de Sept-Îles
Cégep de Sherbrooke
Cégep de Sorel-Tracy
Cégep de Thetford
Cégep de Trois-Rivières
Cégep du Vieux Montréal
Cégep de Victoriaville
Collège Ahuntsic
Collège d'Alma
Collège Dawson
Cégep Édouard-Montpetit
Collège Lionel-Groulx
Collège de Maisonneuve
Collège Mérici
Collège de Rosemont
Collège Shawinigan

Saskatchewan
Parkland College
Saskatchewan Polytechnic

Manitoba
Assiniboine Community College
Red River College

Ontario
Algonquin College
Collège Boréal
Cambrian College
Canadore College
Centennial College
Conestoga College Institute of Technology and Advanced Learning
Confederation College
Durham College
Fanshawe College
Fleming College
George Brown College
Georgian College
Humber College Institute of Technology and Advanced Learning
La Cité
Lambton College
Mohawk College
Niagara College
Northern College
St. Clair College
St. Lawrence College
Sault College
Seneca College
Sheridan College Institute of Technology and Advanced Learning

New Brunswick
Collège communautaire du Nouveau-Brunswick
New Brunswick Community College

Nova Scotia
Nova Scotia Community College

Newfoundland and Labrador
College of the North Atlantic

Prince Edward Island
Holland College

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- Northlands College
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Manitoba
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Ontario
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- Cambrian College
- Canadore College
- Centennial College
- Collège Boréal*
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- Fanshawe College
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- Loyalist College
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- Northern College
- Sault College
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- Cégep de Rivière-du-Loup*
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Newfoundland and Labrador
- Centre for Nursing Studies
- College of the North Atlantic
- Fisheries and Marine Institute of Memorial University of Newfoundland

New Brunswick
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- New Brunswick Community College (NBCC)

Prince Edward Island
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- Association québécoise de pédagogie collégiale
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* *Francophone*
** *Indigenous*

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