



C I CANADA'S L INNOVATION LEADERS 2014

Canadian Science Makes its Mark on the Global Stage

Countries Put Faith in Global Partnerships to Solve Grand Scientific Challenges

By Debbie Lawes

What does a Canadian geneticist studying the behaviour of fruit flies have in common with an American doctor specializing in pediatrics? Both represent the new face of global science and perhaps our planet's best hope for tackling some of the toughest challenges of our time, from climate change and energy security to infectious diseases and poverty.

Earlier this year, Dr. Marla Sokolowski at the University of Toronto and Dr. Thomas Boyce at the University of California, along with colleagues in Canada, Illinois and Paris, published a pivotal series of studies showing how early experiences influence a child's biology to increase the risks of poorer health later in life, learning difficulties and poor social functioning. It effectively put to rest the age-old debate over nature versus nurture. The studies may never have happened had the majority of the research team not been members of the Canadian Institute for Advanced Research. Headquartered in Toronto, CIFAR affords the world's brightest thinkers the freedom to transcend national borders and scientific disciplines to collaborate on questions of importance to Canada and the world.

CIFAR brings together some 400 scientists from 16 countries, including nearly two-thirds from Canada. Over 40% of CIFAR Fellows are in the top 1% of their fields, and 15 Nobel Laureates have been associated with CIFAR since it was launched in 1982.

"The rise of global research networks has become the modus operandi of so much science now. It's about attracting the world's best, not just the best in your own country," says Dr. Alan Bernstein, president and CEO of CIFAR. "CIFAR builds on our domestic strengths to help position Canadian researchers

and Canada in the middle of global research networks."

The global scientific landscape has changed dramatically in the last two decades. While international collaboration has always been integral to scholarly pursuits, scientific grand challenges, finite financial resources, ultra-fast communications networks, mass data storage and supercomputing have made it more imperative – and technically possible – to accelerate the scope and pace of international research.

Today, about one-fifth of the world's one million scientific papers are co-authored by researchers collaborating with international partners. More than 40% of academic publications by Canadians have co-authors from other countries – twice the rate of 15 years ago.

Those numbers come as no surprise to Dr. Martin Osmond, CEO and scientific director of the Children's Hospital of Eastern Ontario (CHEO) Research Institute in Ottawa, where the majority of its 160 researchers work with national and international partners.

"Those collaborations are critical in pediatric research where many of the conditions we see are rare," explains Osmond. "You need to work with other centres to have a sufficient number of patients to do (clinical) studies faster, get the results more quickly and because you're already networked with people globally, it's easier to get those results out into practice."

CHEO and Canada are recognized internationally for their expertise in many rare diseases, which collectively affect over 3.2 million Canadians, mostly children. The costs to treat these diseases with orphan drugs can easily exceed \$500,000 annually for each patient, placing a heavy financial burden on both patients and provincial health budgets.

In June, a pan-Canadian research team led by Dr. Kym Boycott at CHEO used powerful

new gene sequencing technologies to examine 264 undiagnosed disorders. The results were impressive: the team uncovered the root genetic causes for 146 rare diseases.

The Finding of Rare Disease Genes (FORGE Canada) project has now rolled into an international research program called CARE for RARE, also led by CHEO. The team hopes to identify even more rare disease genes, as well as design and test therapies in the lab to treat specific rare diseases.

"The results of this study are already having a big impact on patients," says Osmond. "Rather than undergoing months of tests – some very expensive – a simple blood test can now identify exactly what a child has, what the prognosis is and potential treatments."

PARTNERSHIP FUNDING ON THE RISE

The chair of Canada's Science, Technology and Innovation Council (STIC), which advises the federal government, says Canada's has always punched above its weight in terms of total number of scientific publications and citations. Government investment in publicly funded research also ranks near the top of OECD countries.

The last few years have seen more of that funding go to international collaborations. "Several of the (research) granting councils have begun to invest more in international science and technology projects where Canada has a particular strength," says Dr. Howard Alper. "For example, you have CIHR (Canadian Institutes of Health Research) investing with Japan in areas like epigenetics and with the EU on Alzheimer's and neurodegenerative diseases."

There was a time not long ago, notes Alper, when Canada invested too little in international collaborations. "When I attended the G8 Carnegie Group (of international

science leaders) a year ago, the European Commission representative noted that Canada had not been a major player in Europe, and then congratulated us on being the number one non-EU country involved in research collaborations with them."

Building on that momentum is the goal of Dr. Mario Pinto who is moving from Simon Fraser University this month to take over the top job at the Natural Sciences and Engineering Research Council in Ottawa. As NSERC's new president, Pinto says there is no shortage of opportunities for Canadian researchers to partner internationally. What's needed is the funding to make it happen.

a soft landing pad for Canadian technology companies wanting to do business in one of the world's fastest growing economies.

SFU is also leveraging its expertise in hydrogen and fuel cell technology research to set up another joint venture in India, this one in partnership with Indian Oil Corporation.

"We are their preferred partners to help them develop expertise in fuel cell science," says Pinto. "The collaboration, which includes a partnership PhD program, will enable exchanges for SFU faculty and students to work in Indian Oil's research facilities, while providing the company's researchers access to SFU work."

Likewise, when Finnish-based telecommunications giant Nokia wanted to know more about its users' music listening habits, it approached Dr. Matthew Woolhouse, a music cognition professor at the University of Cambridge in the U.K. Woolhouse has since moved to McMaster University where he opened a joint lab with Nokia last year to study the company's massive database of music streaming and downloading records to understand how music affects people and shapes cultures.

“ The rise of global research networks has become the modus operandi of so much science now. It's about attracting the world's best, not just the best in your own country. ”

Dr. Alan Bernstein, President and CEO, Canadian Institute for Advanced Research

"That will be a key focus of NSERC's new strategic plan. We must have skin in the game ... and on a scale where we can make a real contribution," he says.

Pinto spearheaded a strong global focus during his tenure as VP research at SFU, including a partnership with Tata Consultancy Services in India to pool R&D efforts in areas such as genomics and bioinformatics to track infectious and chronic diseases. Last year, SFU joined with Ryerson University to launch the first Canadian-led business accelerator in collaboration with India's Bombay Stock Exchange. The incubator is home to about 40 Indian companies and will provide

Woolhouse's research is partly funded by the Social Sciences and Humanities Research Council (SSHRC), which has joined research funding agencies in Europe, Brazil, Mexico and the U.S. to create the Trans-Atlantic Platform. The consortium wants to make it easier for social sciences and humanities projects involving researchers from three or more countries to be funded, with minimal red tape and maximum impact.

"Usually it's a case where one researcher gets funded but their international partner doesn't," says Dr. Ted Hewitt, executive VP

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Photo: Plant agriculture professor Manish Raizada has developed hardy millet seed and agricultural tool kits for farmers in India, Sri Lanka and Nepal.

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Research that gave birth to the laser, MRI and the computer was integral to the first quantum revolution. World-renowned theorists, experimentalists and technologists at the University of Waterloo's Institute for Quantum Computing are at the forefront of discoveries shaping the new quantum age.

Quantum technologies being developed in Canada Excellence Research Chair David Cory's lab (shown here) have the potential to reach the highest sensitivity, efficiency and selectivity that nature allows. These devices promise to transform conventional medical diagnostics, environmental monitoring and geological surveys.

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50
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UNIVERSITIES



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Canada's TOP 50 RESEARCH UNIVERSITIES 2014

Rank	Rank	University	Sponsored Research Income			Full-time Faculty**	Research Intensity	Province
			FY2013 \$000	FY2012 \$000	% Change 2012-2013	2012-2013 #	\$ per Full-time Faculty \$000	
2013	2012							
1	1	University of Toronto* **	\$1,110,663	\$1,038,390	7.0	2,377	\$467.3	Ontario
2	2	University of British Columbia*	\$566,789	\$585,154	-3.1	2,403	\$235.9	British Columbia
3	3	Université de Montréal* (a)	\$527,971	\$526,213	0.3	1,879	\$281.0	Quebec
4	4	McGill University*	\$465,209	\$483,527	-3.8	1,653	\$281.4	Quebec
5	5	University of Alberta*	\$417,757	\$452,436	-7.7	1,683	\$248.2	Alberta
6	9	University of Calgary*	\$328,736	\$282,771	16.3	1,528	\$215.1	Alberta
7	6	McMaster University*	\$322,502	\$325,156	-0.8	1,375	\$234.5	Ontario
8	7	Université Laval*	\$306,831	\$302,783	1.3	1,350	\$227.3	Quebec
9	8	University of Ottawa*	\$297,813	\$302,341	-1.5	1,284	\$231.9	Ontario
10	10	Western University*	\$254,457	\$241,095	5.5	1,471	\$173.0	Ontario
11	12	Queen's University*	\$189,990	\$168,025	13.1	790	\$240.5	Ontario
12	17	University of Waterloo	\$166,920	\$137,006	21.8	1,072	\$155.7	Ontario
13	14	University of Guelph	\$158,255	\$161,172	-1.8	752	\$210.4	Ontario
14	13	University of Saskatchewan*	\$157,976	\$166,677	-5.2	1,176	\$134.3	Saskatchewan
15	16	Dalhousie University*	\$148,879	\$140,099	6.3	1,070	\$139.1	Nova Scotia
16	15	University of Manitoba*	\$137,281	\$159,763	-14.1	1,206	\$113.8	Manitoba
17	18	Memorial University of Newfoundland*	\$127,816	\$107,078	19.4	935	\$136.7	Newfoundland
18	19	University of Victoria	\$124,779	\$103,007	21.1	700	\$178.3	British Columbia
19	11	Université de Sherbrooke*	\$120,969	\$185,222	-34.7	1,079	\$112.1	Quebec
20	20	Simon Fraser University	\$102,643	\$95,614	7.4	826	\$124.3	British Columbia
21	22	York University	\$72,040	\$67,280	7.1	1,335	\$54.0	Ontario
22	21	Université du Québec à Montréal	\$71,262	\$73,901	-3.6	1,086	\$65.6	Quebec
23	23	Institut national de la recherche scientifique+	\$55,778	\$62,226	-10.4	156	\$357.6	Quebec
24	25	Carleton University	\$55,160	\$50,372	9.5	742	\$74.3	Ontario
25	24	University of New Brunswick	\$49,115	\$52,287	-6.1	448	\$109.6	New Brunswick
26	26	Concordia University	\$44,358	\$44,816	-1.0	772	\$57.5	Quebec
27	27	Ryerson University	\$32,400	\$28,695	12.9	779	\$41.6	Ontario
28	28	University of Windsor	\$29,734	\$28,074	5.9	479	\$62.1	Ontario
29	29	Université du Québec à Chicoutimi	\$27,418	\$25,687	6.7	231	\$118.7	Quebec
30	33	Université du Québec à Trois-Rivières	\$24,039	\$21,049	14.2	392	\$61.3	Quebec
31	34	École de technologie supérieure+	\$23,883	\$20,048	19.1	150	\$159.2	Quebec
32	31	Lakehead University*	\$22,465	\$23,895	-6.0	323	\$69.6	Ontario
33	32	University of Regina	\$20,778	\$23,264	-10.7	380	\$54.7	Saskatchewan
34	30	Université du Québec à Rimouski	\$20,580	\$24,768	-16.9	200	\$102.9	Quebec
35	38	University of Prince Edward Island	\$17,391	\$15,893	9.4	244	\$71.3	Prince Edward Island
36	36	University of Lethbridge	\$17,228	\$19,135	-10.0	330	\$52.2	Alberta
37	37	Université du Québec en Abitibi-Témiscamingue	\$16,511	\$17,235	-4.2	93	\$177.5	Quebec
38	39	Laurentian University*	\$16,442	\$14,509	13.3	399	\$41.2	Ontario
39	35	Royal Military College of Canada+++	\$14,962	\$19,856	-24.6	183	\$81.8	Ontario
40	40	Trent University	\$14,310	\$13,842	3.4	263	\$54.4	Ontario
41	41	Brock University	\$14,285	\$12,641	13.0	562	\$25.4	Ontario
42	43	Wilfrid Laurier University	\$12,961	\$11,819	9.7	521	\$24.9	Ontario
43	45	University of Ontario Institute of Technology	\$10,562	\$9,665	9.3	178	\$59.3	Ontario
44	42	University of Northern British Columbia	\$10,105	\$11,854	-14.8	179	\$56.5	British Columbia
45	46	St. Francis Xavier University	\$8,845	\$8,989	-1.6	237	\$37.3	Nova Scotia
46	48	Université du Québec en Outaouais+++	\$8,704	\$7,803	11.5	202	\$43.1	Quebec
47	47	Université de Moncton	\$8,596	\$8,019	7.2	340	\$25.3	New Brunswick
48	50	Saint Mary's University	\$8,306	\$7,528	10.3	245	\$33.9	Nova Scotia
49	49	University of Winnipeg	\$8,177	\$7,537	8.5	269	\$30.4	Manitoba
50		Acadia University	\$6,966	\$6,512	7.0	201	\$34.7	Nova Scotia

Notes:

- Sponsored research income includes all funds to support research received in the form of a grant, contribution or contract from all sources external to the institution.
- Financial data were obtained from Statistics Canada, except where noted.
- Fiscal 2012 research income figures may have been adjusted as more accurate information became available.
- Faculty data were obtained from RESEARCH Infosource Canadian University R&D Database.
- All data are provided for the main university/college including its affiliated institutions, where applicable.
- All institutions are members of the Canadian Association of University Business Officers (CAUBO).

- * Has a medical school ** Includes full, associate and assistant faculty only
 + Not a full-service university
 ++ Sponsored research income administered by affiliated hospitals was reported one fiscal year in arrears
 +++ Sponsored research income figures were obtained directly from the university

(a) Faculty count based on 2011-2012 data as 2012-2013 data were not available.

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Research Universities of the Year 2014

Three universities gain RESEARCH Infosource's designation of *Research University of the Year* in their category for their performance on a balanced set of input, output and impact measures for FY2013. These universities demonstrated superior achievement both in earning research income and in publishing research in leading scientific journals.

Rank	Medical/Doctoral	Score*	Rank	Comprehensive	Score*	Rank	Undergraduate	Score*
1	University of Toronto	100.0	1	University of Waterloo	81.5	1	Ryerson University	80.4
2	McGill University	65.8	2	Institut national de la recherche scientifique	69.0	2	Université du Québec à Rimouski	72.2
3	University of British Columbia	63.8	3	University of Victoria	66.6	3	Lakehead University	70.1

*The Score in each category is out of a possible 100 points based on the following indicators and weighting: 2 input measures: total sponsored research income (20%), and research intensity (20%); 2 output measures: total number of publications in leading journals (20%) and publication intensity (20%), and 1 impact measure: publication impact (20%). For each measure, the top ranking institution is assigned a score of 100 and the other institutions' scores are calculated as a percentage of the first ranked institution. To be eligible to be included in the Research Universities of the Year Tier Group rankings, universities must first have ranked in the top 50% in their respective tier group for publication impact and then ranked in the top 50% in their respective tier group for at least 1 out of the 2 input measures, and 1 out of the 2 output measures. See www.researchinfosource.com for details.

Canada's Top 50 Research Universities

RESEARCH INCOME CONTINUES SLOW PACE OF GROWTH

Fiscal 2013 research income at Canada's Top 50 Research Universities increased by only 1.1%, the same as in Fiscal 2012. Total research income in Fiscal 2013 reached \$6.78 billion from \$6.70 billion in Fiscal 2012. Research intensity (research income per full-time faculty) increased slightly, by 1.3% in Fiscal 2013. Twenty-nine universities in Fiscal 2013 reported increases in their research income, while 21 reported declines.

Overall funding from federal granting agencies (NSERC, CIHR, SSHRC, CFI) increased by 3.7% between Fiscal 2012-2013. CFI funding increased by 10.7% in Fiscal 2013, followed by SSHRC (6.8%) and NSERC (4.5%). CIHR declined by -1.0%. Funding from Corporate sources also declined marginally (-0.7%), as did Not-for-profit/foundation funding (-2.4%). Provincial government funding rose only slightly in Fiscal 2013, by 1.3%.

THE \$100 MILLION CLUB

RESEARCH Infosource welcomes Simon Fraser University to the prestigious \$100 Million Club – an elite group of universities that posted \$100 million or more of research income in Fiscal 2013. SFU is one of only 4 Club members – along with University of Waterloo, University of Guelph and University of Victoria – that do not have a medical school to boost its results. In total, Club members accounted for \$6.0 billion of research income in Fiscal 2013, 89% of the Top 50 total. Within the leading group of 20 universities, research income rose by 2.8%, compared with a -11.0% drop among the 30 non-Club institutions, which indicates a growing concentration of research resources among larger institutions.

PROVINCIAL PERFORMANCE

In Fiscal 2013, research income growth in Newfoundland (19.4%), Prince Edward Island (9.4%), Nova Scotia (6.0%), Ontario (5.4%), Alberta (1.2%) and British Columbia (1.1%) offset declines in Manitoba (-13.1%), Saskatchewan (-5.9%), Quebec (-4.6%) and New Brunswick (-4.3%).

Top 50 – Leading Provinces	
Province	% of Total
Ontario (18)	41
Quebec (13)	25
British Columbia (4)	12
Alberta (3)	11

Ontario's 18 universities accounted for the lion's share (41%) of total research income in Fiscal 2013, up from 40% in Fiscal 2012 and 38% in Fiscal 2011. Quebec's 13 universities captured 25% of the country's Top 50 research income total, down from 27% last year and the year before. British Columbia's 4 universities and Alberta's 3 universities accounted for 12% and 11% respectively of the total research income in Fiscal 2013.

RESEARCH INCOME GROWTH

In Fiscal 2013, 29 universities posted research income growth versus 21 where income dropped. This is an

Spotlight on University International Research Collaboration 2008-2012

RESEARCH Infosource shines the spotlight on international research, as measured by research collaboration: the proportion of total publications at each institution during the period 2008-2012 that were co-authored with researchers outside of Canada.

Rank	Medical/Doctoral	% Intl.	Rank	Comprehensive	% Intl.	Rank	Undergraduate	% Intl.
1	McGill University	49.9	1	University of Regina	51.3	1	Saint Mary's University	53.8
2	University of British Columbia	48.4	2	University of Victoria	51.2	2	St. Francis Xavier University	48.4
3	University of Toronto	48.1	3	Simon Fraser University	50.2	3	Royal Military College of Canada	43.7
Tier Average (16)		44.9	Tier Average (12)		44.2	Tier Average (22)		37.6

Overall university international research collaboration rate (50): 44.3%

Notes:

- Based on universities on the 2014 Top 50 Research Universities list and had a total of 250 or more publications over the 5-year period.
- Publication data were obtained from Observatoire des sciences et des technologies' (OST) Canadian bibliometric database which contains data from the SCI-Expanded, SSCI and AHCI databases of Thomson Reuters.
- See www.researchinfosource.com for details.

improvement over Fiscal 2012, when 22 universities recorded income growth, versus 28 where research income declined. University of Waterloo headed the growth category with a 21.8% jump in research income in Fiscal 2013, slightly ahead of University of Victoria (21.1%). Research income also expanded strongly at Memorial University of Newfoundland (19.4%), École de technologie supérieure (19.1%) and University of Calgary (16.3%).

RESEARCH INTENSITY

Research intensity – research income per full-time faculty position – increased by 1.3% for the Top 50 research universities as a result of a small decline in faculty combined with a small increase in research income. In Fiscal 2013, on average, the Top 50 had research intensity of \$175,900 per full-time faculty, up slightly from \$173,600 the year before. In total, 14 universities bested the average: University of Toronto (\$467,300 per full-time faculty), Institut national de la recherche scientifique (\$357,600) and McGill University (\$281,400) topped the ranking.

TIER GROUPS

Sixteen Medical/Doctoral universities accounted for research income of nearly \$5.5 billion in Fiscal 2013, 81% of the total Top 50 research income. In total, 12 Comprehensive institutions grew their research income in Fiscal 2013 by 5.8% and accounted for 14% of the Top 50 total, up from 13% last year. Twenty-two Undergraduate institutions posted a 2.4% increase in research income and accounted for 5% of the total.

RESEARCH UNIVERSITIES OF THE YEAR

RESEARCH Infosource is pleased to highlight the achievements of 3 *Research Universities of the Year* – the leading institutions that excelled on a balanced scorecard of research input and output/impact indicators. This year's winners are: University of Toronto in the Medical/Doctoral category, University of Waterloo in the Comprehensive category and Ryerson University in the Undergraduate category.

THIS YEAR AND NEXT

The last couple of years have seen comparatively slim

The \$100 Million Club

2013 Rank	University	Research Income \$000
1	University of Toronto*	\$1,110,663
2	University of British Columbia*	\$566,789
3	Université de Montréal*	\$527,971
4	McGill University*	\$465,209
5	University of Alberta*	\$417,757
6	University of Calgary*	\$328,736
7	McMaster University*	\$322,502
8	Université Laval*	\$306,831
9	University of Ottawa*	\$297,813
10	Western University*	\$254,457
11	Queen's University*	\$189,990
12	University of Waterloo	\$166,920
13	University of Guelph	\$158,255
14	University of Saskatchewan*	\$157,976
15	Dalhousie University*	\$148,879
16	University of Manitoba*	\$137,281
17	Memorial University of Newfoundland*	\$127,816
18	University of Victoria	\$124,779
19	Université de Sherbrooke*	\$120,969
20	Simon Fraser University	\$102,643

*Has a medical school

pickings for university research. Research income gains have hovered around 1%, which means that in real terms – after inflation – income has slipped. Delving into the sources of research income growth we see a more complex explanation. Federal Government funding was steady last year; it increased by 2.8%, above the 1.1% total increase. Provincial Government funding was more restrained, growing by only 1.3%. These 2 sources accounted for fully 67% of all university research income, so as government funding goes, so goes the total. Foreign Government funding declined by -2.0%, although it only accounted for 2% of the total. Corporate funding declined slightly by -0.7% and accounted once again for 12% of total research income; still respectable compared other countries.

Top 10 Research Intensive Universities

2013 Rank	Research Intensity Overall	University	Research Intensity (\$ per full-time faculty) \$000
1	1	University of Toronto*	\$467.3
2	23	Institut national de la recherche scientifique ⁺	\$357.6
3	4	McGill University*	\$281.4
4	3	Université de Montréal ⁺⁺⁺	\$281.0
5	5	University of Alberta*	\$248.2
6	11	Queen's University*	\$240.5
7	2	University of British Columbia*	\$235.9
8	7	McMaster University*	\$234.5
9	9	University of Ottawa*	\$231.9
10	8	Université Laval*	\$227.3

*Has a medical school ⁺Not a full-service institution
⁺⁺⁺Based on 2011-2012 faculty counts; 2012-2013 were not available

Top 10 Universities by Growth

2013 Rank	Income Growth	Overall	University	% Change 2012-2013
1	12	University of Waterloo		21.8
2	18	University of Victoria		21.1
3	17	Memorial University of Newfoundland*		19.4
4	31	École de technologie supérieure ⁺		19.1
5	6	University of Calgary*		16.3
6	30	Université du Québec à Trois-Rivières		14.2
7	38	Laurentian University*		13.3
8	11	Queen's University*		13.1
9	41	Brock University		13.0
10	27	Ryerson University		12.9

*Has a medical school ⁺Not a full-service institution

Many institutions are hopeful that signs of improving finances at the federal level will result in increased funding next year. At the provincial level there is more uncertainty. But overall next year looks to be one of restrained funding growth. This calls for more efficiency in research performance to get the most out of the available dollars.

ENGAGING RESEARCH

WWW.SFU.CA/VPRESEARCH



Dr. Anne Salomon studies the impacts of humans on British Columbia's coastal marine ecosystems. She is one of many SFU researchers who are putting research dollars to work to address our most pressing social, economic, and environmental issues.

As the newest member of the \$100 Million Club, SFU will continue to increase its research capacity and leverage its partnerships to contribute to the well-being of its communities.

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The dozens of research institutes and laboratories on our campus are operating in fields ranging from particle physics to climate change, to Indigenous hip hop culture. The University is home to 10 Canada Research Chairs, and is the only Canadian institution home to two Fulbright Scholars this year.

Our researchers are building Saskatchewan's international reputation as a leader in innovation with research that matters. To us, that's research done right.



University of Regina 2014-15 Fulbright Scholars, Dr. Shanthi Johnson (left) and Dr. Peter Leavitt.

University
 of Regina

PARTNER PERSPECTIVE

Laval Drives Canada's Leadership in Northern Science

By Debbie Lawes

Canada is the world's second largest Arctic country. It is also a – if not *the* – global leader in northern research, driven by the region's growing geopolitical importance and looming questions over Arctic sovereignty.

Rapid climate change and modernization in northern regions has intensified the need for data and knowledge to ensure local communities, policymakers and industries “get it right” in adopting strategies and practices that ensure sustainable economic and social development.

Much of Canada's rise as an international powerhouse in this field can be attributed to Université Laval. The Quebec City institution hosts what is arguably the world's largest concentration of scholars studying the far north, everything from the impacts on local communities and biodiversity to resource development and national sovereignty. This expertise is spread among 12 research

centres, two research institutes and the Laval-hosted ArcticNet Network of Centres of Excellence, one of the federal government's most successful research consortiums.

“Laval has been at the forefront of northern research for more than 50 years. This isn't expertise you develop overnight,” says Dr. Sophie D'Amours, Laval's vice-rector of research and innovation.

One of Laval's longest running programs, the Centre for Northern Studies, started with about 20 researchers and students when it launched in 1961. The centre now boasts some 50 scientists and more than 180 graduate students.

Nearly 10% of Laval's total faculty is involved in northern and Arctic research, including about 300 graduate students and 125 professors from nine faculties: science and engineering; social sciences; forestry and geography; agriculture; art, design and architecture; law; education, medicine; and business.

“For example, Michel Allard, a

geography professor here at Laval, has been working closely with our engineers on the effects of thawing permafrost for airports in Nunavik and Nunavut,” says D'Amours. “This multidisciplinary project will have broad implications for how and where we build these infrastructures, which will have a big impact on

program, supplemented by another \$30+ million from partners. This strategic funding helped to establish TAKUKVIK, a partnership with France's National Centre for Scientific Research (CRNS) that has brought six of France's top scientists to Quebec City to jointly study Arctic ecosystems and geosystems.

“Laval has been at the forefront of northern research for more than 50 years. This isn't expertise you develop overnight.”

Dr. Sophie D'Amours, Vice-Rector of Research and Innovation, Université Laval

issues such as safety as well as the transport of both people and goods.”

Sixteen of Laval's 125 professors are also research chairs, each with more than \$1 million in funding. One of the most prestigious is held by Dr. Marcel Babin, who received \$10 million in 2011 through the Canada Excellence Research Chair

Laval leads seven such northern research centres involving multiple universities from across Canada and internationally. Its crown jewel is ArcticNet, which sees over 145 Arctic researchers from across Canada and other countries, as well as northern communities and research institutes, conducting field work each

year aboard the CCGS Amundsen research icebreaker.

Since launching in 2003, ArcticNet has received more than \$113 million from the federal government and another \$173 million from public and private sector partners for state-of-the-art research and innovation. The network represents Canada's largest commitment to date to explore the social, economic and environmental impacts of climate change and modernization in the coastal Canadian Arctic.

Laval's most recent vote of confidence came from the Quebec government, which last month awarded \$3 million in seed funding to Laval, McGill University and Quebec's National Institute of Scientific Research (INRS) to establish the Institut Nordique du Quebec under the province's Plan Nord strategy. The new institute will draw on basic and applied research from the social sciences, natural sciences, engineering and health to generate the scientific and technical knowledge

needed for sustainable development in northern Quebec, a territory covering two-thirds of the province.

Such funding support is helping Laval buck a trend that saw Quebec universities drop 4.6% in research income in 2013, compared to a marginal increase of 1% for Canadian universities. Laval posted a 1.3% rise last year with \$306.8 million in research income.

D'Amours says the increase in research income reflects the excellence of Laval's science and the value it places on both partnerships and multidisciplinary research. “When you consider that provincial budgets are very tight right now, this recent investment from the Government of Quebec, and support from our other public and private sector partners, sends a strong message that excellent science and partnerships are essential to solving the complex challenges of today's world.”

Debbie Lawes (debbie@dovercourteditorial.ca) is an Ottawa-based science writer.

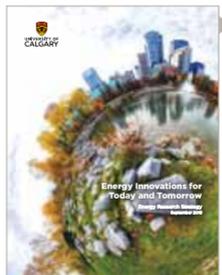
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In October, we launched the first of our **global energy research sites** — in Beijing, China. Researchers from Canada and China will collaborate to explore new and sustainable ways of developing unconventional resources.

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CANADA'S UNIVERSITIES: Drivers of Innovation



Mo Elbestawi
Vice-President, Research & International Affairs
McMaster University

While once considered solely a place for higher learning, Canada's universities are now widely regarded as centres of innovation. Their collective output is far more than highly qualified graduates, universities now play an integral role in keeping Canada competitive,

working hand-in-hand with industry and governments to move research out of the labs and into the marketplace.

According to the Association of Universities and Colleges of Canada, universities – the country's second largest performer of research behind the private sector – are now a \$34 billion enterprise, undertaking some \$11.9 billion worth of research activities last year. Moreover, some 55 to 60 percent of that funding came from external sources, with the federal government alone investing some \$3.1 billion.

The investment is, without doubt, providing research that is excellent, novel and relevant. The challenge, however, is finding a direct path to innovation. The question remains, how do we, collectively, transfer that research – the knowledge – into value that benefits the economy? How do we bridge the innovation gap

between basic research done at universities and the more applied needs of businesses and industries that are competing on the global stage?

The Jenkins Report paid tribute to Canada's strong foundation to building success in the knowledge economy, but also noted that we lag behind other developed countries in business innovation. To bridge this innovation gap, our universities have a vital role to play.

Universities need to be the anchor for technology development, education and workforce training. As the knowledge creators, they need to work with their partners in government and industry to create the kinds of innovation clusters that will drive Canadian competitiveness.

Thankfully, we are seeing more and more of these clusters developing around the country. In Hamilton, for example, the McMaster Automot-

ive Resource Centre (MARC), at the McMaster Innovation Park, has become the go-to place for automotive industries to tap into the expertise of McMaster's research community, allowing our students to engage in real-world R&D projects. It's ideally located next to the country's premier materials research facility, CANMET, contributing to our critical mass of expertise in this area.

Universities need to create and embrace a culture of innovation. While that sounds rather simple and obvious, the practical aspect is somewhat more cumbersome, as it requires a cultural shift in thinking and doing.

We need to develop programs that encourage entrepreneurship at every level – from undergraduate students to tenured faculty and everyone between. But it's far more than changes to the curriculum; we need to work with our community partners to develop the entire innovation ecosystem, including funds, mentors and incubation and accelerator space. Many universities and communities are finding success in this type of model.

At McMaster, we're seeing the benefits first-hand through our work with the Innovation Factory, our Regional Innovation Centre. And, we're expecting more success with The Forge – a campus linked accelerator funded, in part, by the Province of Ontario – a dedicated space that will fast-track the growth of new ventures contributing to the local economy and producing the next wave of technology-driven companies.

Partnerships with industry and governments have become commonplace for Canadian universities over the past couple of decades, but we need a more concerted focus on international partnerships, which are proving to be of critical importance. At McMaster, we've spent considerable time identifying targeted areas where collaborations make sense for all parties, where there are mutual benefits in terms of talent, training, R&D, and technology and knowledge transfer.

Case in point: in a unique collaboration with Germany's Fraunhofer IZI, and with support from government partners, we are building a state-of-the-art biomedical engineer-

ing and advanced manufacturing research centre (BEAM), focusing on cell therapy manufacturing and diagnostics. It's yet another example of using university research for economic and social benefit.

But the benefits don't end there. These types of collaborations allow both our graduates students and researchers exceptional opportunities, giving them access to the latest technologies, best practices and international markets.

The role of Canada's universities in research and development on the international stage cannot be underestimated. We are the conduit to connecting the knowledge producers with those who have the infrastructure and capacity to commercialize our knowledge and, ultimately, with the end users – the global consumer.

The funding programs are in place – from traditional granting agencies, to the Canada Foundation for Innovation, to FedDev and provincial programs alike. It's up to universities to capitalize on these programs, to build on our research excellence and create the requisite cultures of innovation and entrepreneurship.

From Ivory Tower to International Chessboard



Daniel Coderre, PhD
Rector
INRS University

Scientists used to answer only to their peers and were judged solely on newly-acquired knowledge. They are now not only required to answer to their funding partners whether they are private or public, but also must generally demonstrate their contribution to the development of economy and well-being of society.

This trend is not unique to Canada and has become the norm the world over. Does this mean better results? It is possible; however, it is imperative that fundamental research be preserved and that academic and industrial partners be willing to engage with one another.

However, on its own, this is not enough. A second important component in the evolution of research and innovation is the internationalization of knowledge development and the structuring of international theme-based networks. University researchers have always collaborated amongst themselves and shared

their research in peer-reviewed scientific publications and at international conferences. As such these publications and events are the main performance criteria in academia. However, they are rarely motivated by short-term gains and meeting users' immediate needs. And while the relationship between academia and industry remains difficult within Canada, it is in its early stages on the international scene.

The difficult economic situation in most countries following the economic crisis of 2008 has had a negative impact on the development of research as well as international partnerships. Some developed countries have even adopted a free-rider strategy, counting on the development of research and innovation in other countries and hoping to reap the rewards. This strategy, while it may be beneficial for some developing countries, has proved to be very harmful for

developed countries. Canada has invested significantly in research and innovation in the recent past and this positions our country as a leader and ideal partner in a number of fields relevant to our social and economic development. We have the status and talent to play a very important role internationally. The establishment of the Canada Foundation for Innovation more than 17 years ago has provided Canada with leading edge research infrastructures among the best in the world in a number of key sectors. We are a partner of choice.

Yet in Canada the support for international partnerships has been rather low key while the European Union has established an ambitious program of innovation and research support over the next six years for a total investment of 80 billion euros. Our country has continued in a more traditional approach with few means of support for our inclusion in large-

scale projects of international scope.

Canada cannot excel in each and every field. We can, however, develop and hone our strengths, all the while favouring university-industry partnerships on an international scale. Perhaps we could make real breakthroughs, relevant to both academia and industry on the international chessboard, yet seemingly of less interest locally. Establishing such financing for structured international collaboration allows for innovative research, motivated by industry-specific needs and achieving international impact. This type of research can be nothing if not beneficial for everyone involved. Pooling together niched innovations, targeting support for small and medium businesses, training highly-qualified students in growth sectors, all have both short and long-term benefits.

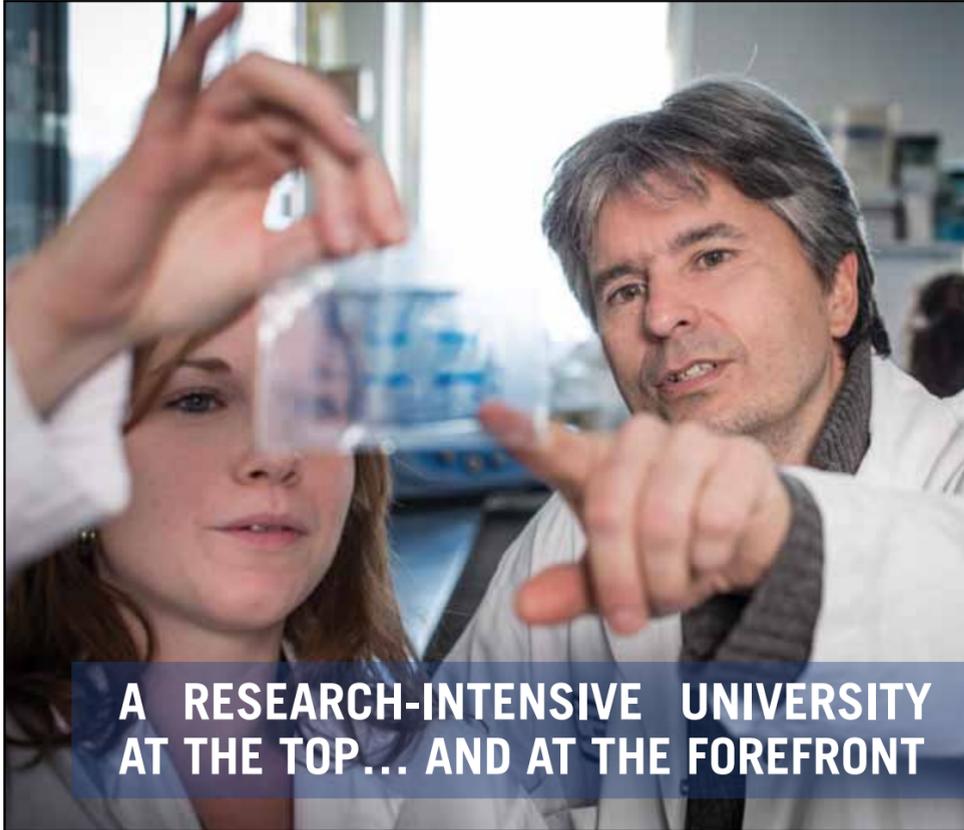
Should we let support for developing countries, unlikely to be

considered in such an approach, simply fall to the wayside? Absolutely not. We must go from an approach far too often philanthropic to that of genuine partnership and collaboration. We must favour, for foreign students, an approach based on research that can have concrete benefits for their countries and can create fertile ground for the emergence of new business partnerships.

Canadian researchers have to play an even greater role on the world stage to further strengthen Canada's connection to the global supply of ideas, talent, and technology and be positioned at the forefront of science. International collaborations must be encouraged and supported since international knowledge and intercultural skills are indispensable to meet globalization's challenges.

The international chessboard of science is where the mutually beneficial research game must be played.

The Canadian approach to research, and the resulting innovation, has evolved at an accelerated pace over the past few decades. While research was once a field reserved for scholars, often confined to their ivory towers and employing a language understood by a select few, it has now become in a way everyone's concern.



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How Canadian Science Drives Innovation



Jonathan Bagger
Director
TRIUMF

TRIUMF is Canada's national laboratory for particle and nuclear physics, and the name itself symbolizes Canadian innovation.

Nearly fifty years ago, three universities came together to build the world's largest cyclotron. TRIUMF, the TRI-University Meson Facility, quickly outgrew its name. Today, TRIUMF includes 18 member universities stretching from Halifax to Victoria. (On November 6, Western University will join TRIUMF as its nineteenth member.) From the beginning, scientific excellence has been at the core of TRIUMF, driving innovation for the benefit of Canada.

In October, at a conference in Halifax, I met with the directors of Canadian laboratories to learn how these facilities fuel innovation. The laboratories produce world-class science and, although the subject matter may differ, each values a culture of passion, curiosity, and creativity.

TRIUMF, among the oldest and most established of Canada's laboratories, has a rich history of innovation. Why? Because the questions we ask demand it. Our experiments are beyond the state of the art; therefore we must invent the necessary tools and technology. This requires innovation, each and every day.

Science and society advance together; they are two sides of the same coin. At TRIUMF, the tools we

invent also have applications ranging from medicine to materials. As director, my job is to fuel the spirit of innovation and realize benefits from our research.

Fortunately, I have the wind at my back. From healthcare to information technology, laboratory-born inventions have reshaped our everyday lives. Two examples offer important lessons.

First, let us look to CERN, the world's largest particle physics laboratory. Thousands of scientists from around the world go to CERN to collaborate on experiments, and when they go home, they continue to work together. Before the Internet, organizing such global collaborations was an extraordinarily difficult challenge.

In 1989, Tim Berners-Lee, a CERN computer scientist, was driven to find a solution. He developed a computer interface to connect CERN's far-flung collaborations. The laboratory saw the potential and invested resources into the technology that became the World Wide Web. Over time, CERN's tool for collaboration evolved into a revolutionary platform for commerce, education and entertainment.

For an example closer to home, let us look to the medical isotope crisis that took center stage in 2010. With failures in the global supply chain, Canada was desperate to secure the medical isotope used in 80% of procedures to detect, image, and treat disease. TRIUMF rose to the challenge.

With its expertise in nuclear physics and accelerator science, and with funding from Natural Resources Canada, TRIUMF led a multidisciplinary team with the BC Cancer Agency, Lawson Health Research Institute, and Centre for Probe Development and Commercialization. The team devised a new way to produce the isotope on existing cyclotrons across the country. TRIUMF is now in the process of commercializing this process to help secure the supply of this essential medical isotope.

Why was TRIUMF able to help? The answer is simple: TRIUMF had

the expertise, the funding, and the human capital. Laboratories like CERN and TRIUMF provide powerful platforms for progress, but only if they are sustained over time with appropriate funding.

At TRIUMF, our mission includes the challenge to "transfer knowledge, train highly skilled personnel, and commercialize research for the benefit of all Canadians." TRIUMF trains 150 students and postdocs every year. With our partner Nordion, TRIUMF produces 2,500,000 doses of isotopes each year for hospitals around the world – and we've been doing this for over 35 years. Through Advanced Applied Physics Solutions, Inc., TRIUMF creates spin-off companies – five in the past five years – each contributing to Canada's innovation landscape.

TRIUMF's newest facility ARIEL, the Advanced Rare-Isotope Laboratory, builds on our excellence in science and research commercialization and is poised to become one of the top rare-isotope facilities in the world. Today, ARIEL is two-thirds complete and when fully operational it will triple our scientific capacity, allowing Canada to advance the frontiers of science, medicine, and business.

Budget 2014 announced continued funding for TRIUMF and for that we are grateful. We acknowledge the pressures as the nation emerges from a challenging economic period. Nevertheless, TRIUMF's level of funding has been frozen since 2005. With no accommodation for increasing costs, TRIUMF will lose its ability to innovate.

It is for these reasons that TRIUMF proposed CAPTURE, an innovation-based initiative for Budget 2015. CAPTURE will allow TRIUMF to continue to push the frontiers of science and develop "Made in Canada" solutions to real-world problems.

With Canada's ongoing support and commitment, we will continue to challenge the limits of what's possible and take Canada towards an even brighter future.

Addressing questions of importance to the world

CIFAR creates knowledge that will transform our world. We bring together outstanding researchers to work in global networks that address some of the most important questions our world faces today. Our networks support the growth of research leaders and are catalysts for change in business, government and society.

Established in 1982, CIFAR is comprised of nearly 350 fellows, scholars and advisors from more than 100 institutions in 16 countries. CIFAR partners with the Government of Canada, provincial governments, individuals, foundations, corporations and research institutions to extend our impact in the world.

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Douglas Wallace
Scientific Director
Marine Environmental Observation
Prediction and Response Network
(MEOPAR)

Canada and the Ocean Frontier

rush to the frontier is outpacing our ability to characterize and understand it. Realistically, given the connectedness and vastness of the ocean and the global nature of change, the situation can only be improved through international cooperation in research and development.

An important step in this direction took place in May 2013, in Ireland, where Canada, the US and the EU signed the *Galway Statement on Atlantic Ocean Cooperation*. This recognised “the importance of the Atlantic Ocean to our citizens, prosperity, human health and well-being, adaptation to climate and other environmental change, and security.” A new tripartite Research Alliance was established to “increase knowledge of the Atlantic Ocean and its dynamic systems.” Amongst several key areas, the Alliance calls for a “North Atlantic multi-platform ocean observing and forecasting system driven by science and societal needs.” Coordination of the Alliance is in the hands of US-EU and Canada-EU Working Groups. Within Canada, a Marine Working Group, under the leadership of Fisheries and Oceans Canada, is developing an overall Canadian response to this initiative.

The EU rapidly implemented several calls for proposals under the *Blue Growth* component of the Horizon 2020 research programme to support Galway Alliance initiatives. This included a call for research towards “deployment of an Integrated Atlantic Ocean Observing System (IAOOS) building on existing capacities on both sides of the Atlantic.” Funding for the 1st round of Galway-related programmes was approximately EUR 30 million.

The Alliance and the Horizon 2020 calls are both an opportunity and a challenge to Canada. On one hand, the research can benefit Canada, given our shared interest with the EU and the US in the Atlantic and Arctic Oceans. On the other hand, without active participation of Canadian researchers, there

is no guarantee that Canadian priorities and needs will be addressed. Further, a significant amount of research under Horizon 2020 will be conducted by SMEs as the programme aims to create economic opportunity for European nations and businesses. The research is relevant to the needs and capacity of Canada’s strong ocean industries, including the energy, fishing, and technology sectors. However, without a linked Canadian effort, how Canadian companies can participate in European-led research programs is at best unclear.

The Marine Environmental Observation Prediction and Response (MEOPAR) Network of Centres of Excellence is working closely with the Canadian Marine Working Group to develop a strategy to incorporate Canadian interests, needs and capacities into an Integrated Atlantic Ocean Observing System. Implementation will require a new, multisectoral approach to planning and support of ocean observation along Canada’s Atlantic coast: from northern Baffin Bay to the Gulf of Maine in the South. This region covers a number of areas of major economic, ecological and scientific significance. This approach could serve as an integrative model to manage Canada’s three oceans, building on government, academic and private sector efforts in other regions, including activities of other ocean science networks. MEOPAR proposes to work cooperatively towards establishing: the new regional approach, a technology roadmap to guide choice and development of required technologies, and establishment of a number of sentinel areas along Canada’s Atlantic coast where the interests and information needs of industry and scientific research, including the international research community, coincide and can be aggregated. These sentinel areas can become the observation posts required to observe, understand, protect and guide our activities along the ocean frontier.



McMaster researchers Guillaume Paré, MD, Cisco Professor in Integrated Health Biosystems and Andrew McArthur, PhD, Cisco Research Chair in Bioinformatics

So what’s the big deal on big data? Just ask Guillaume Paré and Andrew McArthur who, with Cisco’s support, are improving the way vast amounts of biomedical data are managed, analyzed, integrated and distributed. They want to make sure that the right data is working for the right people at the right time. Their work will transform the way research is conducted and how healthcare is delivered. The way we see it, that’s a big deal.

research.mcmaster.ca



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Ryerson University’s Model of Innovation Goes Global

Wendy Cukier,
Vice President,
Research and Innovation
Ryerson University

Challenging the status quo is what Ryerson University does. Ryerson’s unique approach to research and innovation has not gone unnoticed here at home or abroad. In addition to being named one of the research universities of the year by Research Infosource, our Digital Media Zone was ranked fifth in the world among incubators in 67 countries by the University Business Incubator (UBI) Index and we were also named Canada’s first Ashoka Changemaker Campus.

Building on our polytechnic roots and our unique mission – to meet societal needs – Ryerson prides itself on its strong connections with industry and community and its legacy as a city-builder. While attention has focused globally on the “innovation

gap”, Ryerson has pioneered new models to commercialize research, mobilize results, develop multidisciplinary collaborations with partners to solve problems, and build and support the pipeline for the entrepreneurs of the future. Whether it is creating new products and services, incubating or accelerating startups, driving change in existing organizations or pioneering social change, Ryerson plays a key role in the innovation ecosystem. Its approach of ‘zone learning’, which provides the space, support and connections required to turn student-driven ideas into action, has produced measurable results. Since its launch in 2010, Ryerson’s DMZ has incubated and accelerated 159 startups and created more than 1300 jobs. And that is only the tip of the iceberg: other Ryerson Zones include the Innovation Centre for Urban Energy, The Transmedia Zone, The Fashion Zone, Design Fabrication Zone, and

Social Venture Zone. The University also has the largest Entrepreneurship program in the country and a myriad of programs and clubs advancing for-profit and social entrepreneurship as well as a unique collaboration on big data incubation, known as OneEleven.

Our unique approach to innovation has opened doors worldwide. The Digital Media Zone has become a “soft landing” site for entrepreneurs at top-ranked universities in India, China, South Africa and Israel. Last year, Ryerson, along with its for-profit arm Ryerson Futures, forged a unique partnership to build an incubator with the Bombay Stock Exchange Institute – BIL-Ryerson DMZ – to support transnational entrepreneurship.

Of course the foundation of continuous innovation is a strong research base. In the last year alone, we have collaborated with industry and government to open new multi-

disciplinary centres for innovation, including the Ryerson Centre for Cloud and Context-Aware Computing (RC4) with nodes in Transmedia and Advanced Manufacturing, Design and 3D Printing, as well as the Institute for Biomedical Engineering, Science and Technology (iBEST) with St. Michael’s Hospital.

Every faculty has major projects working with global partners to tackle “wicked problems” and advance innovation. A few examples: The Centre for Urban Energy (CUE) has a satellite centre with Anna University in India and is extending its global clean tech collaborations. Dr. Gideon Wolfaardt (Chemistry and Biology) holds a joint appointment at Stellenbosch University in South Africa for a Chair in Wastewater as part of a global network on water research. Dr. Ali Mazalek, Canada Research Chair in Digital Media and Innovation, works with tangible interfaces to advance cre-

ativity, design and development with partners in the USA, India, Australia, and the Netherlands. Dr. Kathryn Woodcock (Public Health and Safety) is collaborating with major theme parks to support her work on the user experience and safety of amusement park rides. Through CIHR’s China-Canada Joint Health Research Initiative, one of our leading researchers Dr. Michael Kolios (Physics) is collaborating with Chongqing Medical University to research nanoparticle emulsions for targeted ultrasound and photoacoustic molecular imaging of cancer. Dr. Candice Monson’s (Psychology) research on innovative approaches to treating posttraumatic stress disorder (PTSD) is driving change in the treatment of PTSD in Canada and the USA.

Part of Ryerson’s success is its commitment to advancing research on entrepreneurship and innovation. In addition to examining innovation processes, women and immigrant

entrepreneurs, and training and incubation programs, Ryerson’s researchers are part of the world’s largest study of transnational entrepreneurship, the Global Entrepreneurship Monitor (GEM). Studies by the Ted Rogers School of Management (TRSM)’s Drs. Howard Lin, Mary Han, and Sui Sui are also advancing knowledge on transnational entrepreneurship. Ryerson researchers are part of the European Union-led SI-DRIVE project, which will map social innovation and entrepreneurship in 67 countries. The Canada-China Institute for Business & Development at TRSM focuses on building collaborations between Canadian and Chinese entrepreneurs and educational institutions.

Ryerson is a university on the move. Our double-digit growth in research funding and the international demand for our unique approach to innovation are a few indicators that, as Ted Rogers prophetically said, “The best is yet to come”.

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Leaders' Corner



Improving Ontario's clinical trials environment is a priority for Clinical Trials Ontario, a stakeholder-initiated organization supported by the Ontario government. We are working with hospitals, universities, research ethics boards, industry and others to streamline research ethics review and harmonize processes to advance clinical research crucial to our health and well-being.

*Susan Marlin
President and CEO
Clinical Trials Ontario*



Basic, theoretical or applied, Canadian university research plays an invaluable role in helping global society to move forward on a multitude of fronts – human rights, cities, health, advanced manufacturing, the arts and so many others. With the increasing trend toward collaborative research, I believe universities are better positioned than ever before to carry out this invaluable mission.

*Dr. Peter N. Lewis
Interim Vice President,
Research and Innovation
University of Toronto*



Applied research is a cornerstone of the creative undergraduate experience at Sheridan. By providing our students with opportunities to collaborate with professors and industry partners on solution-focused projects, we are preparing them for a world in which innovation – the ability to acquire new knowledge and apply it in novel ways – is the key to prosperity.

*Dr. Jeff Zabudsky
President and CEO
Sheridan College*



Ryerson's trajectory of research growth is unparalleled. Our researchers, with the support of our community, industry and government partners, are helping to drive innovation nationally and globally. Ryerson continues to demonstrate that universities can combine research excellence and relevance to respond to society need, to solve complex problems and drive social, cultural and economic development.

*Wendy Cukier
Vice President,
Research and Innovation
Ryerson University*



Big scientific and social challenges confront our world today. Research Universities are key to innovation breakthroughs. At Université Laval we're passionate about achieving excellence and creating and applying our knowledge in collaboration with leading universities, networks, and public agencies on a national and global scale.

*Dr. Sophie D'Amours
Vice-Rector of Research
and Innovation
Université Laval*



Global thinkers, shaped here – York University turns research into action. Working collaboratively with external partners, building knowledge and creating opportunities for research commercialization maximizes research outcomes from the sciences to fine arts, from business to health, engineering to sustainability and beyond.

*Robert Haché, Ph.D.
Vice-President,
Research and Innovation
York University*



SFU researchers work hand-in-hand with local, national, and international partners from all sectors. Together, we share knowledge, tools, ideas and solutions for the betterment of individuals, families, and communities in Canada and around the world. We are proud to be in the spotlight for our exceptional international research collaboration and as the newest member of the \$100 Million Club.

*Dr. Joy L. Johnson
Vice-President, Research
Simon Fraser University*



Finding solutions to global challenges requires the best and brightest minds. With unique centres such as the Canadian Light Source, VIDO-InterVac, and global institutes for food and water security – plus unparalleled molecular imaging tools for human, animal and plant research – we are attracting top international talent and partners for research success.

*Dr. Karen Chad
Vice-President Research
University of Saskatchewan*

Tackling Grand Challenges Using Innovation



Dr. Peter A. Singer
Chief Executive Officer
Grand Challenges Canada

This year, we celebrated the 10th Anniversary of the original Grand Challenges in Global Health initiative. Grand Challenges – launched initially by the Bill & Melinda Gates Foundation and now involving many global partners – changed the course of global health. Before 2003, there was skepticism that world-class discovery science had a legitimate role, despite the fact that some of the greatest scientific advances were the bulwark of the public health approach to global health. The Grand Challenges in Global Health initiative has, more than any other single intervention, established the legitimacy – indeed the necessity – of innovation in global health.

Grand Challenges Canada became one of the founding members of the Grand Challenges network upon its launch in 2010. Funded by the

Government of Canada, Grand Challenges Canada invests in Bold Ideas with Big Impact that bring together social, business and technological innovation – called Integrated Innovation. We fund innovators in Canada and in low- and middle-income countries. Our ultimate desired outcome is saving and improving lives in developing nations, with a particular focus on women and children and those that are most in need.

Since 2010, Grand Challenges Canada enabled the creation of a pipeline of global health innovations, and evolved into a platform that nurtures innovative solutions and offers opportunities for social enterprises and impact investors to generate measurable and sustainable social impact. To date, Grand Challenges Canada has funded 637 innovations implemented in over 80 countries. In Canada, we have supported 226 global health innovations totaling \$40 million.

Innovation is often thought of as a long term undertaking with 10 year or longer timelines to impact. With less than 20% of our projects reporting early results, we have already reached 1.2 million beneficiaries, providing them access to a global health product or service. This has saved thousands and improved tens of thousands of lives in developing countries.

Continued on page 10

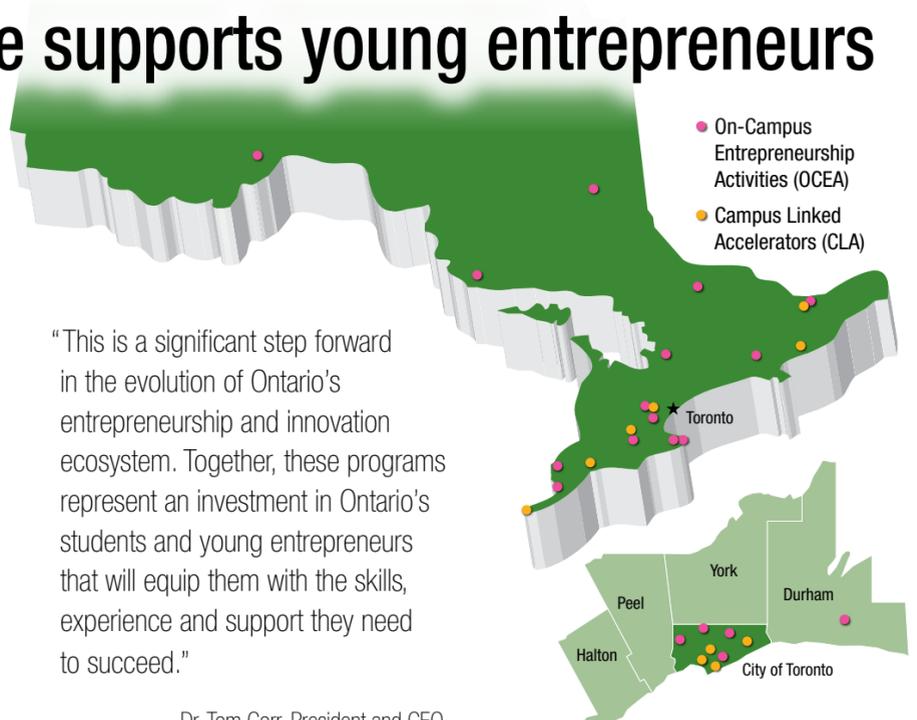
Ontario Centres of Excellence supports young entrepreneurs

Many of today's students and youth are excited by the idea of turning a creative idea into a business whose innovative products or services can help make the world a better place. In Ontario, they are being provided with the support, mentoring and training in entrepreneurial skills they need to help them realize their dreams and career ambitions.

In partnership with the Government of Ontario, Ontario Centres of Excellence is providing support across the spectrum of youth entrepreneurship: direct entrepreneurial fellowship support to students; seed capital funding for students and youth-led starts ups; and infrastructure support for entrepreneurial activities at Ontario postsecondary institutions.

For more information about Ontario Centres of Excellence visit oce-ontario.org

This province-wide initiative includes funding for 10 Campus Linked Accelerators (CLAs) that support student-led start-up companies; create, improve and sustain a culture of entrepreneurship among students and youth; and provide connections to investors and industry. And through our On-Campus Entrepreneurship Activities (OCEA) program, we are providing experiential learning opportunities for the next generation of innovators, helping student entrepreneurs transfer knowledge and intellectual property from Ontario post-secondary research institutions to the marketplace.



"This is a significant step forward in the evolution of Ontario's entrepreneurship and innovation ecosystem. Together, these programs represent an investment in Ontario's students and young entrepreneurs that will equip them with the skills, experience and support they need to succeed."

– Dr. Tom Corr, President and CEO,
Ontario Centres of Excellence

Ontario's network of CLAs along with its OCEA program is building and sustaining a culture of entrepreneurship amongst students and youth in their regions

Canadian Science Makes its Mark

Continued from page 1

at SSHRC. "With this platform, we think we can develop mechanisms for one adjudication process and multiple funders. It's about removing some of those barriers to collaboration."

One model for the platform is the Digging into Data Challenge, a competition to promote innovative research using large-scale data analysis. It represents a global first in research funding cooperation sponsored by SSHRC, NSERC, the Canada Foundation for Innovation and funding agencies in several countries. Rather than each researcher applying to every funder in their own country, international teams apply to just one competition.

"This is a way to get more Canadian researchers more effectively and successfully engaged in international research that has impact," says Hewitt.

HOPE FOR TREATING EBOLA

Another area where Canada is having a global impact is infectious diseases, the most recent example being the deadly Ebola virus. In August, two American medical workers infected with Ebola were treated with an experimental drug treatment developed a decade ago in Winnipeg at the Public Health Agency of Canada's (PHAC) National Microbiology Lab in collaboration with the University of Manitoba (U of M).

Today, the serum is being brought to market by a small U.S. company, in partnership with Toronto-based Defyrus Inc.

Why did this discovery happen in Manitoba first? In addition to PHAC having one of the few level

4 biosafety labs in the world able to handle this highly infectious virus, U of M also has a 40-year track record in studying infectious diseases.

"And we have a strong collaboration with scientists at the national microbiology lab, and with students working with researchers from both institutions," says Dr. Digvir Jayas, the university's VP research and international, adding that U of M recently received funding to establish a level 3 biosafety lab at the University of Nairobi in Kenya.

The U of M is also a major contributor to Arctic and climate change research, attracting both investment and partners from countries such as Greenland, Iceland, Norway and Denmark. As a member of the ArcticNet Network of Centres of Excellence, U of M collaborates with 145 researchers from across Canada, as well as research teams from 12 countries to study the impacts of climate change, including melting sea ice.

"Work done by Dave Barber (director of U of M's Centre for Earth Observation Science and one of Canada's top sea-ice experts) has shown how quickly the multi-year ice is evaporating, and the potential for it becoming open water through the year is becoming closer to reality," says Jayas.

Further west at the University of Calgary (U of C), the ink is still drying on a major joint venture with Kerui Group, a large oil and gas producer in China. Kerui built 4,000 square metres of lab space for U of C to collaborate with universities in Beijing and China's state-owned enterprises on unconventional oil and gas (e.g. shale

oil and gas and coalbed methane).

The university's VP research, Dr. Edward McCauley, calls it a natural partnership. "The University of Calgary is one of the world leaders in unconventional oil and gas research and minimizing the environmental impact associated with that. Anything we can do to help China move from coal to tapping their unconventional resources will have a dramatic impact on reducing their greenhouse gas emissions."

Even the best science won't guarantee that a technology will be a global blockbuster.

U of C is making its mark in Qatar as well, building on the success of a nursing program established there in 2006 that trains 500 students each year. McCauley says the Qatar campus has elevated the profession of nursing throughout the Middle East and opened new windows for education, training and joint research in areas such as health care systems, child and maternal health and energy.

SCIENCE UNDER THE SEA

One of world's most impressive technological feats can be found off the coast of British Columbia. Managed by Ocean Networks Canada (ONC) at the University of Victoria, the NEPTUNE and VENUS observatories supply continuous power and Internet connectivity through marine cables to hundreds of sensors operating on the bottom of the ocean, throughout water columns and in bore holes drilled deep into the seafloor. Researchers control these instruments remotely and receive

real-time data in their home laboratories, anywhere on the planet.

ONC's Innovation Centre (ONCIC) – one of Canada's Centres of Excellence for Commercialization and Research – is working to turn this \$200-million public investment into at least \$270 million in new business for Canadian companies by 2021. ONCIC is targeting several countries that are either developing or expanding their undersea observatories, including Brazil, China, Korea and Australia.

"Instead of just using NEPTUNE and VENUS for our own research, we're taking these platforms global and allowing Canadian companies to use them as technology test beds," says Dr. Kate Moran, ONC's president and CEO.

The test beds include remote sensor systems, observatory and digital infrastructure and data analytics that track everything from microbes and whales to earthquakes and tsunamis. It's a one-stop shop approach that reduces the cost and time required to build new ocean monitoring systems.

"The proposals we're involved in mostly involve small- and medium-sized enterprises working together with our observatory know-how to put together a robust proposal that no one else in the world can do," says Moran.

OPENING CANADIAN LABS TO THE WORLD

Canada's strength in materials research is also attracting interest from international research organiza-

tions and companies. Xerox Research Centre of Canada (XRCC) recently signed a two-year deal to provide Battelle Memorial Institute of Columbus OH with access to its Mississauga ON research labs, including its 2500 square metre chemical pilot plant, as well as expertise in printable electronics and proven experience in moving advanced chemical processes from concept to market.

Joining forces with the world's largest contract research organization fits with XRCC's strategy to open its labs to external researchers and companies.

"There is a unique combination of value-added private sector materials science R&D capability, engineering infrastructure and managerial expertise currently housed under the aegis of XRCC that is not replicated elsewhere in North America," says Dr. Paul Smith, VP and director of XRCC.

Founded in 1974, XRCC holds Xerox Corp.'s global mandate for materials research and in August was issued its 2000th patent for an invention that uses a super-thin and ultra-strong material called graphene for use in digital manufacturing.

"Every core hardware product offered through the parent company's sprawling global market channels contains technology that was invented and/or developed at the Canadian research centre," says Smith. "It remains one of the little known, but enduring, Canadian innovation success stories driven by a proven ability to develop, attract and retain the world's top research talent."

THE OTHER INGREDIENTS FOR SUCCESS

Globally competitive countries need excellent R&D and fortunately

Canada ranks near the top of many international indicators. But even the best science won't guarantee that a technology will be a global blockbuster.

Business innovation and strategic collaborations are as critical as R&D, says Dr. Sorin Cohn, a strategic development executive at the Canadian Advanced Technology Alliance (CATA), which represents 600 member companies – 80% of which are exporters.

"I've never seen a tech company die because they did not have a good product. They died because they focused too much on getting the perfect product, while forgetting to establish the capabilities for marketing and selling their products," says Cohn.

CATA's has a few tips for small- and mid-sized companies looking to crack international markets. First, partner with large anchor companies – like a Bombardier or an IBM – with good reach into global markets. Also, don't shy away from collaborating with other companies in your sector to create a cluster of expertise that strengthens your competitive position globally.

Second, know the rules and the culture of the market you're selling into and have boots on the ground there. And, most importantly, take advantage of free services offered by the Canadian government.

"Companies don't make enough use of our extensive network of trade commissioners overseas," says Barry Gander, executive director at CATA. "They're experts, they work hard and they can open doors for you."

Debbie Lawes (debbie@dovercourt-editorial.ca) is an Ottawa-based science writer.

Canada's TOP 40 RESEARCH HOSPITALS 2014

Rank		Hospital/Health Authority	Research Income			Research Intensity		Province	Main Affiliated Research Institute(s)/Centre(s)
2013	2012		FY2013 \$000	FY2012 \$000	% Change 2012-2013	Researcher** (\$ per Researcher \$000)	Income (Research \$ as a % of Total Income)		
1	1	University Health Network*	\$312,300	\$302,304	3.3	\$581.6	16.2	Ontario	Princess Margaret Cancer Centre, Toronto General Research Institute, Toronto Western Research Institute
2	7	Hamilton Health Sciences	\$182,101	\$123,811	47.1	\$711.3	14.8	Ontario	Population Health Research Institute, Thrombosis/Atherosclerosis Res. Institute, Escarpment Cancer Research Institute
3	3	Hospital for Sick Children	\$179,373	\$171,163	4.8	\$307.7	24.2	Ontario	Peter Gilgan Centre for Research and Learning
4	2	McGill University Health Centre (MUHC)	\$170,498	\$175,666	-2.9	\$473.6	16.1	Quebec	Research Institute of the MUHC
5	4	Ottawa Hospital*	\$136,831	\$152,717	-10.4	\$383.3	9.5	Ontario	Ottawa Hospital Research Institute, Ottawa Heart Institute Research Corporation
6	6	Provincial Health Services Authority	\$128,101	\$127,412	0.5	\$183.5	5.1	British Columbia	Child & Family Research Institute, BC Cancer Research Centre, BC Mental Health & Addictions Res. Inst.
7	5	Vancouver Coastal Health Authority	\$117,971	\$134,266	-12.1	\$278.9	3.8	British Columbia	Vancouver Coastal Health Research Institute, Providence Health Care Research Institute
8	9	London Health Sciences Centre/St. Joseph's Health Care London* (a)	\$114,595	\$103,100	11.1	\$227.8	7.5	Ontario	Lawson Health Research Institute
9	10	Mount Sinai Hospital, Joseph and Wolf Lebovic Health Complex*	\$109,057	\$95,142	14.6	\$956.6	21.7	Ontario	Lunenfeld-Tanenbaum Research Institute
10		CHU de Québec (b)	\$84,113	\$83,709	0.5	\$229.8	7.2	Quebec	Centre de recherche du CHU de Québec
11	8	Sunnybrook Health Sciences Centre*	\$80,432	\$116,700	-31.1	\$303.5	8.4	Ontario	Sunnybrook Research Institute
12	12	Centre hospitalier de l'Université de Montréal (CHUM)	\$66,143	\$66,900	-1.1	\$190.1	7.4	Quebec	Centre de recherche du CHUM
13	13	St. Michael's Hospital	\$61,535	\$61,385	0.2	\$283.6	9.7	Ontario	Keenan Research Centre, Li Ka Shing Knowledge Institute
14	15	Sir Mortimer B. Davis Jewish General Hospital	\$59,856	\$58,420	2.5	\$248.4	14.1	Quebec	Lady Davis Institute for Medical Research
15	14	Centre for Addiction and Mental Health*	\$49,658	\$58,465	-15.1	\$428.1	13.3	Ontario	Campbell Family Mental Health Research Institute, Research Imaging Centre, Temerty Centre for Therapeutic Brain Intervention
16	16	CHU Sainte-Justine	\$43,200	\$47,700	-9.4	\$205.7	10.0	Quebec	Centre de recherche du CHU Sainte-Justine
17	17	Institut de Cardiologie de Montréal	\$40,621	\$43,396	-6.4	\$527.5	18.5	Quebec	Centre de recherche de l'Institut de Cardiologie de Montréal
18	18	Centre hospitalier universitaire de Sherbrooke (CHUS)	\$35,100	\$32,884	6.7	\$162.5	7.1	Quebec	Centre de recherche clinique Étienne-Le Bel du CHUS
19	19	Institut universitaire de cardiologie et de pneumologie de Québec	\$34,431	\$32,283	6.7	\$260.8	12.7	Quebec	Centre de recherche de l'Institut universitaire de cardiologie et de pneumologie de Québec
20	23	Children's Hospital of Eastern Ontario*	\$28,577	\$21,867	30.7	\$210.1	12.0	Ontario	CHEO Research Institute
21	20	St. Joseph's Healthcare Hamilton* (c)	\$27,715	\$29,700	-6.7	\$271.7	na	Ontario	Firestone Inst. for Respiratory Health, Hamilton Centre for Kidney Research, Programs for Assessment of Technology in Health (PATH) Research Institute
22	21	Winnipeg Regional Health Authority (d)	\$25,305	\$24,702	2.4	\$107.7	1.0	Manitoba	Manitoba Institute of Child Health
23	24	Douglas Mental Health University Institute	\$21,358	\$20,690	3.2	\$381.4	16.1	Quebec	Douglas Hospital Research Centre
24	27	Institut universitaire en santé mentale de Québec	\$19,033	\$17,553	8.4	\$284.1	13.7	Quebec	Centre de recherche de l'Institut universitaire en santé mentale de Québec
25	28	Hôpital Maisonneuve-Rosemont	\$18,845	\$16,228	16.1	\$227.0	4.2	Quebec	Centre de recherche de l'Hôpital Maisonneuve-Rosemont
26	26	Baycrest*	\$18,360	\$18,111	1.4	\$573.8	11.5	Ontario	Rotman Research Institute, Kunin-Lunenfeld Applied & Evaluative Research Unit
27	22	Kingston General Hospital*	\$17,037	\$22,930	-25.7	\$115.1	3.8	Ontario	Kingston General Hospital Research Institute
28	25	Capital District Health Authority	\$16,925	\$18,618	-9.1	\$67.7	1.8	Nova Scotia	
29	29	IWK Health Centre	\$15,000	\$15,041	-0.3	\$45.5	5.8	Nova Scotia	Biomedical Translational Imaging Centre, Canadian Center for Vaccinology, Centre for Pediatric Pain Research
30	31	St. Boniface Hospital	\$12,896	\$11,954	7.9	\$348.5	3.7	Manitoba	St. Boniface Hospital Research Centre
31	32	Women's College Hospital	\$11,076	\$10,896	1.7	\$325.8	10.0	Ontario	Women's College Research Institute
32	33	Hôpital du Sacré-Coeur de Montréal	\$10,404	\$9,359	11.2	\$75.9	3.0	Quebec	Centre de recherche de l'Hôpital du Sacré-Coeur de Montréal
33	36	The Royal	\$9,300	\$7,900	17.7	\$138.8	6.1	Ontario	University of Ottawa Institute of Mental Health Research
34		Institut universitaire de gériatrie de Montréal	\$7,508	\$5,959	26.0	\$139.0	11.6	Quebec	Centre de recherche de l'Institut universitaire de gériatrie de Montréal
35	35	Saskatoon Regional Health Authority	\$7,433	\$8,000	-7.1	\$36.3	0.7	Saskatchewan	Saskatoon Centre for Patient-Oriented Research, Cameco MS Neuroscience Research Centre
36	39	Holland Bloorview Kids Rehabilitation Hospital*	\$7,428	\$7,350	1.1	\$412.7	9.3	Ontario	Bloorview Research Institute
37	38	Thunder Bay Regional Health Sciences Centre	\$6,846	\$7,621	-10.2	\$134.2	2.3	Ontario	Thunder Bay Regional Research Institute
38	34	Bruyère Continuing Care*	\$6,600	\$8,663	-23.8	\$140.4	5.0	Ontario	Bruyère Research Institute
39		Centre de santé et de services sociaux Champlain - Charles-Le Moyne (CSSSCCLM)	\$5,668	\$5,275	7.5	\$149.2	1.5	Quebec	Centre de recherche - Hôpital Charles-Le Moyne
40		Health Sciences North (HSN)	\$5,544	\$3,168	75.0	\$59.0	1.3	Ontario	Advanced Medical Research Institute of Canada

Notes:

- Data were obtained through a survey of research hospitals or from financial statements. Information for Alberta and Newfoundland was not available. Information for Ontario was coordinated in part through CAHO (Council of Academic Hospitals of Ontario); CAHO's 24 research hospitals are working to establish a detailed common research finance and impact reporting framework. Most CAHO members are using this framework to report "Total Research Income" and "Total Researchers who Conduct Research".
- Research income includes all funds (direct and indirect) to support research received from all sources (internal and external). Some members of CAHO (indicated with an asterisk *) provided research expenditure data. Other institutions provided research income data.
- CAHO members report on total faculty-level researchers: Core (75% or more of their time protected for research; had an active research account on March 31, 2013; may be clinicians and PhDs with a primary affiliation with the hospital/university). Non-core (less than 75% of their time protected for research; had an active research account on March 31, 2013; may be clinicians and PhDs with a primary affiliation with the hospital/university.) Postdoctoral fellows and graduate students are not reflected in the core/non-core data.

- Data are provided for the main hospital(s) including their affiliated hospitals and research institutes/centres, where applicable.
- FY2012 figures may have been adjusted as more accurate information became available.

*Member of CAHO. Provided total faculty-level researcher count and research expenditure data for FY2013.

**Based on a head count of researchers/scientists/investigators/clinician-researchers conducting research. Does not include research fellows/post docs, technicians, students or support staff.

na = not available

(a) Research income amounts were combined as these hospitals have one research institute.

(b) As of FY2013, data for the CHUG and CHA are combined as the CHU de Québec

(c) Total hospital income was not available.

(d) Data for St. Boniface Hospital are not included with WRHA.

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Canada's Top 40 Research Hospitals

HOSPITAL RESEARCH RESOURCE GROWTH STALLS

Canada's Top 40 Research Hospitals reported an increase of only 1.1% in their combined research resources¹ in Fiscal 2013, compared with a gain of 4.8% in Fiscal 2012. The hospitals' total research resources grew to \$2.3 billion compared with \$2.28 billion the previous year. The number of hospital researchers fell by -1.0% to 8,240 from 8,323.

Toronto's University Health Network topped the national ranking reporting \$312.3 million of research resources. Hamilton Health Sciences jumped 5 places to 2nd overall on the strength of \$182.1 million of research funding, up from \$123.8 million in Fiscal 2012. The Hospital for Sick Children was in 3rd place with \$179.4 million of funding. In 4th position was the McGill University Health Centre at \$170.5 million, followed by the Ottawa Hospital at \$136.8 million. In total 25 hospitals reported gains in research resources, while numbers fell at 15 other institutions.

THE \$100 MILLION CLUB

With research resources in excess of \$100 million in Fiscal 2013, 9 hospitals gained membership in Research Infosource's \$100 Million Club. Furthermore, their resource

Top 40 - Leading Provinces

Province	% of Total
Ontario (19)	59.2
Quebec (14)	26.8
British Columbia (2)	10.7

growth was far stronger than the average; combined research resources expanded by 4.7% compared with a -4.4% decline among the 31 non-Club members. As a result, Club members accounted for 62.9% of all Top 40 hospital research activity, up from 61.7% of the total last year.

PROVINCIAL PERFORMANCE

Nearly half of the Top 40 Research Hospitals (19 in total) are located in Ontario. (Alberta hospital figures are not available.) Ontario institutions accounted for 59.2% of total Top 40 resources in Fiscal 2013. Ontario hospitals' research resources grew by 3.1% over Fiscal 2012, which surpassed the 1.1% national total. Quebec was home to 14 leading research hospitals, which accounted for 26.8% of total research funding. However, growth was flat in Quebec, expanding by only 0.1%. Two health authorities in British Columbia were responsible for

The \$100 Million Club		
2013 Rank	Research Hospital	Research Income \$000
1	University Health Network*	\$312,300
2	Hamilton Health Sciences	\$182,101
3	Hospital for Sick Children	\$179,373
4	McGill University Health Centre (MUHC)	\$170,498
5	Ottawa Hospital*	\$136,831
6	Provincial Health Services Authority	\$128,101
7	Vancouver Coastal Health Authority	\$117,971
8	London Health Sciences Centre/ St. Joseph's Health Care London*	\$114,595
9	Mount Sinai Hospital, Joseph and Wolf Lebovic Health Complex*	\$109,057

10.7% of the Top 40 research resources total, yet funding fell by -6.0% year over year in BC. In Manitoba, 2 hospitals/authorities accounted for 1.7% of total Top 40 resources. Manitoba institutions enjoyed resource growth of 4.2%, which put Manitoba in the lead nationally. Two hospitals/health authorities in Nova Scotia accounted for 1.4% of the total, but their research resources fell by -5.2% in Fiscal 2013. Finally, one institution in Saskatchewan represented 0.3% of national research funding, but suffered a -7.1% year over year drop.

Top 10 Research Hospitals by Growth				
2013 Rank		Research Hospital	% Change	
Income Growth	Overall		2012-2013	2012-2013
1	40	Health Sciences North (HSN)	75.0	
2	2	Hamilton Health Sciences	47.1	
3	20	Children's Hospital of Eastern Ontario*	30.7	
4	34	Institut universitaire de gériatrie de Montréal	26.0	
5	33	The Royal	17.7	
6	25	Hôpital Maisonneuve-Rosemont	16.1	
7	9	Mount Sinai Hospital, Joseph and Wolf Lebovic Health Complex*	14.6	
8	32	Hôpital du Sacré-Coeur de Montréal	11.2	
9	8	London Health Sciences Centre/ St. Joseph's Health Care London*	11.1	
10	24	Institut universitaire en santé mentale de Québec	8.4	

RESEARCH RESOURCE GROWTH

Health Sciences North is new to the Top 40 list this year, and also reported the strongest gain in Fiscal 2013, posting a 75.0% increase in research resources. Hamilton Health Sciences had an impressive 47.1% increase in research resources, followed by the Children's Hospital of Eastern Ontario (30.7%), Institut universitaire de gériatrie de Montréal (26.0%) and The Royal (17.7%).

THIS YEAR AND NEXT

Fiscal 2013 was somewhat disappointing from the perspective of national hospital research funding growth. The total resources of the Top 40 Research Hospitals expanded by only 1.1%, which lagged the effective rate of inflation. The 2013 result came on the heels of a robust 4.8% gain in research funding in Fiscal 2012. Digging deeper into the data a more complex picture emerges. Larger research hospitals – the 9 members of Research Infosource's \$100 Million Club – fared well, gaining 4.7% in total. Thus, much of the pain was felt among the 31 smaller institutions, where combined research resources fell by -4.4%.

Hospitals in Saskatchewan (-7.1%), British Columbia (-6.0%) and Nova Scotia (-5.2%) felt the brunt of the declines. Quebec hospitals barely avoided a drop in their research funding (0.1% gain). Resource gains of 3.1% at Ontario's 19 research hospitals kept the national increase in positive territory at 1.1% growth.

Research hospitals derive most of their research funding from public sources – federal and provincial governments. Other income sources include companies, charities, endowments and bequests, foreign foundations and governments. Corporate and foreign funding has been weak in recent years. Charitable funding has held up, but is too small to affect trends. At the present time government funding will determine the overall health of hospital research funding.

¹ Some members of CAHO (indicated with an asterisk *) provided research expenditure data. Other institutions provided research income data.

Spotlight on Hospital Research Intensity

TOP RESEARCHER-INTENSIVE HOSPITALS

Rank	Large Hospitals	Researcher Intensity (\$ per Researcher**) \$000	Rank	Mid-sized Hospitals	Researcher Intensity (\$ per Researcher**) \$000
1	Hamilton Health Sciences	\$711.3	1	Mount Sinai Hospital, Joseph and Wolf Lebovic Health Complex*	\$956.6
2	University Health Network*	\$581.6	2	Hospital for Sick Children	\$307.7
3	McGill University Health Centre (MUHC)	\$473.6	3	Sunnybrook Health Sciences Centre*	\$303.5

TOP INCOME-INTENSIVE HOSPITALS

Rank	Large Hospitals	Income Intensity (Research \$ as a % of Total Income)	Rank	Mid-sized Hospitals	Income Intensity (Research \$ as a % of Total Income)
1	University Health Network*	16.2	1	Hospital for Sick Children	24.2
2	McGill University Health Centre (MUHC)	16.1	2	Mount Sinai Hospital, Joseph and Wolf Lebovic Health Complex*	21.7
3	Hamilton Health Sciences	14.8	3	Sir Mortimer B. Davis Jewish General Hospital	14.1

Notes:

1. Large hospitals = total income of \$1 billion or more; Mid-sized = total income between \$400 million and \$1 billion; Small = total income of \$400 million or less.
2. Research income includes all funds (direct and indirect) to support research received from all sources (internal and external). Some members of CAHO (indicated with an asterisk *) provided research expenditure data. Other institutions provided research income data.
3. CAHO members report on total faculty-level researchers: Core (75% or more of their time protected for research; had an active research account on March 31, 2013; may be clinicians and PhDs with a primary affiliation with the hospital/university). Non-core (less than 75% of their time protected for research; had an active research account on March 31, 2013; may be clinicians and PhDs with a primary affiliation with the hospital/university). Postdoctoral fellows and graduate students are not reflected in the core/non-core data.

*Member of CAHO. Provided total faculty-level researcher count and research expenditure data for FY2013.

**Based on a head count of researchers/scientists/investigators/clinician-researchers conducting research. Does not include fellows/post docs, technicians, students or support staff.

PARTNER PERSPECTIVE

CAMH: Leaders in Mental Health Research



Dr. Bruce G. Pollock, MD, PhD
Vice President, Research, Centre for Addiction and Mental Health (CAMH)
Director, Campbell Family Mental Health Research Institute

Two years ago we established CAMH's Campbell Family Mental Health Research Institute, with an aim of better understanding the brain's role in mental illness and addictions. This dedicated focus has had a tangible impact on brain research at CAMH. We've recruited international experts, embarked on

paradigm-shifting lines of research and increased our scientific output.

Yet ongoing challenges face all researchers who study this complex organ – challenges we need to address to make the discoveries that will improve the quality of life for the people we serve.

First is harnessing the full potential of our research. Each high-impact advance we make at CAMH contributes to a greater understanding of the brain. It also generates huge amounts of data. Integrating and sharing this data is now considered essential to make true progress in our collective goal of developing brain-based treatments for mental illness.

The second challenge is translating brain-related discoveries into better clinical care. This process can take years. It requires highly skilled staff to manage large multi-site clinical trials, government regulatory approvals and commercialization efforts.

CAMH is well-positioned to address both of these ongoing challenges.

Our scientists are active in international data-sharing networks. As one notable example, CAMH's Campbell Institute was the only Canadian site involved in one of the most significant schizophrenia genetics studies to date. The study, published in July in *Nature*, identified 108 genetic variations associated with the illness.

Dr. Jo Knight headed CAMH's contribution as part of the international Psychiatric Genomics Consortium. These breakthrough findings, which identified new brain targets for treatment, were only achieved by pooling genetic data from nearly 150,000 individuals by researchers in more than 80 institutions. Ongoing work of the consortium means further discoveries are likely. Strengthening our capacity for data sharing both within CAMH, and with external networks is a priority.

As Canada's leading research hospital on mental illness and addictions, we have significant expertise in moving lab-based research to clinical trials. One model example is the Temerty Centre for Therapeutic Brain Intervention, part of the Campbell Institute. Under the direction of Dr. Jeff Daskalakis, a core team of scientists is using non-invasive brain stimulation techniques to investigate how brain physiology changes in mental illness, and applying these findings to clinical studies.

Brain stimulation holds the greatest hope for people who haven't had success with medications or talk therapy, often after years of trying. For one in three people with depression, current treatments don't work. As clinicians, we call this treatment-resistant illness.

What it means for our patients is a poor quality of life, and a much higher risk of suicide and homelessness. Such patients might be candi-

dates for ECT, which is effective but requires anesthetic, has risks such as long-term memory loss, and a high degree of stigma associated with it.

But there are alternatives. Repetitive transcranial magnetic stimulation (rTMS), a type of brain stimulation, alleviates symptoms in up to 50 per cent of patients with treatment-resistant illness, and many achieve complete remission. Using small coils placed on the scalp, rTMS stimulates neurons in part of the brain thought to be underactive in people with depression with few, if any side-effects. The Temerty Centre is continuing to refine this treatment and apply it to other conditions such as obsessive compulsive disorder and anorexia nervosa.

Through our studies of rTMS and other brain stimulation approaches, we've helped people who've had depression for decades get their lives back, to enjoy their relationships, work and other fulfilling activities.

How do we use our knowledge to improve clinical care more widely? By working with policy-makers to provide greater access to evidence-based treatments. Through collaborating with companies that develop brain stimulation technologies to test if treatment can be more effective. By establishing networks with other experts such as the new Canadian rTMS Treatment and Biomarker Network in Depression (CARTBIND).

These types of activities at the Temerty Centre, and elsewhere in the Campbell Institute, are crucial for progress.

So while we can say with confidence that CAMH's Campbell Mental Health Research Institute has had a successful two years, we're also committed to undertaking these efforts and tackling the ongoing challenges to ensure that our research has a tangible impact in improving people's lives.

PARTNER PERSPECTIVE

A Healthier, Wealthier, Smarter Ontario



Karen Michell
Executive Director
Council of Academic Hospitals of Ontario

The Council of Academic Hospitals of Ontario (CAHO) congratulates this year's top 40 research hospitals in Canada. Research is critical to better health care and Canada's capacity for innovation.

CAHO represents Ontario's 24 research hospitals. Our member hospitals are places of healing. What makes them unique is that they are also places of learning and discovery. CAHO hospitals edu-

cate the next generation of health care providers, and researchers in our hospitals translate knowledge into better patient care by taking research from the bench to the bedside.

How does this make a difference to Canadians? First, it makes us healthier, by constantly improving patient care – discovered here, tested here, and delivered here. Second, it makes us wealthier, by creating new jobs and industries through the commercialization of new discoveries and the global marketing of these discoveries. Ontario's research hospitals invest \$1.2 billion in R&D and employ 16,000 researchers and research staff. This investment stimulates \$3.2 billion in output and supports 36,000 jobs across Ontario. Health research makes

us smarter by driving a knowledge based economy that attracts and engages the brightest minds from here and around the world. Implementing research evidence creates a higher quality and more productive health care system that benefits patients.

None of this happens spontaneously or in a vacuum. It requires the deliberate choice to lead in supporting the unique mission of research hospitals through investment, partnerships and people.

CAHO is calling on all partners in government, health care, education and research to work together to sustain the health research enterprise in Ontario and across Canada and use it to improve health care, reduce health care costs and drive the jobs and growth of tomorrow.

Tackling Grand Challenges Using Innovation

Continued from page 8

For example, JSI, an innovator we support through the Saving Lives at Birth partnership, introduced chlorhexidine for cord care in Nepal, and trained over 30,000 female health volunteers to deliver this live saving innovation to women, who in turn applied chlorhexidine to approximately half a million newborns. Research shows that using chlorhexidine for cord care (a tube of chlorhexidine costs a mere 20 cents) saves one newborn life for each 200 beneficiaries who receive it. That means that 2,700 newborn lives have been saved so far.

In Haiti, Zanmi Lasante is providing treatment and care for depression, psychosis and epilepsy, as well as child and adolescent disorders. This project so far allowed screening for depression of 2,866 individuals and a further 3,408 patients received treatment for epilepsy and depression.

We are learning valuable lessons on how innovation at the interface of public and private sectors can enable impact. Innovation can be taken to scale through public health systems,

social enterprises, small companies with angel investors, through large companies with a shared value approach or by leveraging large companies.

As a recent example, an international group of public and private organizations (Monash University, GSK, McCall MacBain Foundation, Planet Wheeler Foundation and Grand Challenges Canada) collaborated to accelerate the development of an innovative inhaled form of oxytocin. Oxytocin is used to manage postpartum hemorrhage but is currently only available in an injectable form, requiring refrigerated storage conditions, a problem in resource-poor settings. Formulated as a dry powder, inhaled oxytocin would solve storage and delivery issues and grant access to this life-saving drug for many more women in low-resource settings.

Another model is investing in a fund which then creates a portfolio of direct investments. Grand Challenges Canada is an anchor investor into the \$108 million Global Health Investment Fund (GHIF). Earlier this year, the GHIF committed \$5 million USD to support the

final stages of the development of a new oral cholera vaccine. Expanding the supply of high-quality, low-cost oral cholera vaccine will play an important role in increasing vaccination coverage for those most at risk.

A question to be answered is how we can accelerate the quantity and quality of innovations transitioning to scale in a sustainable manner? One solution could be a global innovation marketplace. This marketplace is still at a very early stage but offers the promise of systematically linking promising innovations and innovators with partners who can help them to go to scale.

So what is the next great frontier for innovation in global health? Looking at the rich pipeline of affordable innovations that we have invested in, we realize applicability in Canadian health care. At the moment, most innovation in Canada is slightly better but much more expensive. Effective, low-cost innovation, created in response to a lack of resources and the needs of poor populations in developing nations, could be put to use at home to help to bend the rising healthcare cost curve.

Canada's TOP 50 RESEARCH COLLEGES 2014



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Rank		College	Research Income			Faculty*	Research Intensity	Prov	Main Research Institute/ Centre/Facility
2013	2012		FY2013 \$000	FY2012 \$000	% Change 2012- 2013	2012- 2013 #	\$ per Faculty \$000		
1	5	British Columbia Institute of Technology	\$15,240	\$5,201	193.0	110	\$138.5	BC	Building Science Centre of Excellence
2	2	NAIT - Northern Alberta Institute of Technology	\$9,737	\$6,334	53.7	104	\$93.6	AB	NAIT Boreal Research Institute
3	22	George Brown College	\$9,269	\$2,036	355.3	62	\$149.5	ON	Food & Innovation Research Studio
4	10	Cégep de la Gaspésie et des Îles	\$6,665	\$3,474	91.9	40	\$166.6	QC	Centre d'initiation à la recherche et d'aide au développement durable
5	1	SAIT Polytechnic	\$6,602	\$9,752	-32.3	88	\$75.0	AB	Enerplus Centre for Innovation
6	7	Red River College	\$5,821	\$4,372	33.1	39	\$149.3	MB	Technology Access Centre
7	9	Cégep Édouard-Montpetit (a)	\$5,441	\$3,842	41.6	36	\$151.1	QC	Centre technologique en aérospatiale
8	8	Seneca College	\$4,356	\$4,158	4.8	82	\$53.1	ON	Centre for Development of Open Technology
9	6	Sheridan College	\$4,270	\$4,554	-6.2	62	\$68.9	ON	Screen Industries Research & Training Centre
10	4	Yukon College	\$4,256	\$5,385	-21.0	9	\$472.9	YT	Yukon Research Centre
11	11	Cégep de Trois-Rivières	\$4,057	\$3,306	22.7	54	\$75.1	QC	Centre de métallurgie du Québec
12	13	Niagara College	\$4,036	\$3,246	24.3	67	\$60.2	ON	Niagara College Advanced Manufacturing Innovation Centre
13	12	Centennial College	\$3,941	\$3,277	20.3	72	\$54.7	ON	Applied Research & Innovation Centre
14	17	Cégep André-Laurendeau	\$3,563	\$2,390	49.1	19	\$187.5	QC	OPTECH Montréal
15	26	Cégep de Lévis-Lauzon	\$3,401	\$1,593	113.5	35	\$97.2	QC	Centre de robotique et de vision industrielles
16	33	Cégep de Thetford	\$3,211	\$1,400	129.4	36	\$89.2	QC	Centre de Technologie Minérale et de Plasturgie
17	16	Lambton College	\$3,108	\$2,405	29.2	14	\$222.0	ON	Lambton Water Centre
18	14	La Cité collégiale	\$3,034	\$2,948	2.9	56	\$54.2	ON	Centre de recherche appliquée en biovalorisation
19	15	Grande Prairie Regional College	\$2,962	\$2,556	15.9	25	\$118.5	AB	National Bee Diagnostic Centre
20	46	Lakeland College	\$2,613	\$640	308.3	5	\$522.6	AB	Centre for Sustainable Innovation
21	24	Cégep de Saint-Jérôme	\$2,515	\$1,852	35.8	19	\$132.4	QC	Centre de développement des composites du Québec
22	19	Mohawk College	\$2,434	\$2,245	8.4	10	\$243.4	ON	iDeaWORKS
23	18	Justice Institute of British Columbia	\$2,413	\$2,310	4.5	20	\$120.7	BC	Centre for Resilient Communities
24	42	Humber College	\$2,393	\$982	143.7	25	\$95.7	ON	
25	25	Durham College	\$2,282	\$1,691	34.9	37	\$61.7	ON	
26	34	Collège de Maisonneuve	\$2,150	\$1,352	59.0	29	\$74.1	QC	Centre d'études des procédés chimiques du Québec
27	23	Olds College	\$2,018	\$1,956	3.2	25	\$80.7	AB	Olds College Centre for Innovation
28	21	Nova Scotia Community College	\$2,013	\$2,117	-4.9	64	\$31.5	NS	Applied Geomatics Research Centre
29	36	Fleming College	\$1,934	\$1,224	58.0	24	\$80.6	ON	Centre for Alternative Wastewater Treatment
30	29	Conestoga College	\$1,903	\$1,530	24.4	69	\$27.6	ON	Centre for Entrepreneurship
31	31	Algonquin College	\$1,881	\$1,471	27.9	52	\$36.2	ON	Design Centre
32	27	Collège Shawinigan	\$1,842	\$1,561	18.0	13	\$141.7	QC	Centre National en Électrochimie et en Technologies Environnementales
33	41	Collège communautaire du Nouveau-Brunswick	\$1,723	\$1,037	66.2	22	\$78.3	NB	Centre pré-commercial de technologies en bioprocédés
34	32	Cégep de Sainte-Foy	\$1,549	\$1,410	9.9	28	\$55.3	QC	Centre d'enseignement et de recherche en foresterie de Sainte-Foy
35		Cégep de La Pocatière	\$1,513	\$2,196	-31.1	17	\$89.0	QC	Biopterre
36	37	Cambrian College	\$1,490	\$1,117	33.4	22	\$67.7	ON	Northern Ontario Assessment Resource Centre
37		Camosun College	\$1,397	\$1,151	21.4	15	\$93.1	BC	Camosun Technology Access Centre
38	38	Red Deer College	\$1,388	\$1,103	25.8	65	\$21.4	AB	Centre for Innovation in Manufacturing
39	50	Cégep de Rimouski	\$1,293	\$450	187.3	14	\$92.4	QC	Service de recherche et d'expertise en transformation des produits forestiers
40	49	Saskatchewan Polytechnic (b)	\$1,281	\$503	154.7	53	\$24.2	SK	Saskatchewan Polytechnic BioScience Applied Research Centre
41	3	College of the North Atlantic	\$1,107	\$6,026	-81.6	13	\$85.2	NL	Applied Entomology Lab
42		Bow Valley College	\$1,103	\$1,223	-9.8	21	\$52.5	AB	
43	40	St. Lawrence College	\$1,080	\$1,062	1.7	20	\$54.0	ON	Sustainable Energy Applied Research Centre
44	35	Cégep de Sherbrooke	\$1,073	\$1,301	-17.5	27	\$39.7	QC	Centre de productique intégrée du Québec
45	39	Lethbridge College	\$1,026	\$1,076	-4.6	26	\$39.5	AB	Aquaculture Centre of Excellence
46	47	Holland College	\$969	\$622	55.8	35	\$27.7	PE	Canada's Smartest Kitchen
47	44	Dawson College	\$957	\$824	16.1	19	\$50.4	QC	Ctr. de recherche pour l'inclusion scolaire et professionnelle des étudiants en situation de handicap
48	45	Cégep de Sept-Îles	\$878	\$675	30.1	19	\$46.2	QC	Institut technologique de maintenance industrielle
49		Collège d'Alma	\$865	\$740	16.9	16	\$54.1	QC	Agrinova
50		Fanshawe College	\$700	\$1,130	-38.1	40	\$17.5	ON	Centre for Sustainable Energy & Environments

Notes:

- Research income includes all funds (direct and indirect) to support applied and scholarly research received from all sources to the organization (internal and external).
- Data were obtained through a survey of publicly-funded colleges and from financial statements.
- Data are provided for the main college including affiliated research institutes/centres, where applicable.
- FY2012 figures may have been adjusted as more accurate information became available.

*Head count of faculty/teaching staff and/or dedicated researchers conducting research. Does not include support staff or student researchers.

(a) Formerly named Collège Édouard-Montpetit.

(b) Formerly named SIAST - Saskatchewan Institute of Applied Science and Technology.

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Canada's Top 50 Research Colleges

RESEARCH ON A RAPID GROWTH PATH

Canada's Top 50 Research Colleges maintained a rapid pace of growth, posting a 30.8% increase in combined Fiscal 2013 research income to \$152.8 million, up from \$116.8 million the year before. The number of faculty involved in research expanded by 10.6% to 1,874 from 1,694 the prior year. As a result, Fiscal 2013 research intensity – research income per faculty – expanded by 18.2% to \$81,500 from \$69,000 in Fiscal 2012.

British Columbia Institute of Technology headed the Top 50 list by attracting \$15.2 million of research income, followed by Northern Alberta Institute of Technology (NAIT) at \$9.7 million and George Brown College at \$9.3 million. Cégep de la Gaspésie et des Îles (\$6.7 million), SAIT Polytechnic (\$6.6 million), Red River College (\$5.8 million), Cégep Édouard-Montpetit (\$5.4 million), Seneca College (\$4.4 million), Sheridan College (\$4.3 million) and Yukon College (\$4.3 million) rounded out the top 10 colleges.

PROVINCIAL PERFORMANCE

On a provincial basis, Ontario's 16 colleges accounted for 31.5% of total Top 50 research income (\$48.1 million). They were followed by 16 colleges in Quebec, which recorded 26.8% of the total (\$41.0 million) and 8 colleges in Alberta, which were responsible for 18.0% of national research income (\$27.4 million).

Top 50 – Leading Provinces

Province	Average \$ (millions)	% of Total
Ontario (16)	\$3.00	31.5
Quebec (16)	\$2.56	26.8
Alberta (8)	\$3.43	18.0

British Columbia institutions led their peers by recording an average of \$6.35 million each of research income. Second on the list was Manitoba, where its lead research college – Red River College – attracted \$5.82 million of income. Yukon College pushed that territory into 3rd place by attracting \$4.26 million of research income.

INCOME GROWTH LEADERS

Ten colleges exhibited very high growth in income. George Brown College saw its research income expand by more than three times (355.3%). Lakeland College (308.3% increase) and British Columbia Institute of Technology (193.0% increase) led the pack in income growth. Five other colleges had income growth in excess of 100%. These figures reflect the effects of both real income growth and a move towards improved income reporting.

RESEARCH INTENSITY

Average Top 50 research intensity – research income per faculty – advanced by 18.2% to \$81,500 in Fiscal 2013. This follows a 13.4% intensity improvement from \$69,000 in Fiscal 2012. Twenty-two of the 50 research colleges posted research intensities higher than the national average.

Lakeland College topped the intensity ranking with \$522,600 per researcher, followed by Yukon College (\$472,900), Mohawk College (\$243,400), Lambton College (\$222,000) and Cégep André-Laurendeau (\$187,500).

THIS YEAR AND NEXT

This is the second year that Research Infosource has reported on the research income of Canada's research colleges. Data reporting and data consistency are improving, and we thank the colleges for their cooperation.

As this year's data clearly show, Canada's colleges are expanding their role in research. Thanks in large measure to increased funding by federal and provincial governments and continuing support from industry, more resources are being made available and colleges are responding. As a result (see *Spotlight on College*

Top 10 Research Intensive Colleges

2013 Rank	Research Intensity Overall	Research College	Research Intensity (\$ per faculty) \$000
1	20	Lakeland College	\$522.6
2	10	Yukon College	\$472.9
3	22	Mohawk College	\$243.4
4	17	Lambton College	\$222.0
5	14	Cégep André-Laurendeau	\$187.5
6	4	Cégep de la Gaspésie et des Îles	\$166.6
7	7	Cégep Édouard-Montpetit (a)	\$151.1
8	3	George Brown College	\$149.5
9	6	Red River College	\$149.3
10	32	Collège Shawinigan	\$141.7

(a) Formerly named Collège Édouard-Montpetit.

Research Activity) the number of research partnerships and projects with external organizations is growing rapidly. So too is the number of college researchers involved.

College research tends to be applied; it is focussed on meeting the needs of local companies and organizations. From a national innovation perspective college research provides a valuable complement to university research, much of which is curiosity-driven. Students comprise the

Top 10 Research Colleges by Growth

2013 Rank	Income Growth	Research College	% Change 2012-2013
1	3	George Brown College	355.3
2	20	Lakeland College	308.3
3	1	British Columbia Institute of Technology	193.0
4	39	Cégep de Rimouski	187.3
5	40	Saskatchewan Polytechnic (b)	154.7
6	24	Humber College	143.7
7	16	Cégep de Thetford	129.4
8	15	Cégep de Lévis-Lauzon	113.5
9	4	Cégep de la Gaspésie et des Îles	91.9
10	33	Collège communautaire du Nouveau-Brunswick	66.2

(b) Formerly named SIAST - Saskatchewan Institute of Applied Science and Technology.

bulk of the research workforce at colleges, and student involvement in research is also growing. This hands-on involvement provides students with a better understanding of research tools and methods and makes them more valuable employees. This represents a real win-win situation for colleges, students, employers ... and the economy.

Spotlight on College Research Activity

TOP COLLEGES BY # OF PARTNERSHIPS*

Rank	Large Colleges	Partnerships #	Rank	Mid-sized Colleges	Partnerships #	Rank	Small Colleges	Partnerships #
1	Algonquin College	120	1	Olds College	55	1	Collège d'Alma	109
2	George Brown College	101	2	Cégep Édouard-Montpetit (a)	53	2	Cégep de Thetford	83
3	British Columbia Institute of Technology	100	3	Bow Valley College	45	3	Collège Shawinigan	27
			3	La Cité collégiale	45			

TOP COLLEGES BY # OF COMPLETED PROJECTS*

Rank	Large Colleges	Completed Projects #	Rank	Mid-sized Colleges	Completed Projects #	Rank	Small Colleges	Completed Projects #
1	Algonquin College	180	1	La Cité collégiale	62	1	Collège d'Alma	147
2	George Brown College	91	2	Cégep Édouard-Montpetit (a)	58	2	Cégep de Thetford	81
2	Sheridan College	91	3	Cégep de Trois-Rivières	41	3	Cégep de la Gaspésie et des Îles	61
3	NAIT - Northern Alberta Institute of Technology	67	3	Collège communautaire du Nouveau-Brunswick	41			

Notes:

Large college = total income of \$100 million or more; Mid-sized = total income between \$50 million and \$100 million; Small = total income of \$50 million or less.

*Research partnerships and completed projects with external organizations in FY2012-2013 that were governed by formal written agreements. Includes research contracts and collaborative research agreements. Does not include research grants.

(a) Formerly named Collège Édouard-Montpetit.

PARTNER PERSPECTIVE



Dr. Darren Lawless
Dean of Undergraduate Research
Sheridan

As Dean of Undergraduate Research, I've had the opportunity over the past several years to see firsthand how Sheridan's Centres of Expertise and curriculum-based research programs have created a wellspring of new ideas, technology development, and training for both small- and medium-sized enterprises (SMEs) and leading corporations. Our mission is to help Canada create a prosperous culture of innovation by enriching both the current and future workforce.

The Centre for Advanced Manufacturing and Design Technologies (CAMDT), located at our Davis Campus in Brampton, Ontario, is an exemplar of Sheridan's growing role as a hub for students, industry partners and faculty expertise. Offering SMEs a "technology playground" to help them develop and adopt

Building Community Innovation from the Inside and Out

new technology alongside Sheridan researchers, CAMDT is turning Brampton into a 'hub'-urb – a vibrant place where experts come together, ideas collide, and innovation flourishes.

As a response to Canada's continued challenge to fuel innovation, CAMDT is embracing a new research and development model that is being realized through a shared commitment to transfer best practices to the regional manufacturing community. This model ensures long-term involvement of industry leaders that is directly linked to helping fellow manufacturers adapt, develop, and commercialize new technology.

Under the visionary leadership of CAMDT Director Dr. Farzad Rayegani, the Centre now acts as the central link between large, leading corporations that provide the technology and expertise to the College, and the local SMEs that explore how to integrate these new tools into their businesses with the help of Sheridan's faculty and student researchers. This approach

allows the College and its innovation collaborators to address the challenges of the industry, but also helps to produce graduates with the skills required to make an immediate and positive impact on the workforce.

Through undergraduate research projects – which involve students, faculty advisors and staff working together to solve a particular challenge for an industry partner – Sheridan has become established as a respected community partner in manufacturing, with a track record of helping clients succeed through creative thinking. Since 2012, CAMDT has worked with over 40 companies in addition to conducting more than 20 energy/engineering assessments, all while ensuring the knowledge developed is transferred to partners through consulting and training.

Insights from each project then feed back into the student researchers' learning experience. These hands-on opportunities support Sheridan's approach to engineering education as members of the world-

wide Conceive, Design, Implement and Operate (CDIO) initiative.

Through multi-year partnerships with industry leaders like Cimatrix and ABB, who share a commitment to enriching the local manufacturing sector, CAMDT now makes a suite of advanced technology accessible to its SME research partners as a way of furthering technology adoption. Thanks to significant commitments of cash and in-kind contributions from each of these collaborators, CAMDT can help local manufacturers explore emerging tools that could make them more productive, more sustainable, and more competitive.

For example, a recent partnership with Cimatrix brought a state-of-the-art additive manufacturing (3D printing) lab to the Centre enabling the new Product Innovation Lab to become a cornerstone of the Centre's activity, providing an effective solution for local SMEs looking to transform their ideas into prototypes at a fraction of the conventional cost. Further, Sheridan partnered with Canadian Manufacturers & Exporters (CME) to launch Canada Makes,

a national network of excellence dedicated to promoting the development of additive manufacturing in Canada.

"CAMDT is one of the most advanced applied research labs in Canada and it has the latest technologies and software in the field of Fused Deposition Modeling (FDM). We are proud to help make this state-of-the-art laboratory available to SMEs across the country," said CME President and CEO Jayson Myers. CME and Sheridan will collaborate on a series of workshops, demonstrations, and customized projects with SME partners.

CAMDT's technology transfer capacity was also recently enhanced once through the launch of the CAMDT-ABB Robotics Centre, another multi-year collaboration. The new robotics facility features over 12 robots with capabilities including: welding; picking, packing and palletizing; machine tending; material handling and product assembly; and advanced vision-related programming.

"Keeping pace with global

manufacturing demands starts with the education of the Canadian workforce. The CAMDT-ABB Robotics Centre is about creating opportunities for our students to work with industry on client projects using these state-of-the-art tools, but it's also about transferring knowledge to industry partners through training and consulting that may be difficult for them to access otherwise," said Dr. Rayegani.

Through the dedication of our faculty, staff, and students at CAMDT, Sheridan is becoming more than an innovation partner in manufacturing – we're becoming true innovation catalysts. By bringing industry partners into the classroom, we ensure that our students work on real, interdisciplinary problems that challenge them to be creative as they prepare to enter the workforce. And through long-term partnerships with industry leaders we bring Sheridan's state-of-the-art spaces for R&D out to industry in order to link regional SMEs to the tools, knowledge and support they need to make groundbreaking ideas a reality.

Turn ideas into innovations

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Creativity isn't just for artists anymore. Partner with Sheridan and use our creative campus for prototypes, feasibility studies, commercialization strategies and skills upgrading.

Sheridan | Get Creative

Canadian Colleges and International Research



Marc Nantel, PhD, P.Phys.
Associate Vice-President –
Research & Innovation
Niagara College Canada

Which type of project is favoured by each post-secondary institution is likely to vary, and highlight the different roles that colleges and universities can play in international research. For Niagara College's Research & Innovation Division, the order of priority follows the list from 1) to 4).

Niagara College has had success in developing and conducting international research projects throughout the world. Three examples from Korea, Brazil, Argentina are outlined below.

In 2006-8, Niagara College partnered with an Ontario company and HOSEO University in South Korea to develop organic light-emitted devices (OLEDs). The devices were built at the college by our Photonics students and faculty in collaboration with our industry partner, and were tested in equipment simulating accelerated aging conditions in Korea. There were two-way exchanges of students, a new product was developed, and the Canadian industry partner was able to access highly specialized, difficult-to-find test equipment. This work was funded by the Ontario Centres of Excellence and the South Korean government.

More recently, we were the first college in Canada to receive funding from the International Development Research Centre (IDRC) for the Mulheres Mil project. The project's objective was to bring education and training to 1,000 under-privileged Brazilian women (and was then expanded by Brazilian President Lula to 100,000 women). Niagara College led the project to develop a sustainable framework and methods of evaluating the impact of the program, as well as to conduct workshops to train the Brazilians who would be administering it. This two-year project was a resounding success, with 7 Niagara College staff and students working in Brazil with our partners and contributing to a better life for these Brazilian women.

A final example involves the need to feed the world's ever-increasing population with our limited resources. Dr. Mike Duncan, Niagara

College's NSERC Industrial Chair in Precision Agriculture and Environmental Technologies, is working with companies in Ontario and in Argentina on improving the yield of grain crops, like corn, wheat and soy. By devising methods to better address a grower's field, Dr. Duncan is reducing the cost to the farmer and increasing the bounty from the ground, while minimizing unwanted fertilizer run-offs that can lead to algae blooms and dangerously affect biodiversity. Because the growing seasons in the northern and southern hemispheres are opposite, the work in Argentina enables Dr. Duncan and his research team to test their solutions twice as frequently as if they were only being implemented in Canada. Dr. Duncan's work has been noticed by scientists associated with the Food and Agriculture Organization of the United Nations, and could bring great relief in more challenging zones such as sub-Saharan Africa.

Niagara College and its partners have been fortunate to reap the benefits of international research collaborations: student exchanges, access to world-class equipment for our local partners, help for other countries in need, an acceleration of some of our research, and making the world a better place. Our students are getting crucial international experience, helping make them "world ready" upon graduation, and our faculty are afforded interesting development experiences.

International research for Canadian colleges continues to evolve. The Canadian Bureau of International Education (CBIE) and Colleges and Institutes Canada (CICan) are working to promote new opportunities.

International research and partnerships can be challenging. This is why it is important to choose one's international partners carefully and to stick to a manageable number of institutions or countries. A key consideration for Niagara College is the benefit to our students, faculty and local industry partners. Although the work in finding the right international project may seem daunting, the rewards are worth the hard work.

COLLEGES AND POLYTECHNICS: Enhancing Collaboration Globally



Joe Boyd
Program Head, Applied Research
Liaison Office
British Columbia Institute of
Technology (BCIT)

also 25 years of providing applied research and innovation services to industry and the community.

When BCIT opened its doors in October 1964, 498 students were on campus, in Engineering, Health and Business. We have grown one hundred fold in the 50 years since, to over 48,000 students on 5 campuses, earning practical career credentials designed for the workplace which span Applied and Natural Sciences, Business and Media, Computing and Information Technology, Engineering, Health Sciences and Trades.

BCIT has also grown beyond its Burnaby campus, with five main campuses and satellite locations province wide. Beyond our provincial borders also: BCIT's international partnerships span training, education and research initiatives in South America, Central America,

East Asia and Eastern Europe.

Many other Canadian colleges and polytechnics have shown a similar growth pattern in students and disciplines, and are also expanding into international markets. The Canadian college and polytechnic model is an applied education and training model that produces career ready graduates, enables the transfer of knowledge and skills, and enhances collaboration with foreign educational institutions and industry partners across the globe.

This model is receiving increasing international recognition. Recently BCIT and several other BC colleges hosted a delegation of education leaders from Asia who came to study our applied model of education and research. Why? Their government

BCIT is honoured to be recognized as Canada's top research college this year. This is a milestone year for us to receive this recognition, as 2014 marks BCIT's 50th anniversary, and

Continued on page 15

The science behind the smiles

Red River College's research experts, in collaboration with Canadian and international partners, developed the Science of Early Child Development (SECD), an innovative multimedia resource used by countries around the world.

SECD promotes understanding of the profound importance of the early years of life, helping to improve outcomes for children and creating a better future for everyone.

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Canada's TOP 100 CORPORATE R&D SPENDERS 2014

Rank		Company	R&D Spending			Revenue	Research Intensity	Industry
2013	2012		FY2013 \$000	FY2012 \$000	% Change 2012-2013	FY2013 \$000	R&D as % of Revenue***	
1	1	Bombardier Inc.*	\$2,193,719	\$1,900,240	15.4	\$18,693,984	11.7	Aerospace
2	2	BlackBerry Limited* **	\$1,324,470	\$1,508,396	-12.2	\$7,016,810	18.9	Comm/Telecom Equipment
3	6	Magna International Inc.*	\$576,752	\$514,794	12.0	\$35,877,082	1.6	Automotive
4	3	BCE Inc.	\$575,400	\$576,100	-0.1	\$20,400,000	2.8	Telecommunications Services
5	5	Pratt & Whitney Canada Corp. (fs)	\$544,782	\$526,984	3.4	nd	nd	Aerospace
6	4	IBM Canada Ltd. (fs)	\$492,000	\$540,000	-8.9	nd	nd	Software & Computer Services
7	8	Rogers Communications Inc.	\$394,000	\$346,000	13.9	\$12,706,000	3.1	Telecommunications Services
8	10	Canadian Natural Resources Limited	\$390,000	\$270,000	44.4	\$16,145,000	2.4	Energy/Oil & Gas
9	7	Atomic Energy of Canada Limited	\$353,600	\$384,100	-7.9	\$184,000	192.2	Engineering Services
10	9	Ericsson Canada Inc. (fs)	\$318,000	\$325,000	-2.2	nd	nd	Comm/Telecom Equipment
11	29	CGI Group Inc.	\$252,116	\$95,449	164.1	\$10,084,624	2.5	Software & Computer Services
12	13	Apotex Inc.	\$222,439	\$207,745	7.1	\$1,779,586	12.5	Pharmaceuticals/Biotechnology
13	12	Cenovus Energy Inc.	\$213,000	\$264,000	-19.3	\$18,657,000	1.1	Energy/Oil & Gas
14	11	AMD Canada (fs)	\$211,000	\$265,702	-20.6	\$450,000	46.9	Electronic Systems & Parts
15	14	Imperial Oil Limited	\$199,000	\$201,000	-1.0	\$32,722,000	0.6	Energy/Oil & Gas
16	21	Constellation Software Inc.*	\$190,554	\$128,769	48.0	\$1,246,996	15.3	Software & Computer Services
17	18	Synocrude Canada Ltd.	\$185,165	\$157,200	17.8	nd	nd	Energy/Oil & Gas
18	15	General Motors of Canada Limited* (fs)	\$182,089	\$186,425	-2.3	nd	nd	Automotive
19	17	Open Text Corporation*	\$168,916	\$168,975	0.0	\$1,404,120	12.0	Software & Computer Services
20	33	Valeant Pharmaceuticals International, Inc.*	\$161,473	\$79,020	104.3	\$5,942,202	2.7	Pharmaceuticals/Biotechnology
21	16	TELUS Corporation	\$161,000	\$170,000	-5.3	\$11,404,000	1.4	Telecommunications Services
22	22	BRP Inc.**	\$144,900	\$128,200	13.0	\$3,194,100	4.5	Transportation
23	19	CAE Inc.	\$144,096	\$144,389	-0.2	\$2,104,500	6.8	Aerospace
24	24	Sanofi (fs) (a)	\$129,100	\$122,408	5.5	\$647,607	19.9	Pharmaceuticals/Biotechnology
25	26	GlaxoSmithKline Inc. (fs)	\$118,224	\$112,266	5.3	\$891,943	13.3	Pharmaceuticals/Biotechnology
26	25	Ontario Power Generation Inc.	\$117,000	\$113,000	3.5	\$4,863,000	2.4	Electrical Power & Utilities
27	36	MacDonald, Dettwiler and Associates Ltd.	\$116,602	\$71,340	63.4	\$1,818,984	6.4	Software & Computer Services
28	27	Hydro-Québec	\$100,000	\$100,000	0.0	\$12,881,000	0.8	Electrical Power & Utilities
29	32	Cisco Canada (fs)	\$94,554	\$87,600	7.9	nd	nd	Comm/Telecom Equipment
30	35	Westport Innovations Inc.*	\$94,517	\$74,010	27.7	\$168,939	55.9	Transportation
31	30	PMC-Sierra Ltd.* (fs)	\$82,278	\$90,345	-8.9	\$133,601	61.6	Electronic Systems & Parts
32	34	Amgen Canada Inc. (fs)	\$79,963	\$74,215	7.7	nd	nd	Pharmaceuticals/Biotechnology
33	31	Pfizer Canada Inc. (fs)	\$78,324	\$89,920	-12.9	\$1,333,901	5.9	Pharmaceuticals/Biotechnology
34	39	Sierra Wireless, Inc.*	\$78,253	\$64,320	21.7	\$455,078	17.2	Comm/Telecom Equipment
35	40	Janssen Inc. (fs)	\$67,430	\$64,053	5.3	\$1,448,667	4.7	Pharmaceuticals/Biotechnology
36	44	Linamar Corporation	\$64,274	\$53,526	20.1	\$3,595,489	1.8	Automotive
37	43	Mitel Networks Corporation*	\$57,366	\$58,577	-2.1	\$594,158	9.7	Comm/Telecom Equipment
38	42	EXFO Inc.*	\$55,959	\$59,258	-5.6	\$249,394	22.4	Medical Devices & Instrumentation
39	20	Vale Canada Limited (fs)	\$54,000	\$132,000	-59.1	\$5,903,000	0.9	Mining & Metals
40	49	Evertz Technologies Limited	\$52,851	\$44,200	19.6	\$316,305	16.7	Comm/Telecom Equipment
41	45	Teledyne DALSA, Inc. (fs)	\$51,400	\$52,700	-2.5	\$243,100	21.1	Electronic Systems & Parts
42	48	NOVA Chemicals Corporation* (fs)	\$50,466	\$44,982	12.2	\$5,435,890	0.9	Chemicals & Materials
43	46	SMART Technologies Inc.*	\$50,271	\$51,794	-2.9	\$607,001	8.3	Computer Equipment
44	51	Trican Well Service Ltd.	\$48,700	\$43,522	11.9	\$2,115,472	2.3	Energy/Oil & Gas
45	50	Novelis Inc.* (fs)	\$47,376	\$43,982	7.7	\$10,105,524	0.5	Mining & Metals
46		Eli Lilly Canada Inc. (fs)	\$46,724	\$46,457	0.6	nd	nd	Pharmaceuticals/Biotechnology
47	23	Encana Corporation**	\$42,707	\$126,758	-66.3	\$6,033,241	0.7	Energy/Oil & Gas
48	55	Pharmascience Inc.	\$42,455	\$35,994	18.0	\$720,763	5.9	Pharmaceuticals/Biotechnology
49	47	SNC-Lavalin Group Inc.	\$39,900	\$47,168	-15.4	\$7,913,200	0.5	Engineering Services
50	53	Cascades Inc.	\$39,213	\$42,290	-7.3	\$3,849,000	1.0	Forest & Paper Products
51	58	Huawei Canada (fs)	\$35,900	\$32,470	10.6	\$264,600	13.6	Comm/Telecom Equipment
52		Redknee Solutions Inc.*	\$35,452	\$9,379	278.0	\$146,296	24.2	Software & Computer Services
53	67	Bayer Inc. (fs)	\$33,897	\$23,743	42.8	\$755,856	4.5	Pharmaceuticals/Biotechnology
54	62	Dorel Industries Inc.*	\$33,889	\$28,713	18.0	\$2,508,305	1.4	Other Manufacturing
55	59	Total E&P Canada Ltd. (fs)	\$33,000	\$32,000	3.1	nd	nd	Energy/Oil & Gas
56	54	Cangene Corporation* +	\$31,457	\$41,873	-24.9	\$131,125	24.0	Pharmaceuticals/Biotechnology
57	56	Martinrea International Inc.	\$31,449	\$35,827	-12.2	\$3,221,881	1.0	Automotive
58	68	Enghouse Systems Limited	\$31,149	\$23,266	33.9	\$179,886	17.3	Software & Computer Services
59	76	Resverlogix Corp.*	\$29,668	\$19,730	50.4	\$0	\$0	Pharmaceuticals/Biotechnology
60	66	Monsanto Canada Inc. (fs)	\$27,451	\$24,085	14.0	\$625,861	4.4	Agriculture & Food
61	70	Pason Systems Inc.	\$27,252	\$22,467	21.3	\$403,088	6.8	Software & Computer Services
62	52	Thales Canada Inc. (fs)	\$26,951	\$43,300	-37.8	\$424,014	6.4	Electronic Systems & Parts
63	72	Descartes Systems Group Inc.* **	\$26,655	\$21,260	25.4	\$155,820	17.1	Software & Computer Services
64		TransCanada Corporation	\$23,911	\$7,868	203.9	\$8,797,000	0.3	Energy/Oil & Gas
65	82	Trimel Pharmaceuticals Corporation*	\$23,359	\$17,060	36.9	\$0	\$0	Pharmaceuticals/Biotechnology
66	71	AEterna Zentaris Inc.*	\$22,461	\$21,463	4.6	\$76,748	29.3	Pharmaceuticals/Biotechnology
67	81	Tekmira Pharmaceuticals Corporation*	\$22,100	\$18,032	22.6	\$15,927	138.8	Pharmaceuticals/Biotechnology
68	57	DragonWave Inc.* **	\$20,545	\$34,006	-39.6	\$92,704	22.2	Comm/Telecom Equipment
69	87	Resolute Forest Products Inc. (fs)	\$20,400	\$16,500	23.6	\$2,970,000	0.7	Forest & Paper Products
70		ProMetic Life Sciences Inc.	\$19,520	\$11,267	73.2	\$20,644	94.6	Pharmaceuticals/Biotechnology
71	64	QLT Inc.*	\$19,063	\$24,568	-22.4	\$0	\$0	Pharmaceuticals/Biotechnology
72	61	Oncolytics Biotech Inc.	\$18,506	\$31,403	-41.1	\$0	\$0	Pharmaceuticals/Biotechnology
73	91	IMRIS Inc.*	\$18,356	\$14,550	26.2	\$47,419	38.7	Medical Devices & Instrumentation
74	78	Teck Resources Limited	\$18,000	\$19,000	-5.3	\$9,382,000	0.2	Mining & Metals
75	89	Celestica Inc.*	\$17,921	\$15,194	17.9	\$5,969,489	0.3	Electronic Systems & Parts
76	60	Sandvine Corporation*	\$17,781	\$31,577	-43.7	\$109,727	16.2	Comm/Telecom Equipment
77	74	ViXS Systems Inc.* **	\$17,715	\$20,492	-13.6	\$31,309	56.6	Electronic Systems & Parts
78	84	Tembec Inc.	\$17,692	\$17,010	4.0	\$1,534,000	1.2	Forest & Paper Products
79	77	Ballard Power Systems Inc.*	\$17,629	\$19,265	-8.5	\$63,083	27.9	Machinery
80		Northland Power Inc.	\$17,512	\$13,714	27.7	\$557,238	3.1	Electrical Power & Utilities
81	73	Bioniche Life Sciences Inc.	\$16,767	\$20,549	-18.4	\$82	\$82	Pharmaceuticals/Biotechnology
82	79	Xerox Canada Inc. (fs)	\$16,641	\$18,100	-8.1	\$1,139,062	1.5	Machinery
83	93	Bauer Performance Sports Ltd.*	\$16,536	\$13,909	18.9	\$411,547	4.0	Other Manufacturing
84	88	MEGA Brands Inc.*	\$15,849	\$16,212	-2.2	\$416,846	3.8	Other Manufacturing
85	99	ShawCor Ltd.	\$15,687	\$12,242	28.1	\$1,847,549	0.8	Other Manufacturing
86		IMAX Corporation*	\$15,213	\$11,406	33.4	\$296,551	5.1	Medical Devices & Instrumentation
87	75	AstraZeneca Canada Inc. (fs)	\$15,116	\$19,773	-23.6	\$623,241	2.4	Pharmaceuticals/Biotechnology
88	63	Miranda Technologies, a Belden Brand* + (fs)	\$14,777	\$25,700	-42.5	\$42,985	34.4	Comm/Telecom Equipment
89	100	Computer Modelling Group Ltd.	\$14,364	\$12,100	18.7	\$68,620	20.9	Software & Computer Services
90	95	Hydro One Inc.	\$13,980	\$12,950	8.0	\$6,074,000	0.2	Electrical Power & Utilities
91	92	Wipac Ltd.*	\$13,487	\$13,927	-3.2	\$736,256	1.8	Rubber & Plastics
92	90	Nexj Systems Inc.	\$13,448	\$15,156	-11.3	\$27,314	49.2	Software & Computer Services
93		Mediagrif Interactive Technologies Inc.	\$12,267	\$11,168	9.8	\$61,335	20.0	Software & Computer Services
94	94	Canadian Solar Inc.*	\$12,035	\$12,993	-7.4	\$1,703,846	0.7	Other Manufacturing
95		Absolute Software Corporation*	\$11,771	\$11,739	0.3	\$85,666	13.7	Software & Computer Services
96		Avigilon Corporation	\$11,770	\$6,410	83.6	\$178,344	6.6	Computer Equipment
97	83	Rio Tinto Iron & Titanium Inc. (fs)	\$11,744	\$17,057	-31.1	\$1,144,216	1.0	Mining & Metals
98		Halogen Software Inc.*	\$11,226	\$9,310	20.6	\$49,419	22.7	Software & Computer Services
99	96	COM DEV International Ltd.	\$9,939	\$12,839	-22.6	\$215,449	4.6	Comm/Telecom Equipment
100		PNI Digital Media Inc.+	\$9,908	\$9,679	2.4	\$20,899	47.4	Software & Computer Services

Notes:
1. Data were obtained through annual reports, financial statements, securities commission filings, or through a survey.
2. We have attempted, wherever possible, to provide gross R&D spending before deduction of investment tax credits or government grants.
3. We have attempted, wherever possible, to provide revenue net of interest and investment income.
4. FY2012 R&D spending figures may have been adjusted as more accurate information became available.
5. Canadian-owned company results include worldwide revenue and R&D spending; foreign subsidiaries (fs) include revenue and R&D spending for their Canadian operations only.

*Converted to CDN\$ at annual average 2013 = 1.0299, 2012 = 0.9996 (Bank of Canada)
**Revenue reported in US\$ and R&D spending was reported in CDN\$
***\$1 million or more of revenue
+Not current name/acquired/merged
++Fiscal 2014 results were used for year-ended January or February
fs = Foreign subsidiary (includes revenue and R&D spending for Canadian operations only)
nd = Not disclosed
(a) Sanofi Pasteur Limited and sanofi-aventis Canada Inc. (including Genzyme Canada)
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Canada's Top 100 Corporate R&D Spenders

CORPORATE R&D SPENDING ON A MODERATE GROWTH PATH

In Fiscal 2013, Canada's Top 100 Corporate R&D Spenders increased their combined research outlay by a respectable 4.1% to \$12.5 billion from \$12.0 billion in Fiscal 2012. However Top 100 growth failed to keep pace with revenue growth, which expanded by 7.0% to \$326 billion. In total, R&D spending increased at 57 companies, fell at 41 firms and was flat at 2 others.

Bombardier Inc. maintained its first place ranking by growing its R&D spending to \$2.2 billion, up 15.4% from Fiscal 2012. BlackBerry Limited held on to 2nd place on the Top 100 list even though its spending declined by -12.2% to \$1.3 billion. Magna International leaped 3 places in the ranking to 3rd with \$576.8 million of research spending, up 12.0% over Fiscal 2012. BCE Inc. fell one place to occupy 4th position. Pratt & Whitney Canada held on to 5th place.

For the 91 firms that provided revenue information, research intensity – R&D spending as a percentage of revenue – fell to 3.2% from 3.3% the previous year, a decline of -1.9%.

THE \$100 MILLION CLUB

Research Infosource is pleased to announce that 28 com-

panies (up from 27 last year) gained membership in the \$100 Million Club – an elite group of firms that spend \$100 million or more on R&D. The Club includes 21 Canadian companies and 7 foreign subsidiaries.

New to the \$100 Million Club are CGI Group Inc. (#11 overall), Valeant Pharmaceuticals International (#20) and MacDonald, Dettwiler and Associates (#27).

Total \$100 Million Club spending on research was \$10.2 billion, a rise of 6.0% from Fiscal 2012. Club members accounted for 81.4% of total Top 100 spending, up from 80.0% the year before.

INDUSTRY PERFORMANCE

The Aerospace sector accounted for 23.0% of total Top 100 spending as 3 firms increased their total outlay by 12.1%. The second-largest sector was Communications/Telecom Equipment, where 11 firms posted \$2.0 billion of research spending, a decline of -9.0% over Fiscal 2012. Spending expanded by 22.9% among the 15 Software & Computer Services companies that took 3rd position on the Top 100 list. Twenty Pharmaceuticals/Biotechnology firms expanded their combined spending by 11.5% and occupied 4th place in the industry sector ranking. Rounding out the top 5 sectors was Energy/Oil & Gas, where 8 firms spent a total of \$1.1 billion on research, an increase of 3.0%. However, aggregating all

Top 100 – Leading Industries

Industry	R&D Spending (% of Total)
Aerospace (3)	23.0
Communications/Telecom Equipment (11)	16.2
Software & Computer Services (15)	11.3
Pharmaceuticals/Biotechnology (20)	9.6
Energy/Oil & Gas (8)	9.1
Telecommunications Services (3)	9.0
Automotive (4)	6.8

the Information and Communication Technology sector-related firms puts that group of industries in the lead in terms of research investment, with 40.3% of the total.

R&D SPENDING GROWTH

A number of firms displayed especially strong growth in their R&D spending in Fiscal 2013. Spending was especially strong at Redknee Solutions Inc. (278.0%), TransCanada Corporation (203.9%) and CGI Group Inc. (164.1%). Valeant Pharmaceuticals International Inc. also posted a triple-digit increase (104.3%).

THE TOP 10 R&D INTENSIVE FIRMS

This year's list of the most research-intensive companies includes a mix of Engineering Services, Pharmaceuticals/Biotechnology, Transportation and ICT firms.

LOOKING AHEAD

Canada's Top 100 Corporate R&D Spenders sent mixed signals this year about the country's industrial research performance. On the one hand, combined research spending grew by 4.1%, but this was less than the 7.0% growth in revenues.

In many firms R&D spending is (rightly) viewed as a cost and not as an investment. Bombardier's situation illustrates the difficulty of automatically equating high levels of R&D spending with a company's (or country's) competitiveness. Much of that firm's high spending on research is the result of problems bringing a key product to market, rather than an efficient investment in innovation and productivity.

In the coming year, a falling Canadian dollar should help a number of sectors to boost revenues and profits, but will also expose them to higher R&D costs for

The \$100 Million Club

2013 Rank	Company	R&D Spending \$000
1	Bombardier	\$2,193,719
2	BlackBerry	\$1,324,470
3	Magna International	\$576,752
4	BCE	\$575,400
5	Pratt & Whitney Canada (fs)	\$544,782
6	IBM Canada (fs)	\$492,000
7	Rogers Communications	\$394,000
8	Canadian Natural Resources	\$390,000
9	Atomic Energy of Canada	\$353,600
10	Ericsson Canada (fs)	\$318,000
11	CGI Group	\$252,116
12	Apotex	\$222,439
13	Cenovus Energy	\$213,000
14	AMD Canada (fs)	\$211,000
15	Imperial Oil	\$199,000
16	Constellation Software	\$190,554
17	Syncrude Canada	\$185,165
18	General Motors of Canada (fs)	\$182,089
19	Open Text	\$168,916
20	Valeant Pharmaceuticals International	\$161,473
21	TELUS	\$161,000
22	BRP	\$144,900
23	CAE	\$144,096
24	Sanofi (fs) (a)	\$129,100
25	GlaxoSmithKline Canada (fs)	\$118,224
26	Ontario Power Generation	\$117,000
27	MacDonald, Dettwiler and Associates	\$116,602
28	Hydro-Québec	\$100,000

fs = Foreign subsidiary (includes R&D spending for Canadian operations only)
(a) Sanofi Pasteur Limited and sanofi-aventis Canada Inc. (including Genzyme Canada)

imported equipment and labour. Recent income tax changes will give them less relief for R&D capital costs. Government policy for boosting industrial R&D is moving slowly from tax-based support to direct support for research. Unless the global economy takes off, rising US demand spills over to Canada, or Chinese industrial consumption increases, look for Fiscal 2014 to be a repeat of Fiscal 2013.

We Can't Afford to Leave Innovation Behind



Jayson Myers
President & CEO
Canadian Manufacturers & Exporters (CME)

Innovate or die, a little dramatic, as it should be as Canada's economy will either flourish or wither on the decisions being made today. The manufacturing sector continues to be the biggest investor in R&D accounting for more than half the total private sector R&D spending in Canada.

The Jenkins Panel made it clear in their report three years ago, policy that encourages advancement and investment in research and development, or R&D, should be a greater priority for this country. The report also highlighted the importance of advancing a more favorable policy framework to help increase private sector R&D performance. The Independent Panel on Federal Support to Research and Development (R&D) was tasked to do a comprehensive review of federal programs that support business innovation in Canada.

The post-Jenkins federal budget however was not kind to one of the cornerstones of Canada's R&D policy, the Scientific Research & Experimental Development Tax Credit (SR&ED). The significant reductions of the Investment Tax Credit from 20% to 15%, as well as the elimination of capital spending as an eligible expenditure, are two of the more costly changes to manufacturers that were introduced in that budget. This policy hurts Canada's

Business (Intramural) Expenditures in R&D or BERD.

BERD measures Canada's private sector R&D performance and is one of the indicators of R&D activity in a jurisdiction. Between 2007 and 2013 Canada saw a steady decline in BERD spending. Not only did the cuts to SR&ED not stem the decline, their implementation has actually worsened Canada's BERD, and will surely continue to do so this year and next.

Furthermore, the ratio of business expenditure R&D (BERD) as a percentage of GDP has also seen a steady decline since 1999 when it was 1.06 per cent to a new low of 0.83 per cent ratio in 2013, well below the OECD average.

To date, evidence indicates the reforms implemented by the federal government have contributed to the further deterioration of Canada's global competitiveness for attracting R&D dollar investment, particularly from large multinationals. Additionally, the federal government still needs to provide a competitive direct funding framework for business R&D spending.

The decisions made today regarding R&D investment will have a long-term effect on Canada's economy and decide whether we will be a competitive jurisdiction or keep sliding down the ranks.

The federal government still has time to adjust its policy and improve the fiscal environment for business innovation in Canada.

The government can make the difference of making both Canadian and international firms more or less attracted to invest in R&D in this country.

What can be done to make investment in R&D more attractive? First, the federal government needs to improve the fiscal incentives to perform R&D in Canada. The SR&ED program needs to be reformed so that it better reflects the needs of large corporations so that they choose Canada as a destination for R&D activities. For instance,

large corporations should be allowed to cash their unused tax credits so that they can keep investing in R&D, deficits not withstanding.

The government should also reconsider its unwise decision to eliminate capital spending as eligible expenditures under the SR&ED program. At a recent roundtable discussion on the adoption of 3D printing technologies among manufacturers, one of Canada's leading distributors of 3D printing equipment stated that this particular measure significantly impacts the ability of companies to buy 3D printers and other related equipment, which impedes growth in Canada.

Second, the federal government needs to fulfill its promise to provide additional direct funding to support business innovation. The federal government hasn't fulfilled its promise in this area, the government's direct funding to private sector R&D accounts for only 0.04% of all business expenditures in R&D, ranking 23rd out of 34 OECD countries. Obviously, the cuts to the SR&ED tax credit have not been offset by huge increases to direct funding for business R&D.

Third, the government must start placing more emphasis on disruptive technologies that are changing how manufacturing is done in the industrialized world. New emerging technologies such as additive manufacturing, 3D printing, automation, robotics, the Internet of things, and smart materials are all examples of exciting new technologies where dedicated public policies would help accelerate their adoption and development.

Without these three conditions, and making innovation a priority there won't be a magic bullet solution to Canada's poor R&D performance any time soon.

Once these conditions are met, companies will be encouraged to take the risk to invest in R&D in Canada. Canadians have the ability and entrepreneurial spirit to be even greater innovators.

Enhancing Collaboration Globally

Continued from page 13

wanted to improve the employment rate of post secondary graduates in their country by making their education more applied, and knew how successful we have been.

One of the cornerstones of our model is the integration of applied research into the curriculum, providing students with hands on experience solving problems for industry and community partners. Applied research enhances the learner experience, through directed studies and capstone projects, and as undergraduate student researchers working with

faculty and research groups on their projects.

Applied research and innovation in colleges and polytechnics is driven by the needs of our partners, and provides innovative solutions to their real world challenges. A key characteristic of applied research is its multidisciplinary nature, and the resulting collaboration required to successfully solve a clients problem. Collaboration really is the name of the game, occurring between different departments within institutions, with other post secondaries: colleges, polytechnics and universities, and with industry associations, government organizations and funding agencies.

Increasingly this collaboration extends across borders. However when we consider Canadian college and polytechnic research and innovation on the international scene, we encounter a contradiction. One of the strengths of colleges and polytechnics is their close connections to the local community and economy, especially small and medium sized enterprises (SMEs). How does local become global? It turns out that what is successful in Canada is also successful in other countries: working together collaboratively, strong community ties, and practical and innovative solutions to real world problems.





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Natural Sciences and Engineering Research Council of Canada

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In the recent Haitian earthquake, between 100,000 and 160,000 people were killed, mostly due to poor concrete masonry construction. Motivated by this tragedy, a multidisciplinary team of BCIT researchers have focused their research on finding an inexpensive way to test masonry blocks prior to use in construction. Over the course of four years, the team has received support from non-governmental organizations working on Haiti's reconstruction, including the BC Masonry Institute and Building Without Borders. The project has been funded by two NSERC programs, and involved students and faculty from three different BCIT

departments and one of our dedicated applied research groups. They are now close to a solution, developing a prototype for a low-cost device that would be used around the world. With nearly every country in the world using masonry blocks in building, this collaborative research has far reaching implications.

Recent federal research funding developments such as the Community College and Innovation program and research partnership programs and college and polytechnics strong collaborations with industry have allowed us to further develop our research and innovation capabilities. These capabilities go across all pro-

grams as well as enabling globally unique research centres to arise. One example is BCIT's Building Science program. This program now has two Master degrees, drawing students from around the globe to its specialized course offerings, and to conduct research in the BCIT Building Science Centre of Excellence.

Canadian colleges and polytechnics have long histories of collaborative research and innovation. We are now moving beyond Canada to show our capabilities on the global stage. BCIT is proud to be recognized for the role we are playing in these developments, and to be named Canada's Top Research College for 2014.

PARTNER PERSPECTIVE

R&D Drives Oil Sands Innovation at Syncrude



Canada's oil sands industry has come a long way since a washing machine first successfully demonstrated hot water extraction. In the decades that followed, conscious investments in research and development have transformed the oil sands into a viable, innovative and responsible industry.

Syncrude Canada Ltd., one of Canada's top R&D spenders, has always maintained a leadership role in creating and developing innovative technologies to responsibly mine, extract and upgrade high quality crude oil from the oil sands, and to reclaim the land it uses.

When Syncrude was first established in 1964, it was really a research project designed to prove that oil could be produced economically from the oil sands deposits in Northern Alberta. Research was at the fore 14 years before the first barrel of oil was ever shipped, with the effort focused on the environment and developing technology to address

the unique challenges of oil sands mining and extraction.

It was an industry in its infancy where solutions to unlocking the mysteries of the oil sands needed to be imagined, tested and implemented because they simply didn't exist.

"There isn't a lot of off-the-shelf technology for this industry. It was all invented here," says Glen Rovang, Manager of Syncrude's Research & Development Centre, in Edmonton.

Today, R&D continues to open doors to new and better ways to manage the oil sands resource.

Syncrude is one of only a few oil sands operators with a dedicated R&D facility. More than 100 scientists and technologists work there and many more are engaged in research at a fundamental level through their work at universities and research institutes.

In 2013, Syncrude invested \$192 million towards new technologies and processes to improve the reliability and capacity of its operation, reduce costs and address environ-

mental issues. In fact, over half of its research expenditures are directed to environmental projects including a reclamation research program that focuses on landscape creation and performance, with emphasis on watersheds.

The Sandhill Fen Watershed research project, located in a portion of the former East mine, is a unique example in that it is the world's first fen watershed built on a foundation of Composite Tailings. "It can take a very long time for a fen to evolve naturally, and we're trying to speed that up through reclamation," said Jessica Piercey, Project Leader. "The lessons we learn here will help us develop future wetland areas equal in productivity to what was here before mining occurred."

Eight multi-year research programs involving a number of universities are collecting data on hydrology, wetland and terrestrial plant response, carbon dynamics and climate conditions associated with the fen. Early results are encouraging

and the information being gathered will improve wetland reclamation best practices for Syncrude and the oil sands industry.

Sharing research results is an important aspect of Syncrude's R&D program. Despite receiving more than 150 Canadian and U.S. patents for their technology developments, Syncrude openly shares its research and technologies through collaborative industry groups such as Canada's Oil Sands Innovation Alliance (COSIA). Syncrude also collaborates on research projects with universities, government laboratories and agencies, industrial research networks and consortia, private research organizations, and its Joint Venture owners.

Sharing knowledge makes Syncrude a better performer operationally and environmentally, and advances the oil sands industry in general. A dedicated effort to research and development, both financially and collaboratively, ensures the oil sands industry remains at the forefront of innovation.

Photos:

Left: Syncrude's Sandhill Fen watershed research project was built on a foundation of mine tailings in a 54-hectare portion of a former oil sands mine. It was re-vegetated in 2012-13 with many types of native plants and their performance is comparable to the same plants on a natural site. Fens are an important Boreal forest peat land and this large-scale reconstruction effort underscores Syncrude's commitment to returning the land it uses to a condition similar to that prior to disturbance.

Right: Syncrude is leading research to remediate oil sands process water using a process by-product called petroleum coke. The treated water is clean and clear and can support aquatic life. A pilot project is underway to assess treatment efficiency, answer technical questions and inform potential commercial-scale implementation.

Syncrude
Securing Canada's Energy Future

Collaboration is Critical to Sustainable Development



Walter Di Bartolomeo
Vice President, Engineering
Pratt & Whitney Canada

As climate change rapidly rises to the top of the world's agenda, Canada's aviation industry is working overtime to achieve a greener footprint through the development and implementation of airframe and engine technologies that enable aircraft to be significantly more efficient, quieter and greener.

One of the biggest imperatives is to bring to market products that are designed, produced, operated and retired with a minimal impact on the environment throughout their entire lifecycle. This requires major and continuous investments in research and development (R&D), including the implementation of advanced manufacturing technologies to make the final product economically viable and competitive.

The resources, financial and otherwise, for successfully achieving this sustainability goal are considerable and increasingly require joint efforts and collaboration among many stakeholders in the aerospace industry. Fortunately, Canada has an extensive and world-leading aerospace R&D ecosystem that effectively identifies strategic aerospace technology areas and facilitates collaborative research and development among key stakeholders.

This innovation ecosystem

includes original equipment manufacturers (OEMs), universities, research centres and a growing number of small and medium-size enterprises (SMEs). Collaboration is considerably bolstered by a number of organizations and government-supported initiatives which are vital to fostering innovation. They include, for example, the Consortium for Research and Innovation in Aerospace in Quebec (CRIAQ), a unique model of collaborative industry-led research involving universities and research centres. It has proven so successful over the past dozen years that last spring it led to the creation of a Canadian counterpart known as CARIC (Consortium for Aerospace Research and Innovation in Canada). Based upon the CRIAQ model, which puts forward a light networked structure, CARIC will be industry-driven and bring together the best of the entire Canadian industry to identify

technology priorities and facilitate collaborative R&D. I am proud to chair both organizations and believe they will take innovation in aerospace research to a new level. In Quebec, we have a highly effective rallying point for all stakeholders of the aerospace industry through the Aéro Montréal cluster, chaired by Maria Della Posta, Pratt & Whitney Canada's Senior Vice President, Sales and Marketing.

Canada's research ecosystem among OEMs, universities and research centres is mature. The pressing need is to focus and bring more SMEs to play active roles and take leadership positions in this ecosystem through increased and sustained R&D efforts. SMEs represent 97% of all Canadian aerospace firms but only 8% of the aerospace R&D investment in Canada. This is clearly not enough. The SME capacity is a rich pan-Canadian talent pool that we want to leverage to enrich the aerospace ecosystem.

Pratt & Whitney Canada and several other large OEMs are also actively involved in other important initiatives driving sustainability. The Small Affordable Green Efficient (SA²GE) program in Quebec supports industrial demonstration

projects related to "green" aircraft. The Green Aviation Research and Development Network (GARDN) is a Canadian business-led network of centres of excellence dedicated to lowering noise, greenhouse gases and emissions produced by the aerospace industry.

As one of Canada's leading R&D investors committed to innovation, Pratt & Whitney Canada has long made such collaborations and partnerships a pillar of its innovation strategy. We recognize that these approaches are critical to maximizing the effectiveness of our own R&D investments and for sharing the many risks involved in developing new engines and processes.

Our current R&D projects centre on key technologies to ensure new engines surpass emerging stringent environmental standards for air emissions and noise and offer improved fuel efficiency. At the same time, we are also looking for ways to develop engines efficiently with the most advanced manufacturing technologies to ensure they are affordable, reliable and dependable.

In this regard, we are currently investing \$80 million in a world-class centre of excellence for intelligent manufacturing in Quebec

with production lines dedicated to manufacturing highly complex key components for Pratt & Whitney's PurePower® engines for the next-generation of commercial and business jets. By using new materials and technologies to reduce weight, and hence fuel burn and greenhouse gas emissions, these engines will deliver step-change improvements in environmental performance and operating costs. The unique properties of the new materials used require us to design new, fully integrated and ultra-efficient production lines equipped with automation, closed-loop process control and high-precision machining technologies.

Many of the concepts incorporated in these intelligent cells, which are so essential to our sustainability goals, were developed in collaboration with our partners in the academic and research community. They underscore, once again, the importance of such an approach to keep Canadian aerospace at the international forefront of innovation and the drive for sustainability in the global industry – not to mention development of the next generation of Canadian engineers and enhancement of the world-class capabilities and reputations of our universities.

PARTNER PERSPECTIVE

Positioning Canada as an International Magnet for Medical Imaging Commercialization



Bart Sullivan
CEO
Centre for Imaging Technology
Commercialization (CIMTEC)

Since 1998, the Government of Canada has invested more than \$1 billion in medical imaging R&D. Sixteen years later, Canada is known throughout the world for its expertise in medical imaging. Our many academic centres and spin-off companies are developing technologies that have the potential to profoundly affect the detection, diagnosis and treatment of disease and corner a larger percentage of the multi-billion dollar global medical imaging market.

The Centre for Imaging Technology Commercialization (CIMTEC) was formed in 2011 through the federally funded Centres of Excellence for Commercialization and Research program to further leverage the gov-

ernment's investment by providing services that enable and accelerate the commercialization of medical imaging innovations for clinical use world-wide. The overarching goal is to reap health and economic benefits for Canadians through technologies that make the healthcare experience less painful; facilitate easier and faster recovery times; provide greater accuracy and efficiency; and are more cost-effective. In addition, by growing the medical imaging sector there is potential to create many well-paying jobs for highly qualified people in Canada.

CIMTEC is one of the only organizations in the world providing researchers and companies a unique set of services along the entire commercialization continuum. We help

fill the capabilities gap for startups and small and medium-sized companies that don't have the in-house resources to follow through with every step required to bring a product to market.

After three years of operation, we have worked closely with dozens of companies and researchers in Canada on a range of technologies that are addressing better, more efficient and cost-effective solutions to diagnose and treat breast, liver and prostate cancer, as well as Alzheimer's disease and nerve disorders. In addition, companies are licensing CIMTEC's internally developed intellectual property to propel their projects farther and faster. While CIMTEC's reputation is growing domestically,

it is also expanding internationally.

Canada is an emerging magnet for international medical imaging technology commercialization because of our best-in-class technical talent and facilities; internationally credible clinical testing; great access to U.S. markets; and, diverse funding support for new companies. To date, CIMTEC's intellectual property and expansive capabilities in medical imaging commercialization have attracted companies from India, the U.K., China, and the U.S., as well as investment from Asia. As CIMTEC matures, and begins to move its focus outward, we anticipate that we will attract more foreign business and investment, driving economic growth and job creation in Canada.



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