NOVEMBER 4, 2011



Canada's University PREPARED BY RE\$EARCH INFOSOURCE INC., AN IMPACT GROUP COMPANY

RESEARCH INCOME GROWTH STEADY — Canada's Top 50 Research Universities recorded a 3.6% gain in combined research income in Fiscal 2010, up from 3.0% in Fiscal 2009. Total research income reached



RESEARCH

Infosource Inc.





University of Victoria



Inspiring Innovation and Discovery



Everyone Makes a Mark



※	UNIVERSITY OF	
	SASKATCHEWAN	

Rar	nk		Sponsored Research Income				Research Intensity	
010	2009	University	FY2010 \$000	FY2009 \$000	% Change 2009- 2010	2009- 2010 #	\$ per Full-time Faculty \$000	Province
1	1	University of Toronto* ++	\$878,725	\$858,182	2.4	2,439	\$360.3	Ontario
2	2	University of British Columbia*	\$538,398	\$524,569	2.6	2,301	\$234.0	British Columbia
3	4	Université de Montréal* ^(a)	\$524,133	\$486,179	7.8	1,884	\$278.2	Quebec
4	3	University of Alberta*	\$513,473	\$507,613	1.2	1,686	\$304.6	Alberta
5	5	McGill University* ^(a)	\$469,729	\$432,118	8.7	1,614	\$291.0	Quebec
6	6	McMaster University*	\$395,364	\$377,732	4.7	1,275	\$310.1	Ontario
7	7	Université Laval* ^(a)	\$307,928	\$282,657	8.9	1,326	\$232.2	Quebec
8	8	University of Calgary*	\$282,752	\$264,358	7.0	1,572	\$179.9	Alberta
9	10	University of Ottawa*	\$273,278	\$236,977	15.3	1,281	\$213.3	Ontario
10	9	University of Western Ontario*	\$221,236	\$241,700	-8.5	1,422	\$155.6	Ontario
11	11	Queen's University*	\$197,016	\$178,180	10.6	828	\$237.9	Ontario
12	13	University of Saskatchewan*	\$184,756	\$169,450	9.0	1,131	\$163.4	Saskatchewan
13	12	University of Manitoba*	\$164,695	\$172,067	-4.3	1,197	\$137.6	Manitoba
14	15	University of Guelph	\$148,905	\$154,850	-3.8	795	\$187.3	Ontario
15	14	University of Waterloo	\$144,299	\$157,152	-8.2	993	\$145.3	Ontario
16	16	Dalhousie University*	\$125,147	\$125,689	-0.4	1,005	\$124.5	Nova Scotia
17	17	University of Victoria	\$98,481	\$104,812	-6.0	678	\$145.3	British Columbia
18	18	Université de Sherbrooke* ^(a)	\$93,247	\$96,833	-3.7	1,017	\$91.7	Quebec
19	19	Simon Fraser University	\$87,374	\$83,838	4.2	822	\$106.3	British Columbia
20	21	Memorial University of Newfoundland*	\$74,499	\$72,604	2.6	915	\$81.4	Newfoundland
21	23	Université du Québec à Montréal ^(a)	\$70,942	\$63,724	11.3	1,008	\$70.4	Quebec
22	20	Carleton University	\$70,456	\$72,750	-3.2	732	\$96.3	Ontario
23	22	York University	\$69,379	\$68,099	1.9	1,362	\$50.9	Ontario
24	24	Institut national de la recherche scientifique ^{+ (a)}	\$64,998	\$51,656	25.8	153	\$424.8	Quebec
25	25	University of New Brunswick	\$53,919	\$51,169	5.4	546	\$98.8	New Brunswick
26	26	Concordia University ^(a)	\$39,126	\$37,178	5.2	882	\$44.4	Quebec
27	27	University of Windsor	\$28,348	\$34,733	-18.4	507	\$55.9	Ontario
28	30	University of Regina	\$23,822	\$20,258	17.6	369	\$64.6	Saskatchewan
29	36	Université du Québec à Rimouski ^(a)	\$22,848	\$17,439	31.0	189	\$120.9	Quebec
30	29	Ryerson University	\$22,524	\$21,839	3.1	732	\$30.8	Ontario
31	28	Laurentian University*	\$22,428	\$21,963	2.1	417	\$53.8	Ontario
32	32	Royal Military College of Canada	\$20,661	\$18,301	12.9	192	\$107.6	Ontario
33	34	Université du Québec à Trois-Rivières ^(a)	\$18,296	\$17,966	1.8	357	\$51.2	Ouebec

Canada's Top 50 Research Universities 2011









rsité d'avant-garde

Notes:

- Sponsored research income: includes all funds to support research received in the form of a grant, contribution or contract from all sources (internal and external) to the institution.
- 2. Financial data were obtained from Statistics Canada, except where noted.
- 3. Faculty data were obtained from Statistics Canada, Conférence des recteurs et des principaux des universités du Québec (CREPUQ) and the RE\$EARCH Infosource Canadian University R&D Database. For confidentiality reasons, Statistics Canada randomly rounds faculty numbers either up or down by a multiple of "3".
- 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 +Not a full-service university

**Includes full, associate and assistant faculty only

- ++Sponsored research income administered by affiliated hospitals was reported one fiscal year in arrears
- (a) Fiscal 2009-2010 research income was obtained directly from the university and has not yet been validated by CAUBO.

RE\$EARCH Infosource Inc. is Canada's source of R&D intelligence. The Top 50 List is available online at www.researchinfosource.com or by calling (416) 481-7070.

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UNIVERSITY OF

WATERLOO



Quebec city, Canada

Research Universities of the Year 2011

Three universities gain RE\$EARCH 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 FY2010. These full-service 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	99.9	1	University of Waterloo	92.9	1	Université du Québec à Rimouski	81.2
2	McGill University	71.9	2	University of Guelph	88.1	2	Ryerson University	78.3
3	University of Alberta	70.4	3	Simon Fraser University	71.8	3	Royal Military College of Canada	75.4
			3	University of Victoria	71.8			

*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 (20%) and publication intensity in leading journals (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 ranking institution. See www.researchinfosource.com for details.



Continued from page 1

\$6.46 billion from \$6.24 billion in Fiscal 2009. The 2010 result caps a decade in which university research income rose by 134.0%. For illustration, total research income in 2000 was \$2.76 billion, which indicates how strongly the sector has grown.

THE \$100 MILLION CLUB

Sixteen universities – down from 17 last year – gained membership in RE\$EARCH Infosource's \$100 Million Club – an elite group that attracted \$100 million or more of research income. Club members attracted a total of \$5.37 billion of research income, up 1.8% from

The \$100 Million Club

2010 Rank	Re: University	search Incom
1	University of Toronto*	\$878.72
2	University of British Columbia*	\$538,398
3	Université de Montréal*	\$524,133
4	University of Alberta*	\$513,473
5	McGill University*	\$469,729
6	McMaster University*	\$395,364
7	Université Laval*	\$307,928
8	University of Calgary*	\$282,752
9	University of Ottawa*	\$273,278
10	University of Western Ontario*	\$221,230
11	Queen's University*	\$197,016
12	University of Saskatchewan*	\$184,756
13	University of Manitoba*	\$164,695
14	University of Guelph	\$148,90
15	University of Waterloo	\$144,299
16	Dalhousie University*	\$125,142
*Has a me	edical school	

Spotlight on University Research Publication Intensity Growth⁺ 2004-2009

RE\$EARCH Infosource shines the spotlight on universities that made the greatest gains in research publication intensity⁺ between 2004-2009 (5 year % change).

Rank	Medical/Doctoral	% Change	Rank	Comprehensive	% Change	Rank	Undergraduate	% Change
1	University of Toronto	43.0	1	York University	31.5	1	Ryerson University	94.8
2	Université Laval	41.1	2	University of Waterloo	30.1	2	Université du Québec à R	limouski 92.0
3	University of Western Onta	rio 40.6	3	Simon Fraser University	28.9	3	Université du Québec à C	hicoutimi 89.3
	Tier Average (16)	28.2		Tier Average (11)	19.6		Tier Average (16)	30.3

Overall research publication intensity growth (43): 25.4%

*Publication intensity is defined as the total number of publications per full-time faculty (full, associate and assistant). Publication data are offset with faculty data by approximately 2.5 years. This offset allows for the research to be completed and published. It is understood that this time period varies for different disciplines, therefore, the offset of 2.5 years is an average. The publication calendar year 2009 is offset with the number of faculty for the academic year 2006-2007; the publication calendar year 2004 is offset with the academic year 2001-2002. Notes:

1. Based on full-service universities that have been on the Top 50 list and had 50 or more publications in all 6 years.

- 2. 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.
- Faculty data were obtained from Statistics Canada, Conférence des recteurs et des principaux des universités du Québec (CREPUQ) and the RE\$EARCH Infosource Canadian University R&D Database. For confidentiality reasons, Statistics Canada randomly rounds faculty numbers either up or down by a multiple of "3".
 See www.researchinfosource.com for details.

the previous year. As such, they accounted for 83% of total university research income, slightly down from 85% in Fiscal 2009. Eleven of the 16 Club members posted gains in research income in Fiscal 2010, and 5

saw research income declines.

PROVINCIAL PERFORMANCE

From a provincial perspective in Fiscal 2010, university research income rose in 8 provinces and declined in 2. Saskatchewan, with 2 universities, recorded an overall gain of 9.9% in research income, compared with the all-university increase of 3.6%. Research income growth was also strong in Quebec, where 13 institutions reported a combined increase of 8.1%. In Prince Edward Island, research income increased by 7.4%, based on the performance of University of Prince Edward Island. Research income declined by -4.6% in Manitoba and -0.8% in Nova Scotia. Research income growth in Alberta (3.3%), New Brunswick (3.3%), Newfoundland (2.6%), Ontario (2.1%) and British Columbia (1.1%), all advanced more slowly than the national average of 3.6%

GAINERS AND LOSERS

In total, 24 of 50 institutions had research income growth in excess of the 3.6% national average, compared to 28 in 2009. The top 3 full-service universities gainers were Université du Québec en Outaouais (50.9%), Université du Québec à Rimouski (31.0%) and Brock University (21.3%).

A number of institutions saw their research income decline in Fiscal 2010, but year-on-year changes are not uncommon. More important are long-term trends.

RESEARCH INTENSITY RISES

A modest increase in research income (3.6%) combined with slow growth in faculty numbers (1.3%) led to a moderate 2.3% increase in research intensity – research income per full-time faculty position. In Fiscal 2010, on average, each of the Top 50 Research Universities attracted \$170,600, compared with \$166,600 in Fiscal 2009. A total of 11 full-service universities posted research intensity that was higher than the national average.

TIER SHARES UNCHANGED

Sixteen Medical/Doctoral universities accounted for 81% of total research income in Fiscal 2010, the same share as in Fiscal 2009. The share of total research income of the 12 Comprehensive institutions was 14%, and the 22 Undergraduate universities represented 5% of the total, remaining unchanged from the year prior. In Fiscal 2010, Medical/ Doctoral institutions increased their overall research income by 4.3%, compared with the 3.6% national gain. The Comprehensive institutions posted a flat research income growth, whereas research income rose by 2.8% at the Undergraduate institutions in Fiscal 2010. research funding between 2000 and 2010 of 134% leaves a strong legacy of research infrastructure and research activity that can buffer the system, at least for a short time.

However, across Canada government revenues are declining and this will inevitably put limits on the ability of governments to fund a range of desirable activities, university research included. In Ottawa, public servants are actively planning for possible budget cuts of 5 or 10 percent. Their provincial colleagues will not be far behind in their planning. So unless university research is singled out for special attention it is hard to see how the sector will escape some cutbacks.

Contributions from other sectors are unlikely to make up the difference, which means that some belt tightening is likely on the horizon. Last year we forecast that "*In a best case scenario the "new normal" will be research income growth that keeps pace with inflation"*. Time will tell if that was an optimistic view of the future.

TheTop 50 – Leading Provinces

Province	% of Total
Ontario (18)	40
Quebec (13)	26
Alberta (3)	13
British Columbia (4)	11

Top 10 Research Intensive Universities**

2010 Researc) Rank h	Research Intensity (\$ per full-time faculty)					
Intensity	y Overall	University	\$000				
1	1	University of Toronto*	\$360.3				
2	6	McMaster University*	\$310.1				
3	4	University of Alberta*	\$304.6				
4	5	McGill University*	\$291.0				
5	3	Université de Montréal*	\$278.2				
6	11	Queen's University*	\$237.9				
7	2	University of British Columbia*	\$234.0				
8	7	Université Laval*	\$232.2				
9	9	University of Ottawa*	\$213.3				
10	14	University of Guelph	\$187.3				
*Has a med	lical school	**Includes full-service institutions only					

Top 10 Universities by Growth

100 10	Univer	sicies by Growen	
2010 Income Growth	Rank Overall	% Ch University 2009-	ange 2010
1	49	Université du Québec en Outaouais	50.9
2	29	Université du Québec à Rimouski	31.0
3	39	Brock University	21.3
4	28	University of Regina	17.6
5	9	University of Ottawa*	15.3
6	32	Royal Military College of Canada	12.9
7	21	Université du Québec à Montréal	11.3
8	11	Queen's University*	10.6
9	12	University of Saskatchewan*	9.0
10	7	Université Laval*	8.9
*11		**Includes full constant institutions and	



Canada Research Chair, Plant Biotechnology. Goals: Grow pharmaceuticals. Cure cancer.

For both sides of the brain.

Vincenzo De Luca is one of hundreds of innovative researchers at Brock University. As a professor in Biological Sciences and a Tier 1 Canada Research Chair in Plant Biotechnology, the research side of his brain focuses on the inner workings of plants, particularly the medicinal properties of the Madagascar periwinkle, and the resulting valuable products.

Because of the important work and discoveries made by De Luca and other researchers, Brock is moving to the forefront of research and innovation in Canada, advancing three positions in Canada's Top 50. This year, we placed third for research income growth — a jump of 21.3 per cent in the 2010 fiscal year.

We celebrate the achievements of our researchers and we're proud of the significant contributions they make to the world.



RESEARCH UNIVERSITIES OF THE YEAR

RE\$EARCH Infosource highlights the achievements of 3 *Research Universities of the Year* – the leading institutions that excel on a balanced scorecard of research input and output/impact indicators (see our website for details www.researchinfosource.com/top50.shtml).

This year's winners were: University of Toronto in the Medical/Doctoral category, University of Waterloo in the Comprehensive category and Université du Québec à Rimouski in the Undergraduate category.

SPOTLIGHT

This year, RE\$EARCH Infosource has highlighted the topic of *Research Publication Intensity Growth*, 2004-2009. Scholarly publications are a key output of university research. Publication intensity – the average number of publications per full-time faculty – is a way of comparing the publishing performance of different institutions, recognizing this will naturally vary among universities of different sizes and types. This year's spotlight examined the 5-year growth, which is a measure of improvement.

WHAT'S NEXT

Total university research income expanded by a respectable 3.6% in Fiscal 2010. Government sources typically account for around two-thirds of the total, which indicates how closely university research income is tied to the fortunes of the public sector. The substantial growth of

Bottom 10 Universities by Growth**

2010 ncome	Rank	% C	hange
Growth	Overall	University 2009	9-2010
1	43	Université du Québec en Abitibi-Témiscamingue	-22.7
2	47	St. Francis Xavier University	-20.5
3	27	University of Windsor	-18.4
4	38	Université du Québec à Chicoutimi	-17.8
5	40	University of Northern British Columbia	-15.3
6	50	University of Winnipeg	-12.6
7	10	University of Western Ontario*	-8.5
8	15	University of Waterloo	-8.2
9	45	Université de Moncton	-7.4
10	17	University of Victoria	-6.0
Has a medi	ical school	**Includes full-service institutions only	

Still Number One!

Again this year, INRS University ranks first in Canada in terms of research intensity thanks to the excellence of its professors.

Taking a multidisciplinary approach to fundamental and applied research, INRS research teams play a critical role in finding solutions to the problems facing our society, as well as in the training of highly qualified students and researchers.

Congratulations to all our researchers!







Innovative by nature



University of Victoria WE'RE BUILDING ONE OF THE WORLD'S GREENEST SHIPS—the first plug-in hybrid research vessel powered by electricity, hydrogen fuel cells and low-emission diesel fuel. It means a clean, efficient and guiet ship that doesn't add to the noise and pollution harming whales and other marine mammals. With support from government and industry, UVic researchers are pioneering a new generation of marine transportation technologies that promise to strengthen Canada's competitiveness in the emerging green economy. It's the kind of innovative thinking that makes UVic an international leader in fields like oceans, climate change, health, and matter and energy, and places us on *Times Higher Education's* list of the world's top 200 universities.



Will the whales thank us? They probably won't even notice. And that's the point. Check us out at *bit.ly/greenest*—we're going places.

www.uvic.ca/research

Leveraging partnerships to tackle global issues

By Michael Brown



also offer greater funding opportunities, especially with industry where you have a market pull of results being translated much faster into societal benefits."

work side by side at every stage of the to fit out state-of-the-art labs, the research cycle, with every outcome available for publication. The ultimate example of leveraging funding to address a global health problem is the Li Ka Shing Institute for Virology. Launched in April 2010 thanks to a gift of \$28 million from the Li Ka Shing (Canada) Foundation - the university's largest cash gift - and \$52.5 million from Alberta Innovates-Health Solutions, the institute brings together some of the world's leading researchers in virus-based diseases. Among them is Lorne Tyrrell, MD, inaugural director of the institute. He developed lamivudine, the first oral antiviral treatment for chronic hepatitis B.

of view and approaches. Partnerships University and industry researchers Chairs program. With KIP funding U of A built on the province's invest-

(EDMONTON) We know how to get things done at the University of Alberta.

Perhaps it's the pioneering roots of a place settled more than a century ago by folks who scratched a thriving community out of the vastness of a sparsely populated West. Today, Alberta's economy is the most robust in Canada, a mecca for those with big ideas.

That can-do attitude is alive and well at the University of Alberta. Innovation and a commitment to education for the public good are in the very DNA of this institution. The university's founding president, Henry Marshall Tory, promised that the pursuit of knowledge would be for "the uplifting of the whole people."

That's a promise the University of Alberta strives to fulfill daily.

"The researchers that the University of Alberta attracts feel the best way to better the whole of society is to be willing to take risks," said Lorne Babiuk. U of A's vicepresident (research). "Where some

The University of Alberta leverages public and private funding to tackle global health problems.

people say 'it can't be done,' our researchers say 'we'll do it.'

"As a result of this resolve, I believe our researchers are more willing to take on difficult challenges and collaborate with people who have different ideas to better solve complex problems."

Babiuk stresses that partnerships lie at the heart of the university's role in driving innovation and fostering ideas that improve lives, solve problems and address societal needs. Whether they are government, industry or non-profit, organizations seek out the U of A for its track record of strong partnerships.

"Not one individual has all the expertise, the ability, the ideas of how to crack that Gordian knot," said Babiuk. "With partnerships, you have a coming together of different points

One example: the Helmholtz Alberta Initiative, a partnership between the university and the Helmholtz Association of German Research Centres to develop technologically innovative solutions for cleaner energy production and train the next generation of energy-related scientists. The fields of research range from carbon capture and storage and land reclamation to improved extraction processes and geothermal energy, among others. HAI is supported by \$25 million from the Alberta government.

U of A's Centre for Oil Sands Innovation in the Faculty of Engineering, a partnership with industry and government, provides the research base to enable oil sands operations with a reduced environmental footprint by minimizing water use, consuming less energy, lowering greenhouse gas emissions, and yielding high-quality products at lower cost.

Twenty years ago he imagined a virology institute as a good fit for the Li Ka Shing Foundation's support since, according to Tyrrell, hepatitis B is the most common disease in China.

Things don't end there, however. Enter the federal government and its Knowledge Infrastructure Program and Canada Excellence Research

ment in the Katz Group Centre for Pharmacy and Health Research to advance its existing excellence in virology. The fantastic new infrastructure, the Li Ka Shing Institute establishment, and the province's commitment to funding innovation all combined to attract Michael Houghton as one of the U of A's Canada Excellence Research Chairs. Houghton came from the U.S. private sector where he led the team that discovered the hepatitis C virus.

"Ultimately, we want to be the central hub of focused national and international partnerships that address today's complex issues," said Babiuk. "We can draw upon expertise from around the world and bring it to bear on the economic and societal well-being in Alberta and Canada."

These are just a few examples from among dozens that illustrate how the University of Alberta takes a different approach to find solutions that improve lives and lessen environmental impact.

Connect with us. Connect with the world.

McGill University is Canada's most international university. With active research partnerships spanning the globe and a stellar reputation—including the number 17 spot in the 2011 QS World University Rankings—McGill is tackling the world's toughest problems by bringing together the world's brightest minds.

www.mcgill.ca/research



Research and Innovation Key to Addressing Global Challenges



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Peter MacKinnon President University of Saskatchewan and member of the federal Science, Technology, and Innovation Council

n an increasingly complex and interconnected world, bold and strategic advances in research and development are vital to addressing our most fundamental human challenges.

Whether the issue is food security, access to safe reliable water supplies, infectious disease or climate

change, today's global challenges go far beyond what one country, one university or one industry can solve. We've entered a new era of tech-

nological change that is altering the way scientists do research and how the next generations of knowledge workers will be trained. New global networks enable researchers to collaborate in new and innovative ways that draw on ideas from around the world on a daily basis. The result is that today's pre-eminent research is defined at the international level, with ideas, people and solutions flowing across national, corporate and academic disciplinary boundaries.

But in this rapidly evolving "innovation ecosystem", Canada's lagging performance in R&D, notably our private sector investment, threatens to undermine wealth and job creation – and ultimately our standard and way of living. Despite a better-thanaverage overall economic performance in relation to major trading partners and recent public investment in science and related infrastructure, our overall national expenditures in R&D remain below the G7 average. Canada can and must do better than settle in as a mid-level innovator. So how can we create greater value from the science, technology and innovation taking place across this country?

Invest in talent. We need to increase our number of highly qualified and innovative people, especially master's and PhD graduates. Continued support for programs such as the Canada Research Chairs, Canada Excellence Research Chairs, Vanier Scholarships for graduate students and Banting Post-Doctoral Fellowships helps to build research capacity and attract thought leaders from around the world.

Increase public-private partnerships for global economic and social value. Increasingly, companies, government agencies, communities and NGOs are reaching out to universities to help solve pressing problems and create new products and processes.

Such research partnerships build on strategic university strengths to create national and international collaborations, as well as train the next generation of researchers. tors, b

Increase private sector investment in innovation. Canada's overall business expenditures on R&D lag behind those of international competitors. We need to increase partnerships between companies and universities and improve capacity to transfer new knowledge to the marketplace. The challenge is to create partnerships that benefit both private industry and public universities, while preserving the very different mission and values of each and respecting the strengths of each. But with safeguards in place to protect academic freedom, these challenges can, and must be, met.

Create and connect clusters of innovation. Strategic clusters of talent, investment and industrial engagement opportunities are forming on campuses across Canada and are key to enhancing R&D capacity and productivity growth. With these clusters, researchers from universities, industry and government join forces with international collaborators, bringing many perspectives to bear on today's S&T challenges.

Create a national framework for funding major science facilities. Canada is home to more than a dozen major science projects that provide world-class opportunities for research, training and commercial development, while delivering major long-term economic returns.

As the magnitude and costs of these projects increase over time, providing operational funding to ensure their success is beyond the scope of any one university, province or federal department or agency. National public policy that addresses this challenge is imperative to ensure that these national "idea factories" continue to be engines of discovery and innovation.

At the University of Saskatchewan, we are working with our partners to address these challenges and opportunities.

For instance, we've built upon our historic strengths in medical imaging, crop development, and animal and human infectious disease research to create a dynamic life sciences cluster that now includes two of Canada's major science facilities – the Canadian Light Source synchrotron and the new \$140-million International Vaccine Centre (InterVac), a facility specially designed to handle diseases such as pandemic flu, West Nile and 'mad cow' disease. The latter disease alone has had an economic impact to Canada of more than \$6.5 billion.

These two world-class facilities, funded by all three levels of government including the City of Saskatoon, attract top researchers, foster business-researcher linkages, and create national and international research collaborations. The estimated economic impact to Canada of these two research investments, based on 2012-13 forecasts, will be more than \$80 million per year, with almost 800 jobs created.

Investments such as these in research talent, partnerships and clusters will be critical to ensuring Canada can compete and prosper in the global economy of the 21st century.



Research Means Collaboration

Guy Breton Rector Université de Montréal

ur relationship to research has changed a great deal in recent years. Although we no longer ask why we should do research, we should still ask if we do it the right way and, above all, how we generate value from the fruits of our labours.

The time has come to be innovative when it comes to innovation. In terms of innovation and productivity, Canada ranks low these days. All the classifications done in the past few years show Canada lagging behind other industrialized countries where innovation and productivity are concerned. Worse yet, productivity improvement is poorer here than in other parts of the world. According to an INSEAD study, Canada ranks 95th out of 132 countries in workforce productivity growth.

Productivity is a complex phenomenon and it is dangerous to name one single cause when things are not going as smoothly as desired. Especially in Canada, research and development, a cornerstone of productivity, is a responsibility shared much better than elsewhere.

It is a little-known fact that Canada stands out among the G7 countries for the concentration of research and development in the university sector. Canadian universities perform over one-third of all R&D in the country (36.6%), compared to 12.8% in the United States, 19.7% in France and 11.6% in Japan. Canadian companies, on the other hand, conduct 52.8% of the country's R&D, a significantly lower figure than in the United States (72.6%) or Japan (78.5%).

This is what leads me to say that if there is any key to improving Canadian productivity, it is to be found not within the business sector, nor in the universities or government, but rather in the interface between these three major pillars of R&D. Precisely because R&D is more evenly shared here than elsewhere, collaboration between these three economic players is strategically.

"Collaboration" is the key word. We must facilitate collaborations by reducing the cultural gaps between industry and universities and by cutting red tape in knowledge transfer. Our universities are internationally renowned, and the Université

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Nurturing ideas from inspiration to realization

Our researchers share a common goal – to take the seed of an idea and nurture it to its full potential. Whether it is decoding ancient antibiotic resistant genes or the Black Death, managing intellectual capital or the software in vehicles to ensure our safety, we are cultivating innovations that nourish the future. Growing our research funding from \$107 million to more than \$395 million over the past decade is just a start. We are turning over new furrows to grow a healthier, safer and more sustainable future for generations to come.

www.mcmaster.ca/research





Discoveries with impact

At the University of Saskatchewan, we are harnessing the power of research to improve health, protect our environment and help drive the economy.

As one of the top 10 universities in Canada for research income growth,* we are experiencing an unprecedented \$1-billion building boom and attracting top talent including a \$30-million Canada Excellence Research Chair in Water Security.

We are working with our partners in Canada and abroad to deliver discoveries with impact in health, innovative materials, water quality, food security and sustainable resource development. Recent projects include:

- Developing new vaccines to fight childhood respiratory disease—at VIDO-InterVac, the only facility of its kind in Canada
- Shedding light on nanotechnology for advanced batteries and fuel cells—at the Canadian Light Source, Canada's national synchrotron
- Probing potential links between oilsands mining and pollutants in rivers and finding solutions for remediation—at our unique-in-Canada Toxicology Centre

Our discoveries help communities thrive and fuel commercialization at Innovation Place, one of North America's most successful research parks.

Discover us at www.usask.ca/research

Water research in northern Saskatchewan

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Real-world solutions for real-world challenges

Ryerson University researchers make a difference

Research at Ryerson has a practical bent that builds on traditional strengths. Our investigators shape their research questions around real-world problems, and often work together across disciplinary boundaries to find innovative solutions.

For example, Dr. Catherine Middleton of the Ted Rogers School of Information Technology Management is one of Canada's leading experts on the emerging digital economy. She holds the Canada Research Chair in Communication Technologies in the Information Society. Her research focuses on how our society adopts new communication technologies, and she's interested in how Canadians use (or don't use) the Internet in their daily lives – and why.

Or consider Sri Krishnan of the Department of Electrical and Computer Engineering. As holder of the Canada Research Chair in Biomedical Signals, his research focuses on understanding human physiology from an engineering perspective. One area that Krishnan is exploring is how to reduce sudden cardiac death. By capturing the complex electrical signals generated by the heart, converting them into data and conducting analyses, Krishnan is using the results to identify people who are at risk of a heart attack. Ultimately, this knowledge will help physicians make better-informed decisions.

Thanks to the work of Middleton, Krishnan and other first-rate researchers, externally funded research at Ryerson has more than doubled in the past five years.

If you would like to learn more about research at Ryerson, and how our researchers are making their marks in a variety of fields, please visit www.ryerson.ca/research.

Top: Catherine Middleton Bottom: Sri Krishnan



Everyone Makes a Mark

Many elements help make research hospitals amongst their country's best, including visionary leaders, exceptional clinicians and brilliant scientists, but what truly sets them apart?

SUSTAINED COLLABORATIVE EXCELLENCE: THE KEY TO BEING A TOP RESEARCH HOSPITAL

The track record of the partner hospitals of the McGill University Health Centre (MUHC) and their research and teaching arms,—the Research Institute of the MUHC (RI-MUHC) and McGill University—, predates Canada's confederation while the efforts of its professionals continue to enrich the world's understanding of diseases and how best to prevent, diagnose, treat and/or cure them.

Consider tuberculosis, which still claims roughly 2 million lives per year worldwide. The MUHC and its affiliated partners have made internationallyrecognized contributions in this area since the early 20th century. Edward William Archibald, a TB survivor, McGill University graduate and a surgeon-inchief at the Royal Victoria Hospital of the MUHC performed North America's first thoracoplasty in 1912 to collapse a patient's tuberculous lung and let it rest and heal. While Dr. Archibald did not invent this procedure, he believed that advances in surgery must stem from research. His efforts improved thoracic surgery and education standards significantly, leading the Government of Canada to recognize him as one of the nation's Persons of National Historic Significance. Flash forward to 2011. Dr. Madhukar Pai, a researcher at the RI-MUHC and an associate professor at McGill, published findings that led to the World Health Organization's first ever "negative policy recommendation" on current commercial TB diagnostics. Dr. Pai collaborated with researchers at the University of Washington School of Public Health and Johns Hopkins University School of Public Health. Also in 2011, the MUHC, Meakins-Christie Laboratories at McGill and RI-MUHC launched the first Bacillus Calmette-Guérin (BCG) World Atlas, supported in part by the Public Health Agency of Canada, National Sanitarium Association-Canada and Canada Institutes for Health Research. The database provides detailed information for more than 180 countries on current and past BCG policies and practices, thus supporting clinicians, researchers and decision-makers in interpreting diagnostics, designing vaccines and developing/refining policies.

THE MUHC'S \$2.25-BILLION REDEVELOPMENT PROJECT, AN INNOVATIVE PLATFORM TO ENHANCE COLLABORATIVE EXCELLENCE

The spectacular success of modern biology, the growing convergence of genomics, chemistry and medicine, and the rising expectations of society for a more rapid translation of scientific results into tangible benefits require a novel approach to health care and science. Already, collaborative relationships on 6 continents are having a positive impact on health outcomes and the MUHC's vision for research as part of its multi-billion-dollar redevelopment will provide impetus because Canada's finest research facilities are under construction.

The Hon. Arthur T. Porter, Director General and Chief Executive Officer of the MUHC, and Dr. Vassilios Papadopoulos, Executive Director of the RI-MUHC and Chief Scientific Officer of the MUHC, stand behind this vision, as it will optimize healthcare and clinical-knowledge translation; enhance the development and commercialization of intellectual property; attract and retain world-class talent; and establish the ideal platform upon which to improve the health of individuals throughout their life span. The RI-MUHC's potential was recognized by a prestigious international panel. The result: the largest-ever grant by the Canada Foundation for Innovation to a single institution (nearly \$100 million), matched with \$100 million from the Quebec government and bolstered by \$50 million from the MUHC's *The Best Care for Life* campaign. Major facilities include the Centre for Innovative Medicine and Centre for Translational Biology.

- Will be Canada's largest dedicated academic clinical research centre, with clinical and evaluative researchers focused on Evaluating and Optimizing Health Management and Innovation in Medical Informatics
- Addresses clinical research continuum: basic science discoveries to clinical milieu; translation of new knowledge into clinical practice and health policy; and translation from clinical experience to hypothesis-driven basic research
- Subject evaluation pods, performance testing suites, monitoring facilities, CT imaging centre and clinical trials and biostatistics unit
- Directly linked to preventive, emergency, chronic and community-based care

CENTRE FOR TRANSLATIONAL BIOLOGY

- Biomedical scientists organized in research neighbourhoods investigate, amongst other themes, Prenatal and Childhood Origin of Disease, Cancer Metastasis, Infectious and Immunity, Respiratory Diseases and Drug Discovery, and Experimental Therapeutics
- Shared research platforms, drug discovery and experimental therapeutics unit, vivarium, vaccine challenge unit, clinical trials suite and distance research unit
- Directly linked to microbial and DNA archives, emerging and international pathogens, quantitative immunogenetics and biomarker discovery

STATS

6 hospitals, partnered with Faculty of Medicine of McGill University

Close to **14,000** healthcare professionals and staff, including **610** researchers

Close to **3,000** people per year receive clinical and research training, including **825** medical and surgical residents, **1,075** nurses, **450** medical students and **525** allied-health students

1,700 publications per year

24 patent applications

Significant regional, national and international contributions to health care and science from 1821 to 2011

Professionals recognized by Gairdner Awards, Killam Prize, Canadian Medical Hall of Fame, Order of Canada, Ordre national du Québec, Royal Society of Canada, and Canadian Association of Health Sciences, amongst others

MUHC.CA/CONSTRUCTION MUHC.CA/RESEARCH

Centre universitaire de santé McGill McGill University Health Centre



L'Institut de recherche du Centre universitaire de santé McGill The Research Institute of the McGill University Health Centre

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The Hon. Arthur T. Porter and Dr. Vassilios Papadopoulos discuss blueprints for the Glen Campus, where research will be accelerated thanks to cutting-edge facilities and world-class investigators.

NOVEMBER 4, 2011



PREPARED BY RE\$EARCH INFOSOURCE INC., AN IMPACT GROUP COMPANY

HOSPITAL RESEARCH TOPS \$2 BILLION — Canada's Top 40 Research Hospitals reported a substantial \$2.07 billion in research income in Fiscal 2010, up from \$1.93 billion in Fiscal 2009 – a 7.2% year-over-year increase.



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	Ra	nk		Research Income					
	2010	2009	Hospital	FY2010 \$000	FY2009 \$000	% Change 2009- 2010	Hospital Type	Province	Main Affiliated Research Institute(s)/Centre(s)
INNOVATION ATLAS CANADA™	1	1	University Health Network	\$267,654	\$261,113	2.5	General	Ontario	Ontario Cancer Institute, Toronto General Research Institute, Toronto Western Research Institute
	2	2	Hamilton Health Sciences	\$180,435	\$191,200	-5.6	General	Ontario	Population Health Research Institute, Thrombosis/Atherosclerosis Res. Inst., Escarpment Cancer Research Inst.
	3	3	Hospital for Sick Children	\$172,213	\$146,260	17.7	Pediatric	Ontario	Hospital for Sick Children Research Institute
•	4	4	McGill University Health Centre (MUHC)	\$131,147 \$106.000	\$130,092	0.8	General	Quebec	Research Institute of the MUHC
THE	6	6	Ottawa Hospital	\$104,948	\$87.720	19.6	General	Ontario	Ottawa Hospital Research Institute
GROUP	7	16	British Columbia Cancer Agency ^(a) (Provincial Health Services Authority)	\$81,765	\$41,708	96.0	Cancer	British Columbia	
	8	7	Mount Sinai Hospital, Joseph and Wolf Lebovic Health Complex	\$81,000	\$85,100	-4.8	General	Ontario	Samuel Lunenfeld Research Institute
	9	5	Vancouver General Hospital/UBC Hospital ^(b) (Vancouver Coastal Health Authority)	\$80,977	\$99,890	-18.9	General	British Columbia	Vancouver Coastal Health Research Institute
Centre universitaire de santé McGill McGill University Health Centre	10	9	Centre hospitalier universitaire de Québec (CHUQ)	\$75,735	\$74,089	2.2	General	Quebec	Centre de recherche du CHUQ
UInstitut de recherche	11	10	Centre hospitalier de l'Université de Montréal (CHUM)	\$65,300	\$64,300	1.6	General	Quebec	Centre de recherche du CHUM
of the McGill University Health Centre	12	14	British Columbia Children's Hospital (Provincial Health Services Authority)	\$64,232	\$45,992	39.7	Pediatric	British Columbia	Child and Family Research Institute
	13	11	London Health Sciences Centre*	\$63,700	\$57,700	10.4	General	Ontario	Lawson Health Research Institute
	14	15	Sir Mortimer B. Davis Jewish General Hospital	\$51,497	\$44,893	14.7	General	Quebec	Lady Davis Institute for Medical Research
CickKide	15	12	St. Michael's Hospital	\$49,300	\$47,400	4.0	General	Ontario	Keenan Research Centre, Li Ka Shing Knowledge Institute
SICUNIUS	16	18	Institut de Cardiologie de Montréal*	\$49,192	\$39,344	25.0	Heart/ Lung	Quebec	Centre de recherche de l'Institut de Cardiologie de Montréal
	17	13	CHU Sainte-Justine - Le centre hospitalier universitaire mère-enfant	\$49,000	\$47,000	4.3	Pediatric	Quebec	Centre de recherche du CHU Sainte-Justine
	18 19	17 20	Centre for Addiction and Mental Health Centre hospitalier universitaire de Sherbrooke	\$42,933 \$36,270	\$40,556 \$33,976	5.9 6.8	Psychiatric General	Ontario Quebec	Çentre de recherche clinique
A C A H O	20	19	(CHUS) University of Ottawa Heart Institute	\$33,402	\$34,331	-2.7	Heart/	Ontario	Etienne-Le Bel du CHUS Ottawa Heart Institute Research
A C I S U	21	21	St. Joseph's Healthcare Hamilton	\$30,100	\$26,900	11.9	General	Ontario	Firestone Institute for Respiratory Health, Hamilton Centre for Kidney Research Brain-Body Institute
	22	23	Institut universitaire de cardiologie et de pneumologie de Québec	\$28,071	\$24,789	13.2	Heart/ Lung	Quebec	Centre de recherche de l'Institut universitaire de cardiologie et de pneumologie de Québec
	23	22	Health Sciences Centre (Winnipeg Regional Health Authority)	\$22,615	\$26,609	-15.0	General	Manitoba	Manitoba Institute of Child Health
Pfizer	24	24	IWK Health Centre	\$20,892	\$21,058	-0.8	Pediatric	Nova Scotia	
Working together for a healthier world™	25	25	Douglas Mental Health University Institute	\$18,024	\$18,649	-3.4	Psychiatric	Quebec	Douglas Hospital Research Centre
morethanmedication.ca	26	26	Queen Elizabeth II Health Sciences Centre (Capital District Health Authority)	\$17,153	\$17,227	-0.4	General	Nova Scotia	
pfizer.ca	27	28	Kingston General Hospital	\$16,330	\$15,640	4.4	General	Ontario	
	28	29	Baycrest	\$15,568	\$15,639	-0.5	Geriatric/ Long-Term	Ontario	Rotman Research Institute
	29 30	33 32	Toronto Rehabilitation Institute ^(c) Centre hospitalier affilié universitaire de	\$15,392 \$15,093	\$11,620 \$11,986	32.5 25.9	Rehab General	Ontario Quebec	Centre de recherche du CHA
	31	27	Québec (CHA) Children's Hospital of Eastern Ontario	\$13,768	\$15,862	-13.2	Pediatric	Ontario	Children's Hospital of Eastern
	32	30	St. Boniface Hospital	\$12,935	\$13,601	-4.9	General	Manitoba	St. Boniface Hospital Research Centre
SANOFI	33	31	Hôpital Maisonneuve-Rosemont*	\$12,125	\$12,053	0.6	General	Quebec	Centre de recherche de l'Hôpital Maisonneuve-Rosemont
	34	35	Holland Bloorview Kids Rehabilitation Hospital*	\$8,400	\$7,200	16.7	Rehab (Pediatric)	Ontario	Bloorview Research Institute
	35	36	Royal Ottawa Health Care Group	\$8,100	\$7,000	15.7	Psychiatric	Ontario	University of Ottawa Institute of Mental Health Research
RESEARCH	36	34	Hôpital du Sacré-Coeur de Montréal	\$6,764	\$8,779	-23.0	General	Quebec	Centre de recherche de l'Hôpital du Sacré-Coeur de Montréal
MONEY	37	39	Hôpital Rivière-des-Prairies*	\$5,807	\$4,679	24.1	Psychiatric (Pediatric)	Quebec	Centre de recherche Fernand-Seguin
	38	37	Bruyère Continuing Care	\$5,763	\$5,773	-0.2	Geriatric/ Long-Term	Ontario	Élisabeth Bruyère Research Institute
Canada's source of R&D intelligence. Data used for this table were extracted	39	38	Institut universitaire de gériatrie de Montréal	\$5,000	\$5,000	0.0	Geriatric/ Long-Term	Quebec	Centre de recherche de l'Institut universitaire de gériatrie de Montréal
trom our Canadian Research Hospitals Database, a proprietary database. Hospitals wishing to be included in future editions of the Top 40 List	40	40	Thunder Bay Regional Health Sciences Centre	\$4,637	\$3,710	25.0	General	Ontario	Thunder Bay Regional Research Institute

Notes:

- 1. Research income includes all funds to support research received in the form of a grant, contribution or contract from all sources (internal and external) to the institution.
- 2. Data were obtained through a survey of research hospitals, except where noted. Data were not obtained from institutions in Alberta, Saskatchewan, New Brunswick, Prince Edward Island and Newfoundland.
- 3. Data are provided for the main hospital(s) including their affiliated research institutes/centres, where applicable.

*Research income numbers were obtained through the institution's financial records, therefore may not include the total research income amount.

(a) Considered to be a tertiary care cancer hospital.

(b) Research income amounts were combined as these two hospitals are clinicallyaffiliated with research conducted across sites.

(c) In FY2011, became part of University Health Network.

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Continued from page 7

The country's largest research hospital is Toronto's University Health Network, which on its own garnered \$267.7 million of research support. Hamilton Health Sciences (\$180.4 million) and Toronto's Hospital for Sick Children (\$172.2 million) rounded out the top 3 institutions in the country, followed by Montreal's McGill University Health Centre (\$131.1 million).

Twenty-six hospitals posted increases in their research income, compared with 14 hospitals where income was flat or declined.

THE \$100 MILLION CLUB

In Fiscal 2010, 6 research hospitals gained membership in RE\$EARCH Infosource's \$100 Million Club, an elite group of institutions that each attracted at least \$100 million of research income. This was an increase from 4 hospitals in Fiscal 2009. Sunnybrook Health Sciences Centre (\$106.0 million) and Ottawa Hospital (\$104.9 million) joined the Club in Fiscal 2010.

The \$100 Million Club								
2010 Rank	Researc Research Hospital	h Income \$000						
1	University Health Network	\$267,654						
2	Hamilton Health Sciences	\$180,435						
3	Hospital for Sick Children	\$172,213						
4	McGill University Health Centre							
	(MUHC)	\$131,147						
5	Sunnybrook Health Sciences Centre	\$106,000						
6	Ottawa Hospital	\$104,948						

PROVINCIAL PERFORMANCE

Nineteen Ontario hospitals on the Top 40 list accounted for 59% of total reported research income, followed by 14 hospitals in Quebec that received 27% of total income. Three British Columbia hospitals garnered 11% of total research income.

Top 40 – By Province	
Province ¹	% of Total
Ontario (19)	59
Quebec (14)	27
British Columbia (3)	11
Nova Scotia (2)	2
Manitoba (2)	2

Average research income per province varied considerably. Three British Columbia hospitals on the list attracted an average of nearly \$75.7 million in

Top 40 – Average Research Income		
Ave Province ¹	erage Research Income FY2010 \$000	
British Columbia (3)	\$75,658	
Manitoba (2)	\$17,775	
Ontario (19)	\$64,192	
Quebec (14)	\$39,216	
Nova Scotia (2)	\$19,023	
Total Research Hospitals (40	0) \$51,731	

research income, compared with \$64.2 million for 19 research hospitals in Ontario. On average, the 40 hospitals received \$51.7 million each.

Ontario hospitals led the list on the basis of research income received per-capita (per provincial resident). Ontario hospitals attracted an average of \$92 research dollars per capita, followed by Quebec hospitals (\$69), British Columbia (\$50), Nova Scotia (\$40) and Manitoba (\$29).

Top 40 – Research Income Per Capita		
Province ¹	Research Income Per Capita \$	
Ontario (19)	\$92	
Quebec (14)	\$69	
British Columbia (3)	\$50	
Nova Scotia (2)	\$40	

HOSPITAL TYPE PERFORMANCE

The majority of research is conducted at General hospitals. Twenty-two General hospitals accounted for 69% of total research income received by the Top 40. A group of 5 Pediatric institutions accounted for an additional 15% of the total, followed by 3 hospitals specializing in Heart/Lung research. Ten hospitals providing Cancer, Psychiatric, Geriatric/Long-Term and Rehabilitation care accounted for a total of 10% of research income.

GAINERS AND LOSERS

Overall, 26 hospitals posted gains in research income compared with 14 where income declined or flat. Strong gains in income were reported at two institutions operated by the Provincial Health Services Authority – British Columbia Cancer Agency (96.0%) and British Columbia Children's Hospital (39.7%). Strong gains were also recorded at Toronto Rehabilitation Institute (32.5%), Sunnybrook Health Sciences Centre (26.2%) and Centre hospitalier affilié universitaire de Québec (CHA) (25.9%).

While research income declined/flat at 14 hospitals, year-on-year drops are less significant than long-term trends.

THIS YEAR AND NEXT

Canada's Top 40 Research Hospitals are a key part of the national innovation system. To illustrate, the \$2.07 billion of research income garnered by the Top 40 is equivalent to about 1/3 of the total research income reported by Canadian universities. If research hospitals that did not report data this year were to be included, the proportion would undoubtedly be even higher. Many hospitals operate on a scale of research activity that compares favourably with universities. For instance, the 6 largest hospitals all attracted research income in excess of \$100 million, which was more income than was received by 34 of the country's Top 50 Research Universities. In fact, most research hospitals work closely with local universities; hospital researchers are commonly cross-appointed to university faculties, and vice versa. Clearly, our leading hospitals are research powerhouses, and awareness of the importance of research hospitals in the national system of innovation is growing.

Like all research institutions hospitals are heavily dependent on outside funding forces. Most of their income comes from sources external to the institution; in particular governments, charities and the corporate sector. It is no secret that the pharmaceutical sector has seen its Canadian research funding support decline for a number of years. Charitable support has grown in recent years, but charities depend on the contributions of individuals, who may cut back as economic conditions deteriorate. Foreign sources also sponsor a considerable amount of research at Canadian hospitals, and a slowing world economy will put pressure on those sources of support.

Economic headwinds will make 2011 and beyond a difficult environment in which to attract research income. Government funders in par-

ticular will be looking to rein in deficits. The bottom line is that hospitals' research funding situation is clouded. The research community is anxiously awaiting forthcoming federal and provincial budgets for clues about research support.

IOP IU	Kesearo	in nospitals by Growth	
2010 Income Growth	Rank Overall	% C Research Hospital 2009	hange 9-2010
1	7	British Columbia Cancer Agency	
		(Provincial Health Services Authority)	96.0
2	12	British Columbia Children's Hospital	
		(Provincial Health Services Authority)	39.7
3	29	Toronto Rehabilitation Institute	32.5
4	5	Sunnybrook Health Sciences Centre	26.2
5	30	Centre hospitalier affilié	
		universitaire de Québec (CHA)	25.9
6	16	Institut de Cardiologie de Montréal	25.0
7	40	Thunder Bay Regional Health Sciences Centr	e 25.0
8	37	Hôpital Rivière-des-Prairies	24.1
9	6	Ottawa Hospital	19.6
10	3	Hospital for Sick Children	17.7
Apparent ti	es due to rou	nding	

2010 Income Growth) Rank Overall	Research Hospital	% Change 2009-2010
1	36	Hôpital du Sacré-Coeur de Montréal	-23.0
2	9	Vancouver General Hospital/University	of
		British Columbia (UBC) Hospital	
		(Vancouver Coastal Health Authority)	-18.9
3	23	Health Sciences Centre	
		(Winnipeg Regional Health Authority)	-15.0
4	31	Children's Hospital of Eastern Ontario	-13.2
5	2	Hamilton Health Sciences	-5.6

Bottom 5 Research Hospitals by Growth

Top 40 – By Hospital Type			
Hospital Type	% of Total	Leader	
General (22)	69	University Health Network	
Pediatric (5)	15	Hospital for Sick Children	
Heart/Lung (3)	5	Institut de Cardiologie de Montréal	
Cancer (1)	4	British Columbia Cancer Agency	
		(Provincial Health Services Authority)	
Psychiatric (4)	4	Centre for Addiction and Mental Health	
Geriatric/Long-Term ((3) 1	Baycrest	
Rehabilitation (2)	1	Toronto Rehabilitation Institute	

¹ Data were not obtained from institutions in Alberta, Saskatchewan, New Brunswick, Prince Edward Island and Newfoundland.



Dr. Michael Julius Past Chair of Research Canada: An Alliance for Health Discovery



Getting Down to "Business"

\$200 billion is enough to buy the best care. This includes supporting close to 1,000 health care facilities nationwide, along with their staff of health care professionals and the medicines and equipment needed to deliver the best care. Where does the "best" care come from?

Research. Today's discoveries are tomorrow's care. Rates of illness and death caused by disease have dropped dramatically over the last should be bigger, the bottom line is that we're not doing very good "business" with the current level of investment.

Why not?

ederal and provincial health economists are looking for "return on investment," approget the to ensure that we best bang for our buck. Understanding return on investment is simple: it is the value created from our investment. How, then, is value determined? If you're a patient or family member of a patient in hospital, value for you is the quality of acute care provided after a life-threatening incident, or the lifesaving treatment given for a disease. By this definition, we're doing well in creating value. There is much room for improvement, however, namely in supporting the discovery pipeline that ensures the innovations of medical scientists get into the clinic. The delivery of the best care depends upon this.

Before an experimental technology or drug becomes a new treatment, it must be put through the rigours of testing to ensure it is safe and effective, and that it works better and perhaps more efficiently than currently available drugs or technology. In addition, these activities, if harnessed, add another dimension to the value of our health care system: an economic dimension achieved through job and business creation.

monumental opportunity – one that if seized would ensure that we have the best health care system in the world, and that we can capitalize on the collateral activities that contribute to the economic stability of our health care system and growth of the knowledge-based economy.

A challenge in achieving this goal of national health and wealth is that for the most part, federal and provincial investments into health care and to govern the integration of these activities.

What's the solution?

■ irst, we need to understand all of the pieces of this puzzle. Then, we must understand the micro- and macro-economics that tether these pieces. Once this catalogue of activities is complete, then and only then will we be able to craft overarching governing policies. Joining all of the dots, from discovery research, to developing and testing these discoveries, to creating companies or partnering with global leaders in this realm, and finally to delivering the discoveries into our health care system - now that would be an innovative world first! The time is right as we move forward to renew our national health accord. Innovation is within our grasp. It'll be a bumpy road, but let's fasten our seatbelts and get down to business.

on health care annually. A large sum, to be sure, but most would agree: we'd pay whatever it costs because our health, and that of our families and friends, trumps all. Moreover, good health underpins national productivity and prosperity. But, are we getting the best bang for our tax dollars? Many argue not. Here's the challenge.

We expect the best health care. Not unreasonably, we expect that 20 years because of research. We're living longer and better. That's because we're discovering the root causes of disease, enabling the creation of better treatments and technologies.

The portion of our \$200 billion national health care budget which supports innovation toward achieving the "best" health care ensures Canada has an internationally acclaimed body of scientists dedicated to making discoveries and getting them into the Canadian health care system. Although the proportion of investment into the national research and development enterprise arguably Unfortunately, we're not doing nearly as well in getting this knowledge and its products into our health care system, or in capitalizing on the potential economic value from the knowledge that our investment in health research creates.

We could argue, and indeed some do, that we should simply "import" the best health care. But that would only undermine investments already made in health research. Moreover, it would mean the loss of a health research in this country do not inform one another. Do we have too many cooks in the kitchen, or are they not talking one to another? We would propose that both of these issues contribute to an incongruous national funding model.

Funding for health care, research, business development, and all the other collateral activities that need to be integrated to capitalize on our health research investments, is not coordinated. We have multiple agencies, often covering similar ground, under different jurisdictions. And, we do not have a national policy

Need + Creativity + Opportunity = Improved Health



Christopher Paige, Ph.D. Vice President, Research University Health Network

nnovation. We talk about it. We label funding programs with it. We have prizes for it. We even have Ministries named for it. And we know it when we see it. But we do not do enough of it, at least not in health care. Why? The reason, in my view, is that our current investment is not used optimally.

Innovation requires three elements. A need – a creative mind – an opportunity. It is not hard to identify need in health care.

We still do not fully understand the initiation and progression of many diseases. We do not understand the key differences that result in diverse outcomes in two individuals with apparently similar disease treated the same way. And what we do understand about a disease is generally understood in isolation, rather than in the real world where co-morbidities are the rule rather than the exception.

Our approach to treatment is less than optimal. Only a small fraction of our patients are being treated on a clinical study protocol which means we lose vast amounts of potentially valuable information that could change practice. It also remains a challenge to bring multidisciplinary approaches to treat patients that need complex care.

And the health care delivery system needs help. Our ability to collect, analyze and utilize data remains primitive in comparison to other industries. Coordination of care to ensure that the right patient is directed to the right level of care at the right time is sub – optimal.

It is not hard to find creative minds in health care.

One could argue that some of the most creative minds in Canada have been drawn to health research and heath care delivery. And they reside not only in Research Hospitals and Universities but across the spectrum of our health care system. systematic testing of novel treatments, novel approaches to care, and novel ways to operate the health complex to maximize both outcomes and efficiencies.

How do we link need, creativity and opportunity?

⁶⁶ It is not hard
 to find creative minds
 in health care. ⁹⁹

Christopher Paige, University Health Network

It is somewhat harder to deal with the third critical component of innovation in health care: opportunity.

Opportunity means resources which means time and money. Time to propose, implement, and evaluate change of practice both in clinical protocols and in health management. And well-funded infrastructure which allows the A pilot program should be launched to designate 20 hospitals across Canada as Health Innovation Leads with the responsibility to optimize health care through a process of study, implementation, and evaluation. Innovation Leads would be centred in a hospital to take advantage of the large base of medical research already performed in hospitals but would include the full spectrum of health care providers. Practice improvements discovered by these hospitals will be disseminated through a national database available to all Canadian health care providers so that advances by one Innovation Lead will be rapidly shared by all.

The process of becoming an Innovation Lead would be competitive with evaluation by international panels of health care experts. After the 20 hospitals are chosen they would be linked to form a national network to avoid duplication and optimize cooperation. Each hospital would receive \$5M/yr for 7 years to establish the infrastructure to undertake both their most innovative clinical and health service studies. The established infrastructure provides the basis for attracting external project specific funding as well. This approach is similar to the very successful Comprehensive Cancer Centre program in the USA.

Recipients of the Innovation Lead funds would be held to account by rigorous evaluation of progress on a regular basis. Renewal after 7 years would be competitive and based on demonstrated accomplishment where innovation in heath care can be measured in tangible improvements in outcomes and/or efficiencies.

Ultimately this program should be funded provincially as part of the Provincial mandate to provide health care. Like any other industry, health care should be investing a small amount of its funding in improvement. The proposed plan would require the reallocation of approximately 0.0007% of current public spending on health care.1 However, I think the Federal Government should also play a key role by funding the pilot program - the first 7 years. This will kick start a Canada wide network of hospital based Innovation Leads and give the Provinces time to both evaluate the success of the program and to adjust their budgets to continue funding of the subsequent 7 years and beyond.

The potential improvements – both better treatments and more efficient health care delivery systems – will be valued at many multiples of this investment.

¹ Canadian Institute for Health Information

Moving at the Speed of Discovery... From Bench to Bedside to Business



Glenn Brimacombe President & CEO ACAHO

s <u>the</u> national voice of the country's Research Hospitals, academic Regional Health Authorities and their Research Institutes, the Association of Canadian Academic Healthcare Organizations (ACAHO) is pleased to see that many members have participated in RE\$EARCH Infosource's inaugural Top 40 Research Hospitals list.

The list serves an important role in terms of shining a light on many

of the academic healthcare organizations across the country that explicitly incorporate research and the early adoption of innovation – from research-to-practice – as part of their strategic focus, and relationship to advanced patient care and educating the next generation of health providers.

It is the integration of these three missions – patient care, education and research & innovation – that uniquely differentiates ACAHO members from other organizations in the health system that focus predominantly or exclusively on the provision of health and health care services. Each mission serves to reinforce the other two, with the objective of providing Canadians with access to world-class patient care, well-trained health providers, and state-of-the-art research.

Our own studies show that as *engines of health innovation*, the total research budgets of ACAHO members exceeded \$1.8 Billion in 2009, attracting close to 80 cents of each public dollar invested in health research. They are the living laboratories and practice settings of at least 1,500 clinical trials annually, employers of thousands of talented research staff and students

who work with them, and account for at least \$340 million in clinical trial revenue annually. They also generate millions in technology transfer income, and account for hundreds of new disclosures, patents, licenses, and dozens of world-firsts and spin-off companies annually. the 19th, 20th and 21st Centuries; from basic research that has led to the improvements in the health status of individuals and populations; to innovative ways to deliver a range of cost-effective health care services to Canadians in need; to changes in organizing and managing our health delivery system;

⁶⁶ The process of innovation is a race with no finish line. It is relentless and in perpetual motion.

Glenn Brimacombe, ACAHO

Investments in research improve the *health* & *wealth* of Canadians. From the perspective of ACAHO members, it is the contributions of health research – applying the tools of science & technology – that have produced some of the most significant discoveries of to the development of innovative products and services that bring with it skilled jobs, investment, income growth, wealth generation and a robust public revenue

stream. If knowledge is the new global currency in an increasingly interdependent and competitive world, then research is the foundation upon which innovation rests. In its dimensions, it is about health, health care and the economy; in the aggregate, it is about Canadabuilding in the 21st Century and raising our overall quality of life and standard of living.

The process of innovation is a race with no finish line. It is relentless and in perpetual motion. It is clear that countries which continue to invest significant resources in research and development over the long-term are likely to be the knowledge leaders of tomorrow – and will be well positioned to reap the health, social and economic rewards that come with it.

Over the past decade, the federal government has played a key leadership role in creating new policies, programs, and investing sizable resources to increase our capacity to discover, apply and innovate – and they should be strongly applauded for doing so.

While there is an impressive track record of achievement, more needs to be done. In particular, it is essential to create a national dialogue across all sectors which are involved in the health research & innovation value chain – academic healthcare organizations, universities & colleges, governments, industry, health providers and the charitable sector – to ensure that we create an attractive environment that nurtures and celebrates research and looks to maximize the health, social and economic impacts that flow from innovation; from bench to bedside to business.

While ACAHO members continue to make important contributions to this conversation, we believe that it must be done in full partnership with others if we are to fully leverage our public, private and charitable investments in health research and innovation to the benefit of all Canadians.

What is now required is that we be bold in our vision, focused in our implementation and relentless in our pursuit of excellence. The road to Canada's future is paved by science and driven by innovation... it is in everything we are, experience and will become.

I know we are up to the challenge!

For more information on the activities of ACAHO, I would invite you to visit our web-site at www.acaho.org.







W. Robert McMaster ~ Executive Director Vancouver Coastal Health Research Institute ~ Associate Dean of Research Faculty of Medicine, University of BC



Heather Harris-Harper Director of Operations BCCRIN

uring the Vancouver Winter Olympics, the world witnessed Canada in a convergence of talent, resources, coordination, the will to win, and meticulous planning. Attention was given to each detail needed to "Own the Podium" – from the training of every athlete, to the building of infrastructure; from the role of every volunteer, to the way we would welcome delegates from around the world.

If this is a winning formula for international business, we share a belief that Canada can use a similar approach for reclaiming its global position as one of the most attractive environments in the world for clinical trial research. After all, we have a track record of success; some of the world's best healthcare organizations and research talent; motivated industry leaders, and willing government partners.

For academic healthcare organizations like Vancouver Coastal Health Authority and others, and the newly established BC Clinical Research Infrastructure Network (BCCRIN), clinical trials provide some of the most literal opportunities through which research and innovation can be generated and used to positively impact human health and the economy. Clinical trials are the point of contact between the potential of science and the possibilities for a patient. They hold the potential for the diagnosis, treatment, and elimination of disease. They allow us to attract leading clinicians and researchers in the global competition for talent and to generate jobs and spin off effects. In 2007-2008, clinical trial contracts with academic healthcare organizations accounted for an estimated 300 million dollars in potential revenue.

However, over the past four years, there has been a decline in clinical trials in Canada. While we have many strengths, through the eyes of global head offices with resources to invest, we may also be perceived as a national market that has comparatively cumbersome start up times, higher costs, multiple provincial regulatory environments, fewer incentives, and a fragmented population from which to recruit patients as clinical trial participants.

To help address these issues, in September 2011, a Canadian Clinical Trial Summit was co-

Based Pharmaceutical Companies (Rx&D), the Canadian Institutes for Health Research (CIHR), and the Association of Canadian Academic Healthcare Organizations (ACAHO). Led by a multisector steering committee, over 130 representatives from industry, clinical sites, universities, and governments spent a full day together; generating options that could help Canada address both operational and strategic barriers to future clinical trial competitiveness. The Summit was opened by the announcement from ACAHO, Rx&D and CIHR of a model National Clinical Trial Template Agreement for negotiating single and multisite clinical trial agreements among sponsors, clinical sites, and principle investigators that will be piloted across Canada in the next six months. While work is now underway to synthesize the ideas generated into a draft action plan for discussion, three things became immediately obvious:

sponsored by Canada's Research

• If we are deliberate about choosing and coordinating strategies, there are quick wins available for addressing individual operational barriers to our competitiveness. These range from strategies to reduce the time needed to negotiate contracts, set up a study, ensure ethical standards of practice are met, standardize various operating procedures, control costs, and engage the public in clinical trial opportunities.

2. The solutions that we need to be able to implement are not

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Healthier Children. A Better World™ www.sickids.ca

only within the walls of any one organization or sector, but across them. The success of our individual or regional activities will be accelerated or undermined by the national leadership and

⁶⁶ Clinical trials are the point of contact between the potential of science and the possibilities for a patient. ⁹⁹

W. Robert McMaster and Heather Harris-Harper

coordination available to tie a diverse range of activities together and present an attractive storefront to global offices.

3. When it comes to the human, social and economic benefits of clinical trials to Canada, it is hard to tell which voice belongs to academia, healthcare, government or industry. Within the field, it is clear that our competition is neither internal nor sectorial, but global. The questions we are now discussing are no longer whether or for whom, but what and how.

For the co-sponsors and attendees of the clinical trial summit, the success of our day together will depend on how well we develop, mobilize and execute an action plan. What if we don't? The analogy is the team of all star athletes with the potential to bring home the gold, but with no coach, no GM, and no place to plan or practice.

SickKids

We have what it takes to succeed – raw talent, a track record, reputations, outstanding academic healthcare organizations and universities, supportive governments, regional leadership, a convergence of interests, and established initiatives. But this year, we need to huddle, plan, and execute, and maybe even pack the Team Canada jersey alongside the lab coats, scrubs and business suits to ensure Canada remains a leading country for Clinical Trials.









APPLIED RESEARCH: College and Business Partnerships Shaping Success



Robert Fripp Senior Associate The Impact Group

his has been a remarkable year for applied research in colleges. Remarkable!" Trish Dryden's comment refers to the situation in Ontario, not Canada as a whole. "The whole acceleration of applied research in colleges is really happening. It's really taking place."

Still, college and business partnerships in applied research are coming together in many parts of Canada. We'll get to that. Dryden, Associate VP, Research and Corporate Planning at Centennial College in Toronto, expects a continuing, accelerating ramp-up for a process that began slowly a decade ago.

Listening to Dryden reminded me of sitting through an economics lecture in a past millennium, taking notes on an economic take-off model propounded by W.W. Rostow. Rostow's model evolved in stages, from Preconditions for take-off, to Take-off, followed by Drive to maturity. College-business partnerships in applied research have not reached what one might call maturity in any part of Canada, but in many cases they are seriously moving from take-off to drive. It is even apparent that the available college faculty, students and equipment falls short of rising demand: "The need among our small and medium sized enterprises (SMEs) is much greater than what colleges are currently able to provide." At this point, Janet Walden adds history. Walden is VP, Research Partnerships, at the Natural Sciences and Engineering Research Council of Canada. NSERC has had a clear mandate for facilitating universitybased research for years, but that mandate did not include colleges. "We did a cross-Canada tour in 2003 and noticed how the colleges were changing, attracting people with higher level degrees," she says. "They were becoming involved in

applied research in a more sophisticated way than before. Provincial governments' expectations were rising, too; they were granting mandates to colleges for training students to advanced degrees. We were impressed by what we saw."

The following year, NSERC took a step forward. "We launched a pilot project in 2004 to gauge what would happen in community colleges' local environments, and in local businesses working with those colleges.

"We had just six colleges spread across Canada for a three-year, \$3.6 million NSERC project. The result was a real enhancement of teamwork between colleges working to help local businesses solve some of their research and prototyping development challenges.

"It was good for the colleges' students, too; their opportunities to work with local business communities gained them experience and links to potential future employers.

"Our pilot returned enough benefit that we were able to make a strong case to the federal government. In 2008 the government invested \$15 million while making the program permanent."

That initiative introduced a qualitative shift, as well. NSERC's mandate was restricted to science and engineering. But college curricula extend beyond that, so the new federal money expanded the 2008 initiative into other fields. The result: NSERC now manages the program in association with the Social Science and Humanities Research Council (SSHRC) and the Canadian Institutes of Health Research (CIHR) - "Now we can cover the full spectrum of research activity right across the country," adds Walden. Colleges and local businesses across Canada enjoyed a close relationship a decade ago, because colleges produced the graduates that businesses hired," says James Knight, President and CEO of the Association of Canadian Community Colleges (ACCC). "Colleges were already giving input to businesses about emerging technologies and new types of programs." For at least that long, colleges have been forecasting local labour-market conditions to tailor their syllabuses to match their regions' needs. "That relationship was strong," says Knight. But it was also largely informal. However, that degree of collaboration launched a new discussion: "How could colleges assist businesses with their technical challenges, their marketing needs, product and marketing design requirements, and their need to manufacture prototypes?" For SMEs, collaborating with colleges opened a range of production and development opportunities, such as applying college faculty and

student skills with equipment and technologies - typically leadingedge - which colleges have in place to train their students.

"Canada is ahead of most countries in investing a great deal of public money in research fields," says Knight, whose ACCC membership now exceeds 150 colleges, cégeps, and related institutions from coast to coast.

"Our granting councils invest considerable sums - in universities. We had to work with ministers and the granting councils to put pilot projects in place before we could see how things went with colleges, too."

Similar initiatives were converging from several directions. Provincial governments were exploring applied research between colleges and businesses. Quebec led the field, installing some 45 technology transfer centres in colleges that engaged

CONII is more than a key player in linking colleges to businesses to drive forward the innovation economy. Williamson reminds us of the many students who find what may be their first employment with college-linked businesses. "Organizations such as CONII are funnels in a system that provides businesses with the highly qualified, skilled personnel they will need far into the future. That's our thrust, in my opinion.

"Yes, we are here to solve business needs - but not only the technical side of those needs. It's the student factor, student training and their promise in, and for, the future: That matters, too. It's a potent synergy: the amazing expertise of what they are looking for, how we can provide it, and how through their work they can help everyone else to build."

Applied research programs

⁶⁶ There is growing recognition about the impact that colleges can have on their local communities ⁹⁹

Janet Walden, NSERC

with local businesses. Things move forward. "As an advocacy body, we" - ACCC - "successfully advocated launching programs a few years ago, and then watched the scope as those programs expanded. The Government of Canada has been extremely responsive, ramping up funds and assigning them into new areas." The messages feeding back to Ottawa must have been positive. The 2010 budget doubled the funding available to NSERC's original, competitive, Community and College Innovation Program. The same budget increased virtually no other program. The funding for CCIP stood out. Quebec, in effect investing its full college system in working with local businesses in applied research and commercialization, is leading the nation's way. "Ontario comes next," says ACCC's James Knight, with its Colleges Ontario Network for Industry Innovation, (CONII). "We're a bit of a matchmaker," concedes CONII's executive director, Vanessa Williamson. "We help identify key business partners and connect them to colleges that are right for them. We set up first dates and hope they get into long-term relationships."

between colleges and businesses don't work automatically because they seem like the right thing to do. Collaboration is not just a matter of natural fusion. They work because college administrators are making collaboration work on a continuing, systematic basis.

Agency for Southern Ontario (Fed-Dev Ontario) - rolled out, the colleges receiving the funding formed a mini-network. We were all on a conference call every two weeks, asking: What forms do you use for this? How do you calculate that? Each college uploaded its industrialpartner application forms to a new web site, and together we boiled them all down to one."

However, one problem has long been recognized. Traditionally, university teachers enjoy contracts that assign 40% of their time to teaching, 40% to research, and 20% to community service. College faculty contracts are more restrictive: much of teachers' time is assigned to teaching. Since education is a provincial responsibility, the colleges' mandate was to educate, period. Research, pure or applied, was not a college function. That is changing. "We are seeing the provinces giving research mandates to community colleges. There is growing recognition about the impact that colleges can have on their local communities," says NSERC's Janet Walden.

Some 195 colleges are spread through, and interlinked with, 900 Canadian communities. NSERC is extending its role again, being careful - "Absolutely not to turn colleges into universities!" stresses Walden. "It's up to a college and its province to determine how much applied research a college can undertake with SMEs." NSERC makes a key distinction, using a different set of terms and conditions with colleges (as opposed to universities), while a different team manages relations with them.

NSERC states that its "College and Community (CCI) Program will advance the Science and Technology strategy's 'entrepreneurial advantage." Translated, that means CCI helps college faculty and students turn their knowledge into practical applications for their business partners. This helps businesses harness research and development to improve their capacity for innovation. The bottom line: colleges help businesses create and spread prosperity. At present, colleges receive 1.5% of disbursed government funds; university-based research takes the rest. ACCC's Jim Knight hopes the college component will rise to 5% in the next three years. Centennial's Trish Dryden comments that collegebased research is slated to receive a full \$38 million by 2013-14. "So I'm not sure that the 5% figure matters any more as long as we keep going down this pathway." Certainly the effectiveness is already seen to be profound. The number of college students now gaining exposure to innovation and entrepreneurial readiness tell

a "remarkable story," says Dryden. The Conference Board of Canada reports that, in Ontario, as many as 50% of students working in applied research projects end up being hired by companies they worked for.

"The productivity end, and the jobs end, of programs like CCI and FedDev Ontario is spectacular. "It's a huge value-added for applied research!" In a difficult environment, she adds, "Companies that are gaining in productivity are getting to keep their employees, even taking on new ones."

At this point, Dryden introduces us to one of Centennial College's business partners, Nick Efston, President of EfstonScience, "Canada's leading retailer of scientific and technical products since 1970."

Nick's father, EfstonScience's founder Evan Efston, began selling solar cells and alternative energy experiment kits very early on. Father and son were already ahead of the curve when they built their passively solar-heated flagship EfstonScience SuperStore. Then Nick set up eSolar. ca, a division dedicated to renewable energy solutions. He commissioned Toronto's first Hybrid Wind+Solar LED Streetlight to be installed at the store.

When you bought a Model T Ford you knew it was bound to be just like your neighbour's, and probably black. Those days are gone. "Customers all want something different" [in wind and solar energy], says Efston. "We partnered with Centennial in the FedDev program because we needed to set up a test-bed to test different configurations and combinations - turbines, solar panels, batteries - And our customers wanted tools, a troubleshooting tool, and

"In Ontario we had federal money from 2004 and provincial money from 2006," says Centennial's Trish Dryden. "More and more faculty and students got into the process. More and more industry partners. But industry partners, particularly SMEs, don't have time to work their way through a college bureaucracy. They need to know right away: 'This is the office I call, and here's where I get help.'

"Because we were small we compensated by forming incredibly strong networks provincially and nationally among colleges to share knowledge about best practices. That was crucial in getting the rocks out from under our mattress. We have had some of the frankest collegial conversations about: Why did this work? Why didn't this work? How do you assess an industry partner for readiness?

"When the FedDev projects -Federal Economic Development another one they could look at and say, 'We saved X dollars without dumping Y tons of carbon dioxide in the environment!'

"That's what we are doing with Centennial, testing for different configurations, optimizing for urban and off-grid lighting, seeing how we can take off-grid power and return it to the grid. Our customers want to sell power at peak times and buy at off-peak. There are lots of things you can do - when you have data that shows what you are producing. You can show real return on investment figures and back them up. Having a third-party independent institution - Centennial College - involved in doing the testing helps everyone."

That, in a nutshell, illustrates collaborative applied research at work. Coincidentally, the day after I interviewed Trish Dryden, a crew working for Nick Efston began constructing the first of three different solarand-wind experimental streetlights at Centennial College, outside her office window.

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Innovation, creativity and collaboration are vital to our economy, and to our community. Centennial's Applied Research and Innovation Centre catalyzes and accelerates business productivity and competitiveness. Find out how we can help your company grow – visit centennialcollege.ca/applied

College Applied Research Grows



Nobina Robinson CEO of Polytechnics Canada and a member of the Federal Expert Review Panel on R&D

n Calgary, college students have helped an entrepreneur develop a compact energy-efficient hot water boiler. In Ottawa, a builder is providing award-winning shelters to disaster areas, thanks to the efforts of engineering students at a local college. And in Toronto, Game Design faculty and students at a leading college are helping a high-tech startup to access much-needed venture capital by proof-of-concept work that completed the animation and integration of a game designed to help children with learning disabilities. Such applied research success stories demonstrate concretely how told us many revealing things:

SME Innovation

Canada's under-tapped colleges are

contributing to innovation success in

Colleges help small- and mid-

sized enterprises (SMEs) solve

a variety of challenges, from the

design and prototype stages of new

products to their commercializa-

tion. Overcoming these innovation

hurdles are undoubtedly among the

major obstacles facing Canada's

For their part, Canada's colleges

consider contributing to the country's

economic success to be an integral

part of their 21st century mission. At

Polytechnics Canada - an alliance of

nine leading research-intensive, pub-

licly funded colleges and institutes of

technology in key economic regions

- and at other leading colleges, we

foster economic growth through

applied research that addresses com-

mercial needs. Our research is driven

by industry requirements, not by

academic curiosity. And being close

to our clients, we deliver business

When the recently concluded

results quickly and efficiently.

business sector today.

meaningful ways.

 speed-to-market is their principal challenge because government does not adequately support "demanddriven" innovation (since so much funding is focused on the "ideapush" model of pushing invention out to consumers);

• most firms, with an average size of half a dozen employees, do not have in-house R&D talent or facilities; and

• financing and capital are difficult to obtain in the time needed.

Many identified the commercialization gap as critical – the vital near-to-market stage when products, processes and service innovations need to be tested, scaled-up or retooled. But this is where colleges can play the role of innovation intermediaries or innovation "midwives," to coin a phrase. We bridge the "death valley" between pure research and commercial problem-solving. That bridge leads to economic growth and jobs. Few other institutions performs that role. Yet, the predominant federal response to spurring innovation has been to support discovery and breakthrough research, enticing companies to collaborate on largescale, multi-year academic research projects with universities.

Clearly, we need to grow the number of innovative firms. Of Canada's 1.1 million SMEs, less than 20 per cent invest in R&D. This number must grow.

More than a decade ago, applied research projects emerged as a byproduct of the training colleges performed for local firms and employers to meet their labour market demands. Armed with the ability to offer high-quality, technologyintensive undergraduate degrees, Polytechnics Canada members, along with other leading colleges, began integrating these research projects into their curricula. As a result, college students have learned to apply their knowledge as they complete their academic credentials.

Now, companies approach colleges for applied research and business innovation assistance services. In response, Canada's largest colleges and polytechnics are showing an increasing research-intensity, operating research enterprises that are leveraging both government and private investment.

Since 2008, Polytechnics Canada's members have serviced more than 2,500 SMEs, conducted nearly 1,200 applied research projects to solve industry-identified problems, involved some 13,500 college students in hands-on applied research projects and developed 560 prototypes for their industry partners.

Federal recognition of these growing trends has been slow and disparate, often supported through small-scale pilot projects. However, through recent programs such as NSERC's College Community Innovation Program, FedDev Ontario's Applied Research and Commercialization Initiative and announcements such as the NRC's new Industrial Research Assistance Program for ICT adoption, modest support is being provided to connect the applied research talents and facilities of colleges and polytechnics with the business needs of SMEs. Even through these very recent programs over 500 firms have increased their

R&D exposure and activity. The time has come to strengthen these programs and think of new ways to support SME innovation, through programs with proven track records such as commercialization vouchers that enable firms to choose the commercialization service provider of their choice.

And now, a new trend is emerging where successful applied research projects at colleges are creating new positions at the client firms that are then filled by the very students who were working on the projects. In this way, college students are not just being trained to fill jobs vacated by baby-boomers leaving the workforce; they're creating new, high-quality, sustainable jobs that the economy needs. Our graduates have the entrepreneurial talent so needed by small firms to grow commercial success. This is "demand-driven" innovation in action - one effective, albeit underutilized, way to grow SME innovation and productivity in Canada.

Nobina Robinson is CEO of Polytechnics Canada and a member of the Federal Expert Review Panel on R&D, which issued its report in October.

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TURNING RESEARCH INTO SOLUTIONS

What Canada is Getting Right

Debbie Lawes Consulting Editor RE\$EARCH Money

f you're a regular reader of reports on Canadian innovation (be warned: there are several), you can be forgiven for thinking that our country is going to hell in a hand basket when it comes to converting billions of dollars of publicly funded research into solutions that make us richer, healthier and safer.

The statistics have become all too familiar: lagging productivity, low rates of business spending on research and development, and a dearth of venture capital, particularly for young technology companies.

These challenges are real, but they don't tell the whole story. They don't tell us, for example, that Canada's economic policies have become the envy of the world or that among G7 countries, Canada has the highest proportion of post-secondary educated graduates in the workforce. We are also prolific publishers of scientific papers. In 2008, with only 0.5% of the global population, Canada produced 3.3% of the world's scientific papers, placing us eighth internationally.

The Executive Director of the Institute for Competitiveness and Prosperity, a Toronto-based think

tank, believes there is reason for optimism. He points to tax changes at the federal and provincial levels that make it more attractive for companies to invest, an openness to international trade that is solidifying new markets, and research and development tax credits that are among the most generous in the world.

"So, does this mean our worries are over?" asks James Milway. "Of course not. It takes a while for these things to kick in and for the results to be felt."

Turning Research into Profits

Despite the challenges, Canadian companies prove time and again that they can compete with the best globally when it comes to making and selling home grown technologies.

Take **Teledyne DALSA**, a pioneer in the design and manufacture of digital imaging and machinevision products. Its cameras are used to inspect the majority of the world's flat panel televisions and its image sensors on the Mars Rover captured the highest resolution pictures ever taken from another planet. Watch for them as well on NASA's New "Curiosity" rover.

The company's Canadian operations grew annual revenues more than 30% to a record \$212 million in 2010. Even during slow times, it has routinely invested about 20% of revenue in R&D.

"We have a strategy for growing the business and it starts with creating products and services that our customers want," says Dr. Gareth Ingram, V.P. and General Manager, Teledyne DALSA Digital Imaging.

What customers want, he adds, is more powerful and sophisticated cameras. Teledyne DALSA is responding with smaller, lighter and less power hungry cameras that share much of the same high tech circuitry and software found in computers and cell phones. It is also developing cameras that can see outside the visible part of the spectrum, including X-rays, infrared and ultraviolet light, to locate someone in a search and rescue operation or identify tooling defects in machinery too small for even a microscope to detect.

"We're launching a new product this year called Argos. It's an X-ray detector that is designed for panoramic dental imaging," says Ingram. "A variation of it will also be used for mammography."

Advances in science and engineering are also helping Canadian companies stay ahead of the global pack in the fiercely competitive aerospace sector. One of those leaders is Pratt & Whitney Canada Corp., which has 18 engine programs currently in progress, including a nextgeneration aircraft engine that will use 20% less fuel while generating less noise and fewer emissions. The company expects to invest nearly \$2 billion over the next five years on engineering and development and hire 200 new engineers, bringing its Canadian engineering workforce to more than 1500.

P&WC's V.P of Engineering, Walter Di Bartolomeo, says their R&D strategy is two-fold: be consistent in investments, even when sales are slow, and develop technologies that won't become obsolete during the 20-to-40 year lifecycle of the aircraft.

"We do this by continuing to reinvent ourselves, by improving our productivity, leveraging the knowledge that we have and taking advantage of trends in other industries," says Di Bartolomeo. "For example, how do we use the vast amounts of computing power available to monitor how an engine is performing in the field."

Greening the Oil Sands

Environmental challenges are demanding technological solutions in several industry sectors, particularly in Alberta's carbon-intensive oil sands.

Syncrude Canada Ltd. – the only oil sands operator with a dedicated research facility – is betting on innovation to reduce its environmental impact, improve the reliability of its operations and reduce costs. One of its early innovations was the introduction over a decade ago of a warm-water extraction process that uses about 40% less energy to produce one barrel of bitumen.

Today, it is focusing heavily on land reclamations and remediation. For example, it is transforming a former mine site near Fort McMurray into a man-made wetland. Once completed in 2012, Syncrude researchers will begin a 10-year study to monitor the sustainability of the Sandhill Fen Watershed.

"The oil sands are a relatively young industry and, because of that, there is considerable room for innovation and technology development," says Glen Rovang, Syncrude's Manager of R&D. "Over the next period of time, we will be strongly biased towards environmental research and tailings management technologies."

Environmental research comprises about 60% of Syncrude's total annual R&D budget. Syncrude has also joined six other oil sands producers in a new consortium that will invest at least \$90 million annually, and share intellectual property, for new technologies to reduce and clean wet tailings generated during surface mining.

The Risks of Getting it Wrong

Very few innovations are radical new discoveries. The majority of companies – particularly those dealing with complicated industrial processes – rely on incremental innovations to boost productivity or reduce costs.

Forest products producer **Tembec Inc.** works with FP Innovations, an industry R&D organization, and university researchers to understand how these processes work and how best to improve their performance.

"The benefits are always potentially huge. But getting it wrong can be disastrous if it results in millions of dollars a year in unexpected operational or maintenance costs," says Paul Dottori, V.P. Energy, Environment and Technology at Tembec. "That's why you need to understand the fundamentals well."

Dottori says all of Tembec's R&D is driven by business needs: cost reductions, worker safety, energy efficiency, environmental improvements and new products. Specialty pulp is a particularly hot area because the end product can be used in a wide variety of chemical products, from pharmaceuticals and rayon to additives in concrete, bread and ice cream.

Tembec is moving quickly to capitalize on the research. It is building an \$8.4-million pilot plant that will develop Next Generation Sustainable Fibre, a stronger and more durable structural material that responds to a growing demand for environmentally sustainable, lightweight structural composite products.

The risks of getting it wrong are even higher in the pharmaceutical sector, which is why **Hoffmann-La Roche Ltd.** is focusing on a new health care model that tailors treatments to an individual's unique genetic makeup – rather than a one pill treats everything approach.

"The one big differentiator between Roche and the rest of the industry right now is the belief in personalized health care," says President and CEO, Ronnie Miller. "It's about giving the right drug to the right patient at the right time, right place and at the right dose."

Roche's approach led to its development of Herceptin for treating breast cancer patients that have the HER2 gene, and Zelboraf, a soon-tobe-launched treatment for patients with late-stage malignant melanoma who express the BRAF V600E gene mutation.

Canada is a major R&D centre and a leader in clinical trial recruitment for the Swiss-headquartered company. While Canada represents 3% of the corporation's global sales, it accounts for 10% of its clinical trial participation. That was one factor in the company's recent decision to invest \$190 million over the next five years in a global pharmaceutical development site in Mississauga, Ont., responsible for managing operations for all stages of clinical trial research.

"Why Canada? The most important thing is the educated and capable workforce here," says Miller.

From Blackberry to AIDS Cure

Research In Motion Limited is another research powerhouse that has capitalized on Ontario's wealth of human capital. The demand for the company's BlackBerry smartphone has brought thousands of jobs to the Waterloo area, many for local graduates.

The secret to much of RIM's global success is the under-the-hood technologies that drive its products, including wireless security, video chat and an indoor navigation technology that uses WiFi hotpots to find a location inside a building.

"These features were all things that started within the scope of research at RIM," says Dr. Mark Pecen, V.P. Advanced Technology at RIM.

RIM is also focusing on the industry's biggest trend to date: wireless broadband. It is working on a standard for advanced video compression that would more efficiently deliver high quality video to handheld devices.

Pecen notes, though, that the

Transferring the knowledge gained through research to society where it can be harnessed and applied to some of the most pressing issues of our day is a priority for universities. Our institutions have worked hard to improve the efficiency and speed of knowledge mobilization and this commitment must continue for universities to remain the engines of innovation in the new knowledge economy.

Dr. Howard Brunt Vice-President Research University of Victoria

We have seen a huge leap in health biotechnology innovations over the last 20 years. Research and development in this sector has

Dr. Clive Ward-Able Executive Director, R&D Amgen Canada Inc.

Colleges and polytechnics are relevant and responsive to demanddriven innovation – when industry needs to solve a R&D or commercialization challenge. Through students involved in applied research projects, we also build career-ready talent for Canadian companies. Polytechnic institutions, facilities, faculty, and our students, are essential enablers of industry innovation.

> Dr. Don Wright President of BCIT and Chair of Polytechnics Canada

Where some people say 'it can't be done,' our researchers say 'we'll do it.' Today's problems are complex. Not one individual has all the expertise, the ability, the ideas of how to crack that Gordian knot. With partnerships, you have this coming together of different approaches.

> Lorne A. Babiuk, OC, PhD Vice-President (Research) University of Alberta

A ll universities are educational institutions at heart, but we also have an obligation as public stewards of knowledge to ensure that the scholarship we generate and maintain is made available to the broader community. Universities' role in this regard is more vital than ever. The scope and complexity of our research and innovation make Canadian universities powerfully capable of helping to move humanity forward. *Dr. R. Paul Young, FRSC*

Dr. R. Paul Young, FRSC Vice President, Research University of Toronto

The talent at leading colleges like Sheridan – with its creativity and innovation – has been driving forward applied research projects with industry. Ontario's economy needs more innovation, new products, and new commercialization. Applied research and innovation projects allow our students to become engaged in leading edge technology to be part of a new economy – building new products, new services, and new kinds of jobs for the future.

Jeff Zabudsky, Ph.D. President and CEO Sheridan College Institute of Technology and Advanced Learning

Research and creativity are driving forces for Canada's innovation, productivity and competitiveness in the new global economy. At York University, we recognize the importance of interdisciplinary and international research collaborations in building and strengthening research capacity and the sharing of global perspectives to face complex societal challenges.

Robert Haché Vice-President Research & Innovation York University

For over 40 years, INRS has played a critical role in the advancement of science in Canada and around

the world, and in the training of highly qualified researchers. We are very proud to rank first again this year in research intensity thanks to the outstanding performance of our professors, our many partnerships in various strategic sectors, and our state of the art research facilities.

Daniel Coderre, Ph.D. Director General INRS

Pfizer Canada is proud of our collaborative work with community partners to drive a healthy and competitive life-science sector in Canada. Important partnerships with the Canadian scientific community, healthcare professionals, the public sector, patients and consumers allow us to advance medicines and technology, drive more innovation and secure Canada's position as a world leader in research and development. Paul Lévesque President

Pfizer Canada Inc.

Hugh O'Neill President and CEO Sanofi Canada

verybody loves the idea of a blockbuster or revolutionary breakthrough – some radical technology that changes the world. For decades, the pharmaceutical industry business model has been built around the discovery and development of breakthrough medicines, and while we continue our search for cures and better treatments, our business model and our concept of research and development (R&D) need to change.

The old business model focused

Changing Our Conception of R&D for the Benefit of Patients and Healthcare

model. At Sanofi, we have made it our mission to let go of this traditional model, to become part of a collaborative effort to derive optimal results from precious healthcare resources. This effort involves all partners – governments, healthcare professionals and patients themselves – working together to ensure that our science, systems, processes, negotiations and values always put patients first.

Putting patients first means changing our conception of R&D as well. It means complementing our medical research with social research, extracting more knowledge from our clinical trials and investing in improvements to healthcare delivery – to better serve patient needs.

For example, Sanofi has started to map the "patient journey" in looked at the barriers patients face in that journey: barriers to physicians, to information, to psychosocial support, to medicines. And we are searching deep and wide to determine how we can deliver the right mix of solutions – education, home care, online resources – that treat the entire patient.

Clinical trials give Canadian patients access to the latest medicines at no cost and are also accompanied by a unique level of care and follow-up. In addition, these clinical trials contribute to the development of our country's own researchers and healthcare professionals, which helps create a local knowledge-based economy that encourages and attracts further research activity.

Incidentally, clinical trial activity in Canada has declined significantly mance. We need to lighten the administrative red tape involved in initiating clinical trials and improve the operational efficiency of research, since these are barriers to R&D investment in Canada. Ideally, we should be striving to integrate health research and care delivery as opposed to having them function separately.

Creating a research environment that puts the patient experience at the centre is also fertile ground for what our industry calls incremental innovations, where many small improvements or breakthroughs culminate in the development of major advances over time. Health administrators in Canada currently have policies that reward "true" or "radical" innovations at the expense of these incremental innovations, which are arguably the dominant source of new ideas and just as meaningful for the patient. For example, insulin was discovered in Canada 90 years ago.

Our company's Canadian history includes the world's first largescale insulin production site, but we continue to push forward with insulin innovations. We now provide a 24-hour insulin that is making a significant difference in the lives of people living with diabetes.

All of these new ways of doing research contribute to our knowledge of patients and should be part of our larger conception of R&D in Canada – especially since they put patients first and because they fully leverage the resources, not just drugs, that our industry offers – people, experience, collective knowledge and proven ingenuity.

This is why the current Canada-European Union Comprehensive Economic and Trade Agreement (CETA) negotiations, especially the discussion around intellectual class intellectual property protection so that our country remains an attractive place to do clinical research, innovate and launch new products. The more innovative products launched in Canada, the greater our knowledge base will be and the easier it will be to attract broader R&D opportunities.

The pharmaceutical industry is the largest R&D investor in the world and at Sanofi, we are aiming to better leverage the R&D we are doing. Let's make sure these investments stay in Canada by showing that our country offers the same advantages as other countries in areas such as intellectual property protection, the efficiency of clinical trials and the integration into patient care of innovations stemming from research. That way we will continue to create the jobs and

on trying to recoup investments in brilliant discoveries by "selling" those discoveries through a push oncology to gain insights on how patients and their families could be better served and supported. We've in recent years because the research infrastructure is becoming less competitive in terms of cost and perfor-

property protection, are so crucial to R&D in Canada. We need to ensure that Canada offers world-

develop the knowledge economy so coveted by emerging and developed economies alike.

Jenkins Report Calls for Major Shake-up in the Way Ottawa Supports Business R&D and Innovation

Mark Henderson Editor RE\$EARCH MONEY

on't expect an expert review panel's report to transform the way in which the federal government supports corporate research and development (R&D) any time soon. Accepting the report's advice is one thing, but implementing the recommendations of the Expert Review Panel of Federal Support to Research and Development promises to be a highly complex undertaking. Any changes will take time and involve a shift in mindsets and cultures that have proven highly resistant to change in the past.

Commissioned last year by the Conservative government, the longawaited report's six main recommendations represent a massive rebalancing of federal support for R&D, with new programs for directly supporting business innovation to help grow innovative companies into large enterprises with global reach and muscle. Known as the Jenkins Report after panel chair Tom Jenkins, executive chair of Open Text Corp – it calls for the dismantling of the National Research Council (NRC) and reduced eligibility for federal R&D tax credit program with the savings shifted to programs that directly support business R&D.

The report also answers longstanding demands for government procurement to play a much larger role in support of business innovation, more federal funding of start-up and follow-on funding for early-stage and growing innovative firms, a ministerial champion with a mandate to position innovation as a central tenant of economic strategy, and greater collaboration with the provinces and business leaders.

But it is the report's call for disbursing the assets of the NRC and limiting SR&ED tax credits to labour-related costs that are generating controversy.

In what is described as an "evolution", the assets of the 95-year-old NRC would be disbursed over the next five years by transforming the individual institutes into "a constellation of large-scale, sectoral collaborative business R&D centres involving business, the university sector and the provinces". Policy-related activities would be transferred to the "appropriate federal agencies".

The NRC's highly rated Industrial Research Assistance Program (IRAP) would be transferred to a major new organization – the Industrial Research and Innovation Council (IRIC) – an arm's length funding and delivery agency that is demanddriven with clear performance metrics and a government-wide orientation. IRIC would become the common service platform for a reduced number of larger, more flexible business innovation support programs and would ultimately be responsible for developing a federal business innovation strategy. IRAP's budget would be increased and a five-year "national commercialization vouchers pilot program" would be established. industry needs "funded by amounts drawn against existing NRC appropriations together with revenue earned from collaborative activities" Those with a more fundamental research focus would become affili-

⁶⁶ There's no doubt a serious re-think of federal support for R&D and innovation is long overdue. ⁹⁹

Mark Henderson, RE\$EARCH MONEY

The majority of NRC institutes are engaged in business-related R&D and they would be transformed into national institutes motivated by ated with one or more universities, while NRC policy functions would be transferred to relevant government departments. Institutes that do not fit into any of the above categories would be closed.

Equally contentious are the report's recommendations for changes to SR&ED – the bedrock of existing federal support for business R&D accounting for \$3.5 billion or 70% of the funding covered by the review.

"The Panel has concluded that the program should be simplified to reduce compliance and administration costs," states the report. "Moreover, the benefit should be restructured to generate savings for reallocation to other initiatives benefiting small and medium-sized firms."

Reducing the complexity of SR&ED by limiting it to labourrelated costs will reduce the amount of money firms have to spend on tax consulting firms, the report says. It acknowledges, however, that the government should consider extending the labour-based approach to all firms over time to give larger firms that incur high non-labour R&D costs a chance to adjust. At least one SR&ED tax consultant has described the recommendation as wrongheaded.

It will be up to the government to accept or reject the recommendations – which it stipulated had to be revenue neutral. It's estimated that federal R&D spending by more than 100 programs and institutes totaled \$6.44 billion in 2010-11. The panel examined 60 programs with spending of \$4.96 billion.

There's no doubt a serious rethink of federal support for R&D and innovation is long overdue. In the past decade, Canada's productivity and competitiveness rankings have plummeted in relation to competing nations like the UK, US and Germany. Despite having one of the most generous tax incentives schemes in the world, business R&D spending has lagged and a long list of promising firms supported by public dollars have been snapped up by foreign interests.

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WHAT CANADA IS GETTING RIGHT

Continued from page 11

company's long-term research extends beyond emerging trends or as a culture, involving all our 11,000

"We see discovery and innovation

favoured science-driven inventions over market-relevant innovations. While he insists both have to be supported, there must be a balance.

"We shouldn't kid ourselves into thinking that if we have lots of research, he adds. Rather, it's doing more to ensure that publicly funded research translates into new products and approaches that improve health care for patients. For Mount Sinai researcher Dr. Daniel Drucker, that meant developing a once-weekly treatment for type 2 diabetes that may replace the more common twice-daily injection. For Dr. Jeff Wrana, it resulted in a new technology that screens breast cancer tumours to help determine a patient's best treatment options. "The most significant thing Mount Sinai and Lunenfeld have done over the past decade to improve our value creation is to attract and nurture the best scientists we can. That's what attracts companies," says Woodgett.

funding from both the Quebec and Canadian governments. We're now heading into phase three clinical trials."

Similar efforts are underway at Canada's largest university. Dr. Peter

strategy. It is now common to find an engineer collaborating with a computer scientist and a cell biologist, for example. Universities are also partnering more with industry, all levels of government and

any single area.

"For example, research focused on finding solutions for finite spectrum or battery consumption also focuses on more efficient radio and handset technology design," he explains. "RIM aims to establish and set trends through ongoing R&D."

Of course, not all research results in a new commercial product, service or process. Sometimes the impacts are societal.

At the University of British Columbia (UBC), Dr. Julio Montaner found it is possible to effectively cure AIDS through aggressive treatment with antiretroviral drugs. That discovery resulted in the Seek and Treat pilot program, which is expanding access to HIV/ AIDS medications among hard-toreach and vulnerable populations in Vancouver's downtown east side and Prince George.

"This is another way to create value from research," says Dr. John Hepburn, V.P. Research, UBC. "No new drugs have been created. Rather, it's the application of known drugs but in a new way that has had an enormous impact worldwide."

UBC is building deeper partnerships with the private sector that extend beyond the traditional feefor-service relationship. Through its Campus as a Living Lab initiative, for example, UBC works with companies to develop and test new technologies.

"We're interested in the possible applications, such as energy distribution and energy generation systems," says Hepburn. "Rather than just having us buy a technology, we partner with companies to develop it and use it on our campus. That level of partnership involves a lot more trust."

Bringing **Non-Researchers** onto the Team

Increasingly, university research is expanding beyond the lab and closer to those who ultimately will benefit from it. At the **Capital District** Health Authority, that means making all health care workers part of the research teams at Queen Elizabeth II Health Sciences Centre and other hospitals across Nova Scotia.

Traditional health research is headed by a scientist in a lab or a physician in a hospital. Capital Health wants greater participation from all staff.

employees – one that is focused on point-of-care, is team-based and puts the patient experience first," explains Dr. Raymond LeBlanc, V.P. Learning, Research and Innovation at Capital Health. "This improves the research outcomes, makes it easier for patients to participate in research protocols and provides them with a more sophisticated level of care."

This innovative approach was used to monitor changes over time in the optic nerves of patients, which is key to understanding glaucoma and other blinding diseases. Two decades of collaborative research with a German instrument manufacturer led to the development of a sophisticated eye-imaging machine technology to diagnose and monitor diseaserelated changes in the eye. Capital Health helped develop the algorithm that is now used in over 5,000 of these machines worldwide.

Making Science Relevant to Society

At Ryerson University, all faculties are encouraged to forge partnerships with the private sector and to focus on research that is relevant to society. Sheldon Levy, President, insists basic academic research must continue to be supported, but don't expect it to become your main commercial engine.

"It doesn't matter if you're in political science, geography or aerospace, the mission of our university is to be relevant to society," says Levy. "That could mean economic value, jobs value or social value, such as working with communities to fight childhood obesity or promote health and food security."

The problem, he says, is that traditional research granting agencies provide little support for applied research and commercialization activities, such as Ryerson's Digital Media Zone.

"Through the Zone, we support undergrad and grad students who are building companies and products," says Levy. "They aren't eligible nor are they receiving grants from typical sources, yet that group has created around 40 companies this year and about 200 full time jobs. This is an activity I think Canada should be encouraging"

Milway at the Institute for Competitiveness and Prosperity agrees Canada's policies have traditionally

investments in inventor-driven discoveries that are going to magically appear as innovation that is relevant to the consumer," he says. "Our problem in Canada is that our sophistication is lacking on the business side, not the science side. That's our weak link."

The Birth of **Commercialization Factories**

Canada is taking steps to strengthen that link. In 2009, the federal government launched a new program that has seen 22 commercialization "factories" established across the country. Called Centres of Excellence for Commercialization and Research (CECRs), these public-private partnerships are matching promising research with business acumen to commercialize technologies and grow companies.

"I disagree with those that suggest that Canadians are not entrepreneurial," says Dr. Rafi Hofstein, President and CEO of MaRS Innovation, a CECR providing a one-stop shop for commercializing early-stage technologies from 18 institutions in the Toronto area. "Rather, what's needed is more nurturing and that's the gap our centre fills. We triage and bundle the best technologies, take care of intellectual property protection, develop business and marketing plans and secure pre-seed financing."

MaRS Innovation has helped launch seven companies so far, including VitalHub, a spin off of Mount Sinai Hospital that uses an iPhone-based system to give physicians secure, remote access to patient records and test results from a hospital's internal data network. Despite a poor climate for financing, VitalHub has managed to raise \$1 million in financing so far, is expanding its customer base and hiring employees.

"We have gotten much better at marketing and clustering our technologies," says Dr. Jim Woodgett, Director of Mount Sinai's Samuel Lunenfeld Research Institute. "Instead of taking a single discovery or piece of information and trying to market that, we try to build value and take it further along the value chain. In short, less 'R' (research) and more 'D' (development)."

That doesn't mean cutting back on fundamental, discovery-based

Rewarding Professors Who Innovate

There is growing enthusiasm within Canadian universities to work with external partners to translate research into solutions. However, there is still one major obstacle - professors are generally rewarded based on the number of scientific papers published and research grants received, not for collaborating on a project or bringing a new technology to market.

"Universities, for the most part, haven't changed their rules for how you get promoted," says Dr. Vassilios Papadopoulos, Director of the Research Institute of the McGill University Health Centre (MUHC). "It is getting better. Now, if you file a patent, it's viewed as a positive, but getting a paper published in Nature is still seen as better, even if the patent results in an even bigger innovation."

Papadopoulos has worked hard to change that culture since joining MUHC in 2006. Two years ago, he helped MUHC create a Certificate of Business Administration program that researchers can take in the evenings to learn the business of innovation. He also recruited a business development officer to identify commercially promising discoveries, and facilitate meetings between researchers, companies and investors.

Another priority has been to encourage researchers to apply to non-traditional sources for grant money, such as the U.S. Department of Defence (DND) or the pharmaceutical industry, or seed funding from an investment firm.

"We've identified drugs, for example, that can be used for new applications. This isn't something CIHR (Canadian Institutes of Health Research) would fund so we got funding from a US agency, brought in an investor firm, and also received

Lewis, Associate V.P. Research at the University of Toronto, says his favourite phrase these days is "knowledge application", and it's something he is encouraging more faculty to engage in.

"Knowledge generation at the university has been going on for hundreds of years but the knowledge application piece hasn't," he says. "Our processes now recognize that kind of contribution as something towards their dossier as it comes up for promotion."

Multidisciplinary research and partnerships with external organizations are key components to this other research institutes to leverage funding, facilities and expertise to come up with solutions to complex problems.

Lewis points to the Structural Genomics Consortium, a publicprivate sector partnership involving scientists from the universities of Toronto and Oxford that has mapped three-dimensional structures of more than 1,300 proteins. All findings are made available freely to the global research community.

"This is an example of an international partnership that could in the end lead to a cure for cancer," says Lewis.

RESEARCH MEANS COLLABORATION

Continued from page 4

de Montréal, which ranks among the top five universities in Canada for research, delivers a major contribution to science in our country. And that means not only the work of our researchers today, but also the training we provide for the scientists of tomorrow. Every year, we award 1 out of every 13 doctorates earned in Canada.

Managing healthcare, the fight against crime, aboriginal governance, combating the school dropout problem - all are questions that business and government alike must address, and that researchers at the Université de Montréal and throughout the country are working on day in and day out.

It seems that the time has come for governments and businesses to appeal to researchers to support their policy decisions, on one hand, and their business decisions, on the other. This is not to disparage the public service, or independent experts, but rather to supply the scientific tools to help them better fulfill their respective missions. It is not their role to stand on the frontiers of knowledge in today's world and identify what has worked or not worked. That is the role of researchers...who ask nothing more than to contribute even more directly to the welfare of their fellow citizens.

The Université de Montréal will begin this movement. In the near future, we will propose to the federal and provincial governments that they should call on our researchers in one or more of our 200 research units in order to test hypotheses for solving the challenges that confront them. And we're planning to create a single-window resource for this purpose, which would allow researchers from every field to have direct access to our research expertise. This single window would also make accountability in research more fluid by standardizing the various administrative tasks researchers must comply with and which far too often distract them from their own work.

Let us create a movement that encourages research for the benefit of all citizens. Let us involve our governments and businesses in putting our massive knowledge-based capital, much of it internationally celebrated and developed by researchers in our country, to work for economic growth and the common good.

If research can give us smartphones, why can't it also give us a smart country, a better place for all of us in which to live and work?

BECAUSE YOU SEE BLUE WE THINK GREEN

With every new engine we develop, we're reducing noise, emissions and fuel consumption. Today, we're building engines that better many International Civil Aviation Organization standards by up to 50%. Because our world's future depends on greener technology. And for that the world can depend on us.

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Canada's R&D Conundrum

Karna Gupta President and CEO Information Technology Association of Canada (ITAC)

hile necessity is, indeed, the mother of invention, invention does not occur automatically once the need for it has arisen. There is always a process of idea generation, prototype creation, testing, and so on that leads to the final product which in fact solves a business problem. The usability – the problem solving capacity – of this final product, then, determines its value, and the value of the research and development process that created it.

Research and development is fundamental to the Canadian ICT industry. While the industry represents 5.5 percent of our national GDP, it represents 38 percent of all business R&D performed in this country. That's more than twice that of any other sector. Those of us in the ICT industry are therefore extremely vested in the health of our R&D investment environment.

First and foremost, in order to derive the true "value" of R&D, we must maintain the health of those programs that currently exist to stimulate R&D expenditure by business. The Scientific Research and Experimental Development (SR&ED) federal tax incentive program – which has existed in its current form for 25 years – is the largest single source of federal government support for industrial research and development in Canada, providing more than \$3 billion in tax assistance annually. As a tax credit, for the most part, SR&ED works. Other countries (including the US) have begun implementing similar tax credits – or making improvements to their current tax credit programs – based on the Canadian model.

But the program is not perfect. For some types of companies, SR&ED does not work as intended. For a variety of reasons, a number of investors in R&D cannot access or do not recognize value from the SR&ED program.

There is an opportunity to address these SR&ED shortcomings in a way that will not represent added fiscal expenditure to Canada (indeed, in many cases, quite the opposite). This would involve allowing companies to choose between a refundable R&D wage credit and the SR&ED credit as it now exists. In those cases where companies would choose the refundable wage credit, it would represent a very real incentive for them to invest in R&D in Canada. And since wages represent about 70 percent of R&D expenditures, the fiscal cost to Canada would be significantly less. The province of Quebec has implemented a payroll-based tax incentive for R&D, and the robustness of its R&D sector suggests there is merit in this approach. Considering that the key determinant for investing in R&D in a particular jurisdiction is the availability of talent, such a wage credit would also contribute to the attraction and retention of talented workers in R&D related positions in Canada. Canada's relatively rich talent pool is a key asset in attracting R&D – we must do all we can to grow it rapidly.

ITAC is also supportive of programs for direct support of R&D, but we would recommend that more emphasis be placed on market-pull initiatives that actively engage industrial partners who

bring real market consideration to the R&D process. The recently terminated PRECARN is an example of this model. This falls in line with a key message of ITAC's, that no matter how great the idea, without a customer it is stillborn. A lack of commerce competence in both the technical founders of R&D intensive firms, as well as their financial, legal and governing supporters, has been proven to be a key contributor to the downfall of many Canadian R&D intensive firms. And this problem isn't easily solved when many of these exact competencies are not taught in universities and colleges. They are learned on the job, working for top R&D firms. Alas Canada's R&D conundrum. We need more large ICT firms in Canada to grow the expertise necessary to grow large Canadian ICT firms.

If there is one key ingredient missing in the current recipe for value-driven R&D in Canada, it is access to capital. The biggest gap in the current suite of government programming for R&D, for instance, relates to venture capital. While Statistic Canada reports that there exist 31,500 Canadian ICT companies, only 11 of these companies report annual revenue over \$1 billion. Only 217 report more than \$10 million in annual revenue. We must figure out how to grow these 200-plus companies, turning at least some of them into the next RIM or OpenText.

Programs for the support of R&D in Canada will evolve over time and be subject to the imperatives of our overall economic health. What must remain constant, meanwhile, is a concerted national discourse and concerted efforts by various business sectors and government partners to show the true value of excellence in R&D. Canada, with a highly educated workforce and significant investments in research and science, can punch above its weight among global competitors for R&D investment. This investment nourishes all our knowledge-based industries. It must be preserved and expanded.

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in combined revenues. R&D spending fell to \$9.42 billion in Fiscal 2010, from \$10.4 billion in Fiscal 2009. This continues the negative trend of R&D spending for the 5th consecutive year.

However, the steep decline in overall R&D spending was more a result of significant drops in R&D spending by two Top 100 companies - Nortel Networks Corporation (Nortel was still active in 2010) and TELUS Corporation. After adjusting for this by removing them from the calculation, overall R&D spending by the remaining 98 firms posted a respectable 3.5% increase in Fiscal 2010.

Research intensity - R&D spending as a share of revenue among the 92 companies that reported revenue was 2.8% in Fiscal 2010, down a significant -14.8% over Fiscal 2009. However, when we remove Nortel and TELUS, a more realistic picture emerges with the 90 companies, posting a more moderate decrease of -2.2% in research intensity in 2010.

Research In Motion remained Canada's top corporate R&D spender, devoting nearly \$1.4 billion to research in Fiscal 2010, an increase of 26.3% over Fiscal 2009. RIM's spending on research expanded slightly faster than its revenue (20.1%).

This year, 48 companies posted increases in their research spending compared with an equal number (48) where spending declined. (R&D spending was flat at 4 other firms.)

The \$100 Million Club

2010 Rank	Company	Industry
1	Research In Motion	Comm/Telecom Equipment
2	BCE	Telecommunications Services
3	IBM Canada (fs)	Software & Computer Services
4	Atomic Energy of Canada	Engineering Services
5	Magna International	Automotive
6	Pratt & Whitney Canada (fs)	Aerospace
7	Ericsson Canada (fs)	Comm/Telecom Equipment
8	AMD Canada (fs)	Electronic Systems & Parts
9	Alcatel-Lucent (fs)	Comm/Telecom Equipment
10	Bombardier	Aerospace
11	Apotex	Pharmaceuticals/Biotechnology
12	Sanofi (fs) ^(a)	Pharmaceuticals/Biotechnology
13	Pfizer Canada (fs)	Pharmaceuticals/Biotechnology
14	Open Text	Software & Computer Services
15	Ontario Power Generation	Electrical Power & Utilities
16	Rogers Communications	Telecommunications Services
16	TELUS	Telecommunications Services
18	GlaxoSmithKline Canada (fs)	Pharmaceuticals/Biotechnology
19	CAE	Aerospace
20	Nortel Networks	Comm/Telecom Equipment
21	Imperial Oil	Energy/Oil & Gas
22	Hydro-Québec	Electrical Power & Utilities
fs = Foreign	n subsidiary (includes R&D spending f	or Canadian operations only)

THE \$100 MILLION CLUB

Each year RE\$EARCH Infosource highlights the companies in its \$100 Million Club – an elite group of firms that spend \$100 million or more annually on research. This year 22 firms joined the Club. Fourteen members were Canadian companies and 8 were foreign subsidiaries. Total Club spending on research was \$6.67 billion, a decline of -13.1%. Omitting Nortel Networks and TELUS from the analysis revealed that the 20 remaining Club members managed a solid 4.5% increase in combined R&D spending. In contrast, the other 78 Top 100 firms managed only a 1.1% increase over the period.

Joining the \$100 Million Club this year were AMD Canada, Rogers Communications and Imperial Oil. Dropping off were Novartis Pharmaceuticals Canada, Valeant Pharmaceuticals International (formerly Biovail) and Suncor Energy.

Reflecting the importance of larger R&D performers, the \$100 Million Club members accounted for 71% of total Top 100 spending in Fiscal 2010.

Among the 20 companies that were members of the \$100 Million Club in both 2010 and 2009, 9 companies increased their R&D spending, while 10 companies decreased spending between during this period. One company was flat.

Companies in the ICT (information and communications technology) sector dominated the \$100 Million Club. Ten of the 22 members were in the ICT sector, followed by 4 firms in Pharmaceuticals/Biotechnology. Three Aerospace firms were also members of the \$100 Million Club in 2010.

INDUSTRY PERFORMANCE

Twelve Top 100 performers in the Communications/Telecom Equipment sector spent a total of \$2.42 billion on research, and accounted for 26% of total Top 100 spending in Fiscal 2010. Next in combined R&D spending were 26 Pharmaceuticals/ Biotechnology companies that devoted a total of \$1.47 billion to research, or 16% of the Top 100 total. Four firms in the Telecommunications Services sector spent \$1.1 billion, representing 12% of total R&D spent in Fiscal 2010.

The Communication/Telecom Equipment sector without Nortel Networks included, increased its R&D spending by a significant 23.3% (with Nortel included this sector had an overall -11.6% decrease). Both Aerospace (5.8%) and Software & Computer Services (3.3%) sectors each increased their R&D spending in Fiscal 2010. However, Transportation (-11.6%) and Energy/Oil & Gas/Electric Power sectors (-5.3%) posted negative R&D spending during the period.

THE TOP 10 R&D **INTENSIVE FIRMS**

In Fiscal 2010, 7 of the 10 most research-

intensive firms - companies that spent a high proportion of revenues on research - were in the Pharmaceutical/Biotechnology sector. This is typical since large up-front investments are required for success in this sector. These firms tend to spend more on research than they gain in revenue because they are early-stage companies whose products have yet to enter the market.

GAINERS AND LOSERS

The top ten firms in growth stand out because of their substantial gains in R&D spending of 40% or more between Fiscal 2009 and Fiscal 2010. Leading the group was Hydro One, which posted a 124.0% gain in R&D spending. Ericsson Canada recorded a strong 79.2% increase in spending, followed by EnCana (69.4%), Medicago (68.8%) and Azure Dynamics (59.6%).

A number of well-known companies led the list of firms where R&D spending dropped substantially in Fiscal 2010. This group included Nortel Networks (-87.3%), TELUS (-81.0%) and Suncor Energy (-58.3%)

LOOKING AHEAD

In the wake of the 2009 financial crisis it is not surprising that Fiscal 2010 corporate R&D spending results should disappoint: down -9.4% for all Top 100 firms and up a modest 3.5% with two large outliers removed from the calculation. However, 2010 is not unique; in the past 10 years RE\$EARCH Infosource has documented spending drops in 7 years. Yet, during that period company revenues have increased in all but 2 years. So, there does not appear to be a strong relationship between R&D spending and corporate revenues. Clearly, other factors are at play in the anaemic performance.

Certainly, government incentive programs play a role. So too do global trends; for example, the migration of manufacturing activity to the Far East. Also contributing is the changing nature of corporate R&D itself. In decades past most R&D was performed by in-house corporate research labs, whereas today those labs have largely disappeared. Current public sector innovation support programs are still largely a remnant of this by-gone era.

Today research is more diffuse; often it is offloaded to suppliers and to universities, hospitals and colleges. Another factor is the increasing impact of the service sector. The service sector accounted for about 72% of GDP in 2010, yet government programs in support of innovation are mostly oriented toward the goodsproducing elements of the economy.

One bright spot is that according to Statistics Canada, the number of companies performing research jumped from 9,649 companies in 1997 to 22,314 in 2007. At least, more firms are playing the game.

The economy is facing new headwinds in the form of a global slowdown. It remains to be seen how deep this will be and what its effect will be on the corporate R&D scene. RE\$EARCH Infosource has its fingers crossed.

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Industry	R&D Spending (% of Total)
Communications/Telecom Equipment (1	2) 26
Pharmaceuticals/Biotechnology (26)	16
Telecommunications Services (4)	12
Software & Computer Services (11)	11
Aerospace (5)	8
Energy/Oil & Gas/Electric Power (10)	6
Transportation (4)	6

Top 10 Research Intensive Companies*

2010 Research Intensity	Rank 1 / Overall	Company	R&D as % of Revenue
1	96	Transition Therapeutics	293.3
2	94	ProMetic Life Sciences	117.8
3	62	Azure Dynamics	113.4
4	69	Tekmira Pharmaceuticals	105.5
5	4	Atomic Energy of Canada	103.4
6	54	QLT	74.9
7	70	AEterna Zentaris	74.2
8	26	PMC Sierra (fs)	55.6
9	87	Theratechnologies	47.1
10	78	Bioniche Life Sciences	39.0
*Based on c fs = Foreign	ompanies w subsidiary (in	ith \$1 million or more of revenue of cludes R&D spending for Canadian of	only perations only)

Top 10 Companies by Growth

2010 P&D	Rank		% Change
Growth	Overall	Company	2009-2010
1	83	Hydro One	124.0
2	7	Ericsson Canada (fs)	79.2
3	40	EnCana	69.4
4	95	Medicago	68.8
5	62	Azure Dynamics	59.6
6	86	Vecima Networks	56.2
7	16	Rogers Communications	53.1
8	75	Trican Well Service	50.3
9	50	Linamar	48.2
10	71	Teck Resources	40.0
fs = Foreign s	ubsidiary (inc	ludes R&D spending for Canadian o	perations only)

Bottom 10 Companies by Growth

2010	Rank		% Change 2009-2010	
R&D Growth	Overall	Company		
1	20	Nortel Networks	-87.3	
2	16	TELUS	-81.0	
3	32	Suncor Energy	-58.3	
4	70	AEterna Zentaris	-58.1	
5	33	Valeant Pharmaceuticals		
		International	-49.0	
6	84	Cardiome Pharma	-48.2	
7	64	Nexen	-46.7	
8	45	Cangene	-33.9	
9	79	Tembec	-33.7	
10	87	Theratechnologies	-32.5	

The research we're doing in Canada will improve today's health care.

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leaders.

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Pratt & Whitney Canada

United Technologies Compar

52 53

97

98

99

100

Notes:

government grants.

net of interest and investment income

more accurate information became available

We have attempted, wherever possible, to provide gross

R&D spending before deduction of investment tax credits or

We have attempted, wherever possible, to provide revenue

FY2009 R&D spending figures may have been adjusted, as

revenue and R&D spending; foreign subsidiaries (fs) include

revenue and R&D spending for Canadian operations only.

Canadian-owned company results include worldwide

2.

3.

RESEARCH

RE\$EARCH Infosource Inc. is

Canada's source of R&D intelligence. Data used for this table were extracted from our Canadian Corporate R&D Database, a proprietary database. Companies wishing to be included in future editions of the Top 100 List, or who wish to adjust their figures should contact us directly.

The Top 100 List is available online at www.researchinfosource.com or by calling (416) 481-7070.

For advertising information, please contact Arlene Dwyer at (416) 481-7070 ext. 23 arlene@ impactg.com

43	NOVA Chemicals Corporation* (fs)	\$36,047	\$45,680	-21.1	\$4,712,822	0.8	Chemicals & Materials
53	Pharmascience Inc.	\$34,603	\$33,000	4.9	\$701,843	4.9	Pharmaceuticals/Biotechnology
60	SMART Technologies Inc.*	\$34,585	\$28,563	21.1	\$667,349	5.2	Computer Equipment
54	QLT Inc.*	\$34,486	\$32,650	5.6	\$46,033	74.9	Pharmaceuticals/Biotechnology
48	Aptalis Pharma Inc.* (fs)	\$32,663	\$41,154	-20.6	\$365,189	8.9	Pharmaceuticals/Biotechnology
50	Cascades Inc.	\$32,500	\$35,200	-7.7	\$3,959,000	0.8	Forest & Paper Products
59	Evertz Technologies Limited	\$32,026	\$28,719	11.5	\$286,455	11.2	Comm/Telecom Equipment
52	Westport Innovations Inc.	\$29,835	\$33,003	-9.6	\$130,712	22.8	Transportation
64	Angiotech Pharmaceuticals, Inc.*	\$27,591	\$27,067	1.9	\$253,605	10.9	Medical Devices & Instrumentation
62	Sandvine Corporation	\$27,402	\$28,162	-2.7	\$93,762	29.2	Comm/Telecom Equipment
72	Xerox Canada Inc. (fs)	\$25,625	\$21,877	17.1	\$1,166,584	2.2	Machinery
90	Azure Dynamics Corporation	\$24,851	\$15,568	59.6	\$21,913	113.4	Transportation
57	57 Ballard Power Systems Inc.*		\$30,409	-19.4	\$66,963	36.6	Machinery
44	44 Nexen Inc.		\$45.000	-46.7	\$5,411,000	0.4	Energy/Oil & Gas
58	SNC-Lavalin Group Inc.	\$23.665	\$29.340	-19.3	\$6.314.990	0.4	Engineering Services
83	Bridgewater Systems Corporation	\$23.652	\$17.718	33.5	\$93.376	25.3	Software & Computer Services
	Thales Canada Inc. (fs)	\$23,500	\$28,200	-16.7	\$504.000	4.7	Electronic Systems & Parts
73	Miranda Technologies Inc.	\$23,228	\$21,799	6.6	\$143.673	16.2	Comm/Telecom Equipment
79	Tekmira Pharmaceuticals Corporation	\$22.522	\$18,679	20.6	\$21,355	105.5	Pharmaceuticals/Biotechnology
40	AFterna Zentaris Inc.*	\$21,160	\$50,496	-58.1	\$28,531	74.2	Pharmaceuticals/Biotechnology
91	Teck Resources Limited	\$21,000	\$15,000	40.0	\$9.339.000	0.2	Mining & Metals
68	Bell Aliant Regional Communications, LP	\$20,738	\$24,214	-14.4	\$2,357,445	0.9	Telecommunications Services
	Monsanto Canada Inc. (fs)	\$20,000	\$20.000	0.0	\$560.000	3.6	Agriculture & Food
	Total F&P Canada Ltd. (fs)	\$20,000	\$20,000	0.0	nd		Energy/Oil & Gas
	Trican Well Service Ltd	\$19 307	\$12 848	50.3	\$1 478 293	13	Energy/Oil & Gas
88	DragonWave Inc * ++	\$19,234	\$16 224	18.6	\$121 538	15.8	Comm/Telecom Equipment
77	ViXS Systems Inc. * ++	\$18,206	\$19,850	-8.3	\$94 473	19.3	Electronic Systems & Parts
100	Bioniche Life Sciences Inc	\$17 922	\$13 315	34.6	\$45 899	39.0	Pharmaceuticals/Biotechnology
65	Tember Inc	\$17,677	\$26,646	-33.7	\$1 877 000	0.9	Forest & Paper Products
87	Descartes Systems Group Inc * ++	\$17,478	\$16 558	56	\$102 140	171	Software & Computer Services
85	ArcelorMittal Dofasco Inc. (fs)	\$17,000	\$17,000	0.0	\$3,270,000	0.5	Mining & Metals
00	Pason Systems Inc	\$16 472	\$13 140	25.4	\$249 562	6.6	Software & Computer Services
	Hydro One Inc	\$16 350	\$7 300	124.0	\$5 124 000	0.3	Flectrical Power & Utilities
56	Cardiome Pharma Corp.*	\$15,798	\$30,493	-48.2	\$68.039	23.2	Pharmaceuticals/Biotechnology
97	Resverlogix Corp	\$15,699	\$13,616	15.3	\$0	23.2	Pharmaceuticals/Biotechnology
,,	Vecima Networks Inc	\$15,688	\$10,044	56.2	\$113 206	13.9	Comm/Telecom Equipment
70	Theratechnologies Inc	\$14 998	\$22,226	-32.5	\$31 868	47.1	Pharmaceuticals/Biotechnology
89	20-20 Technologies Inc.*	\$14 663	\$15,698	-6.6	\$67 183	21.8	Software & Computer Services
86	Enablence Technologies Inc	\$14,034	\$16,805	-16.5	\$53,892	26.0	Electronic Systems & Parts
78	Dorel Industries Inc *	\$14 033	\$19,600	-28.5	\$2 382 144	0.6	Other Manufacturing
76	Psion Inc. (fs)	\$13,888	\$20,023	-30.6	\$279 773	5.0	Computer Equipment
94	Winnak I td *	\$13,881	\$14,068	-1 3	\$596 766	23	Rubber & Plastics
75	Rio Tinto Iron & Titanium Inc. (fs)	\$13,800	\$20,408	-32.4	\$975 347	14	Mining & Metals
, 5	ProMetic Life Sciences Inc	\$13,469	\$13 197	21	\$11 433	117.8	Pharmaceuticals/Biotechnology
	Medicago Inc	\$13,365	\$7 917	68.8	\$109	117.0	Pharmaceuticals/Biotechnology
81	Transition Therapeutics Inc	\$13,208	\$17 942	-26.4	\$4 504	293 3	Pharmaceuticals/Biotechnology
01	Enghouse Systems Limited	\$13,200	\$12,049	8.9	\$94 208	13.9	Software & Computer Services
99	MEGA Brands Inc *	\$12,977	\$13 441	-3.5	\$379.024	3.4	Other Manufacturing
98	Héroux-Devtek Inc	\$12,814	\$13,505	-5.1	\$320 354	4.0	Aerospace
96	SXC Health Solutions Corp *	\$12,800	\$13,648	-6.2	\$2,006,646	0.6	Software & Computer Services
70	one ricular solutions corp.	\$12,000	\$13,010	0.2	\$2,000,010	0.0	solution of computer services

*Converted to CDN\$ at annual average 2010 = 1.0299, 1. Data were obtained through annual reports, financial 2009 = \$1.1420 (Bank of Canada) statements, securities commission filings, or through a survey.

- **Revenue reported in US\$ and R&D spending in CDN\$
- ***\$1 million or more of revenue
- ++Fiscal 2011 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) Fiscal 2010 revenue was calculated using U.S. GAAP, therefore it is not comparable with revenue reported on prior Top 100 lists as these figures were calculated using Canadian GAAP.

(b) Includes sanofi-aventis Canada Inc. and Sanofi Pasteur Limited.

- (c) Fiscal 2009 R&D spending is the combined amount for Merck Frosst Canada Ltd. and Schering-Plough Canada Inc.
- (d) Fiscal 2009 R&D spending is the combined amount for Suncor Energy Inc. and Petro-Canada.
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