

NOVEMBER 6, 2009

Canada's University Innovation Leaders

A SUPPLEMENT PREPARED BY RESEARCH INFOSOURCE INC., AN IMPACT GROUP COMPANY

RESEARCH INCOME GROWTH ACCELERATES — Research income at Canada's Top 50 Research Universities expanded by a healthy 6.0% in Fiscal 2008, bettering the pedestrian 3.5% increase the year before. ▶

Canada's Top 50 Research Universities 2009

Rank		University	Sponsored Research Income			Full-time Faculty**	Research Intensity	Province
2008	2007		FY2008 \$000	FY2007 \$000	% Change 2007-2008	2007-2008 #	\$ per Full-time Faculty \$000	
1	1	University of Toronto* ++	\$844,861	\$854,759	-1.2	2,400	\$352.0	Ontario
2	2	University of Alberta*	\$491,742	\$461,396	6.6	1,602	\$307.0	Alberta
3	4	University of British Columbia*	\$470,146	\$401,267	17.2	2,190	\$214.7	British Columbia
4	3	Université de Montréal*	\$468,729	\$415,043	12.9	1,887	\$248.4	Quebec
5	5	McGill University*	\$418,554	\$375,739	11.4	1,590	\$263.2	Quebec
6	6	McMaster University*	\$373,542	\$346,280	7.9	1,194	\$312.8	Ontario
7	7	Université Laval*	\$278,621	\$268,313	3.8	1,341	\$207.8	Quebec
8	10	University of Ottawa*	\$245,524	\$229,194	7.1	1,182	\$207.7	Ontario
9	8	University of Calgary*	\$236,202	\$254,179	-7.1	1,539	\$153.5	Alberta
10	9	University of Western Ontario*	\$222,336	\$238,047	-6.6	1,386	\$160.4	Ontario
11	13	University of Saskatchewan*	\$203,546	\$150,507	35.2	1,050	\$193.9	Saskatchewan
12	11	Queen's University*	\$192,502	\$213,047	-9.6	828	\$232.5	Ontario
13	12	University of Manitoba*	\$161,700	\$154,946	4.4	1,182	\$136.8	Manitoba
14	14	University of Guelph	\$142,119	\$132,947	6.9	768	\$185.1	Ontario
15	15	University of Waterloo	\$135,152	\$121,604	11.1	960	\$140.8	Ontario
16	16	Dalhousie University*	\$123,950	\$111,511	11.2	1,017	\$121.9	Nova Scotia
17	17	University of Victoria	\$112,429	\$89,292	25.9	672	\$167.3	British Columbia
18	18	Université de Sherbrooke*	\$91,557	\$86,172	6.2	957	\$95.7	Quebec
19	20	Simon Fraser University	\$86,739	\$77,586	11.8	816	\$106.3	British Columbia
20	19	Carleton University	\$84,033	\$84,817	-0.9	711	\$118.2	Ontario
21	22	Université du Québec à Montréal	\$70,232	\$66,981	4.9	1,005	\$69.9	Quebec
22	21	Memorial University of Newfoundland*	\$69,044	\$75,674	-8.8	876	\$78.8	Newfoundland
23	23	York University	\$63,919	\$60,906	4.9	1,401	\$45.6	Ontario
24	24	Institut national de la recherche scientifique+	\$49,771	\$55,671	-10.6	156	\$319.0	Quebec
25	25	University of New Brunswick	\$46,540	\$46,591	-0.1	570	\$81.6	New Brunswick
26	26	Concordia University	\$38,647	\$35,599	8.6	828	\$46.7	Quebec
27	27	University of Windsor	\$27,421	\$25,909	5.8	510	\$53.8	Ontario
28	28	University of Regina	\$20,528	\$21,497	-4.5	345	\$59.5	Saskatchewan
29	33	Laurentian University*	\$19,949	\$15,519	28.5	453	\$44.0	Ontario
30	31	Ryerson University	\$19,922	\$16,192	23.0	663	\$30.0	Ontario
31	35	Université du Québec à Chicoutimi	\$19,022	\$14,698	29.4	210	\$90.6	Quebec
32	30	Lakehead University*	\$17,685	\$20,129	-12.1	276	\$64.1	Ontario
33	41	Trent University	\$17,321	\$11,142	55.5	270	\$64.2	Ontario
34	29	Royal Military College of Canada	\$17,285	\$20,209	-14.5	147	\$117.6	Ontario
35	38	University of Lethbridge	\$16,683	\$13,663	22.1	330	\$50.6	Alberta
36	37	University of Northern British Columbia	\$16,589	\$13,798	20.2	180	\$92.2	British Columbia
37	39	University of Prince Edward Island	\$16,421	\$13,152	24.9	180	\$91.2	Prince Edward Island
38	32	Université du Québec à Trois-Rivières	\$14,853	\$16,150	-8.0	330	\$45.0	Quebec
39	36	École de technologie supérieure+	\$14,475	\$14,339	0.9	147	\$98.5	Quebec
40	42	Université du Québec à Rimouski	\$14,146	\$10,670	32.6	177	\$79.9	Quebec
41	34	Brock University	\$13,568	\$14,881	-8.8	525	\$25.8	Ontario
42	43	Université du Québec en Abitibi-Témiscamingue	\$12,713	\$10,249	24.0	105	\$121.1	Quebec
43	40	St. Francis Xavier University	\$12,679	\$11,679	8.6	228	\$55.6	Nova Scotia
44	44	Saint Mary's University	\$10,497	\$9,775	7.4	243	\$43.2	Nova Scotia
45	47	Nova Scotia Agricultural College+	\$8,968	\$6,844	31.0	66	\$135.9	Nova Scotia
46	45	Université de Moncton	\$8,815	\$9,692	-9.0	339	\$26.0	New Brunswick
47	46	Wilfrid Laurier University	\$8,347	\$9,437	-11.6	462	\$18.1	Ontario
48	49	Acadia University	\$6,778	\$5,974	13.5	198	\$34.2	Nova Scotia
49	50	Université du Québec en Outaouais	\$6,009	\$5,156	16.5	174	\$34.5	Quebec
50	48	University of Ontario Institute of Technology+	\$5,592	\$6,086	-8.1	105	\$53.3	Ontario

Notes:

1. Sponsored research income: includes funds to support research paid in the form of a grant, contribution or contract from a source external to the institution.
2. Financial data were obtained from Statistics Canada.
3. Faculty data were obtained from Statistics Canada, Conférence des recteurs et des principaux des universités du Québec (CREPUQ) and the RESEARCH Infosource Canadian University R&D Database. For confidentiality reasons, Statistics Canada randomly rounds the figures either up or down by a multiple of "3".
4. Data are provided for the main university/college including its affiliated institutions, where applicable.
5. All institutions are members of the Canadian Association of University Business Officers (CAUBO).

*Has a medical school

+Not a full-service university

++Sponsored research income administered by affiliated hospitals was reported one fiscal year in arrears

**Includes full, associate and assistant faculty only

RESEARCH Infosource Inc. is Canada's source of R&D intelligence.

The Top 50 List is available online at www.researchinfosource.com or by calling or faxing us at: Telephone: (416) 481-7070 ext. 21; Fax: (416) 481-7120.

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Research Universities of the Year 2009

Three universities gain RESEARCH Infosource's designation of *Research University of the Year* in their category for their performance on a balanced set of input, output and impact measures for FY2008. 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	100.0	1	University of Waterloo	93.1	1	Trent University	82.1
2	McGill University	71.5	2	University of Guelph	88.9	2	Royal Military College of Canada	78.3
3	University of British Columbia	70.7	3	University of Victoria	79.6	3	University of Northern British Columbia	73.3

*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 faculty 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.

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Total income reached nearly \$6.1 billion, up from \$5.7 billion in Fiscal 2007. A review of the last 10 years shows that between 1999 and 2008, total Top 50 research income expanded by 172.4%, or an average of nearly 19.2% a year. The Fiscal 2008 increase was on the low end during that period. Thirty-four institutions reported an increase in their research income while 16 had a decrease in Fiscal 2008, compared with 30 and 20 the year before.

The 2008 research income advance was driven by four factors: a 7.0% overall increase in funding from the four federal granting agencies (NSERC, CIHR, SSHRC, CFI); a 10.3% expansion of Corporate support; a 10.5% rise in Non-Corporate funding; and, a 13.4% increase in funding from the Not-for-profit/Foundation sector. Meanwhile, funding from Foreign sources plummeted by -22.8% and income from university Endowments/Investments fell by a precipitous -47.3%. Provincial government support lagged behind, rising by 3.0%

THE \$100 MILLION CLUB EXPANDS

Seventeen universities achieved \$100 Million Club status, posting research income of \$100 million or more in Fiscal 2008, which was up from 16 institutions last year. Most Club members benefit from the research income of their medical schools and affiliated teaching hospitals. However, 3 institutions – University of Guelph, University of Waterloo and University of Victoria – gained Club status without the advantage of medical schools. Within the Club, 13 members had increases in research income, while 4 members saw their income decline.

The \$100 Million Club		
2008 Rank	University	Research Income \$000
1	University of Toronto*	\$844,861
2	University of Alberta*	\$491,742
3	University of British Columbia*	\$470,146
4	Université de Montréal*	\$468,729
5	McGill University*	\$418,554
6	McMaster University*	\$373,542
7	Université Laval*	\$278,621
8	University of Ottawa*	\$245,524
9	University of Calgary*	\$236,202
10	University of Western Ontario*	\$222,336
11	University of Saskatchewan*	\$203,546
12	Queen's University*	\$192,502
13	University of Manitoba*	\$161,700
14	University of Guelph	\$142,119
15	University of Waterloo	\$135,152
16	Dalhousie University*	\$123,950
17	University of Victoria	\$112,429

*Has a medical school

MIXED PROVINCIAL PERFORMANCE

Four provinces' universities made substantial gains in research income. Growth was especially strong at Saskatchewan universities with a combined research income growth of 30.3%, as well as in Prince Edward Island (24.9%), British Columbia (17.9%) and Nova Scotia (11.7%).

Ontario's 18 universities still dominate the funding landscape, accounting for 40% of total research income, slightly less than their share of 42% in Fiscal 2007.

Thirteen Quebec institutions captured 25% of the total, up from 24% in Fiscal 2007. Three universities in Alberta gained 12% of the total, whereas 4 institutions in British Columbia accounted for 11% of all research income in Fiscal 2008.

Top 50 – Leading Provinces	
Province	% of Total
Ontario (18)	40
Quebec (13)	25
Alberta (3)	12
British Columbia (4)	11

GAINERS AND LOSERS

Twenty-eight of the Top 50 experienced research income increases that were higher than the national average of 6.0%. The group was paced by Trent University, where research income expanded by 55.5%. Other standouts were University of Saskatchewan (35.2%), Université du Québec à Rimouski (32.6%) and Nova Scotia Agricultural College (31.0%).

For other universities, Fiscal 2008 proved a more disappointing year, with some double-digit drops.

RESEARCH INTENSITY GROWS LESS

Total Top 50 research income expanded by 6.0%, whereas Top 50 research intensity – research income divided by full-time faculty – grew slightly less, increasing by 4.4%. This reflects the effect of a small 1.5% overall expansion in faculty numbers. On average, each university attracted \$165,000 of research income per full-time faculty position in Fiscal 2008, up from \$158,000 last year. Twelve full-service universities bettered the national per-faculty income average.

Although its research intensity was slightly reduced from the year before (-2.0%), University of Toronto easily led the pack, posting \$352,000 of income per full-time faculty. The next two universities were more closely matched, with McMaster University in second place (\$312,800 per faculty) and University of Alberta in third (\$307,000 per faculty).

TIER SHARES UNCHANGED

Sixteen Medical/Doctoral universities – those with medical schools – captured 81% of total research income in Fiscal 2008, the same share as last year. Twelve Comprehensive institutions accounted for 14% of the total and 22 Undergraduate institutions shared the remaining 5% of income. All 3 university groupings saw their income rise, led by the Undergraduate universities (10.7%), Comprehensive (7.1%), and Medical/Doctoral institutions (5.5%).

RESEARCH UNIVERSITIES OF THE YEAR

RE\$earch Infosource once again shines the spotlight on 3 *Research Universities of the Year* – the leading institutions that excel on a balanced scorecard of research input and output/impact indicators.

This year kudos go to: University of Toronto in the Medical/Doctoral category, University of Waterloo in the Comprehensive category and Trent University in the Undergraduate category.

SPOTLIGHT ON RESEARCH PUBLICATION GROWTH

The effect of increased research funding over the past decade is apparent in the primary research output of institutions – publications in peer-reviewed scientific journals. Data provided by the Observatoire des sciences et des technologies, indicated that 9 institutions performed especially well. Université de Sherbrooke led the Medical/Doctoral category, increasing its publication total by 61.2% between 2002 and 2007, followed closely by University of British Columbia (58.9%) and University of Ottawa (56.7%). University of New Brunswick headed the Comprehensive category with a rise of 68.9% in publications, with Simon Fraser University (61.9%) and University of Regina (59.4%) close behind. In the Undergraduate category Ryerson University made a dramatic 170.9% gain in research publication output. Trent University (84.7%) and Université de Moncton (83.6%) also registered strong gains.

THIS YEAR AND NEXT

Against the backdrop of a weak economy the Fiscal 2008 university research income results come as a relief, rising by 6.0% overall. Although Investments/Endowments and Foreign sources of income were down sharply and Provincial support was relatively flat, Corporate, Non-Corporate and Not-for-profit/Foundation support made strong gains, and Federal funding was solid.

Do the Fiscal 2008 research income results represent the calm before the storm? Will the storm intensify in Fiscal 2009? With government sources typically accounting for about 70% of all university research income (up to 80% in the case of smaller institutions), stable support from the public sector – and the federal government in particular – obviously holds the key. Contrary to some recent public statements, it appears as though the public sector is consciously not cutting research support overall, in an effort to stabilize and protect the system.

Our review of the last decade has demonstrated a remarkable resurgence of research funding in Canada, with total research funding rising by 172.4% over 9 years. All institutions have benefited, with the smaller institutions making the greatest gains. The US administration has promised a substantial re-investment in university research after a period of neglect, and that will create a dilemma for Canadian policymakers – whether or not to try to match the rising pace of US investment. However, nowadays all incremental government spending is on the back of borrowed money, which whatever its potential returns must give cause for concern. Along with the broader research community, our fingers are crossed for next year.

Top 10 Research Intensive Universities**			
2008 Rank Research Intensity		Research Intensity (\$ per full-time faculty) \$000	
Overall	University		
1	1	University of Toronto*	\$352.0
2	6	McMaster University*	\$312.8
3	2	University of Alberta*	\$307.0
4	5	McGill University*	\$263.2
5	4	Université de Montréal*	\$248.4
6	12	Queen's University*	\$232.5
7	3	University of British Columbia*	\$214.7
8	7	Université Laval*	\$207.8
9	8	University of Ottawa*	\$207.7
10	11	University of Saskatchewan*	\$193.9

*Has a medical school **Includes full-service institutions only

Top 10 Universities by Growth			
2008 Rank Income Growth		% Change 2007-2008	
Overall	University		
1	33	Trent University	55.5
2	11	University of Saskatchewan*	35.2
3	40	Université du Québec à Rimouski	32.6
4	45	Nova Scotia Agricultural College ⁺	31.0
5	31	Université du Québec à Chicoutimi	29.4
6	29	Laurentian University*	28.5
7	17	University of Victoria	25.9
8	37	University of Prince Edward Island	24.9
9	42	Université du Québec en Abitibi-Témiscamingue	24.0
10	30	Ryerson University	23.0

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

Bottom 10 Universities by Growth			
2008 Rank Income Growth		% Change 2007-2008	
Overall	University		
1	34	Royal Military College of Canada	-14.5
2	32	Lakehead University*	-12.1
3	47	Wilfrid Laurier University	-11.6
4	24	Institut national de la recherche scientifique ⁺	-10.6
5	12	Queen's University*	-9.6
6	46	Université de Moncton	-9.0
7	41	Brock University	-8.8
8	22	Memorial University of Newfoundland*	-8.8
9	50	University of Ontario Institute of Technology ⁺	-8.1
10	38	Université du Québec à Trois-Rivières	-8.0

*Has a medical school +Not a full-service university
Apparent ties due to rounding

Spotlight on University Research Publication Growth 2002-2007

RE\$earch Infosource shines the spotlight on universities that made the greatest gains in the number of research publications between 2002-2007 (5 year % change).

Rank	Medical/Doctoral	% Change
1	Université de Sherbrooke	61.2
2	University of British Columbia	58.9
3	University of Ottawa	56.7

Rank	Comprehensive	% Change
1	University of New Brunswick	68.9
2	Simon Fraser University	61.9
3	University of Regina	59.4

Rank	Undergraduate	% Change
1	Ryerson University	170.9
2	Trent University	84.7
3	Université de Moncton	83.6

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. See www.researchinfosource.com for details.
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.

Let me tell you a story.

It's about a university. This university is just up the street from where John A. and the boys once met to discuss an idea—an idea that would become a country.

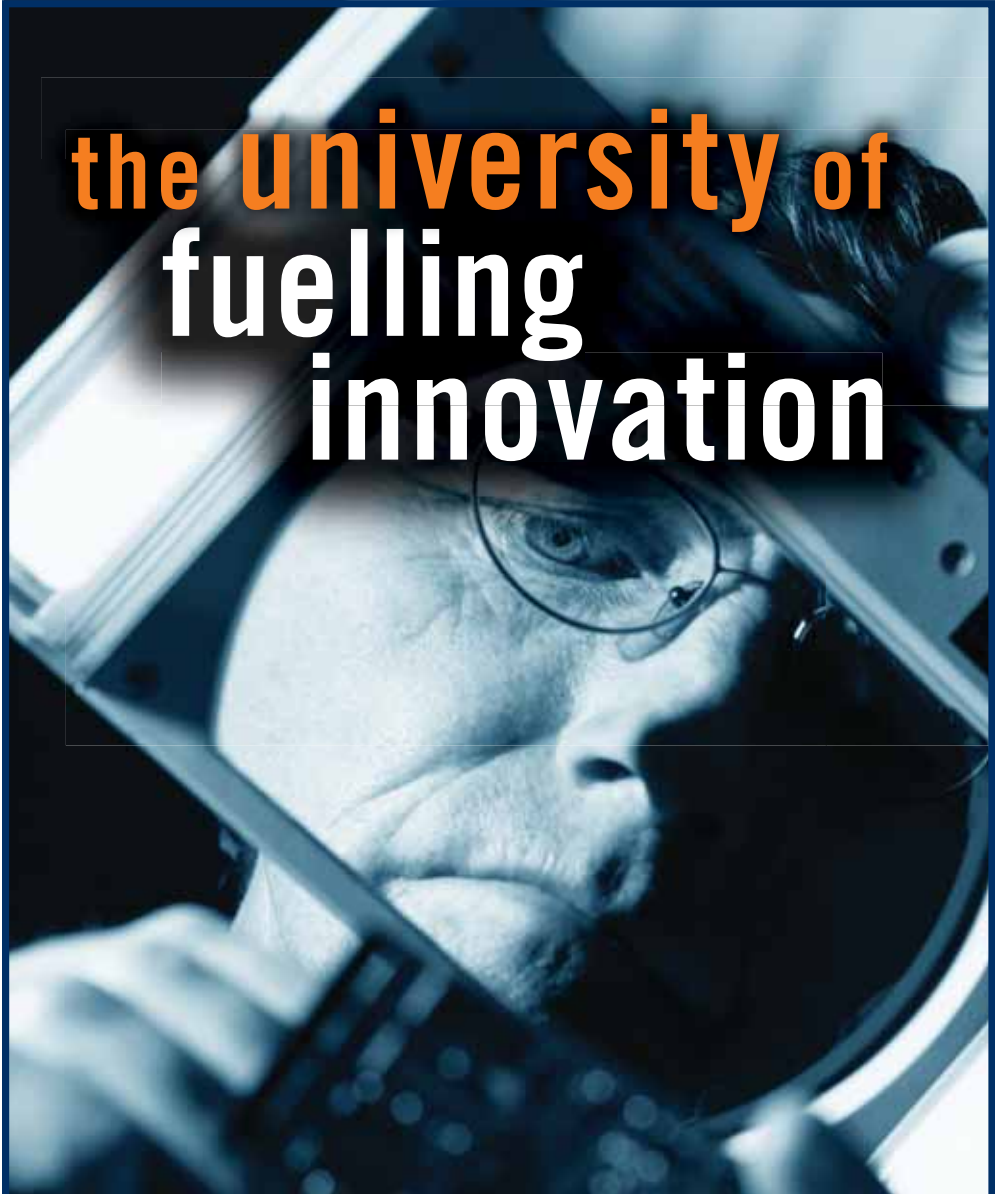
This university likes to talk about ideas, too. Sometimes it talks about the nearly magical effect singing has on human health and wellbeing. Sometimes it talks about new techniques to find and destroy cancer using light and sound.

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NSERC: Laying the Groundwork for Recovery



Dr. Suzanne Fortier
President
Natural Sciences and Engineering
Research Council of Canada (NSERC)

The unprecedented crisis in the global financial system has given the world a strident wake up call and a new understanding of the interdependency of our economies and future prosperity. Added to the need of improving Canada's record in innovation, the crisis has called attention to the urgency of laying the

groundwork for an R&D-driven economic renewal.

As in many developed countries, Canada enjoys a complex, rich and dynamic system of Science and Innovation. Our challenge is to fully exploit this system so as to realize the objective of "Mobilizing Science and Technology to Canada's Advantage", Canada's S&T Strategy. First and foremost, this starts with an unfettered commitment to the Strategy's fundamental principles. Striving for excellence, working as partners, making the tough choices and being accountable for them is the foundation on which we need to lay the groundwork for Canada's economic recovery. Second, we all need to understand our place in this system, playing our distinct roles to the best of our abilities and interacting optimally with other parts of the system. Working as a system and sharing a common vision and goals are critical to ensuring that we can all reap

the benefits of the tremendous investments that have been made and will continue to be made in S&T. Finally, we need to turn this wake up call into a call for action. To use the words of the Council of Science, Technology and Innovation State of the Nation 2008 report: "Now is the time to up our game".

At NSERC, we have heard the call for action and have been engaged in initiatives to transform ourselves, focusing our efforts on our distinct roles and working in partnership with other key S&T players.

Empowering people to unleash their creative potential is an essential component of an innovative society and economy. As validated by two major independent reviews, NSERC's Discovery Grants program is one of the most effective and productive tools in the world for promoting creativity, making Canadian researchers the envy of their peers. Implementing the recommendations

of these reviews has increased the competitive edge of the program, making it a more dynamic instrument to raise the bar for excellence in R&D. Not only are the program resources invested in the most productive researchers but additional funds are specifically targeted to accelerate research breakthroughs. The implementation of these changes has also demonstrated that Canadian researchers are ready to up their game.

Since its inception thirty years ago, NSERC has had a strategy for bringing academic researchers and companies together. In today's highly competitive global marketplace, however, this strategy needs to be constantly renewed and kept alive. Over the last few months, NSERC has mobilized an advisory committee of leaders from industry, government and academia and has held consultations across the country with over 400 representatives from these sectors to help us develop a

Strategy for Partnerships and Innovation (SPI) that responds to today's needs and positions NSERC to do its part to lay the groundwork for Canada's economic recovery.

The Strategy, which will be launched in the coming weeks, aims to increase innovation by connecting industry to the world-class academic research network in a more flexible and agile way. We at NSERC are determined to extend the reach and impact of our programs so that a greater number and range of companies and researchers can benefit from them. The recently announced Automotive Research Initiative is a good example of a new model of dynamic and responsive partnerships that can work to move Canada's economic recovery forward.

In all our work, NSERC is committed to act as a good steward and use the resources entrusted to us wisely to build a strong and broad base of research capacity and

advance the priorities of Canadians. We have recently developed a tracking system to identify existing and emerging clusters of research excellence as well as areas where more investments are needed. This tracking system is proving invaluable in making R&D investments more strategic and transparent and in ensuring that NSERC's work is contributing fully to implementing Canada's S&T strategy. It will also help us to better showcase the returns on Canada's S&T's investments.

Over the last decade, Canada has built an excellent and powerful research engine. Whether in sports or R&D, however, excellence alone is not sufficient to be and remain competitive. Agility in seizing strategic exceptional opportunities is also needed. At NSERC we are taking action to ensure that excellence and agility are a part of all we do so that we can fully contribute to laying the groundwork for a robust, R&D-driven renewed economy.



The Batawa-Carleton Initiative

WHEN YOUR PLAN IS TO RESURRECT A SMALL TOWN, PARTNERSHIP IS EVERYTHING.

The town of Batawa, Ontario was ravaged when their legendary shoe company closed. Working with Sonya Bata, Carleton researchers and twenty-six of our students were given the rare opportunity to help revive the town. It was the chance to re-imagine it completely and create a new sustainable community with a promising future. It's another example of how Carleton, along with our exceptional partners, is leading real-world research that delivers results that are **anything but textbook**.



research.carleton.ca

Laurentian among top 10 universities by growth*



Fifty years ago, Laurentian University was created to bring knowledge to northern Ontario. Today, Laurentian is exporting expertise and creativity beyond Canada's borders.

Building on its success delivering excellent undergraduate education, Laurentian is a growing graduate and research institution, with six doctoral programs complementing 14 master's programs. Laurentian now boasts 19 research centres and five Canada Research Chairs. Laurentian researchers contribute to the environment, health, mining, and many other areas.

Laurentian is a mirror of Canada itself, as it is one of only two bilingual universities in the country. Among its 9,000 full-time and part-time students, there is a significant Native student population, as well as a growing number of international students.

The university is expanding its program offerings, partnerships, and research.

- The Vale Inco Living with Lakes Centre, a leading-edge environmentally friendly facility, is under construction to house Laurentian's world-renowned research into freshwater ecology.
- The Northern Ontario School of Medicine – launched in collaboration with Lakehead University in 2005 – promotes northern and rural health education and research.

(*ranked #6)



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David Johnston, President
University of Waterloo



Amit Chakma, President
University of Western Ontario

As fallout from the global recession continues to settle on Canada's economic landscape, we are faced with the question of how best to lay a new foundation for sustainable economic prosperity.

Canada's innovation system has a role to play in getting the country moving in the right direction. However, we are simply not investing enough in research and development. Currently, R&D expenditures account for 1.9 per cent of Canada's GDP, which is below the Organization for Economic Co-operation and Development's average of 2.2 per cent.

Venture capital, which is so vital to the innovation process, is becoming scarce in this country. Canada's Venture Capital & Private Equity Association reports that venture capital investments are down 42 per cent from last year.

Most worryingly, Canada's business R&D intensity is also in decline. The Council of Canadian Academies reports that business R&D as a percentage of GDP has fallen by 20 per cent between 2001 and 2007. This slide in intensity was well under way before the current economic crisis.

On the bright side, Higher Education Research and Development (HERD) spending is on the rise in Canada, with \$10.6 billion spent on research in 2007-2008, a six per cent

increase over the previous year. However, as universities and the federal government have increased their share of HERD spending, the business sector's contribution to university research has flatlined over the last decade.

This stagnation of business investment in university R&D is unfortunate, especially when we consider that collaboration among government, academia and industry is essential to improving Canada's economic prospects.

There is a solution to this problem. We believe that the federal government should reduce its direct involvement in research and development and focus its resources on increasing the amount of private sector and university research collaboration. Its primary role should be as an enabler and connector, bringing together businesses and university researchers to foster innovation.

Evidence suggests that this collaborative approach could reap considerable dividends. Sociologists Fred Block and Matthew Keller conducted a review of award-winning innovations in the United States between 1971 and 2006 and concluded that groundbreaking innovations have increasingly resulted from partnerships among government, business and academia, rather than from companies acting on their own. In 1971, 86 per cent of the top innovations were developed privately, but by 2006, that number had fallen to 31 per cent. Clearly, collaboration counts.

With that in mind, the government should invest its resources where they will do the most good – funding research and teaching activities that will not only develop new technologies for a new economy, but train talented people to make the most of those innovations. By supporting research, and educating people around that research, the government would get a double bang for its buck.

Key government research laboratories should be fully integrated within the university system in Canada, along the models of U.S.

national laboratories such as the National Nanotechnology Initiative, to achieve increased synergies.

To create a culture of innovation and entrepreneurship among Canada's future leaders, the federal government should consider the creation of 1,000 "young innovator" and "young entrepreneur" prizes, worth \$50,000 each and awarded annually to support the creation of new ideas and enterprises.

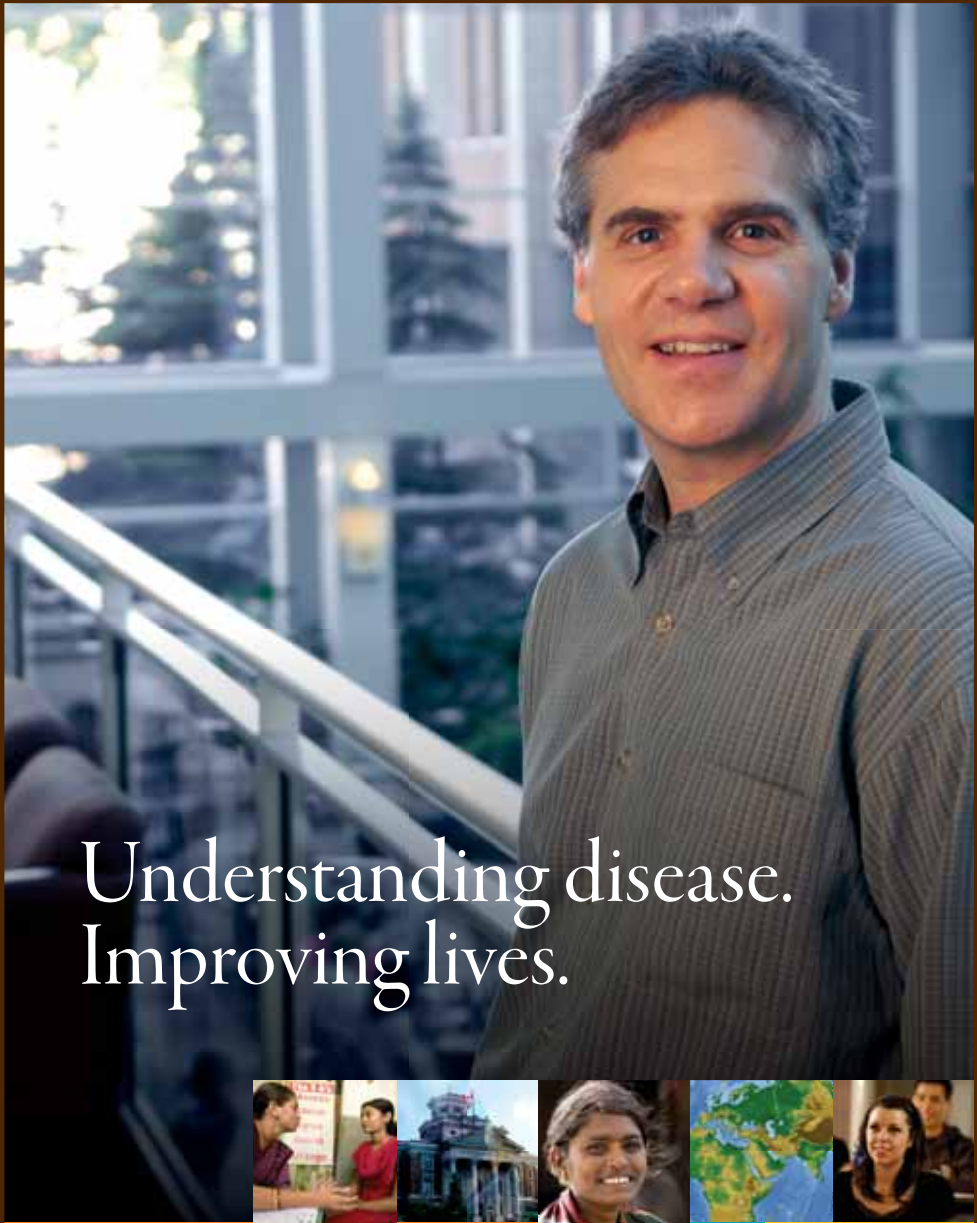
To remove the barriers to innovation caused by a lack of venture capital, the government should administer a venture capital seed fund to support university-based innovation through the Business Development Bank of Canada.

Greater co-ordination on the national level is required in order to strengthen this country's innovation system. We believe the answer will be found in the establishment of a federal Learning and Innovation Act – a "Smart Nation Act" – that will secure Canada's future based on investments in people and their ideas.


Such an act would recognize the overriding social and economic significance of investment in knowledge and in skilled people by establishing goals for investment. It would systematically build Canada's capacity for research and development and to generate knowledge. This must include measures of investment at levels comparable to the best in the world.

Canadian universities have made substantial commitments to the innovation economy: post-secondary institutions perform more than a third of all R&D in Canada. They are positioned at the centre of the drive for economic recovery, thanks to collaborations with government, NGOs and the private sector. We must all seize the opportunity to reinforce and expand upon those commitments.

Developing the skills, talent and innovation capacity of Canadians is the best way to promote long-term economic activity and sustainable economic growth. The time to lay that ever-important foundation is now upon us.




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» Waterloo's Geoff Fong thinks globally ... and acts globally



Geoff Fong wonders:

- » What government policies are most effective in reducing risky health behaviours such as smoking?
- » How can research be used to help governments select and implement truly effective, evidence-based health policies?

As a **University of Waterloo** professor of psychology and health studies, and founder and principal investigator of the **International Tobacco Control Policy Evaluation Project** (ITC Project), Fong is using concepts and methods of social psychology in a global health context to find the answers.

In response to the Framework Convention on Tobacco Control (FCTC), the first international treaty on health, Fong has mobilized researchers in 17 countries — home to 50 per cent of the world's population and 70 per cent of the world's tobacco users — to evaluate the impact of FCTC policies through the ITC Project.

Surveys conducted by ITC Project researchers assess what kinds of warning labels on cigarette packages are most effective in reducing smoking, as well as the effects of smoke-free laws and higher taxes on tobacco control.

Fong, along with colleagues Mary Thompson and David Hammond, won a **2009 Canadian Achievements in Health Research award** for "their outstanding work with the International Tobacco Control Policy Evaluation Project in assessing the effectiveness of various programs to reduce smoking around the world."

Waterloo has more than 340 institutional agreements with leading international agencies in 56 countries to pursue collaborative research as well as exchange, training, and development initiatives.

"The ITC Project is finding out which policies are working and which are not," says Fong. And who's listening?
"Policy makers around the world."

LEADERS' CORNER



Current economic challenges give added urgency to research investments, given that our post-recovery economy is unlikely to be “business as usual.” Many anticipate that the economy will look considerably different, with innovation playing a more central role than in previous generations. Thus, investing in research and education today will help ensure Canada’s competitiveness and prosperity tomorrow.
- *Eliot A. Phillipson, President and CEO, Canada Foundation for Innovation*

The Sanofi-aventis Group is proud to be the leading investor in Canada’s innovative biopharmaceutical industry. Our challenge today is to build on our legacy of discovery and development by partnering with healthcare stakeholders to ensure our medicines and vaccines are used optimally and deliver maximum value to patients and the healthcare system.
- *Hugh O'Neill, President and CEO, Sanofi-aventis Canada*





The concentration of so many of Canada's top research-intensive companies in Toronto, Mississauga, Vaughan and Markham – plus the region's outstanding research institutions – are fueling the Toronto Region's stature as a global centre for research and innovation.
- *Courtney Pratt, Chairman and CEO, Toronto Region Research Alliance*

Université Laval is a prestigious Québec City institution whose actions and decisions are governed by the principles of sustainable development. Over 60 of our 226 research groups, chairs, and centers are active in areas linked to sustainable development. Université Laval was recently certified a “Sustainable Campus” by the Sierra Youth Coalition. www.ulaval.ca
- *Denis Brière, Rector, Université Laval*



We need new R&D metrics. Universities need to track graduates and the value they create. Track revenue, growth and profit of enterprises formed. Promote and recognize faculty, staff and students that facilitate commerce and wealth creation. Governments need to focus support programs on people and exporting organizations that grow profitably.
- *H. Douglas Barber, Distinguished Professor in Residence, McMaster University; a founder and former CEO, Gennum Corp.*


To avoid an economic recovery that is 'less of the same', Canada's governments should: aim to have the best-educated population in the world; generously support the full costs of research across disciplines; and help early-stage companies by offering them direct grants and tax breaks while underwriting pools of risk capital.
- *David Naylor, President, The University of Toronto*



The high level of peer-reviewed scholarly output for which SFU is recognized, and its impact on the advancement and transfer of knowledge, is the best measure of creative thought. Out of creativity comes innovation, and out of innovation, applications that benefit individuals and communities and boost local, provincial, and national economies.
- *Dr. B. Mario Pinto, Vice-President, Research, Simon Fraser University*




Research-intensive universities have a significant opportunity and responsibility to participate in the economic and social development of their communities. At McMaster, we're creating a culture of innovation and entrepreneurship. And, we're developing the McMaster Innovation Park – a cluster of research excellence – to ensure we capture the true economic value of our research.
- *Mo Elbestawi, Vice-President, (Research & International Affairs), McMaster University*



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

For example, Dr. Marcello Papini (Canada Research Chair in Abrasive Jet Technology) and Getu Hailu (Vanier Canada Graduate Scholarship winner) are making manufacturing more environmentally friendly and competitive with micro-sandblasting. And the research of Dr. Catherine Middleton (Canada Research Chair in Communication Technologies in the Information Society) is a significant contribution to understanding the impact of the Internet on individuals and organizations.

Thanks to the work of Papini, Hailu, Middleton and other first-rate researchers, externally funded research at Ryerson has more than doubled in the past four years. In addition, Ryerson is proud to be recognized by Research Infosource as the university with the greatest growth in research publications from 2002 to 2007 in the undergraduate category.

If you'd 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: Dr. Marcello Papini and Getu Hailu
Bottom: Dr. Catherine Middleton



RYERSON UNIVERSITY

Everyone Makes a Mark

Restoring Our Economy: Great Expectations for R&D



Robert Fripp
Senior Associate
The Impact Group

Anticipating recovery from this recession, Canadian leaders are seeking ways to support research and innovation that will lift Canada's rank in world trade as our economy improves.

Our present outlook worries informed leaders. Here is Bell Business Markets' president, Stéphane Boisvert, in a speech prepared for the Telecom Summit (June, 2009): "The greatest test of our leadership is how successful we are at promoting technology advancement for enterprise... Technology is a strong and durable guarantee of Canada's long-term prosperity... So when this conference talks about 'Embracing Transformation'... it's about our national prosperity and our international competitiveness.

"Economists predict that innovation is going to be more important than ever to continued economic and competitive success..." In that respect "the U.S. ranks number one in the world. We're number eight."

Boisvert's office updated me later. In September, Canada ranked 15th. By October 2nd, delegates to IBM Canada's Science and Innovation Summit were challenging that figure as optimistic.

Our present mixture of policies supporting R&D is unfit for purpose. Canada needs more comprehensive support and funding policies.

"I've been doing R&D in Canada for over 25 years," says Gino Palumbo, President and CEO of Integran Technologies Inc. Integran, which won the Royal Bank Innovative Business of the Year Award in 2007, produces high performance nanocrystalline metals for industry, aerospace, defence and transportation parts. "The big promise is that R&D really will lead to new products and technologies." Unfortunately, "We appreciate the support we've received in Canada, but over the years Integran's had much more support from the U.S. Department of Defense – and it's hard for Americans to go outside their jurisdiction. Even so, it's quicker and easier, very focused, with more dollars available." Recently, a consortium from the European Community approached Palumbo, easily obtaining EC matching funds "to adapt our technology."

By contrast, "Canada's scientific tax credit program actually excludes items necessary to market a product: for example, you can't claim costs relating to patenting technology or business development central to bringing your product to market.

"I'd like to hire more graduates and expand faster here in Canada," Palumbo adds, "but we can't get the support we need, so most of our expansion is currently in the US."

It will take leadership to untangle the Gordian knot of overlapping roles among universities, businesses, governments and what one writer calls an "alphabet soup of technology-push funding programs."

"THE CONCEPT OF R&D AS A CATALYST for recovery and growth has gone in and out of favour since the Second World War," says Steven Liss, Associate VP for

Research at the University of Guelph. "Our private sector supplies 50 to 60 percent of R&D funding, but it comes from a few large companies." The decline of Nortel – Canada's R&D funding leader for more than a decade – will precipitate changing sources for investment dollars. "The question is: Can investment move small and medium enterprises? We will see more emphasis on what happens in S&MEs, getting them to recognize the value their R&D can have in building relationships with universities and vice-versa.

"Guelph's history of achievement ranks it among global leaders in food, agriculture, environment, animal health and life sciences. That didn't happen overnight. I'm concerned that R&D funding pressures will demand short term returns and fast gains. How will this affect longer research cycles?"

"We've been thinking acutely about the economic and recovery roles of research," says Rob Steiner, Assistant VP Strategic Communications at the University of Toronto. "We publish more peer-reviewed research than any other university except Harvard and the University of Tokyo. We are figuring out optimal use and the strongest structures with the MaRS innovation centre.

"We want more commercialization, more industry partnerships, but we must ensure our commercialization model supports real success."

"Commercialization *per se* is not the name of the game," Peter J. M. Nicholson, CEO of the Council of Canadian Academies, told the IBM Summit. "Mike Lazaridis licensed just two technologies for RIM in twenty years, but he hired 5,000 students. It's the brains that attract a virtuous circle."

Research in Motion's model suggests a key interface between business and universities. RIM's Tenille Kennedy enlarged this point:

"Michael founded RIM as a co-op student at the University of Waterloo, alternating four-month cycles of school and work. RIM has always employed co-op students. [Michael] understands how important they are to a company. We take 2,000 each year."

"Our economy is evolving to let universities and businesses work well and work together," says Steiner. "What has to change is the interface between industry and universities, without distracting what a university should be."

"Research is a major priority at McMaster," says Mo Elbestawi, McMaster's VP Research and International Affairs. But, "McMaster, a university with a global reputation, also helps regional economic development.... Taxpayers demand accountability for their investment. Creating wealth and new jobs, high-paying jobs: This is part of the university's future role, being socially responsive and progressive."

The Université de Montréal, with affiliated hospitals, institutes, HEC Montréal Business School and École Polytechnique, represent \$400 million research annually. "All these people generate research and innovations!" Gilles Noel is director of technology transfer at the university; Marc Leroux, managing director of Univalor, the commercial arm of the university and its schools.

They agree that "Developing a commercially appetizing technology can take up to six years; these are the ones that can lead to licensing. We have 200 projects in the works, and about 60 licences. When we get a good prospect, we search through thousands of companies worldwide." Leroux and Noel stress that Univalor works in a pull mode, not push. "We engage industry at a very early stage and we keep engaging it!"

Still, universities face a stiff challenge. Jai Menon, an IBM Fellow whose job titles include "VP and

Global Leader of University Programs," reports that IBM asked 765 CEOs and public sector leaders "who they relied on most for their innovative ideas." Employees came first; business partners, second; customers, third. Universities as sources for innovation came ninth.

DIFFERENT SECTORS, DIFFERENT PROSPECTS: Pfizer Canada's president, Paul Lévesque, asked the Canadian Club of Montreal, "How can a major research-intensive industry continue creating wealth and innovation during a 'perfect storm'?" Lévesque listed factors confronting his company and 'big pharma': a 25% drop in revenues as patents expire; a "difficult, costly" transition into researching new biologic medicines and gene-based therapies; intense competition for investors and from global manufacturers and – "The whole world wants in on life sciences." Then came Canada's attitude to innovation: "Our health system is fighting it."

Pharmaceutical companies invest "more than one billion dollars in Canada each year." Any reduction would hit biotech firms and academia.

Lévesque finds hope in the first report by Canada's Science, Technology and Innovation Council (May, 2009). He quotes Council member Heather Munroe-Blum, McGill's principal: "We need to work together to nurture the capacity to create, apply new ideas and finance their translation into commercial success in the global marketplace."

In the I.T. sector, "Companies are under pressure to do more," says Ericsson Canada's Chief Technology Officer, Dragan Neradzic. "Our solutions must give customers more efficiencies and more capabilities at stable prices. That drives our R&D spending which increases our market share, so we can maintain R&D at higher levels. Products become more efficient and effective, making a virtuous circle."

(My prediction: The next economic recovery will replay the 1990s, when businesses adopted technology rapidly, boosting productivity while restraining costs.)

Neradzcic reports rapidly rising volumes of digital data. "We must make sure our customers' investments in I.T. don't rise along that same line as data growth," he says. "Our products must give customers exponential growth efficiency at a stable business cost despite the fact that their traffic is growing."

TELUS spent 147% more on research in 2008 than in 2007. "Telecom may be the most competitive industry on the planet," says TELUS's Jim Johannsson. "We're ensuring we remain on the leading edge of technological innovation, which feeds our success as a business. Products improve every quarter, creating incremental demands on networks to provide service. Our big research increase is about preparing our Next Generation wireless network for launch in 2010. Pushing limits drives R&D investment as well."

"Does the improvement in technology reflect increased employment?" I ask.

"In the first place it reflects productivity. Any industry can now handle at least five times more data per day than 25 years ago." TELUS itself has taken on 10,000 employees in nine years.

For EnCana, the industry leader in extracting 'unconventional' natural gas, R&D brings extensive new leverage. "It's now economically feasible to extract new gas from old holes with new technology," says EnCana's Rhona Delfrari. "We can *now* say we have enough natural gas in North America to last more than a hundred years." R&D made that possible. One expectation is a more predictable energy supply in which businesses can locate, plan expansion, and generate jobs.

We have many success stories. In national terms, just not enough!

FUTURES, TAKING SHAPE: Stan Shapson, VP Research and Innovation, has watched York University grow from farmland – albeit near IBM Canada and sanofi pasteur. The Markham cluster supports more than 40% of medical devices companies. "When new companies need access to ideas


Continued on page 8

THE POWER OF PASSIONATE MINDS


Fueled by the deep partnerships we share with federal, provincial and municipal governments as well as many academic, NGO and private supporters, UNB ranked first in research publication growth and in the top three for research income growth in comprehensive universities between 2002 and 2007 in Canada. Thank you to our partners for making it possible.

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Grad student Matt Beedle and Geography professor Brian Menounos on Castle Glacier east of Prince George.

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David Keith is director of the ISEEE Energy and Environmental Systems Group, and a professor in the Schulich School of Engineering and the Department of Economics at the U of C.



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Ron Freedman
CEO
RESEARCH Infosource Inc.

The initial decade of the 21st century will come to an end next year. It's a good time to look back on Canada's progress in research and innovation. There are two distinct storylines, academic and industrial.

On the academic side there has been tremendous progress – at least on research inputs. Funding for academic (university, hospital, college) research has expanded dramatically - growing 172% in 10 years (up 6.0% last year). Increased support from

Research and Innovation: Where to from Here?

federal, provincial, industry, and non-profit sources has made this possible. Academic research has never been in a better position. All institutions have benefited, with the largest percentage gains occurring at the smaller organizations that had more room to grow. History will declare the last decade as a golden age for academic research funding.

On the output side the picture is mixed. Academic research is of very high quality and Canada ranks well in international comparisons of research publishing – publication totals, citation levels and publication impact factors. However, along with the US, our share of world publications in the leading scientific publications has declined. Some of that decline is inevitable given increased strength in the rest of the world. That said, the steep growth in funding has

not produced a corresponding increase in raw outputs (publications) in the core group of leading international publications, which is something of a conundrum.

In terms of commercialization of academic research, we are moving in reverse. The latest figures show that as we are spending increasing amounts on commercialization activities, revenues to academic institutions from licensing their intellectual property dropped from \$60 million in 2006 to about \$53 million in 2007 – in advance of the financial meltdown. This is no reflection on the quality of research or the capabilities of the commercializing workforce. Both are of international calibre. But it does raise questions about the capacity of domestic industry to build on our excellent academic research base.

One bright spot is that academic research contracting – providing R&D services to government, industry and others – is on a tear, reaching \$1.2 billion last year. This is a powerful expression of knowledge value exchange, in which third parties are willing to pay hard money for research knowledge in our universities, hospitals and colleges.

On the industrial side Canada is stuck in neutral. Corporate R&D spending never recovered from its tech bubble peak early in the decade. Corporate revenues have grown consistently but research spending has been flat. This means that research intensity – R&D spending as a portion of sales – has been slipping. Furthermore, we're losing many of our top R&D performers due to acquisitions or business failure. These firms are at the top of the

research “food chain”, and their loss has broader implications for the research ecosystem.

A seemingly encouraging sign is that the number of firms apparently engaged in research has exploded, doubling in the decade (from around 10,000 to 20,000 firms). However, most of these firms are small. Their combined research efforts account for only a small portion of the total and their economic impact is relatively low. Also, it appears as though the growth in R&D firms may simply be an artefact of Canada's arcane system of government research incentives, and not a real phenomenon.

Over the past 15 years Canada has had a succession of federal and provincial government “innovation strategies”. To little practical effect. Their singular success has been to strengthen the academic research base, which is a necessary (but not sufficient) condition for progress. Their singular failure has been on the industrial side. Regardless of their inherent merits, the strategies have largely been overwhelmed by rapid changes in the real economy. Canadian policy makers have shied

away from direct support of industrial innovation, preferring instead to rely on the blunt instrument of tax incentives to spur research. What little policy attention that has been paid to industrial research has focussed on mostly marginal and esoteric initiatives – essentially patching an obsolete system of incentives and support mechanisms. Effectively, the policy community has run both out of fresh ideas and the will to re-invent the industrial innovation support system in the face of apparent failure.

What's really needed at this juncture is some “zero-based” thinking on industrial innovation support (including industry-academic linkages). On paper, we need to start from scratch: to clarify our goals and objectives and consider what we would do if we had the currently-available funds to support industrial innovation (in the range of \$4 billion annually) – but no programs in place. What would we do if we had a clean slate to work from? Federal government leadership will be key, so it will be interesting to see if Budget 2010 begins to address the core issues.



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New Incentives for Business Innovation



Dr. Peter J. Nicholson
President
Council of Canadian Academies

Canada's number one economic challenge is to increase productivity (output per hour worked) in the business sector. Analysis by Statistics Canada shows that Canada's lagging productivity – which has declined from more than 90% of the U.S. level in the early 1980s to about 75% today – is due to persistently weak growth of “multifactor productivity” (MFP), a statistical measure that captures the efficiency with which labour and capital are combined to produce goods and services. The Council of Canadian Academies' expert panel on business innovation concluded that the long-term average growth of MFP is the best comprehensive indicator of innovation, interpreted broadly to include not only advances arising from science and technology, but also from improvements in business models, marketing, and business processes of all kinds. Canada's persistently weak MFP growth therefore points to an equally persistent shortfall in business innovation.

This evidence begs the question as to “why”. If innovation is good for business, why has Canadian business on the whole been consistently less committed to innovation than analysts and policy makers believe it should be? Three entrenched factors appear to lie at the root.

First – Canada is “upstream” in many North American industries owing to a comparative advantage in resources and adjacency to the

American powerhouse. Canada's upstream position in many continentally-integrated value chains has had the effect of limiting contact with ultimate end-customers – who are always a strong source of motivation and direction for innovation.

Second – Canada's domestic market is relatively small and geographically fragmented. Small markets offer lower potential reward for undertaking the risk of innovation. They also tend to attract fewer leading-edge competitors, and thus provide less incentive for a business to innovate in order to survive. Of course, the innovation success of countries like Finland, Sweden and Switzerland shows that the disadvantage of a small domestic market can be offset by a strong orientation toward innovation-intensive exports. Unfortunately, this has not been Canada's habit.

The third factor is that Canadian companies have adapted very profitably despite the foregoing circumstances. Surprisingly, in more than 80% of the years since 1961, pretax corporate profit in Canada (as a percent of GDP) has exceeded that of the U.S. The reasons for this have not been definitively explained, but the Council's expert panel on business innovation speculated that it may be due to more subdued competition in Canada's domestic market. Whatever the reason, the fact is that Canadian business overall has been quite profitable and has therefore not been motivated to change its strategy. Canadian businesses cannot be expected to adopt more innovation-oriented strategies – which would drive stronger productivity growth in the economy at large – unless the circumstances of Canadian business change in ways that make greater focus on innovation strategies superior to the status quo.

In fact, the circumstances are changing dramatically and the implications are likely to become much clearer as the global downturn gives way to recovery. The new business environment has the following principal characteristics:

• Resources

While resource-based activities will always be important for Canada, they are inherently volatile, very unevenly distributed across the country, and subject to increasingly stringent environmental constraints.

• The U.S. Market

Canada's dependence on access to the U.S. market faces a growing threat of protectionism as America itself adjusts to new competitive pressures from emerging markets. And the ever-present terrorist threat creates a constant risk that the U.S. border could close literally overnight in the wake of an attack.

• Emerging Markets

At the same time, by far the biggest growth opportunities today, and in the foreseeable future, lie in the emerging markets, particularly of Asia but also of Latin America. This is a tremendous opportunity, too little exploited by Canadian businesses, but also a new challenge as China, India and others acquire sophisticated skills and cease to rely exclusively on labour cost advantages.

• New Leaders

A new generation of Canadian business leaders is now in the wings. This is a generation at home in the world and often with strong links to the dynamic economies of Asia and elsewhere. They have few of the old habits of mind that, traditionally, may have curbed business ambition in many sectors of Canada's economy.

Whether or not these new circumstances are sufficient to stimulate a new innovation focus in Canadian business strategy remains to be seen. The incentives certainly are shifting in that direction. But there is still too much complacency and short-termism in the face of a new and far more challenging, though potentially rewarding, global business environment. V.O. Marquez, the former Northern Electric CEO writing in 1972, was right when he said we need “small catastrophes” – shock enough to force change, but not so severe as to wreck everything.

Restoring Our Economy: Great Expectations for R&D

Continued from page 6

and infrastructure, we do that at York. When they need entrepreneurship, we involve students from the Schulich School of Business. Working across sectors, small and large companies, universities and business schools, research and business, that's our model. It's a powerful delivery of research for the new economy.”

Close to York University sits sanofi pasteur, the largest company in the world devoted entirely to human vaccines. Its president, J. Mark Lievonen, remarks, “We started laying the groundwork for future growth in 2000, with our first new building in 25 years.” He adds, “We've spent over \$350 million in capital investments since.

“In this economy people are moving away from manufacturing. We are expanding manufacturing. These are high-tech jobs, high-tech manufacturing. The vaccine business is globally competitive. If you're not among the best in the world the work won't be done here.” Lievonen continues, “We are building on our successes and strengths to become a growth site and a centre of excellence for biopharma-

“WEEK AFTER WEEK, HEADLINES in this newspaper raise unsettling questions about Canada's international competitiveness,” University of Toronto President David Naylor wrote in the Globe and Mail (July 24, 2008) after returning from fact-finding in Israel with the presidents of UBC and the Canada Foundation for Innovation. Seeking an R&D star in the east, the three presidents discovered how Israel had “flipped its economy” from 70% agricultural in the 1950s to one of high-tech exports from home-grown research. Naylor wrote: “First, Israel's research institutions, government, industries and venture capital sector collaborate to nurture innovation.” Second, its research institutes “share 50 per cent of revenues with researchers and students.” Third, Israeli researchers are “heavily rewarded for innovation, but seldom asked to change hats and help run companies.” And, “Fourth, Israelis recognize that the private sector does commercialization, not universities or governments.”

Yes, commercialization belongs in the private sector, says Vicky

WHERE SHOULD CANADA GO FROM HERE? In the first place, to a total bottom-to-top analysis of research grants and tax credit program effectiveness, followed by broad-spectrum repair. Speakers at conference after conference make cogent arguments for reforming the existing structure. Even mature companies with managers experienced in research *and* administration – i.e. Integran Technologies – can't make the system work.

What would work better? Ron Freedman, the CEO of RE\$EARCH Infosource Inc., suggested a model (Toronto Star, August 26): shifting resources to companies “that have identified a market opportunity and need help to pay universities to develop their ideas”; that gives intellectual property rights to companies performing government research; that consolidates “the alphabet soup of federal and provincial funding programs” – while allowing patent and marketing costs; and, that substitute “business engagement strategies” for “commercialization strategies.” Such a program would be easier to create and finesse if Canada had a national software strategy, Freedman argues.

It will take leadership to untangle the Gordian knot of overlapping roles among universities, businesses, governments and what one writer calls an 'alphabet soup of technology-push funding programs.'

ceutical research and development and manufacturing.”

IBM Canada's Public Sector Team is also bullish in forecasting I.T. applications. Like Ericsson's Neradzcic, IBM's Don Aldridge predicts, “The next layer of technology will generate massive amounts of ‘streaming’ data” (data analyzed on the fly, not stored). Never mind economic *recovery*. With IBM the fifth largest corporate R&D spender in Canada, Aldridge boasts technology-based *revolutions* in many fields. But he detects a challenge: “Can we train enough people to carry this into future years?”

“Training must extend to technology transfer administrators,” says John Hepburn, VP Research and International at the University of British Columbia's industry liaison office (ILO). “We must build up administrative expertise commensurate with our research expertise. If you develop a drug and it doesn't get commercialized, you might as well not have developed it!”

At the University of Saskatchewan, the provincial government challenged Glen Schuler's ILO to show benefit from licensing products to companies outside Saskatchewan. Schuler reports: “We were able to show that licence revenue returning to the province brought additional research dollars – and helped starting companies here. We can show \$4 in economic value created for every dollar a government agency put in our ILO.”

Sharpe, President and CEO of Sustainable Development Technology Canada (SDTC). “Getting an idea to market requires an ecosystem of innovation and financing specialists. New companies must scale fast to the point of making revenue that attracts capital from the global market. Players must see an improved appetite for risk linked to reward, ensuring that good ideas move to market.” Among other roles, Sharpe sees SDTC's mission as “bridging the pre-commercial funding gap.” Finding private sector investors demands “extremely extensive due diligence.

“Of the 171 projects we have, 31 companies have attracted money that goes straight to moving them to market. Public investment by SDTC into these 31 companies has been “some \$80 million. Follow-on private sector funding has been \$902 million, forty percent from offshore. We are attracting foreign capital into Canada for wealth and job creation.”

Sharpe believes that university tech-transfer offices should involve the business “ecosystem” sooner and more thoroughly. “When you accept a technology you have to scale it up to prove it. We try to fund a demonstration – it's expensive – hosted by the first user of that technology. That gets us real life performance by a first adopter. The risk to others is minimal, because we tested it.”

Meanwhile, IBM's global survey suggests that, when “CEOs and public sector leaders” consult “top sources of new ideas and innovation,” input from universities ranks ninth. Jeffrey Crelinsten, President of The Impact Group, responds: “Our universities and policy makers still intone the mantra ‘Ideas to Market,’ believing that industry thrives on ideas emerging from universities.” It doesn't.

Jai Menon remarked: “IBM changed its internal culture from one where researchers advanced based on the number of peer-reviewed publications they wrote, to the present system which rewards them for the number of research ideas and projects that lead to customer sales. That full intellectual transition took ten years.”

“Few universities have set up merit and promotion pathways for researchers working with industry,” Crelinsten writes. “I'm not advocating that professors who excel in fundamental research be penalized. We need high-performance researchers on the leading edges of their disciplines to attract other professors and top students. What we also desperately need is top performers in applied research, entrepreneurial learning and support of commerce and wealth creation.”


What Canada needs even more is a massive R&D policy fix. That's the groundwork. The economic recovery component will follow.

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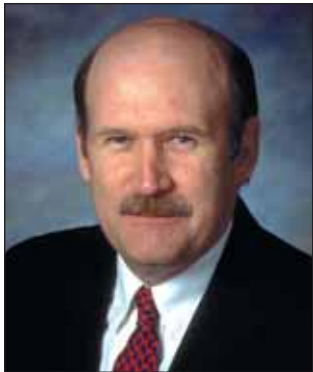
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How Do We Focus Our Scarce Research Dollars



David Martin
Executive Chairman
SMART Technologies

Canadian companies need to think carefully about how they spend research and development dollars in the current economic environment. On a country level, we often hear that Canada's combined government and corporate R&D spending is less than other OECD countries. We also hear that we need to accelerate government spending as a percentage of GDP and corporate spending as a percentage of revenue. For years, Nortel was Canada's corporate gold standard – our biggest R&D spender by a large margin. Now that it has been dismantled as a stand-alone company, where will we stand as a country when measured against others? With R&D intensive companies outside of Canada accelerating their spending, will Canada continue

to tumble down the ranks of innovation-based economies? Canadian companies have to be smarter about their development spending. There are calls for companies to fund basic research in Canada, but that can only be accomplished with a sustainable business model through which new products are created to meet market needs on a continued basis. Nortel spent money on R&D, but was it spent wisely? This is just the kind of question we must ask as we navigate increasingly uncertain terrain. If companies have a replicable new product introduction model, then the taxes they pay, directly and indirectly, can be channelled by government into fundamental research. Companies can also fund researchers who advance their strategic objectives. In the process, both will form a sustainable economic value-creation model that keeps Canada in the ranks of innovation leaders. At SMART Technologies in 1987, for example, we were developing a new product for new markets. Sometimes called a Blue Ocean Strategy, this approach resulted in many subsequent opportunities to create products and solutions that our customers value. Because we took a long-term view, we created a global distribution network that now means our new product ideas can be vetted and moved through our channel with

greater certainty and speed than our competition. This advantage, which was built and refined as part of our corporate strategy over the past 20 years, has resulted in SMART shipping more interactive whiteboards than all other manufacturers combined. When measured by its R&D efficiency? metrics such as gross profit divided by R&D expenses? SMART is twice as efficient at delivering great products than other high growth technology companies. We have succeeded to this degree by cultivating a deep relationship with and understanding of our markets, combining that with our R&D expertise and delivering a suite of products that meets customer needs. The debate in Canada over R&D spending will continue. Governments will continue to fund basic research on a selective basis. University researchers will continue to promote the funding of curiosity-based research. But managers of corporate R&D programs need to be more selective in driving development that produces the best products for global markets. Canadian companies need to be as efficient in their R&D spending as they are with their marketing budgets or operational spending. If they are, it is possible to succeed from a Canadian base of operations. With the demise of Nortel, we need to examine what business models work and what the new models

need to be. Can successful companies like Research in Motion and SMART Technologies be replicated? These companies are category share leaders because they have relentlessly pursued a long-term vision based on customers, and they have built the partnerships and infrastructure to address their needs.

There are direct ties between the development efforts of these two companies and the raft of new products that are released each year for their respective markets. These companies have been around for a while and will continue to be as they maintain their focus on customers. In SMART's case, we have found that we can spend 4-5% on R&D as a percentage of revenue and still grow total product sales more than 25% per year. By taking this approach, our company continues to provide key knowledge-based products and serv-

ices to customers around the world. SMART will be a receptor organization for university graduates who want to stay in Canada and solve difficult product-oriented problems. We will fund targeted research projects. From tax dollars generated by our value-creation process, the Canadian government can fund a variety of needed R&D programs. By understanding our respective roles and obligations in the economic value-creation process, we can create Canadian-based organizations that are truly sustainable and valued in the global context.

What does the Toronto Region offer research-intensive industry?

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Spotlight on Innovative Cities - Number of R&D Performing Companies

RE\$EARCH Infosource shines the spotlight on innovative cities according to the number of R&D performing companies (2005).

Rank	Population More than 900,000	# of R&D Companies*
1	Montréal	2,714
2	Toronto	1,543
3	Calgary	615

Rank	Population 300,000-900,000	# of R&D Companies*
1	Mississauga	763
2	Ottawa	666
3	Québec†	570

Rank	Population Less than 300,000	# of R&D Companies*
1	Vaughan	405
2	Markham	286
3	Windsor	185

*Latest data available were obtained from Statistics Canada.
†Includes Lévis.

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Continued from page 12

\$10.09 billion, a slight decline of -0.2% from Fiscal 2007. With Nortel Networks, Canada's perpetual but soon-to-be-extinct R&D leader removed from the equation, spending by the remaining 99 firms eked out a 1.9% increase.

Research intensity – R&D spending as a share of revenues – was 2.7% down from 3.2% the year before. Excluding Nortel's results research intensity was 2.3% compared with 2.7% the previous year. A sharp 12.3% growth in corporate revenues over the period amplified the decline in research intensity. (We calculated research intensity for the 94 firms that supplied income data.)

Overall, 59 companies achieved positive R&D growth, 40 firms spent less on research and one company was static. These figures are comparable with those in previous years.

THE \$100 MILLION CLUB

In Fiscal 2008, 19 companies qualified for RE\$EARCH Infosource's \$100 Million Club – the elite group of firms that spent \$100 million or more on research. This is the same number of firms as in Fiscal 2007, but down from the 24 firms in Fiscal 2006. Among the Club members were 12 Canadian companies and 7 foreign subsidiaries.

Returning to the \$100 Million Club this year were TELUS, Open Text and CAE; and new to the Club was Aastra Technologies. Two former Club members fell off the list this year because their spending declined below \$100 million.

Among the 19 Club members, 12 companies increased their R&D spending, while 6 firms had negative R&D spending growth and 1 firm reported no growth.

The \$100 Million Club was dominated by 9 companies in the Information and Communication Technology sector. Next in prominence were 4 Pharmaceutical/biotechnology companies, followed by 3 firms in the Aerospace sector.

Club members accounted for 67% of total Top 100 companies' R&D spending (\$6.8 billion), the same share as in the year before.

The \$100 Million Club		
2008 Rank	Company	Industry
1	Nortel Networks	Comm/telecom equipment
2	BCE	Telecommunications services
3	Magna International	Automotive
4	Pratt & Whitney Canada (fs)	Aerospace
5	IBM Canada (fs)	Software and computer services
6	Research In Motion	Comm/telecom equipment
7	Atomic Energy of Canada	Engineering services
8	Alcatel-Lucent (fs)	Comm/telecom equipment
9	Apotex	Pharmaceuticals/biotechnology
10	sanofi-aventis Group (fs)**	Pharmaceuticals/biotechnology
11	TELUS	Telecommunications services
12	Bombardier	Aerospace
13	GlaxoSmithKline Canada (fs)	Pharmaceuticals/biotechnology
14	Ericsson Canada (fs)	Comm/telecom equipment
15	Pfizer Canada (fs)	Pharmaceuticals/biotechnology
16	CAE	Aerospace
17	Open Text	Software and computer services
18	Aastra Technologies	Comm/telecom equipment
19	Hydro-Québec	Electrical power and utilities
fs = Foreign subsidiary (includes R&D expenditures for Canadian operations only)		
**Includes sanofi-aventis Canada Inc. and Sanofi Pasteur Limited		

INDUSTRY PERFORMANCE

Eleven companies in the Communications/telecommunications equipment sector dominated Top 100 spending again this year. These firms accounted for 27% of total Top 100 spending, a slight 1.5% increase over Fiscal 2007. But if Nortel Networks' results are omitted, the remaining 10 Communications/telecommunications equipment firms posted an extremely strong 26.3% gain in their combined R&D spending over the period.

Next in total spending were 31 firms in the Pharmaceuticals/biotechnology sector, which among them accounted for 19% of total spending – similar to the previous year. Four companies in the Telecommunications services sector were responsible for 13% of Top 100 spending, but declined -9.6% from the year before.

Companies in 4 sectors – Engineering services (14.5%), Software and computer services (7.9%), Aerospace (5.6%) and Energy/oil and gas (4.1%) – showed strong or moderate gains in research spending, while their counterparts in other sectors had declines in their spending.

Top 100 – Leading Industries		
Industry	R&D Spending (% of Total)	
Communications/telecom (11)	27	
Pharmaceuticals/biotechnology (31)	19	
Telecommunications services (4)	13	
Aerospace (5)	8	
Automotive (2)	7	
Software and computer services (8)	7	

Between Fiscal 2007 and Fiscal 2008, total R&D spending increased in 5 of the 9 leading sectors represented by the Top 100 R&D spenders.

THE TOP 10 R&D INTENSIVE FIRMS

The 10 most research intensive companies on the Top 100 list spend a large proportion of revenues on research. In the case of 8 of the 10 firms, spending on research was far in excess of revenues. This typically indicates companies that are in a startup or early growth phase in which research spending is high and revenues are low.

Not surprisingly, almost all of the companies on the list this year were Pharmaceuticals/biotechnology companies. These firms normally have long product development cycles, which are characterized by deferred revenues; hence, their high levels of research intensity.

GAINERS AND LOSERS

Ten companies on the Top 100 list exhibited strong gains in research spending, increasing their R&D by 60% or more between Fiscal 2007 and Fiscal 2008. This year's list of gainers included a mix of technology, resources and pharma/bio firms.

Leading the list was Allen-Vanguard, which had a strong 263.5% increase in research spending. Mining and metals company ArcelorMittal Dofasco was next with a sharp 151.9% increase in R&D spending. Telecom services giant TELUS boosted its R&D spending by a hefty 147.1%. Husky Energy expanded its spending by 122.2%, while Pharmaceuticals/biotechnology company Cangene grew its R&D by 104.7%.

Not all firms managed increases in their research spending in Fiscal 2008. A group of 10 firms posted strong pull-backs in R&D. Among the well-known firms where spending declined, were Ballard Power Systems (-37.0%), QLT (-36.8%), Tembec (-29.9%), and Teck Resources (-28.1%).

LOOKING AHEAD

Last year we wrote that “Companies are bracing for the impact of world financial and stock market meltdowns as this analysis is being written. Suffice to say that there are bound to be major repercussions for corporate R&D spending next year. At this time everything is up for grabs. A number of leading firms may not be in existence next year.”

Based on the Fiscal 2008 results Canada's Top 100 Corporate R&D Spenders avoided an R&D wipe-out. Total spending declined by -0.2% (up 1.9% without Nortel Networks), which under the circumstances could be seen to be a minor miracle. Perhaps, though, the so-so 2008 results simply reflected a delayed reaction on the part of firms to their dire business circumstances. Undoubtedly, the less-than-expected R&D spending decline was cushioned by the strong growth of revenues of 12.3% for the Top 100 R&D Spenders.

While the overall Top 100 result held up well (in the circumstances), that could not be said for all individual company results. Forty firms experienced negative R&D growth against 59 firms where spending increased.

The full effect of the deteriorating world economy will be reflected in next year's Fiscal 2009 corporate R&D spending results.

It is hard to envisage better overall performance than in 2008. For one thing, it appears that Canada's perpetual R&D spending leader (Nortel Networks) will be absent from the list in 2009. In consequence, total corporate R&D spending will undoubtedly be affected – in a downward direction.

New measures are needed to reinvigorate corporate research and innovation in Canada. As we have written elsewhere (Canada Needs New Paradigm for Research and Innovation. Toronto Star, 26 August 2009), there are concrete steps that can be taken today, many with little or no net cost, to boost research and innovation:

- Create a research strategy to commercialize our vast services potential.
- Shift a large part of corporate research funding from the tax system to direct support of research through programs such as the National Research Council's Industrial Research Assistance Program (IRAP).
- Strengthen our areas of traditional comparative advantage: agriculture, forestry, mining, mineral processing, energy production and so forth.
- Develop a national strategy to support companies developing instrumentation.
- Modernize procurement policies to allow governments to acquire promising new technologies.
- Reinstate the “unsolicited proposal” program that allowed companies to get support for novel ideas that could be used by government.
- Shift “technology push” resources to “demand pull” – to companies that have identified a market opportunity and need help to pay universities to develop their ideas.

Top 10 Research Intensive Companies*		
2008 Rank		
Research Intensity	Overall Company	R&D as % of Revenue
1	46 Cardione Pharma	3,041.7
2	71 Medicure	1,275.5
3	84 Azure Dynamics	281.0
4	92 ProMetic Life Sciences	176.2
5	34 AEterna Zentaris	149.3
6	97 Tekmira Pharmaceuticals	142.9
7	56 MethylGene	126.1
8	75 Labopharm	115.1
9	48 BioMS Medical	88.5
10	91 Vifor Pharma, Aspreva International (fs)	63.2
* \$1 million or more of revenue fs = Foreign subsidiary (includes R&D expenditures for Canadian operations only)		

- Automatically give intellectual property rights to companies that pay for or perform government research.
- Consolidate the alphabet soup of federal and provincial funding programs and make it easier for companies and individual researchers to navigate the program maze.
- Develop broad university and college “business engagement strategies” and not simply narrow “commercialization strategies.”
- Develop a national software strategy. Canada is an international software powerhouse, producing everything from gaming to financial modelling software.
- Compensate for low levels of venture capital funding by applying the flow-through share model common in the energy sector to research-based companies.

Meanwhile, let's see how well Canada will ride out the global economic downturn.

Top 10 Companies by Growth			
2008 Rank			
R&D Growth	Overall Company		% Change 2007-2008
1	83 Allen-Vanguard		263.5
2	85 ArcelorMittal Dofasco (fs)		151.9
3	11 TELUS		147.1
4	66 Husky Energy		122.2
5	32 Cangene		104.7
6	97 Tekmira Pharmaceuticals		100.2
7	18 Aastra Technologies		91.3
8	86 20-20 Technologies		75.7
9	74 Sandvine		60.7
10	70 Esterline CMC Electronics (fs)		60.6
fs = Foreign subsidiary (includes R&D expenditures for Canadian operations only)			

Bottom 10 Companies by Growth			
2008 Rank			
R&D Growth	Overall Company		% Change 2007-2008
1	91 Vifor Pharma, Aspreva International (fs)		-61.2
2	73 BELLUS Health		-55.5
3	52 Ballard Power Systems		-37.0
4	63 QLT		-36.8
5	81 ConjuChem Biotechnologies		-36.6
6	50 Tembec		-29.9
7	80 Teck Resources		-28.1
8	38 CGI Group		-25.1
9	66 Nexen		-25.0
10	51 Petro-Canada+		-23.1
fs = Foreign subsidiary (includes R&D expenditures for Canadian operations only) +Not current name			



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November 6, 2009

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R&D SPENDING IN THE DOLDRUMS — Corporate R&D spending remained essentially unchanged in Fiscal 2008 compared with the previous year. Spending on research by the Top 100 Corporate R&D Spenders totalled

Canada's Top 100 Corporate R&D Spenders 2009

Rank		Company	R&D Expenditures			Revenue	Research Intensity	Industry
2008	2007		FY2008 \$000	FY2007 \$000	% Change 2007-2008	FY2008 \$000	R&D as % of Revenue**	
1	1	Nortel Networks Corporation*	\$1,677,884	\$1,851,880	-9.4	\$11,108,786	15.1	Comm/telecom equipment
2	2	BCE Inc.	\$985,000	\$1,260,000	-21.8	\$17,698,000	5.6	Telecommunications services
3	3	Magna International Inc.*	\$692,900	\$725,490	-4.5	\$25,268,464	2.7	Automotive
4	4	Pratt & Whitney Canada Corp. (fs)	\$442,000	\$444,000	-0.5	\$3,600,000	12.3	Aerospace
5	5	IBM Canada Ltd. (fs)	\$397,000	\$377,000	5.3	nd		Software and computer services
6	7	Research In Motion Limited*	\$383,577	\$253,839	51.1	\$6,406,015	6.0	Comm/telecom equipment
7	6	Atomic Energy of Canada Limited	\$329,406	\$288,982	14.0	\$582,393	56.6	Engineering services
8	8	Alcatel-Lucent (fs)	\$237,000	\$236,000	0.4	nd		Comm/telecom equipment
9	10	Apotex Inc.	\$218,944	\$181,818	20.4	\$1,348,325	16.2	Pharmaceuticals/biotechnology
10	9	sanofi-aventis Group (fs)**	\$211,542	\$207,156	2.1	\$563,814	37.5	Pharmaceuticals/biotechnology
11	26	TELUS Corporation	\$210,000	\$85,000	147.1	\$9,653,000	2.2	Telecommunications services
12	13	Bombardier Inc.*	\$182,286	\$149,397	22.0	\$21,022,586	0.9	Aerospace
13	12	GlaxoSmithKline Canada (fs)	\$149,751	\$178,451	-16.1	\$979,925	15.3	Pharmaceuticals/biotechnology
14	14	Ericsson Canada Inc. (fs)	\$126,000	\$147,000	-14.3	\$500,000	25.2	Comm/telecom equipment
15	17	Pfizer Canada Inc. (fs)	\$122,897	\$114,015	7.8	\$2,605,537	4.7	Pharmaceuticals/biotechnology
16	21	CAE Inc.	\$113,138	\$89,248	26.8	\$1,423,600	7.9	Aerospace
17	27	Open Text Corporation*	\$112,883	\$84,977	32.8	\$773,417	14.6	Software and computer services
18	41	Aastra Technologies Limited	\$105,463	\$55,129	91.3	\$832,070	12.7	Comm/telecom equipment
19	19	Hydro-Québec	\$100,000	\$100,000	0.0	\$12,717,000	0.8	Electrical power and utilities
20	16	Biovail Corporation*	\$98,972	\$126,952	-22.0	\$807,152	12.3	Pharmaceuticals/biotechnology
21	25	Novartis Pharmaceuticals Canada Inc. (fs)	\$96,000	\$86,000	11.6	nd		Pharmaceuticals/biotechnology
22	18	Merck Frosst Canada Ltd. (fs)	\$92,556	\$109,876	-15.8	\$561,719	16.5	Pharmaceuticals/biotechnology
23	24	AstraZeneca Canada Inc. (fs)	\$88,912	\$86,373	2.9	\$1,328,996	6.7	Pharmaceuticals/biotechnology
24	31	EnCana Corporation*	\$88,500	\$71,982	22.9	\$32,048,224	0.3	Energy/oil and gas
25	30	MDS Inc.*	\$84,214	\$73,086	15.2	\$1,401,790	6.0	Health services
26	22	Imperial Oil Limited	\$83,000	\$89,000	-6.7	\$31,240,000	0.3	Energy/oil and gas
27	23	Ontario Power Generation Inc.	\$75,000	\$88,000	-14.8	\$6,359,000	1.2	Electrical power and utilities
28	20	PMC Sierra, Ltd.* (fs)	\$73,511	\$90,198	-18.5	\$187,503	39.2	Electronic parts and components
29	32	Wyeth Pharmaceuticals (fs)	\$73,090	\$69,937	4.5	\$296,568	24.6	Pharmaceuticals/biotechnology
30	51	Mitel Networks Corporation*	\$66,732	\$44,819	48.9	\$737,672	9.0	Comm/telecom equipment
31	28	Vale Inco Limited (fs)	\$63,000	\$76,800	-18.0	\$8,353,000	0.8	Mining and metals
32	70	Cangene Corporation	\$62,200	\$30,379	104.7	\$166,056	37.5	Pharmaceuticals/biotechnology
33	34	Honeywell Canada (fs)	\$61,258	\$65,445	-6.4	\$1,088,200	5.6	Aerospace
34	55	AEterna Zentaris Inc.*	\$61,240	\$42,184	45.2	\$41,018	149.3	Pharmaceuticals/biotechnology
35	38	Angiotech Pharmaceuticals, Inc.*	\$56,703	\$57,999	-2.2	\$301,968	18.8	Pharmaceuticals/biotechnology
36	42	NOVA Chemicals Corporation*	\$55,432	\$53,740	3.1	\$7,852,156	0.7	Chemicals and materials
37	50	Novelis Inc.* (fs)	\$55,432	\$45,142	22.8	\$11,988,236	0.5	Mining and metals
38	29	CGI Group Inc.	\$54,759	\$73,125	-25.1	\$3,705,863	1.5	Software and computer services
39		Rogers Communications Inc.	\$53,100	\$49,500	7.3	\$11,335,000	0.5	Telecommunications services
40	54	Boehringer Ingelheim (Canada) Ltd./Ltée. (fs)	\$51,500	\$43,000	19.8	\$338,200	15.2	Pharmaceuticals/biotechnology
41	57	Sierra Wireless, Inc.*	\$51,484	\$41,780	23.2	\$604,750	8.5	Electronic parts and components
42	60	Constellation Software Inc.*	\$51,407	\$39,730	29.4	\$352,347	14.6	Software and computer services
43	39	Janssen-Ortho Inc. (fs)	\$50,912	\$56,896	-10.5	\$701,080	7.3	Pharmaceuticals/biotechnology
44	63	Zarlink Semiconductor Inc.*	\$50,848	\$35,146	44.7	\$195,718	26.0	Electronic parts and components
45	43	Syncrude Canada Ltd.	\$50,323	\$53,100	-5.2	nd		Energy/oil and gas
46	40	Cardiome Pharma Corp.	\$48,789	\$56,793	-14.1	\$1,604	3,041.7	Pharmaceuticals/biotechnology
47	48	Corel Corporation*	\$47,451	\$48,056	-1.3	\$285,933	16.6	Software and computer services
48	61	BioMS Medical Corp.	\$46,502	\$38,907	19.5	\$52,561	88.5	Pharmaceuticals/biotechnology
49	45	MacDonald, Dettwiler and Associates Ltd.	\$46,427	\$51,901	-10.5	\$1,168,491	4.0	Aerospace
50	33	Tembec Inc.	\$46,144	\$65,807	-29.9	\$2,376,000	1.9	Forest and paper products
51	44	Petro-Canada+	\$40,000	\$52,000	-23.1	\$27,585,000	0.1	Energy/oil and gas
52	35	Ballard Power Systems Inc.*	\$39,625	\$62,852	-37.0	\$63,512	62.4	Machinery
53	56	DALSA Corporation	\$39,273	\$41,874	-6.2	\$205,960	19.1	Electronic parts and components
54	53	Gennum Corporation*	\$39,001	\$44,000	-11.4	\$135,288	28.8	Electronic parts and components
55	52	Cascades Inc.	\$37,600	\$44,500	-15.5	\$4,017,000	0.9	Forest and paper products
56	65	MethylGene Inc.	\$37,199	\$34,505	7.8	\$29,495	126.1	Pharmaceuticals/biotechnology
57	58	Bayer Inc. (fs)	\$35,536	\$41,546	-14.5	\$874,188	4.1	Pharmaceuticals/biotechnology
58	67	Theratechnologies Inc.	\$35,326	\$31,866	10.9	\$214		Pharmaceuticals/biotechnology
59	75	EXFO Electro-Optical Engineering Inc.*	\$34,596	\$27,086	27.7	\$195,920	17.7	Medical devices and instrumentation
60	81	Bell Aliant Regional Communications LP	\$33,789	\$23,681	42.7	\$2,863,508	1.2	Telecommunications services
61	62	Linamar Corporation	\$33,568	\$36,724	-8.6	\$2,257,000	1.5	Automotive
62	78	Dorel Industries Inc.*	\$31,957	\$25,235	26.6	\$2,325,884	1.4	Other manufacturing
63	47	QLT Inc.*	\$31,519	\$49,901	-36.8	\$132,333	23.8	Pharmaceuticals/biotechnology
64	77	Pharmascience Inc.	\$31,000	\$27,000	14.8	\$489,000	6.3	Pharmaceuticals/biotechnology
65	79	SNC-Lavalin Group Inc.	\$30,251	\$25,064	20.7	\$7,106,869	0.4	Engineering services
66	101	Husky Energy Inc.	\$30,000	\$13,500	122.2	\$24,701,000	0.1	Energy/oil and gas
66	59	Nexen Inc.	\$30,000	\$40,000	-25.0	\$7,424,000	0.4	Energy/oil and gas
68	69	Axcan Pharma Inc.* (fs)	\$29,874	\$30,798	-3.0	\$406,954	7.3	Pharmaceuticals/biotechnology
69	87	Penn West Energy Trust	\$29,000	\$19,800	46.5	\$4,947,000	0.6	Energy/oil and gas
70		Esterline CMC Electronics (fs)	\$28,750	\$17,900	60.6	nd		Comm/telecom equipment
71	83	Medicure Inc.	\$28,660	\$23,336	22.8	\$2,247	1,275.5	Pharmaceuticals/biotechnology
72	76	Westport Innovations Inc.	\$26,684	\$27,041	-1.3	\$71,536	37.3	Transportation
73	36	BELLUS Health Inc.*	\$26,679	\$59,901	-55.5	\$623		Pharmaceuticals/biotechnology
74	91	Sandvine Corporation	\$25,921	\$16,132	60.7	\$51,084	50.7	Comm/telecom equipment
75	74	Labopharm Inc.	\$25,339	\$27,568	-8.1	\$22,014	115.1	Pharmaceuticals/biotechnology
76	73	Psion Teklogix Inc. (fs)	\$24,927	\$28,672	-13.1	\$392,747	6.3	Computer equipment
77	71	Tundra Semiconductor Corporation+	\$24,752	\$30,194	-18.0	\$70,586	35.1	Electronic parts and components
78	86	ratiopharm inc. (fs)	\$24,180	\$20,232	19.5	nd		Pharmaceuticals/biotechnology
79	84	Xerox Canada Inc. (fs)	\$23,171	\$22,334	3.7	\$1,167,930	2.0	Machinery
80	66	Teck Resources Limited	\$23,000	\$32,000	-28.1	\$6,904,000	0.3	Mining and metals
81	64	ConjuChem Biotechnologies Inc.	\$22,212	\$35,034	-36.6	\$61		Pharmaceuticals/biotechnology
82	93	Rio Tinto Iron & Titanium Inc. (fs)	\$22,107	\$16,000	38.2	\$1,244,000	1.8	Mining and metals
83	169	Allen-Vanguard Corporation	\$21,833	\$6,007	263.5	\$309,005	7.1	Medical devices and instrumentation
84	89	Azure Dynamics Corporation	\$21,500	\$17,800	20.8	\$7,651	281.0	Transportation
85	143	ArcelorMittal Dofasco Inc. (fs)	\$19,900	\$7,900	151.9	\$3,850,000	0.5	Mining and metals
86	111	20-20 Technologies Inc.*	\$19,717	\$11,222	75.7	\$83,790	23.5	Software and computer services
87	95	ViXS Systems Inc.*	\$19,450	\$15,683	24.0	\$35,423	54.9	Electronic parts and components
88		SMART Technologies ULC	\$19,442	\$16,226	19.8	\$378,549	5.1	Computer equipment
89	94	Evertz Technologies Limited	\$18,629	\$15,946	16.8	\$272,505	6.8	Computer equipment
90	80	MEGA Brands Inc.*	\$18,621	\$23,914	-22.1	\$477,224	3.9	Other manufacturing
91	49	Vifor Pharma, Aspreva International Ltd. (fs)	\$18,463	\$47,646	-61.2	\$29,227	63.2	Pharmaceuticals/biotechnology
92	92	ProMetic Life Sciences Inc.	\$17,891	\$16,082	11.2	\$10,154	176.2	Pharmaceuticals/biotechnology
93	99	Trican Well Service Ltd.	\$17,781	\$14,637	21.5	\$1,016,083	1.7	Energy/oil and gas
94	96	Miranda Technologies Inc.	\$17,758	\$15,624	13.7	\$129,961	13.7	Comm/telecom equipment
95	97	COM DEV International Ltd.	\$17,381	\$14,971	16.1	\$210,348	8.3	Comm/telecom equipment
96	118	March Networks Corporation	\$16,923	\$10,656	58.8	\$94,410	17.9	Comm/telecom equipment
97	138	Tekmira Pharmaceuticals Corporation	\$16,767	\$8,374	100.2	\$11,732	142.9	Pharmaceuticals/biotechnology
98	98	Bioniche Life Sciences Inc.	\$15,973	\$14,935	7.0	\$27,667	57.7	Pharmaceuticals/biotechnology
99	100	Bridgewater Systems Corporation	\$14,935	\$14,336	4.2	\$44,178	33.8	Software and computer services
100	105	MKS Inc.*	\$14,782	\$12,303	20.1	\$65,223	22.7	Software and computer services

Notes:

1. We have attempted, wherever possible, to provide gross R&D expenditures before deduction of investment tax credits or government grants.
2. FY2007 R&D expenditure figures may have been adjusted, as more accurate information became available.
3. Canadian-owned company results include worldwide R&D expenditures; foreign subsidiaries (fs) include R&D expenditures for Canadian operations only.
4. We have attempted, wherever possible, to provide revenue figures net of interest and investment income.

*Converted to CDN\$ at annual average 2008 = \$1.0660, 2007 = \$1.0748 (Bank of Canada)

+Not current name

**Includes sanofi-aventis Canada Inc. and Sanofi Pasteur Limited

nd = Not disclosed

**\$1 million or more of revenue

fs = Foreign subsidiary (includes R&D expenditures for Canadian operations only)

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