Canadian Innovators Share their Secrets to Success

Canadians are getting impatient and that's turning out to be a good thing. In a world where discoveries of a new gene, molecule or sub-atomic particle are lauded almost daily in the media, it's only natural that people begin asking, "When will these discoveries begin helping me, my community, my country, my planet?"

While basic research continues to serve as the bedrock to provide the foundation for Canada's long-term success in science and technology, the past decade has witnessed a seismic shift in what we do with that knowledge.

Rather than inventing a technology in search of a solution, more and more research is being directed by the needs of companies, consumers, patients, communities and other end users of technology.

In Canada's automotive sector, for example, consumer demands and pending new emission standards are upping the competitive pressure to make vehicles that are safer, greener and better performing.

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> *Director of Canadian Regional Engineering Centre, General Motors of Canada Limited*

General Motors of Canada Limited stepped up its game last year with a commitment to invest an unprecedented $150 million annually on R&D between now and 2016. Its main focus is on light-weighting materials, mechatronics, software and communications.

"We're doing a lot of work on light-weighting and energy efficiency … We have electrical engineers working with software engineers and mechanical engineers to try to optimize the vehicle across the different systems," says Brian LaTouf, Director of GM Canada's Canadian Regional Engineering Centre (CREC) in Oshawa.

GM Canada increasingly relies on computer-aided design to test new ideas instead of more expensive and time consuming trial and error approaches. Canadian universities help GM Canada understand the material and mechanical properties of a light-weight material like aluminium so that manufacturing processes can be optimized – well before the first car is ever manufactured.

"That allows us to use computer-aided engineering simulations to engineer our future products without having to create a physical vehicle," says LaTouf.

Environmental sustainability has become a priority in many industry sectors. In Canada's oil sands, companies are working on several fronts to reduce their environmental footprint, something Joy Romero, V.P. Technology Development at **Canadian Natural Resources Limited** (CNRL), describes as "good business sense".

At its Horizons Oil Sands facility north of Fort McMurray, Alberta, the company is adding CO2 to the tailings, a process that allows the solids to settle more quickly so that the water can be recycled and re-used in the extraction process. The technology will help reduce the size of tailings ponds and reduce CNRL's costs.

"If we built a dyke to contain tailings, that's $50 million a metre, so if we reduce that tailings pond by half that's good business," says Romero. "So every time we reduce our footprint, we improve on our bottom line."

A growing share of CNRL's research and technology development is now being done in partnership with its competitors as part of Canada's Oil Sands Innovation Alliance. Launched in 2012, COSIA's 14 members account for 90% of the oil sands production.

"Some 450 technologies have already been shared amongst the companies," says Romero, "and we're working on 185 active projects right now to accelerate our performance in tailings, water, land and greenhouse gases. And that's just within COSIA."

HELPING CANADIAN FIRMS DO BETTER

In 1990, **Rogers Communications Inc.** was the first company to bring wireless data to the Canadian market. Today, Rogers' national networks, from its slower 2G to its super-fast LTE, provide more than one million machine-to-machine (M2M) connections for a range of applications, including traffic lights, parking meters, automatic teller machines, glucometers, blood pressure cuffs and, coming soon, even your car or dishwasher. "If you look at Ted Rogers' legacy, it was really about bringing innovative new things to Canadians and being the first with things like high-speed Internet, GSM network and digital video," says Mansell Nelson, V.P. of Advanced Business Solutions, Rogers Communications Inc.

With the Canadian M2M market forecast to reach $1 billion in revenue over the next three years, the competitive stakes are high. That's why Rogers is investing millions of dollars to develop the technology platforms, software and systems integration that meet each user's specific needs. Much of this innovation happens at its research centres in Toronto, Vancouver and Montreal, where customers can see first-hand how these technologies can help boost their productivity and better connect with customers.

"It's not so much a technology issue now," says Nelson. "It's back to translating how this technology will help companies be better at what they do."

IMPROVING PATIENT CARE

If ever there was a problem in search of solution, no doubt health care would top the lists of every province and territory in Canada. Ontario and Quebec are already spending half of their total revenues on health, and another six provinces will hit the 50 per cent mark by 2028.

It's not a problem the research community can solve on its own. That's why several universities and research hospitals are working hand-in-hand with provincial funders, policy makers, health care professionals and even patients to identify and implement solutions.

For example, on August 1 the Ontario government cut funding for test strips that diabetics use to monitor their blood sugar levels – saving the province up to $25 million annually. That decision was based on a 2009 study co-authored by Dr. Muhammad Mamdani at **St. Michael's Hospital** in Toronto that found the tests unnecessary for people with type 2 diabetes who are not insulin-dependent.

"These are real out-of-pocket savings for the government that do not adversely affect health care or inconvenience patients," says Dr. Arthur Slutsky, V.P. of Research at St. Michael's Hospital.

One of the hospital's strengths is its 182 research scientists, 110 of whom also hold medical degrees. With one foot firmly in the lab and the other in the clinic, these clinician scientists are trained to translate basic science into better policies and patient care.

Among them is Dr. Kamran Khan, an infectious disease clinician and scientist who developed a web technology – and a spin-off company, Bio.Diaspora – that uses global air traffic patterns to predict the international spread of infectious disease. His research has helped anticipate the risk of epidemics during mass gatherings at the London Olympic Games, FIFA World Cup and annual hajj pilgrimage in Saudi Arabia.

Dr. Slutsky says St. Michael's will be able to accomplish even more, and faster, with the work being done at the Keenan Research Centre and Li Ka Shing Knowledge Institute – new buildings that are connected to each other and to the hospital via a pedestrian tunnel.

"That tunnel is a metaphor for what we want to do, which is to speed up the adoption of discoveries by bridging the knowledge gap between research, education and patient care."

It's a familiar story at **Vancouver Coastal Health Research Institute** (VCHRI), where the opening of the Blusson Spinal Cord Centre in 2008 made it possible to connect patients with the Rick Hansen Institute along with researchers from more than 20 different locations in Vancouver and Vancouver Island. Similarly, the soon-to-be-opened Djavad Mowafaghian Centre for Brain Health will bring together, for the first time under one roof, all the multidisciplinary areas of brain health, including multiple sclerosis, Alzheimer's, mood disorders and clinical trials.

"It allows the patient to move seamlessly when they transition from surgery to treatment, and then integrating research with that," says Dr. Robert McMaster, Executive Director at VCHRI.

That multidisciplinary lens is already producing results in ovarian cancer treatment, where VCHRI's research is closely linked with the BC Cancer Agency next door.

"They've shown, for example, that a lot of cancer originates in the fallopian tubes so now they remove them if it's an appropriate time during surgery," says Dr. McMaster. "That change in practice reduces the incidence of subsequent ovarian cancer by 25 percent."

MAKING OUR MARK GLOBALLY

Similar transformations are taking place at research hospitals across Canada. At **Hamilton Health Sciences** (HHS), research priorities are driven by what will make a difference in people's health over the next five, 10 or 20 years, both domestically and internationally.

"Since health transcends borders and races, we deliberately take an approach that our research here is applicable globally," says Dr. Salim Yusuf, V.P. Research at HHS. "As such, we work with 85 countries on every continent looking at things like chronic diseases and health systems. We need these international comparisons if we want to improve how we do things in Canada."

Here at home, the study of health systems, social factors, government strategies and other structural components is changing how communities deliver health care. In one HHS-led study of 39 Ontario communities, Dr. Lisa Dolovich and her colleagues demonstrated that a community-based health promotion program delivered by volunteers, in partnership with family physicians, pharmacists and community organizations, reduced hospitalization rates for stroke, heart attack and congestive heart failure by nine percent. The Cardiovascular Health Awareness Program is now being evaluated in larger urban centres in Ontario and Quebec.

"This isn't your conventional view of innovation, where I've discovered a new molecule or a new gene," says Yusuf. "They were able to show a reduction in mortality, and costs, by moving away from a physician-based delivery system."

It's not only companies and hospitals that benefit from new technologies. **Simon Fraser University** is home to two of the world's pioneers in using Geographical Information Systems (GIS) to pinpoint crime hotspots and the conditions that might lead to those crimes. The husband and wife team of Drs. Patricia and Paul Brantingham, both RCMP-funded research chairs, have worked with justice officials in Canada, Australia, the U.K. and Chile to set up computerized systems for tracking crime.

"This technology is able to model criminal behaviour as a function of other factors, such as health disparities and social inequities. All these data can then be used to inform policy," explains Dr. Mario Pinto, V.P. of Research at Simon Fraser University.

Universities also look for opportunities to spin-off promising technologies into start-up companies. But not all get the green light. For the past decade, SFU has taken a Dragon's Den-style approach to deciding which projects receive angel funding and other commercialization support.

"You do your due diligence at the front end and you do the critical go/no-go experiments at the front end," says Dr. Pinto. "And if you don't think it will fly, kill it quickly."

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BUILDING REGIONAL CLUSTERS

Leveraging regional strengths is one of the things academic institutions do best. Efforts are underway to solidify Quebec's participation in a north-eastern North American cluster in microelectronics. Bromont and Montreal are already home to Canada's largest semiconductor wafer manufacturing facility and one of the world's most advanced packaging plants.

To support these companies, **Université de Sherbrooke**, IBM and Teledyne DALSA last year opened the MiQro Innovation Collaborative Centre (C2MI), a state-of-the-art microelectronics packaging and testing facility in Bromont. C2MI collaborates with university researchers and 14 industry partners to move innovations from the prototype stage to high-volume commercial production for use in a variety of fields, from medical and automotive to aerospace and telecommunications.

"You have the university doing the fundamental research and proof-of-concept at our new Institute for Interdisciplinary Innovations and Technologies, and then we can go to C2MI to develop and test the actual prototypes used in the manufacturing process. C2MI can also emulate the home, office, hospital or wherever you need to test the technology," says Dr. Jacques Beauvais, V.P. Research at Université de Sherbrooke.

Beauvais attributes this success, in part, to USherbrooke's 50-year-old co-op program. "When you need to find 4,000 internships every year it forces you to think about the needs of your partners."

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Similarly in Nova Scotia, having five federal labs, several small and mid-sized companies, and a university all involved in ocean science created a perfect storm for assembling something bigger and more coordinated.

In just two years that has become a reality with **Dalhousie University**'s opening of the Halifax Marine Research Institute. To top it off, in June Dalhousie launched the Dalhousie Ocean Sciences Building which consolidates many research programs under the same roof.

Dr. Martha Crago, V.P. of Research at Dalhousie University, describes the new building as an "ecosystem of excellence in marine science".

A NEW ERA FOR COLLEGES

Translating promising research into real-world applications has become a priority for Canada's colleges as well.

"If you want to win applied research grants, and you want your students to get jobs, you have to engage with industry and ask, 'where's your pain'," says Dr. James Watzke, the Dean of Applied Research and Innovation at **Seneca College**. "Then we drill back into Seneca and figure out if we have the right expertise to solve these problems. I call it a problem-pull model."

For Seneca, the pull often comes from companies looking to tap into the Toronto college's expertise in solving complex computing problems. In one project, the college built a free software package for a new generation of low-cost, low-energy computers, called the Raspberry Pi. Costing less than $40 each, these credit-card sized computers run off 4AA batteries and yet are powerful enough to create high-definition 3-D games.

In another, Seneca students and faculty worked with Mozilla Corporation, creators of the Firefox web browser, to develop a free open source web app, called Popcorn Maker 1.0, which makes it easy for anyone to enhance, remix and share videos or audio files on the web, using a simple drag-and-drop interface.

"We're trying to prepare our graduates to hit the road running when they get that first job and applied research is an important ingredient in that experiential learning. These projects end up in their portfolios and on their resumes," says Watzke.

Helping industry succeed goes hand-in-hand with ensuring students graduate with job-ready skills. **Centennial College** is working with 28 industry and community partners on 42 different projects involving hundreds of students. "We're trying to erase the boundaries between the classroom and the workplace," says Trish Dryden, Associate V.P. Research at Centennial College, which is making entrepreneurship and innovation essential skills for most students.

Dr. David Carpenter, past Associate V.P., Academic and Applied Research at **NAIT – Northern Alberta Institute of Technology**, says one of their big advantages over many research institutions is that the company retains ownership of any intellectual property (IP) that is developed.

"Our policies are very industry friendly," he explains. "The owner of the IP, in my opinion, is not the key factor. You can always come to a separate agreement as to how you might share the profits of an idea."

One of NAIT's largest projects is with an Israeli company to develop prototypes of a new laser that provides real-time monitoring of nano-sized impurities in industrial processes such as water treatment, cement production and oil and gas. The company has since set up a Canadian subsidiary, Alberta Nano-Monitoring Systems, in its novaNAIT incubator.

Today's Internet has made it possible to collaborate with colleagues anywhere in the world, but there's something to be said for the personal touch that comes from being able to meet at a nearby coffee shop. Such is the case in Newfoundland and Labrador, where there are 17 campuses of the **College of the North Atlantic (CNA).**

CNA's Burin campus located on Newfoundland's east coast is using a former fish plant in the small community of Lord's Cove to demonstrate how a wave-powered piston pump can overcome the two biggest expenses for shore-based aquaculture – pumping the water and treating affluent.

The $4.5-million project uses clean energy from the waves to pump ocean water onshore into tanks containing halibut, salmon and other fish. Seaweed is then used to clean chemicals from the water before it flows back into the sea. Once proven, the system could be installed in communities across the province.

"It would help the economy of the coastal communities where people are struggling with traditional fishing techniques or where traditional aquaculture isn't possible," says Dr. Mohammad Iqbal, who chairs College of the North Atlantic's Office of Applied Research.