

# Wanted: Research Partnerships

Turning science into solutions requires a team effort evolving academia, industry and government



By Debbie Lawes

Many believe it to be one of the greatest challenges – and opportunities – of our time.

How to turn billions of dollars of research spending into solutions that create jobs, boost productivity, improve our health and wellbeing and safeguard our environment.

Throwing more money at a problem doesn't always work. Neither does a go-it-alone attitude. Instead, countries everywhere have become big believers in the power of public-private partnerships to put good research to good use.

"One of the best ways to address this innovation gap is for academia, government and industry, including small businesses and start-ups, to work more collaboratively on common initiatives," says Dino Trevisani, president of IBM Canada, one of Canada's top 10 industrial research spenders. IBM's model is three-pronged: rapidly transform academic innovation into commercial products and services; leverage the global scale of companies like IBM; and export these made-in-Canada innovations globally.

"Our view can be summed up in four

words: collaborate, innovate, incubate, commercialize," he says.

The Southern Ontario Smart Computing and Innovation Platform (SOSCIIP), for example, is a collaboration between IBM Canada Research and Development (R&D) Centre, the Ontario and Canadian governments, the Ontario Centres of Excellence and 14 academic partners. SOSCIIP makes it possible for academic and industry researchers to share Canada's fastest supercomputer and the world's largest analytics cloud – rather than duplicating expensive infrastructure.

To date, the partnership has launched 50 projects in areas as diverse as agile computing, health, water, energy, cities, mining, advanced manufacturing, digital media and cybersecurity. It has spun out 38 small businesses and established a pipeline of nearly \$2 billion in revenue for these firms.

One project created a new data management platform that will help protect drinking water, predict floods and safeguard fragile ecosystems along the Grand River, Southern Ontario's longest river. Based on IBM hardware and software, the platform collects and analyzes data every 15 minutes from 120 sensors over 80 square kilometers. Having instant access to data will make it possible to respond more rapidly to heavy rainfalls and other extreme weather events driven by a changing climate.

"These breakthroughs will not only improve the lives of Canadians, but they also represent homegrown technology we can develop and export around the world," says Trevisani.

The need to boost exports while adapting to the effects of climate change is also top of mind in Canada's wheat industry, which generates more than \$5 billion in export revenues every year.

Again, partnerships are becoming the norm. The National Research Council (NRC)

has teamed with Agriculture and Agri-Food Canada, the province of Saskatchewan and the University of Saskatchewan to form the Canadian Wheat Alliance (CWA). Together, they are developing new wheat varieties that increase yields, use less fertilizer and are more resistant to environmental stresses like disease, heat, cold, drought and flood.

In one project, two of the world's leading plant breeding companies, KWS and Syngenta Inc., are working with CWA to develop high-quality wheat plants by improving doubled haploid technologies, which breeders can use to bring new varieties to market faster. Traditional methods can be costly, inconsistent and time-consuming.

"And we're trying to do it all without resorting to GMO techniques so we can maintain access to (global) markets," says NRC president John McDougall. "If we do this, we will have changed the dynamics and economics of the Canadian wheat industry with a very big benefit to Canada, and with technologies that other people can apply in different ways in other parts of the world."

The NRC was established in 1916 to advise government on matters of science and industrial research. More than a century later, it continues to focus on what McDougall describes as "mission-oriented research".

"We're not trying to invent knowledge as much as we're trying to put existing knowledge to work and that takes a lot of time and effort," says McDougall. "It's not about stuffing knowledge down people's throats. It's about ensuring that what you do is likely to be deployed and that requires understanding industry in a holistic way and the challenges they are facing."

## BRIDGING THE INDUSTRY-ACADEMIC DIVIDE

Bridging the cultural divide between academia and industry requires mutual trust

and understanding – something that can take years to nurture. One bad experience can prove toxic to future collaborations.

To reduce that risk, the Natural Sciences and Engineering Research Council of Canada (NSERC) has established two types of 'get to know each other' programs – Engage and Connect. They provide small grants of up to \$25,000 for activities like networking, research planning or short-term R&D projects.

## Short-term R&D projects help companies and academics get to know each other

"These programs make it very convenient for that first date between academic researchers and business leaders. There's minimum red tape and turnaround time for these applications is only 21 days," says Dr. Mario Pinto, president of NSERC, which works with about 3,500 companies each year.

Some 20% of the companies that worked on Engage projects have since established more formal partnerships with their university partners. As well, one in six students who work on Engage projects end up with full time jobs with the company after graduation. Last year alone, the program supported academic collaborations with nearly 1400 companies.

"We're trying to set up a relationship that is long-term so that when an industrial client has a need – unanticipated at present – they will know who to come back to," says Dr. Pinto.

He cites the example of Dr. Jeff Dahn at Dalhousie University in Halifax who has worked with 3M for 35 years. The Fortune 500 company has brought to market several patented materials based on technology developed by Dahn, including a nickel-manganese-cobalt positive electrode material found today in most electric vehicles and power tools. Starting in 2016, Dr. Dahn will begin a new five-year partnership with Tesla Motors to develop better lithium-ion battery technology. It marks the first time Tesla has collaborated with a Canadian university.

For homegrown multinationals like Bombardier Aerospace, partnering with local universities is a competitive necessity. "I don't know of a single aerospace company in the world that doesn't partner with academia. For us, the bulk of our research activities and partnerships are done in Canada," says Jonathan Hack, Bombardier's manager of strategic technology, university and government relations.

Some of that research is done under the auspices of the Green Aviation R&D Network (GARDN), a Business-Led Network of Centres of Excellence where 30 partners from industry and academia share both the cost and the risk of developing made-in-Canada technologies that reduce the environmental footprint of next generation aircraft, engines and avionics systems.

Such research requires access to specialized facilities like the anechoic (echo-free) wind tunnel at the University of Toronto Institute for Aerospace Studies. The tunnel had fallen into disrepair and Bombardier helped to refurbish it. That investment allowed UTIAS to expand its noise research and Bombardier to test new methods to reduce aircraft noise levels.

*Continued on page 2*

# Wanted: Research Partnerships

Bombardier has also designated Centennial College in Toronto as the “trainer of choice” for its assembly plant in Downsview ON. “The average age of our shop floor workers is 53 years old,” says Hack. “We’re looking to retain those people but also train a generation of aircraft mechanics for our service organization as well.”

## A PROVEN MODEL GOES NATIONAL

Canada’s aerospace industry has pioneered a collaborative R&D approach that is attracting international attention. Modelled on the highly successful Consortium for Research and Innovation in Aerospace in Quebec (CRIAQ), the Consortium for Aerospace Research and Innovation in Canada (CARIC) brokers R&D partnerships between industry, universities, colleges and research institutions.

“Since OEMs (original equipment manufacturers) don’t compete in Canada, that allows us to work together to develop technology that benefits the whole industry,” says Walter Di Bartolomeo, VP engineering at Pratt & Whitney Canada (P&WC). “And these partnerships extend to SMEs (small- and medium-sized enterprises) who can develop materials, manufacturing and supply chain logistics – technologies they can offer not to just to P&WC but to any OEM.”

In one CARIC project, P&WC and partners are working to explore how additive manufacturing – also known as 3D printing – can optimize the design of metallic parts to develop more compact jet engines that make airplanes lighter and more fuel efficient.

Last December, P&WC announced that it would invest \$1 billion in R&D over the next four years to develop a new generation of lighter and quieter engines that use less fuel and produce fewer emissions.

“We will take some of the technologies that we have incubated with universities over the last 15 years and start to materialize them into commercial offerings,” including projects developed as part of CRIAQ and CARIC, says Di Bartolomeo.

Similar challenges face automotive companies. Fierce competition, growing consumer demands and tougher regulations put constant pressure on automakers to produce vehicles that are safer, more fuel efficient and less pol-

luting. Brian Tossan, director of Canadian engineering at GM Canada, predicts the sector will see more changes in the next five years than have occurred in the last 50, driven by technological advances like the “connected car”.

“We’ve been looking to our research partners, our university partners and our supply base to help us define what the connected car of the future will look like,” says Tossan.

## Partnerships extend throughout the supply chain

Much of that research will happen at the company’s engineering centre in Oshawa which is in the process of hiring 100 more software and control engineers. GM Canada’s 20-year history of collaborating with Southern Ontario universities, and the skilled students these institutions produce, were key factors in the company’s decision to expand its Oshawa operations.

To help identify top talent, GM Canada also works with universities to sponsor student competitions, like the EcoCAR, which challenges competitors to build next-generation vehicles that use alternative fuels.

“By sponsoring these types of competitions we’re able to give students and faculty real projects to work on with fundamental deliverables that will result in a working vehicle ... We find those types of interactions have been highly effective in us finding talent that comes to work for General Motors,” says Tossan.

It’s not only universities and government labs partnering with industry. Increasingly, companies are turning to colleges and polytechnics when they need a fast solution to an immediate problem.

“We complement what universities do by taking lab-scale results and developing them to a demonstration scale technology or prototype for imminent commercial use,” explains Dr. John Fallavollita, director, Applied Research and Innovation Services (ARIS) at SAIT Polytechnic in Calgary. “If a company comes and says they need this done

in four months we can help because we deliver products at the speed of industry.”

Over the past five years, more than 1,250 SAIT students have worked with 1,030 SMEs on 575 research projects to produce nearly 400 prototypes. The numbers are expected to rise with the launch this year of Kinetic Ventures. SAIT will provide the industry-led energy technology accelerator with prototyping, design, testing and small-scale manufacturing services to help start-ups de-risk and accelerate technology in four areas: hydrocarbon recovery; energy transport; carbon capture, re-use and disposal; and renewable energy.

While low oil prices are driving down production in Alberta, Fallavollita said in a recent interview that this is a perfect time for companies to work with academia on innovations that will help the industry remain profitable and sustainable over the long term. “I’m meeting with COSIA (Canada’s Oil Sands Innovation Alliance) this afternoon with one of our staff who leads environmental and energy technology. We’re working with COSIA to help them and the companies they represent to cost effectively develop new technologies.”

There’s a saying that “the best technology transfer walks on two feet”, referring to the students who learn job-ready skills by working directly with companies on real-world problems. This type of experiential learning is what today’s employers need and what more universities and colleges are now offering.

“Part of the key to solving our innovation challenge is to ignite the fire of innovation in the next generation. You do this by giving them problems to solve and allowing them the leeway and opportunity to get creative,” says Dr. Darren Lawless, dean of undergraduate research at Sheridan College in Oakville Ontario.

Increasingly, that means drawing on expertise from different faculties, including business, marketing and information technology.

“Instead of a company hiring five different people with different skill sets, our research group can pull together a team that looks at addressing a problem from different angles,” says Lawless. “Innovation is not just technology; it’s a more holistic approach. What’s going to entice someone to reach into their pocket and buy your product?”

## IT’S NOT ABOUT THE MONEY

Public-private partnerships leverage more money for R&D, but everyone interviewed for this article insisted the larger cash pie is secondary to the on-the-ground impact such partnerships are having. The rationale is simple: if you want to produce a technology people will use, involve the people who will be responsible for making it, selling it and ultimately using it.

“We used to think we had all the answers,” says Dr. Alain Beaudet, president of the Canadian Institutes of Health Research (CIHR). “But working with partners made me realize we had a lot to learn: are you nimble, are you listening to patients and the people who actually use the research? Can you do things more efficiently and less bureaucratically? Through our partnerships we learned on all these fronts.”

More than half of CIHR’s funding still goes to early-stage discovery research where it could take decades for the discovery of a new gene, for example, to become a regulatory approved drug. The other half of its grants envelope goes to priority-driven research that addresses more immediate issues, like the health needs of an aging population.

Sometimes those partnerships are between CIHR and the provinces, or between federal agencies. Such was the case with the recent development of a vaccine for Ebola – the result of a collaboration between CIHR, the Public Health Agency of Canada, the International Development Research Centre and the Department of Foreign Affairs, Trade and Development.

“We focused our efforts, energy and funding collectively into a phase 1 trial for a vaccine in Canada using the talent and capacity we already had in the country, and the network for vaccine testing that we had developed a long time ago first dealing with SARS and then H1N1,” says Beaudet.

Based on the success of the phase 1 trial, human trials were launched in Guinea led by the World Health Organization, involving CIHR, PHAC, the governments of Guinea, Médecins Sans Frontières and Britain’s Wellcome Trust charity. Early results this year showed the vaccine protected 100% of trial participants from getting the virus.

At the University Health Network (UHN) in Toronto, it was an expertise in engineering, physics and software that helped commercialize a non-

invasive radiosurgery that treats brain disorders without scalpels and incisions. Most patients are in and out of the hospital that same day and back to their normal routines soon after treatment. The underlying software is now part of an imaging device marketed by a Swedish company.

“The device company knows about the marketplace – expertise we wouldn’t necessarily have,” says Dr. Christopher Paige, VP research at UHN and senior scientist at Princess Margaret Cancer Centre.

UHN medical physicists also invented a sensor called an integral quality monitor, which ensures that the correct dose of radiation therapy is safely and precisely given to a tumour. UHN worked with a German company to refine the technology, which is now bringing the product to market.

“You can’t expect to help patients unless at some time along the development of a new discovery you don’t bring the private sector in,” adds Paige. “We’re 100% in favour of merging the interests of the hospital with the interests of the private sector.”

## Made-in-Canada Ebola vaccine a first

That view is echoed at Innovation York, launched three years ago to provide companies with a single point of entry for York University’s 11 faculties and 24 research institutes and centres in the Greater Toronto Area.

“Innovation York connects people to everything that’s being done at the university,” says Dr. Robert Haché, the university’s VP of research and innovation. “As a result, our research agreements have been growing at about 20% a year over the last three years.”

One of York’s biggest projects is Connected Health and Wellness, involving 19 university, health-care and industry partners, including heavyweights like Blackberry, Rogers and NexJ Systems. The \$38-million project is integrating mobile, cloud-based computer technology to enable patients – for the first time ever – to access and share their health records with family, friends and care teams.

“York is a leader in what is often termed knowledge mobilization, or the transfer of knowledge from beyond technology-driven disciplines into productive users for society,” says Haché.

Of course, not all research ends up in a new gadget, therapy or service. One example is communityBUILD, a partnership between York, the ventureLAB regional innovation centre, Seneca College and United Way York Region. Described as “grounded in community, guided by research and driven by entrepreneurship”, the program offers a system of supports to help for-profit social enterprises address regional challenges such as food security and youth employment.

## SHARING BUSINESS EXPERTISE WITH SOCIAL ENTERPRISES

Another new project led by the University of Ottawa – Linking natural capital and productivity – is developing new approaches to measuring productivity that take into account the state of the environment. The goal is to examine the link between environmental and economic successes to help governments and industries optimize best practices and develop good policies. Partners include five universities, three federal departments, the Forest Protects Association of Canada and Shell Canada.

“Here you have all these partners working together to find ways to ensure profitability but in ways that are environmentally prudent,” says Dr. Ted Hewitt, president of the Social Sciences and Humanities Research Council of Canada, which funded the three-year study.

He adds that tech transfer needs both partnerships and participation from social scientists to be successful. “Technology has very little value until one contemplates how it will be used. That may include developing business plans or knowledge mobilization plans, or studying precisely how one intends to use a technology.”

As for the role of partners, Hewitt insists it’s a no brainer. “If you want to do knowledge translation and have relevant research you have to have partners. It allows you to get at some of these more sophisticated, difficult and more complicated challenges – and ultimately have a bigger impact in the end.”

*Debbie Lawes (Debbie@dover-courteditorial.ca) is an Ottawa-based science writer.*