TURNING RESEARCH INTO SOLUTIONS What Canada is Getting Right



Debbie Lawes Consulting Editor RE\$EARCH Money

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

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

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

The Executive Director of the **Institute for Competitiveness and Prosperity**, a Toronto-based think tank, believes there is reason for optimism. He points to tax changes at the federal and provincial levels that make it more attractive for companies to invest, an openness to international trade that is solidifying new markets, and research and development tax credits that are among the most generous in the world.

"So, does this mean our worries are over?" asks James Milway. "Of course not. It takes a while for these things to kick in and for the results cameras that can see outside the visible part of the spectrum, including X-rays, infrared and ultraviolet light, to locate someone in a search and rescue operation or identify tooling defects in machinery too small for even a microscope to detect.

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

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

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

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

Greening the Oil Sands

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

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

university researchers to understand how these processes work and how best to improve their performance.

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

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

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

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

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

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

Canada is a major R&D centre and a leader in clinical trial recruitment for the Swiss-headquartered company. While Canada represents 3% of the corporation's global sales, it accounts for 10% of its clinical trial participation. That was one factor in the company's recent decision to invest \$190 million over the next five years in extends beyond emerging trends or any single area.

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

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

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

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

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

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

Bringing Non-Researchers onto the Team

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

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

"We see discovery and innovation as a culture, involving all our 11,000 employees - one that is focused on point-of-care, is team-based and puts the patient experience first," explains Dr. Raymond LeBlanc, V.P. Learning, Research and Innovation at Capital Health. "This improves the research outcomes, makes it easier for patients to participate in research protocols and provides them with a more sophisticated level of care." This innovative approach was used to monitor changes over time in the optic nerves of patients, which is key to understanding glaucoma and other blinding diseases. Two decades of collaborative research with a German instrument manufacturer led to the development of a sophisticated eye-imaging machine technology to diagnose and monitor diseaserelated changes in the eye. Capital Health helped develop the algorithm that is now used in over 5,000 of these machines worldwide.

is to be relevant to society," says Levy. "That could mean economic value, jobs value or social value, such as working with communities to fight childhood obesity or promote health and food security."

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

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

Milway at the Institute for Competitiveness and Prosperity agrees Canada's policies have traditionally favoured science-driven inventions over market-relevant innovations. While he insists both have to be supported, there must be a balance.

"We shouldn't kid ourselves into thinking that if we have lots of investments in inventor-driven discoveries that are going to magically appear as innovation that is relevant to the consumer," he says. "Our problem in Canada is that our sophistication is lacking on the business side, not the science side. That's our weak link."

The Birth of Commercialization Factories

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

"I disagree with those that suggest that Canadians are not entrepreneurial," says Dr. Rafi Hofstein, President and CEO of **MaRS Innovation**, a CECR providing a one-stop shop for commercializing early-stage technologies from 18 institutions in the Toronto area. "Rather, what's needed is more nurturing and that's the gap our centre fills. We triage and bundle the best Wrana, it resulted in a new technology that screens breast cancer tumours to help determine a patient's best treatment options.

"The most significant thing Mount Sinai and Lunenfeld have done over the past decade to improve our value creation is to attract and nurture the best scientists we can. That's what attracts companies," says Woodgett.

Rewarding Professors Who Innovate

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

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

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

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

"We've identified drugs, for example, that can be used for new applications. This isn't something CIHR (Canadian Institutes of Health Research) would fund so we got funding from a US agency, brought in an investor firm, and also received funding from both the Quebec and Canadian governments. We're now heading into phase three clinical trials."

Similar efforts are underway at Canada's largest university. Dr. Peter Lewis, Associate V.P. Research at the University of Toronto, says his favourite phrase these days is "knowledge application", and it's something he is encouraging more faculty to engage in. "Knowledge generation at the university has been going on for hundreds of years but the knowledge application piece hasn't," he says. "Our processes now recognize that kind of contribution as something towards their dossier as it comes up for promotion." Multidisciplinary research and partnerships with external organizations are key components to this strategy. It is now common to find an engineer collaborating with a computer scientist and a cell biologist, for example. Universities are also partnering more with industry, all levels of government and other research institutes to leverage funding, facilities and expertise to come up with solutions to complex problems. Lewis points to the Structural Genomics Consortium, a publicprivate sector partnership involving scientists from the universities of Toronto and Oxford that has mapped three-dimensional structures of more than 1,300 proteins. All findings are made available freely to the global research community.

to be felt."

Turning Research into Profits

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

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

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

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

What customers want, he adds, is more powerful and sophisticated cameras. Teledyne DALSA is responding with smaller, lighter and less power hungry cameras that share much of the same high tech circuitry and software found in computers and cell phones. It is also developing Today, it is focusing heavily on land reclamations and remediation. For example, it is transforming a former mine site near Fort McMurray into a man-made wetland. Once completed in 2012, Syncrude researchers will begin a 10-year study to monitor the sustainability of the Sandhill Fen Watershed.

"The oil sands are a relatively young industry and, because of that, there is considerable room for innovation and technology development," says Glen Rovang, Syncrude's Manager of R&D. "Over the next period of time, we will be strongly biased towards environmental research and tailings management technologies." Environmental research comprises about 60% of Syncrude's total annual R&D budget. Syncrude has also joined six other oil sands producers in a new consortium that will invest at least \$90 million annually, and share intellectual property, for new technologies to reduce and clean wet tailings generated during surface mining.

The Risks of Getting it Wrong

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

Forest products producer **Tembec Inc.** works with FP Innovations, an industry R&D organization, and a global pharmaceutical development site in Mississauga, Ont., responsible for managing operations for all stages of clinical trial research.

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

From Blackberry to AIDS Cure

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

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

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

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

Pecen notes, though, that the company's long-term research

Making Science Relevant to Society

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

"It doesn't matter if you're in political science, geography or aerospace, the mission of our university technologies, take care of intellectual property protection, develop business and marketing plans and secure pre-seed financing."

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

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

That doesn't mean cutting back on fundamental, discovery-based research, he adds. Rather, it's doing more to ensure that publicly funded research translates into new products and approaches that improve health care for patients. For Mount Sinai researcher Dr. Daniel Drucker, that meant developing a once-weekly treatment for type 2 diabetes that may replace the more common twice-daily injection. For Dr. Jeff

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