

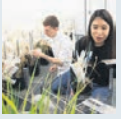
RESEARCH AND INNOVATION



Frustration and concern about our world's future are mounting. Canada's researchers and innovators are leading the way in developing

SOLUTIONS

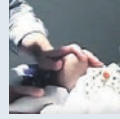
INSIDE



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Boosting food security with machine learning. **R&I 2**



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Leveraging technology tools and data. **R&I 4**



IMMIGRATION:
Studying the challenges of migration and integration. **R&I 9**

INNOVATION-POWERED CLIMATE ACTION

Tackling microplastics pollution, CO₂ emissions and battery waste

RECENT CLIMATE MARCHES IN ST. JOHN'S AND VANCOUVER – AND EVERYWHERE IN BETWEEN – saw hundreds of thousands of participants expressing their concern about our planet's future.

Canadians are increasingly demanding action to combat climate change, one of the most pressing issues of our time. Three cleantech entrepreneurs envision a future, where growing awareness about environmental challenges, collaboration and policy help to accelerate positive change.

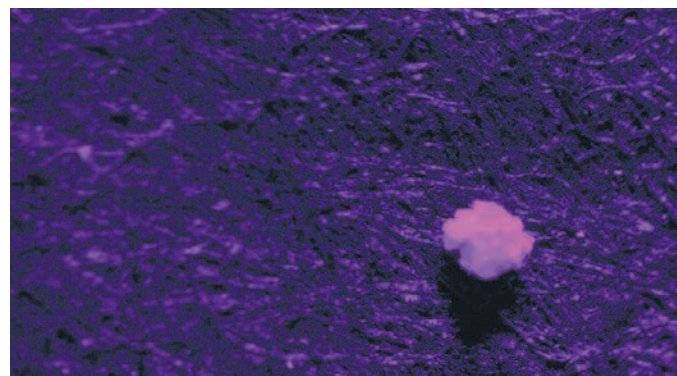
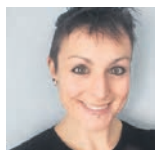
Lauren Smith's attention is on detecting, measuring and reducing microplastics, the very small plastic fragments that can harm our bodies and pollute the environment. The first step was to find a way to measure the problem, says the founder and CEO of PolyGone Technologies. "We take a sample of a liquid, such as beer, juice or water, and then we extract the microplastics. We use a special dye that makes them glow in a hot pink colour under a specific wavelength."

Rather than having to rely on single samples tested with expensive lab equipment, Ms. Smith and her co-founder Nicole Balliston developed a system that leverages automatic image capture and machine learning. "This allows us to analyze how many microplastics are in a sample and where they may come from," she says. "We can then recommend ways to remove them from the process of manufacturing drinks, for example."

PolyGone Technologies is currently working with breweries with

“We believe that increasing awareness of the problem and supporting the push to plastic-free products can make the world a better place.”

Lauren Smith
founder and CEO of
PolyGone Technologies



A special dye that makes microplastics glow hot pink under a specific wavelength is the first step in PolyGone Technologies' mission to detect and eliminate microplastics. **SUPPLIED**

the goal to eventually issue a certification for plastic-free beer. Ms. Smith hopes such a label will be of interest to consumers and food and beverage producers alike. "We believe that increasing awareness of the problem and supporting the push to plastic-free products can make the world a better place."

In addition to preventing plastic fragments from entering the environment, Ms. Smith envisions directing the filtered-out material towards further use, such as by partnering with innovators in the 3D-printing space.

Through its affiliation with an innovation hub, PolyGone Technologies is connected to the innovation ecosystem in the Waterloo area. While this has inspired collaborations, Ms. Smith says the BlackBerry territory's strong focus on software doesn't always align with the needs

and aspirations of a cleantech startup. "The time it takes to test the science behind a new concept is different than when you're working with code," she explains. "We also require lab space and specific equipment."

Although Roger Mah is based in Calgary, the CEO and co-founder of ZoraMat Solutions also finds a "prevailing emphasis on software and unicorns has skewed the perception of startups."

"Clean technologies are often business-to-business solutions that are capital intensive," he says. "As a chemical manufacturer, we need millions of dollars to get to the pilot stage."

Dr. Mah and his team have pioneered a substance that looks like flour but has "a lot of ordered holes on the molecular level," he says. "This allows us to do a lot of neat chemistry. Think of your kitchen

sponge – where it can soak up water, our substance absorbs CO₂."

The material's ability to isolate CO₂ and prevent it from entering the atmosphere makes it perfect for carbon capture, an essential means of addressing climate change, says Dr. Mah. "Our material would grab all the CO₂ molecules and let everything else through. Then, by changing conditions, we would release a pure stream of CO₂ that could be used by cool new technologies. That's the gap we are looking to fill."

In addition to carbon capture for flue gases, for which a licence has already been issued, ZoraMat Solutions is exploring other potential uses. "Since our material rejects water, this gives us entry into markets like renewable natural gas or bio-gas," says Dr. Mah. "We also have interest in niche applications for improving environmental performance."

A provincial grant for ZoraMat Solutions opened doors to mentors and potential partners, says Dr. Mah, who has observed "increased interest in supporting startups on their path to commercialization in recent years."

Dr. Mah describes it like a "switch being flicked" at the University of Calgary, which created entrepreneurship spaces, entrepreneurship courses, innovation fellowships and an entrepreneurship club, all dedicated to "taking ideas past the first few viability stages."

"It is encouraging to see the growth of a system that values and nurtures ideas and talent," he says. "This can help turn Canada into a **See CLIMATE CHANGE on R&I 3**

ENTREPRENEURSHIP

CHALLENGING STEREOTYPES AND CREATING PATHWAYS FOR SUCCESS

Nadine Spencer became an entrepreneur when she was 12 years old. Her mother moved from Jamaica to Canada and left her with a friend, who promptly took her out of school and instructed her to run errands. "She sent me to a place 24 miles away to buy cakes, but she didn't give me enough money for the return trip," Ms. Spencer recalls. "I guess she expected me to walk."

When Ms. Spencer got to the market, she came to an agreement with a local vendor, promising she would become a regular customer if she could get a deal. She then bought a number of cakes and packaging paper, parcelled out the merchandise and sold the packages for a small profit. "I made enough money for the

bus that day and returned weekly," she says. "Becoming an entrepreneur enabled me to take control of my future." When her mother found out about the disrupted education, she brought Ms. Spencer to Canada to continue her studies.

That day at the market, Ms. Spencer's passion for entrepreneurship was ignited – and it never abated. She is now the CEO of marketing and communications agency BrandEQ Group Inc. and the president and CEO of the Black Business and Professional Association. "My legacy is to enable women to achieve financial and personal freedom through entrepreneurship," she says.

Women's economic participation is not a new topic in Canada, but progress has been slow. Fawn Annan



At SheEO, a redesigned ecosystem that supports, finances and celebrates female entrepreneurs, ventures are chosen by voting and supported by crowdfunding. **sheEO**

has been working for nearly three decades on shifting the balance of gender representation in science, technology, engineering and math (STEM) fields.

As the president and CEO of ITWC, Canada's largest content creation and technology news source, she is familiar with the barriers faced by female tech entrepreneurs and the importance of creating systems of support. "Efforts to increase diversity and inclusion have delivered more optics than outcomes. We have seen much talk in the private sector, for example, but it has failed to put appropriate measures in place," she says. "At the current rate, it would take Canada 52 years to reach gender parity. We need systems change."

See WOMEN-LED on R&I 4

A FOOD-SECURE TOMORROW

Harnessing machine learning to create climate-smart crops

For the past century, plant breeders have selected the best seeds to grow through a time-consuming process of manually observing and measuring plants in the field.

But what if scientists could train computers to precisely analyze digital images of plants and routinely identify traits related to plant growth, health, resilience and yield?

Crop breeders would be able to more efficiently introduce new, improved varieties, and producers would have the information they need to make reliable crop management decisions (such as how much fertilizer and pesticide to use) during key growth stages to improve yield or respond to environmental changes.

This transformation is underway through innovative research at the University of Saskatchewan (USask). Computer scientists are teaming up with plant scientists, remote sensing specialists and crop breeders to apply machine learning techniques to plant breeding, with a focus on wheat, canola and lentils.

"Science has generated lots of information about the genetics of plants, but tying genes to specific plant traits is the next big challenge," says USask computer scientist Ian Stavness, who leads the team creating new image analysis tools for identifying desired plant traits (phenotypes) linked to specific DNA variations.

Brought together through the university's Plant Phenotyping and Imaging Research Centre (P²IRC) at the Global Institute for Food Security, the team is one of only half a dozen in the world doing this type of cutting-edge "computational agriculture" work.

"With enough information to breed for specific traits, such as higher yield or resistance to drought, crop breeders can adapt quickly to changing climatic conditions," he

“The collaborative nature of our work across so many disciplines and our partnerships with academia, government, industry and international development organizations are paving the way for the discovery of new technologies that will contribute to food security in Saskatchewan and around the world.”

Andy Sharpe
P²IRC program director



USask computer scientist Ian Stavness (foreground) and graduate students Blanche Leyeza (centre) and Jordan Ubbens (left) are training computers to digitally analyze plant images. Dave Stobbe for the University of Saskatchewan. SUPPLIED

says. "And if we give farmers better information, then they will be able to grow better crops. A lot of farmers have started to own drones to provide images of their crops, but the issue is: How do you get useful information out of these images?"

Part of the answer is a new software program the team has developed called Deep Plant Phenomics, a reference to both digital phenotyping and "deep learning," a class of machine learning techniques. Through the software program, a computer can "learn" to recognize an object or a specific pattern within a set of data derived from drone, sensor or satellite images of crops – similar to what recognition software programs can do for human facial features.

"This deep learning software program is a neural network that can

be trained by giving it a number of examples," he says.

Once trained and presented with new images, the computer can then analyze thousands or even millions of images to "predict" how many wheat heads are in a plot of wheat, how many plants have emerged within a canola plot or how many leaves there are on a canola plant, to cite just a few examples. Leaf number is important in determining a plant's developmental rate and when it will flower.

How well does the automated approach of machine learning using the new software program compare with manual trait identification in predicting these key crop indicators?

"The software program is about as good as manually counting, and of course it saves a lot of manual

work," says Dr. Stavness. "The data we are producing at P²IRC – the images combined with phenotypic information – constitutes some of the largest and most specific datasets that exist in the world for plant breeders."

For USask wheat breeder Curtis Pozniak, who monitors tens of thousands of university research plots across the province, the new software program gives him additional information to improve the precision of selection, reducing site visits and aiding crop development decision-making. Similarly, USask plant breeder Kirstin Belt is applying the new tools to lentil breeding, and Sally Vail, a research scientist at Agriculture and Agri-Food Canada, is using them in canola breeding.

Key plant trait data is recorded through sophisticated non-invasive imaging. Steve Shirliff, a USask plant scientist whose research includes state-of-the-art applications of drones for imaging crops, is identifying new plant traits that were previously impossible to measure.

The research is starting to benefit farmers.

"The main benefit so far is that farmers are getting new types of canola and wheat that will produce higher yields in a wider range of growing conditions," says Dr. Stavness. "Eventually these same datasets and analysis techniques could be used by farmers who use drones to look at the health of their crops and influence how they manage them during each growing season."

While some companies provide information such as how healthy crop fields are, the team's work "provides more precise information down to the specific plant, such as how each individual plant is doing," Dr. Stavness says.

His team has also developed another software program, PlotVision, which makes it easier for breeders and scientists to get images of individual plots from aerial images captured by drones. The tools have been demonstrated in the computer lab, and efforts are underway to build knowledge among potential users.

"We are on a push to make these open-source tools available around the world," says Dr. Stavness. "We think our research has a bigger impact if it doesn't just sit on the shelf but is used by plant scientists both regionally and in other parts of the world."

The P²IRC research program is funded by a \$37.2-million federal Canada First Research Excellence Fund awarded to USask in 2015. "We would not be doing this valuable research without this funding," says Dr. Stavness.

The team of 10 faculty and six software developers also involves 14 graduate students and two post-doctoral fellows.

"We're training some of the next generation of computer scientists who can work in the agricultural sector," says Dr. Stavness, who has a PhD in computer engineering and completed post-doctoral work at Stanford University in bioengineering. "Many agricultural companies will need to bring in highly trained people, and we're definitely training the top people in the world to do data analytics in agriculture for breeding and precision agriculture."

P²IRC program director Andy Sharpe, who helped sequence the genome for bread wheat, says P²IRC is leading the way in Canada and beyond in the areas of plant phenotyping and imaging. "The collaborative nature of our work across so many disciplines and our partnerships with academia, government, industry and international development organizations are paving the way for the discovery of new technologies that will contribute to food security in Saskatchewan and around the world."

ENHANCING RESPONSIVENESS TO DISASTERS

When a major disaster affecting hundreds of thousands of people strikes, such as 2013's massive flood in Calgary or ice storm in Toronto, determining how to best provide emergency services requires quick and effective decision-making.

Unfortunately, there are few systems in place that make disaster and emergency management (DEM) a streamlined process. Most emergency operations need better access to valuable information and tools so they can effectively address risk mitigation, preparedness and response management. That's why Ali Asgary, professor Jianhong Wu and their fellow researchers at York University have developed the Advanced Disaster, Emergency and Rapid Response Simulation (ADERSIM) initiative to study, evaluate and enhance DEM and to plan rapid response and continuity strategies. "As the numbers of disasters and emergencies increase – both industrial and environmental – we have to simultaneously enhance and expand our research, training and operations capacities," says Dr. Asgary.

ADERSIM helps fill this gap by strengthening Canada's DEM knowledge base and translating that into improved public safety. It does this in part through the DEM program at York, which is the first and only Canadian university to provide both bachelor's and master's degrees in this field. "Our grads are shaping the profession in Canada and demonstrating its importance," says Dr. Asgary.

After the ice storm hit, Toronto Hydro and Hydro One had to restore power to more than 800,000 customers. It was impossible to do so efficiently with their own resources so the companies asked for assistance from other utility companies. Dr. Asgary and his team examined such situations when assistance is requested and found "there's an information gap in decision-making. Most of the time, operations are co-ordinated based on people knowing each other and wanting to help, instead of using objective criteria. There wasn't a way to assess whether it's efficient or feasible." So help would often come, but could not be allocated effectively because no system was in place to co-ordinate that help or even know what resources they offered, resulting in wasted time, effort and money.

ADERSIM developed a decision-making application that gathers the information needed when calling on mutual assistance. An operations dashboard monitors the situation and shows what resources



Researchers at York University have developed the Advanced Disaster, Emergency and Rapid Response Simulation initiative to speed responsiveness to disasters. SUPPLIED

“Most of the time, operations are co-ordinated based on people knowing each other and wanting to help, instead of using objective criteria.”

Dr. Ali Asgary
York University researcher

are available so that when requests for help are made, resources can be allocated and managed more efficiently and effectively. ADERSIM's research findings continue to help enhance Canada's disaster response system.

Similarly, ADERSIM helped the City of Vaughan's Fire & Rescue Service to better evaluate its operations by simulating responses and using predictive analysis for its more than 10,000 emergency incidents annually. The results will help determine the placement and allocation of fire stations and other resources.

"Our research comes out of real needs and gives emergency operations practical ways to address their

needs," affirms Dr. Asgary.

To further support DEM, ADERSIM is now constructing a state-of-the-art, one-of-a-kind emergency operations centre funded by the Ontario Research Fund and York University, slated to open in late 2020. Through this centre, ADERSIM can provide real-time assistance during disasters by applying its research and providing much-needed information and direction in the field. "We'll integrate operations with research and examine things as they happen," says Dr. Asgary. "This is a completely new and different way to perform and apply research. We will be able to use our research to help in real time in real emergencies."

MAKING MANUFACTURING SMARTER

Applied learning program a boon to students and industry

Students at Georgian College are getting real-world experience in cutting-edge research and manufacturing companies are benefiting from the students' help.

Applied research and development activities at the Barrie, Ont., post-secondary institution have been helping local companies since 2010. But the college recently received a major cash injection from the federal government for its competitive smart manufacturing program. The \$2-million grant from the Natural Sciences and Engineering Research Council of Canada, through its college and community innovation program, will be disbursed over a period of five years and will go a long way to support local small- and medium-sized

“
... our goal is always to provide students with the education, knowledge and skills they'll need.”

Dr. Mira Ray
director of research and innovation at Georgian College



companies as they look for ways to digitize their products or processes with the goal of increasing productivity, efficiency and competitiveness.

Mira Ray, director of research and innovation at the college, says any manufacturer looking to digitize portions of its business or seek help in product development can apply to work with the college through this program.

“Because this program is based on the concept of digital transformation, you could call it ‘equal-opportunity,’” Dr. Ray says.

The program is clearly useful to manufacturers, who can access help from young minds that may have new ways of thinking. And society always benefits when manufacturing

becomes more efficient, but how does the college benefit? Innumerable ways, Dr. Ray says.

“I always start with students,” she says. “We are a post-secondary institution so our goal is always to provide students with the education, knowledge and skills they'll need when they ultimately leave the nest. The Competitive Smart Manufacturing program enables our students to work hand in hand with industry partners and allows them to apply their school-based learning outside of the classroom. It also gives them an opportunity to maybe learn new processes or tools, and gives them a chance to network and connect with industry – people who could be future employers or future references. They're able to connect with industry in new and different ways.”

The concept, she says, is experiential learning, through which students can see their learning put into practice, with direct, real-world results.

“I see it as learning in a safe environment,” Dr. Ray says, “because they have their faculty mentor to help them problem-solve and develop solutions for industry. It's also giving them the opportunity to communicate with the outside world in a way they would not during their regular course-based activities.”

One such project involves Environmental Systems Corporation (ESC), a Barrie company that is looking to expand its product and service offerings by leveraging technology. The company manufactures “clean rooms” that ship across North America.

Clean rooms are often used by companies that include pharmaceutical manufacturers or cell phone manufacturers. They are environmentally controlled to a high degree to make sure nothing interferes with the sensitive business processes. For example, temperatures have to be held steady in pharmaceuticals to make sure biological reagents remain stable; in computer parts manufacturing, building circuit boards requires a clean room with no particulates in the air.

To further expand the control of the rooms it builds, ESC wants to provide SaaS-based dashboards and mobile applications to allow its sensors, smart HEPA filters and other environmental controls to empower its clients to make better decisions and improve efficiency.

“ESC is looking to collaborate with Georgian College to develop a smart gateway application and the web-based interface for its clean rooms to aggregate all these data points into a centralized system,” Dr. Ray says. “They'll be able to see them in real time. You can imagine a pharmaceutical company that's making immune globulin intravenous drugs. If anything goes wrong in those rooms, they could potentially lose \$1-million worth of inventory. If they know there's a problem before it happens, they can do preventive maintenance and take care of the issue before anything goes wrong.”

And the Georgian students will be able to be part of this exciting innovation.

FROM PAGE 1

CLIMATE CHANGE: CLEANTECH STARTUPS

global leader for innovation.”

Before Ajay Kochhar and Tim Johnston, co-founders of Li-Cycle, became entrepreneurs, they worked as consultants for companies producing chemicals for rechargeable lithium-ion batteries.

“We saw this tsunami of new batteries being produced with little or unclear thought about what happens at the end of their life cycle and how to recover a maximum amount of material in a sustainable and safe fashion,” says Mr. Kochhar. “Batteries have traditionally been recycled with a thermal method that targets just a few metals, particularly cobalt.”

Li-Cycle is changing this, with its operating plant in Ontario leveraging its proprietary technologies to first safely render the batteries inert, then isolate the valuable portions via sustainable chemistry, and finally ensure all other by-products are saleable and returned to the economy.

Mr. Kochhar compares entering the world of cleantech startups to

“taking a leap of faith that is about preparation, opportunity and timing.”

Uncertainty can come from a number of barriers, including access to financing, human capital and infrastructure. In order to address these barriers, Li-Cycle has leveraged a “hosted model for clean technology development,” says Mr. Kochhar. “It means we have a number of partners, such as labs and piloting facilities specializing in metallurgy and organic chemistry. Their modus operandi is they help us scale up while we use their services.”

Such partnerships can help to accelerate the time frame to commercialization, and Li-Cycle is already on the verge of international expansion. Along with a focus on the business, Mr. Kochhar recommends maintaining a “360-degree view about what is needed to solve the various aspects of the climate crisis.”

“When you're so focused on the technology and market, it's impor-

tant to remember as entrepreneurs that there are key related areas where we must be engaged,” he says. “For example, we must do our part to engage with governments and industry associations to ensure they are aware that there are now commercial solutions available for recovering 80 to 100 per cent of batteries.”

Ms. Smith also hopes for a future where more stringent regulations result in reduced plastic use.

“There is growing interest in cleantech solutions,” she says. “People are looking at how companies impact the environment, and I think it's smart for companies to evaluate how they do business.”

The efforts to curb emissions, recycle batteries and reduce microplastics have earned the entrepreneurs recognition from Canada's Clean50, a community dedicated to supporting sustainable solutions, with the view that together, we can make a difference.



New federal funding support for applied research and development activities at Georgian College will benefit local businesses and give students hands-on experience. SUPPLIED

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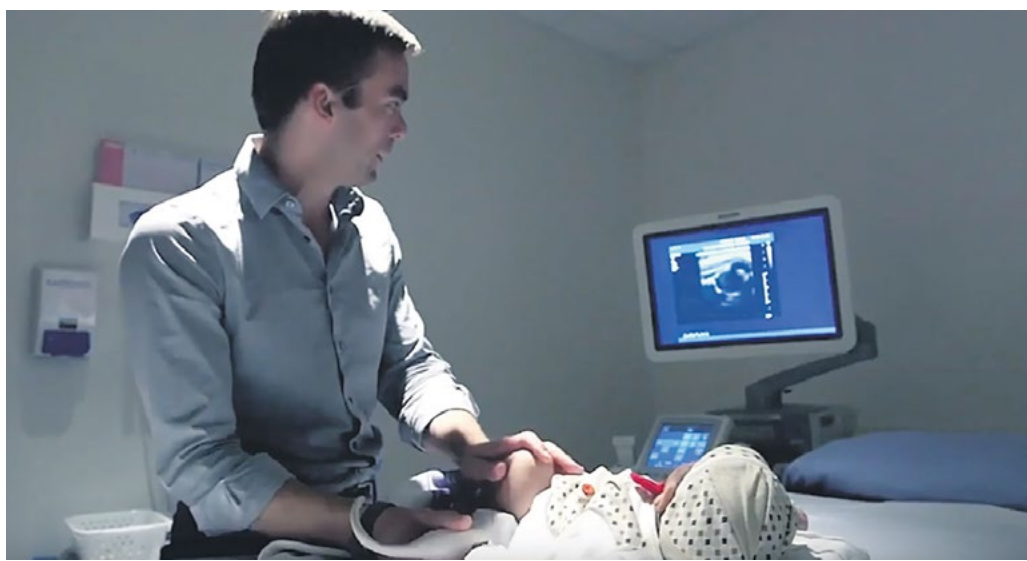
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PORTABLE ULTRASOUND

How a U of A spinoff is using artificial intelligence to make medical sci-fi a reality



University of Alberta radiologist and Medo.ai co-founder Jacob Jaremko performs an ultrasound scan on a baby to look for hip dysplasia. The U of A spinoff company is developing an app that uses artificial intelligence to allow expert analysis of medical ultrasound images with minimal training – a boon for rural and remote areas with limited access to radiology services. MEDO.AI

In the original Star Trek TV series, Dr. McCoy used a tiny device called a tricorder to instantly diagnose his patient's condition. While it seems improbable, a real-life version of the tricorder may be widely available as soon as 2022, thanks to University of Alberta research.

Medo.ai, a University of Alberta spinoff company, uses artificial intelligence (AI), smartphones and ultrasound technology to diagnose common and critical conditions. The company's unique technology analyzes ultrasound images and diagnoses disorders using machine learning accumulated from thousands of similar cases.

Imaging technology makes it possible to see inside the human body with astonishing precision. But MRIs and CT scans are very expensive, often subject to long wait times and accessible only in larger urban centres. Traditional ultrasound, while much more accessible, produces images that are blurry, two-dimensional and extremely difficult to interpret. While ultrasound imaging can happen almost anywhere, a diagnosis still has to wait on the availability of very highly skilled clinicians.

“Ultrasound is very portable. It is cheap and safe; some units fit in your pocket. The problem our technology addresses is that the expertise needed to use these devices is rare.”

Dr. Dornoosh Zonoobi
CEO, Medo.ai

Two-thirds of the world does not have access to medical imaging. In developing countries, access is non-existent.

“Even in [countries] such as Canada, it is very limited,” says Dornoosh Zonoobi, Medo.ai's CEO, who adds she's seen patients drive for hours in the middle of winter to get an ultrasound scan. “We have patients flying in helicopters from the northern territories.”

Driven by the urgent need for better options, she and radiologists Jacob Jaremko and Jeevesh Kapur decided to create software to augment ultrasound technology. Leading a diverse team, the three launched Medo.ai to commercialize the technology they developed.

The company's technology makes it possible to put diagnostic ultrasound in the hands of caregivers in assisted living facilities and minimally trained care providers in the most remote communities. Rather than transporting trauma victims to an MRI scanner, emergency room doctors or even ambulance attendants could diagnose injuries using a hand-held scanner. Your family doctor could diagnose liver and kidney disease in her office.

Medo.ai's first platform was created to diagnose hip dysplasia – a common hip joint abnormality that causes osteoarthritis if it isn't caught early.

“It's one of the leading causes of arthritis of the hip, and the leading cause in young women,” explains Dr. Jaremko, Medo.ai's chief technology officer. “It can be fixed very easily in infancy with a soft harness worn for four to six weeks. If we screened every newborn, we would prevent so much pain and disability for these people in later life. Until now, however, it simply wasn't possible or practical to do so. The mother of one of my daughter's friends is in her early 40s; she has already had bilateral hip replacements because of arthritis caused by hip dysplasia.”

“It is very hard for her to get through her days with young children. And it could have been prevented.”

Medo.ai's technology allows Dr. Jaremko to teach almost anyone how to do a scan in about an hour. In fact, he and Zonoobi gave medical students one hour of training and found they were able to produce 3D images as reliable as those produced by senior technicians.

In Alberta, four babies are born with hip dysplasia each day. Two are undiagnosed, leading to painful osteoarthritis and premature hip replacement surgeries later in life, adds Dr. Zonoobi. This technology can change that, she says.

“Ultrasound is very portable. It is cheap and safe; some units fit in your pocket. The problem our technology addresses is that the expertise needed to use these devices is rare.”

Four leading global children's hospitals are now using the platform in research projects. Once it's approved, it is expected to prevent up to 17 premature hip replacement surgeries each day in Canada and 151 in the United States, representing savings of \$1-billion a year in surgical costs in the U.S. alone. A recent multimillion-dollar seed capital round was oversubscribed, and the platform is now moving toward FDA clearance.

Medo.ai – which employs 24 people in Edmonton, mostly computer programmers, many of them U of A grads – is one of more than 130

U of A spinoffs in operation today.

The university ranks third in the country for spinoffs created between 2013 and 2017, with 108 patents received for its various discoveries.

Drs. Jaremko and Zonoobi say Edmonton is well placed for this type of startup, due to the high quality and integration of its health-care system and the U of A's AI expertise.

The quality-of-life implications are enormous. And with Medo.ai now turning its focus to platforms that address more situations in which cheap, portable and easy-to-use imaging technology could save lives, it's clear – the future of global health care is about to get much brighter.

FROM PAGE 1 WOMEN-LED: AN ECOSYSTEM OF SUPPORT

For Vicki Saunders, founder of SheEO, recent data shows deeply embedded biases. “Only four per cent of venture capital in Canada goes to women. Less than one per cent of corporate procurement goes to women-led businesses. And less than five per cent of women entrepreneurs are able to grow their business to over a million in revenue,” she says. “With women making up 51 per cent of the population, these numbers show that the system is skewed.”

The vast majority of people making funding decisions are men, who tend to support things that resonate with them, explains Ms. Saunders. “When women come with interesting ideas, they often get dismissed.” Take, for example, Toni Desrosiers, the founder of Abeego, who invented a breathable food wrap. Her quest for funding support was met with questions like, “Do you have a business degree? Have you run a business before?” says Ms. Saunders. “The men didn't recognize the value of her idea.”

At SheEO, the reception was much different: everyone voted for Ms. Desrosiers's innovation, since “Abeego is amazing,” says Ms. Saunders. “When you use conventional plastic food wrap to cover a cucumber, it turns to mush in a day. With Abeego, the cucumber lasts for 10 days.”

SheEO's model is inclusive and supportive, with chosen entrepreneurs getting zero-per-cent-interest loans and access to a network of support. The organization also focuses on both social impact and traditional measures of economic growth. “We are tackling the world's ‘to do list,’” says Ms. Saunders.

BBPA, ITWC and SheEO are among the hundreds of organizations supporting the Women Entrepreneurship Knowledge Hub (WEKH) – a new initiative led by Ryerson University's Diversity Institute, the Ted Rogers School of Management and the Brookfield Institute, which has nine hubs across the country. Its partners include diverse organizations supporting women entrepreneurs, financial institutions and investors, incubators and business organizations, and community organizations – all working together to build a more inclusive ecosystem that will connect organizations supporting diverse women entrepreneurs at every stage, across sectors and geographies.

“There are many organizations across the country supporting entrepreneurs generally and women specifically. Think of us as the B2B platform, connecting these organizations together, sharing research and best practices, challenging stereotypes, building pathways and developing a more inclusive and effective innovation ecosystem,” says Wendy Cukier, founder of the Diversity Institute.

Ms. Anan is an enthusiastic supporter of WEKH because of its systems approach. “We have been working for decades to advance women in technology without achieving results,” she says. “We should not make the same mistakes in advancing women entrepreneurs.”

Ms. Saunders stresses the importance of WEKH's strategy to combat the stereotypes of entrepreneurs and to support diverse women across the spectrum and at every stage. Data and research are key.

“With such a big focus on unicorns and winning the market, SMEs get starved of capital,” she says. “We miss important segments of the economy and the populations more likely to be in services industries, the arts or social ventures.”

By linking diverse organizations together to tackle the tough problems “WEKH and its partners will help to shift the balance,” believes Ms. Spencer. “You want to get behind women entrepreneurs to help them succeed.”

TECHNOLOGY INNOVATION AND DATA DRIVING BETTER HEALTH OUTCOMES

Experience shows that innovation in health care can play a significant role in unlocking efficiencies while – at the same time – improving quality of care. For example, the Ottawa ankle rules, a product of world-leading research in clinical decision support, are recognized internationally for optimizing the use of diagnostic imaging for ankle or foot trauma. Not only do they save time and money, they also prevent unnecessary exposure to radiation for patients.

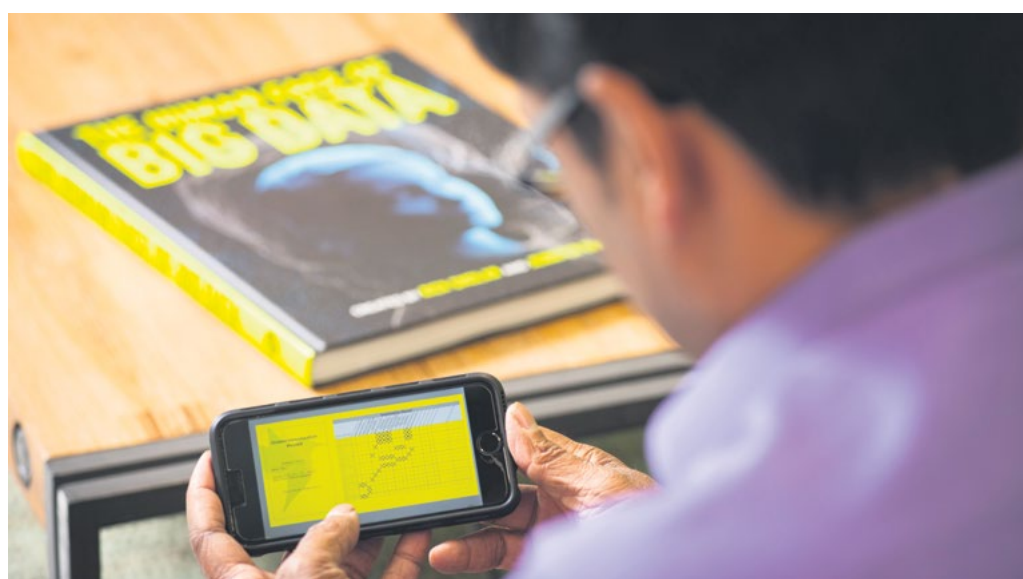
The Ottawa Hospital, where the ankle rules were developed, is building on its strong tradition of innovation by leveraging research, technology and data capabilities to tackle some of today's most urgent challenges, says Alan Forster, vice-president of Innovation and Quality at The Ottawa Hospital and professor at uOttawa.

He sees an “open innovation model,” which brings together partners from both inside and outside the health-care system, as essential. “We need to collaborate to address current challenges like the flood of care demand that comes with an aging population,” says Dr. Forster. “We need to enhance the collaboration with patients, their families and care providers, with governments and private-sector companies as well as with international partners.”

While Canada's situation may be unique, made-in-Canada solutions can have a positive impact across the globe, he says. “By building a global network for innovation, where we all strive to accomplish better health outcomes, we can get there faster.”

A partnership between The Ottawa Hospital and Israel's Sheba Medical Center aims to translate technology capabilities and social innovation in health care into tangible outcomes by leveraging a model called ARC: accelerate, redesign and collaborate.

The model combines prioritizing digital technologies, encouraging teamwork and creating the infrastructure for innovation, explains Dr. Forster. “By enabling partnerships with private-sector entities to test out their ideas with the appropriate oversight, we can evaluate and help to accelerate the uptake of the most



Developing new technologies or systems has to be combined with incentives to adopt them in a timely manner. At The Ottawa Hospital, researchers are collaborating with patients, their families and care providers, as well as governments, private-sector companies and international partners to enhance the impact of health technologies and data. KUMANAN WILSON

promising solutions.”

For Doug Manuel, public health specialist, senior scientist at The Ottawa Hospital and distinguished professor at uOttawa, the ambition to leverage technology and data to create a “learning health system” is reinforcing the hospital's reputation as an innovator. He says, “We know the cycle of learning from past experiences, but can we build systems that accelerate it? And can we embed that into our practice?”

Dr. Forster says developing new technologies or systems has to be combined with incentives to adopt them in a timely manner. “Virtual health care, for example, seems a perfect solution for Canada, a country defined by size and severe winters that can restrict travelling,” he says. “And everybody has a smartphone with videoconferencing functions. Yet there are barriers preventing us from widely adopting this tool for virtual health care.”

The technology that enables people to have their medical appointment from home already exists. And there are systems that allow the remote monitoring of vital signs and other health functions. How can all this be leveraged for

improving patient care?

The answer comes from data, believes Dr. Manuel, who is working to leverage clinical data, community data and behavioural data to inform care delivery. “Data can be used for predictive analytics,” he says. “At The Ottawa Hospital, there are dozens of algorithms describing a patient experience. These can be used for predictive studies that can determine the outlook for these patients, for example, whether they are likely to be re-admitted or need home care.”

Data can enhance the ability to deliver robust personalized treatment plans for an individual, says Dr. Manuel, who adds that The Ottawa Hospital is collaborating with technology partners to upgrade its systems to reflect advances in big data, machine learning and AI.

In addition to enabling virtual health and predictive analytics, technology also carries significant potential to improve the “business of health care,” says Dr. Forster. “How can we manage our capital with a view of bringing the best value to the system? If we use technologies to efficiently manage our time and people, there are huge opportuni-

ties to be realized.”

But what does this mean for patients? How does it affect our ability to care for Canada's aging population? Dr. Forster believes technology advances can translate into high-value health care at the hospital and beyond.

“Today, the hospital is often the last resort when the health situation of patients has deteriorated and they cannot function in their current environment. But we need to be more proactive,” says Dr. Forster. By integrating medical, social and technological innovations (picture, for example, virtual health consultations, drones and autonomous vehicles to support care), people can stay in their homes – connected to their families and communities – as they age, he says. “If we can counter age-related isolation, we can improve health outcomes at the same time.”

The Ottawa Hospital supports the path towards this vision, says Dr. Manuel. “We see the hospital as a resource for patients and the community. And we want to make resources available for partners who create innovation and applications for improving health.”

THE EYE-TO-BRAIN CONNECTION

Research sheds light on how our brains adapt when partial vision loss strikes

We see millions of things every day without even thinking about it. And yet, different parts of our brains are busy parsing all of those images into objects, landscapes and people we recognize and understand.

Jennifer Steeves oversees the Perceptual Neuroscience Laboratory at York University in Toronto where she examines exactly what happens in our brains when we see, or more precisely, when we can't. For more than 25 years, she's studied how the brain changes when individuals lose an eye in early childhood, such as in the case of patients with retinoblastoma, a rare eye cancer. "We look at how hearing and vision interact, and see how the brain adapts," she says.

Dr. Steeves compared the vision of those with one eye to people with two. She discovered that not only is the vision of those with one eye very good, but in some instances, it is actually better than the vision of people with two. How can this be with a smaller visual field and only half of the visual sensory information being received by the brain?

Using an MRI scanner at York's campus, Dr. Steeves and her graduate students found that some parts

of the brain dedicated to vision are actually bigger than they should be in people who have only one eye. This indicates that their brains have actually rewired – taking over brain cells, which were originally connected to the cancerous eye that was surgically removed. This rewiring is called brain plasticity.

The researchers also noted that some of the parts of the brain responsible for hearing were shaped differently from and appeared bigger than those in the brains of people with two eyes, meaning that people with one eye may also hear better, to help compensate for losing one eye.

"The parts of the brain that process vision are still developing throughout childhood, meaning they have greater plasticity or malleability to adapt to having one eye," says Dr. Steeves. People who lose an eye as an adult can still adapt, but plasticity decreases as we age, and therefore their brains show much less rewiring of structures.

"Learning how early vision loss affects other senses and the brain can shed light on understanding how plasticity might work in brain disorders such as traumatic injury or stroke, and even normal aging," explains Dr. Steeves. Her research

can also provide insight for more common pediatric conditions like amblyopia or lazy eye.

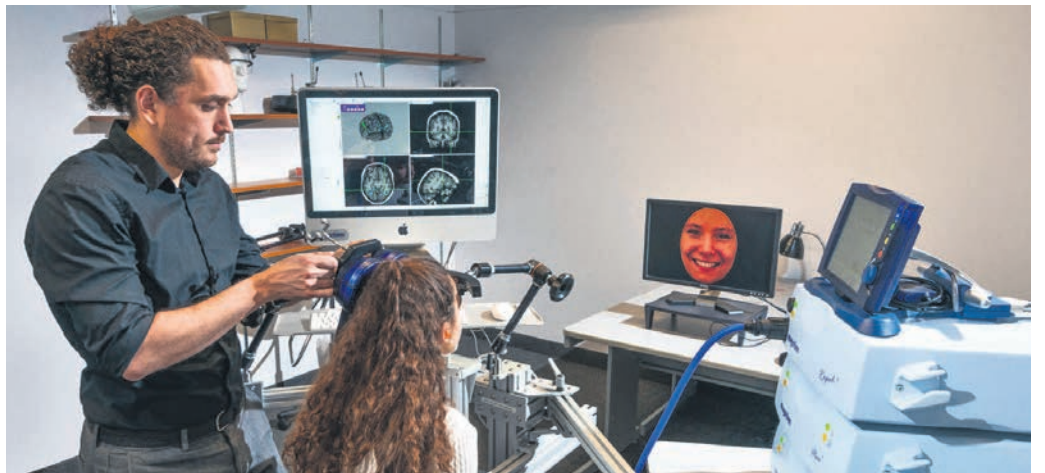
She's also developing a novel therapeutic treatment using transcranial magnetic stimulation (TMS) as a non-invasive therapy for Charles Bonnet Syndrome (CBS). CBS arises after vision loss from diseases such as age-related macular degeneration or

glaucoma. Individuals with CBS see people, landscapes or patterns that do not exist in reality, also known as visual hallucinations.

CBS is highly disruptive to daily life, and often misdiagnosed as a mental health issue rather than an imbalance between the loss of visual input to the visual brain, which remains active. Currently, there is no CBS

treatment. Dr. Steeves's TMS research aims to eliminate visual hallucinations through magnetic brain stimulation to induce changes in the brain.

Understanding how our brains process vision is important because how we see the world affects how we live our lives. "We're visual beings," says Dr. Steeves. "Our vision helps us understand the world around us."



In Professor Jennifer Steeves' lab at York University, graduate students use transcranial magnetic stimulation to learn how a region of the brain responsible for vision is involved in face recognition. SUPPLIED

APATHY.

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As the world's population amasses in urban centres, the health of our cities has never been more crucial. Now, more than ever, we must confront apathy with ingenuity. Tackling complex challenges like climate change, immigration and industrial automation requires a willingness to break down borders and embrace new ways of thinking. This is what we do at Ryerson University.

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DEEP THINKING, SOCIAL JUSTICE

Advancing the integration of knowledge and practice

The university experience involves learning workplace skills, but more importantly, it's about learning how to think critically. Experts say universities that cultivate thoughtful interactions deliver innovative graduates who can make profound differences in their industries, communities and beyond.

"We push students to challenge their own thinking and others' thinking," says Tara Hyland-Russell, vice-president Academic at St. Mary's University in Calgary. "We know there's a really compelling need for transformation in the world. We need thinkers and change-makers who can influence behaviour on pressing issues such as climate change, global migration and poverty."

As a liberal arts school with small classes, St. Mary's University fosters a deep level of thinking through mentorship and a dedication to social justice. "We discuss what really matters because we create space and opportunities for meaningful and career-related learning," she says.

Students at St. Mary's can self-direct their university programs, combining book learning with work-integrated learning. They can choose from study-abroad programs, internships, community service learning, international practicums, faculty-driven or original research projects, and partnerships.

One partnership, for instance, is with a local seniors' community where students from English, psychology and liberal studies programs meet with the seniors to gather, write, edit and publish their stories in a legacy book. Students pursuing gerontology also look at the science of aging. The students build relationships with the seniors, giving back as they gain real-world knowledge related to their disciplines of study. "The students learn to engage with and value our seniors; we work very hard to have meaningful ongoing relationships that equip students with real-life skills," says Dr. Hyland-Russell.

Students bring back such life experiences to the classroom, reflecting on "how they want to have an impact in the world. That can only happen through integration of knowledge and practice," she adds.

The partnerships also benefit the companies and non-profit organizations that participate. Students often bring fresh ideas to the table, and partners can assess up-and-coming talent. Plus, employees and clients can develop important relationships with the students.

Ultimately, the rapidly changing



Students at St. Mary's University can self-direct their university programs and combine book learning with work-integrated learning, such as through a partnership with a local seniors' community. SUPPLIED

By stepping into different situations, students enter different mind spaces. It's not simply being analytical, but being able to put themselves in others' shoes and thinking from their perspective.

Dr. Tara Hyland-Russell
vice-president Academic
at St. Mary's University in
Calgary

nature of society means that the most valuable skill any worker can have is a flexible mindset. Students must be able to adapt and innovate in a changing work landscape now and into the future. "Being flexible, working with ambiguity, lots of

interdisciplinary work and putting students in real situations that really stretch them is all important," Dr. Hyland-Russell affirms. "By stepping into different situations, students enter different mind spaces. It's not simply being analytical, but being

able to put themselves in others' shoes and thinking from their perspective – whether it's a scientific, humanities or Indigenous worldview, for example. It's about learning to listen, to sift and to discern nuances of truth and intention."

OPINION

GIVING CANADIAN INNOVATION A BOOST, ONE PARTNERSHIP AT A TIME



BY DENISE AMYOT
PRESIDENT AND CEO OF
COLLEGES AND INSTITUTES
CANADA

When Goulding's Wholesale, the owner of Chatman's Bakery in Charlottetown, NL, realized it needed to automate parts of its production because of labour shortages, it did what a growing number of Canadian small and medium-sized enterprises (SMEs) are doing and turned to its local college for help.

The College of the North Atlantic assembled a multidisciplinary team of students and expert faculty to replace the bakery's long-used manual method of cutting cookie

bars. They identified that a robotic controlled ultrasonic cutting system would be the ideal solution and worked with the company to develop and implement the new system. Ultimately, this helped Chatman's Bakery speed up their production and grow their business.

Fostering collaboration in all sectors of the economy, including with SMEs, has always been one of the greatest strengths of colleges, institutes and polytechnics. It is what positions them at the centre of Canada's growing innovation ecosystem.

Last year alone, Canadian colleges, institutes and polytechnics were involved in over 7,300 research partnerships that generated more than 4,400 new processes, products, prototypes and services, approximately 87 per cent of which were completed in less than one year. Whether it's testing out new, more energy-efficient technology or developing brand new machinery to improve manufacturing processes, these partnerships allow students to gain valuable experience, while helping businesses grow and innovate.

Most amazing is that they have done all this with access to only 2.5 per cent of federal research funding. It's time that support from government matches the sector's full potential. The most critical need is to enable post-secondary

institutions to maintain permanent services to facilitate linkages with industry and community partners who lack the capacity, resources and networks needed to invest in research and development on their own.

Applied research partnerships can take time to build and need support to sustain, but the payoff is worth it. Students involved get to work hand in hand with employers to drive innovation, while organizations and companies get solutions to their challenges.

This is why Colleges and Institutes Canada, along with six other national and regional associations, recently called on the Government of Canada to help expand SME participation in the innovation ecosystem by investing \$40-million per year in business innovation engagement services. We believe this will double the number of SMEs engaging with their local applied research offices, increasing their willingness and capacity to invest their own resources in research and development.

As we look to Canada's future in a rapidly shifting global economy, fostering more impactful partnerships that drive innovation is critical to success.

These collaborations may just hold the key to unleashing Canadian ingenuity to grow our economy while solving global challenges.

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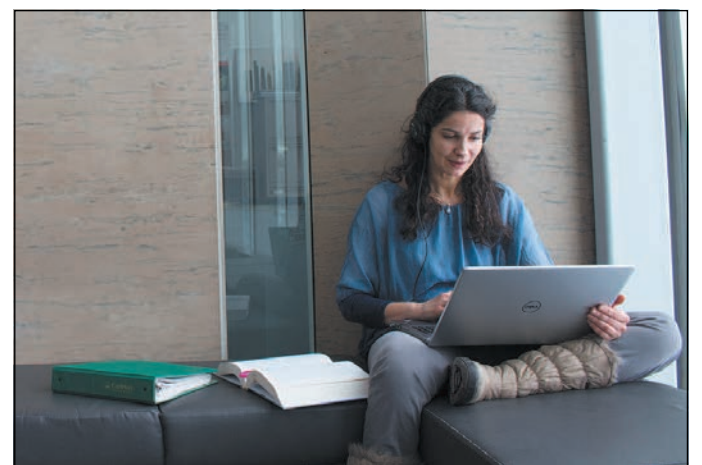
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Evaluators help to ensure that Canadian public programs and services are working as intended. Ensuring the effectiveness of these tax-funded programs means that we need qualified evaluators to measure their performance and contribution to sound public policy.

The problem is that there are few universities or government programs that train highly educated, geographically dispersed evaluators, many of whom are already employed in difficult jobs. This created a problem that Robert Shepherd and his skilled team at Carleton University solved using innovation.

"There's always been a shortage of qualified evaluators, so we knew we needed to enhance our offerings," says Dr. Shepherd, who took over as supervisor of the graduate online Diploma in Public Policy and Program Evaluation (DPPE) at Carleton in 2009, broadened its scope to be nationally and internationally focused, and moved it online in 2016.

The diploma prepares graduate students to assume the roles of

“Our students are already doing such complex work that you have to innovate constantly to stay current and teach these programs well.”

Dr. Robert Shepherd
supervisor of the graduate online Diploma in Public Policy and Program Evaluation (DPPE) at Carleton University



By building a robust evaluation program, and moving a related six-course program online, Carleton University has increased applications to fill 25 to 30 spaces from 20 per year to more than 80 this year. [ISTOCK.COM](#)

evaluators by having them complete an actual evaluation practicum with a real-world client. Since it is delivered exclusively online, participants can complete it while employed without the need to relocate.

"At the time we were considering the online format, I needed to find a way to reach evaluators beyond the federal scene," says Dr. Shepherd. "There was a public need, especially

in provincial and territorial governments, where officials were looking for more than theoretical training."

Carleton University, under Dr. Shepherd's stewardship, has built the most robust evaluation program in the country. Dr. Shepherd says by moving his six-course program online, he's been able to increase applications from 20 per year to more than 80 this year to fill 25 to

30 spaces. Carleton University's DPPE is being seen increasingly as a significant voice in the Canadian field because it teaches students to ask the difficult questions to understand real program effects in ways that are different from traditional approaches.

"Our students are already doing such complex work that you have to innovate constantly to stay current and teach these programs well," says Dr. Shepherd, and innovation has helped the program remain relevant with evaluation practitioners. In fact, his team of instructors are each renowned evaluators – what Dr. Shepherd refers to as the "dream team" of evaluation trainers. "These are people who dedicate a lot of time to working with students because they know how important this is for the next generation."

"We had to adapt to a social climate that needed online teachings to a broad group of people, already in big jobs," Dr. Shepherd says. "Helping to improve the Canadian field is a responsibility we take very seriously at Carleton. I'm proud of how far our program has come."

Q&A THE GOAL? DOUBLE THE NUMBER OF WOMEN ENTREPRENEURS BY 2025



Q&A WITH WENDY CUKIER FOUNDER OF RYERSON UNIVERSITY'S DIVERSITY INSTITUTE AND PROFESSOR OF ENTREPRENEURSHIP AND STRATEGY AT THE TED ROGERS SCHOOL OF MANAGEMENT

With your long-time engagement in fostering diversity and inclusion, what is your sense of what has been achieved?

I began working to advance the representation of women in tech almost three decades ago. While there has been a massive and well-intentioned effort to increase the percentage of women in science, technology, engineering and math (STEM), the fact is that we now

have fewer women in computer science and only marginally more in engineering than we did 30 years ago. There is bias embedded throughout the research and innovation ecosystem. And unfortunately, there is not a lot of evidence that there are generational differences. When you look at tech startups and incubators, for example, "bro culture" is still pervasive. In general, there are real challenges with small and medium enterprises in terms of diversity and inclusion practices. We need an evidence-based intentional strategy to drive system change.

Please tell us about your efforts to boost the representation of women in entrepreneurship.

Research has shown that diverse teams – and the inclusion of women – can lead to more innovation and robust solutions, but there has been a gap between the evidence and what we see in policy and practice. We are working to address this with the Women Entrepreneur-

ship Knowledge Hub (WEKH), which is part of the federal government's Women Entrepreneurship Strategy (WES), an ambitious plan that aims to double the number of women entrepreneurs by 2025.

How can this goal be accomplished?

As a whole-of-government approach to helping women grow their businesses through access to financing, talent, networks and expertise, WES recognizes that work is needed at many levels and to cross silos. WEKH is a foundational piece of the strategy, a platform to promote sharing research and best practices, linking organizations that support women entrepreneurs and driving change through the innovation ecosystem.

Why is research an important part of the strategy?

[Gender bias] is deeply embedded in our society. We need an evidence-based approach and to understand the levers that will drive systems change. Research can help



The Women Entrepreneurship Knowledge Hub is partnering with a range of organizations, including SheEO, an ecosystem supporting, financing and celebrating female innovators. [SheEO](#)

to identify barriers and opportunities, tackle the stereotypes and help inform a co-ordinated national strategy to create a more inclusive innovation ecosystem.

What are some of the barriers women entrepreneurs face?

The first barrier is the stereotype of whom we see as an entrepreneur. If you ask people to name three entrepreneurs, they typically come up with a combination of Mark Zuckerberg, Elon Musk, Bill Gates and Steve Jobs. While entrepreneurship is really a broad concept that involves challenging the status quo or creating something new and covers a wide spectrum of activities, it has become strongly associated with men and technology. This not only shapes the programs and policies but also the aspirations of women because "if you can't see it, you can't be it." Women are under-represented in tech and among tech entrepreneurs generally; they are more likely to be found in services industries, arts and social enterprises, but these sectors tend to be overlooked.

When we look at organizations supporting entrepreneurs, from financial institutions, venture capitalists, incubators and service providers to educational institutions, research shows there are often biases built into their processes that affect what they value and whom they support. But the problem is complex. We know women often have different expectations and attitudes to financing, growth and exporting. That is why we need an integrated strategy, which considers these complex interactions.

How can this be addressed?

On one hand, we can encourage women to see the range of opportunities, to be more ambitious, to grow and expand their business internationally, and to seek financing to realize these goals. But at the same time, we have to understand that women may have different motivations and to meet them where they are. That's why we need a dual perspective. Rather than saying women entrepreneurs must be more like men, we want to remove the barriers for those who want to aspire to grow and expand. We also have to recognize this is not the only pathway to success. Entrepreneurship can take many forms, and when you consider ra-

cialized women, immigrant women, Indigenous women, women with disabilities and others, it adds to the level of complexity. Women in rural areas have different needs, challenges and aspirations than women in cities. Better understanding the amazing work entrepreneurs do in wildly different contexts is part of what makes this project so exciting.

How can this complexity be reflected in one strategy?

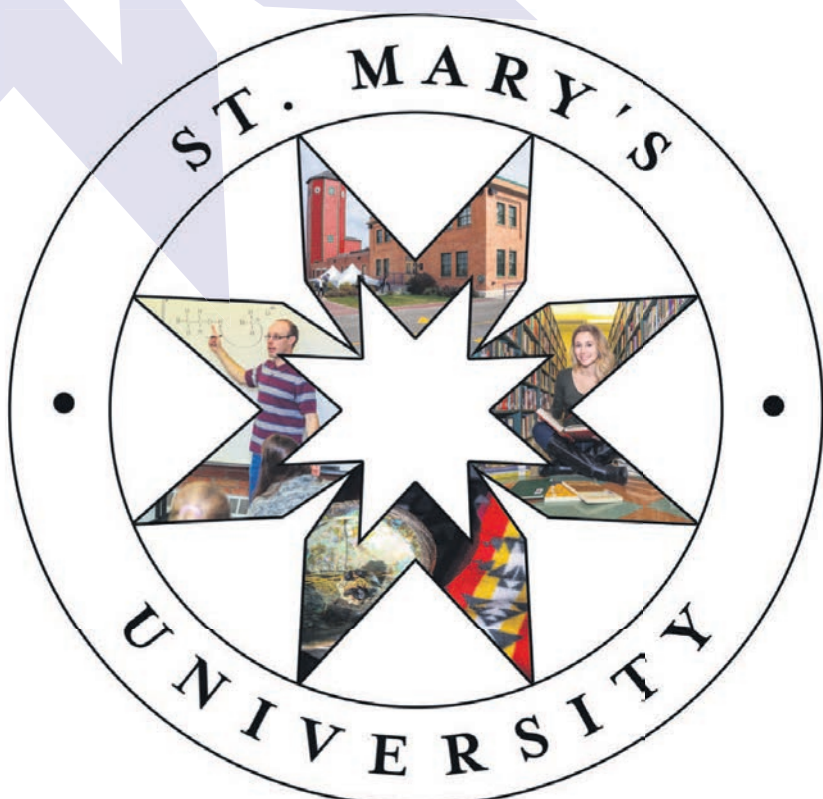
The strategy has to take the incredible diversity of women entrepreneurs into account and have the goal to increase opportunity and support regardless of where the women are and what they aspire to. At the same time, we want to make sure their goals are not constrained because of the barriers they face.

This is part of the reason that the WEKH has engaged with a very diverse set of organizations – including women's entrepreneurship organizations, but also financial institutions, chambers of commerce, incubators, Indigenous organizations and community groups as well as universities. Our hubs recognize the importance of responding to regional diversity and connecting with organizations on the ground. We also have thematic leads for different sectors, where we can support women in tech at the same time as refugee women and artists.

What inspires optimism that the 2025 goal can be reached?

For me, it is encouraging when the champions supporting women's entrepreneurship are not just organizations that have "women" in the title. Beyond resources being devoted to women-focused funds and efforts, it inspires me to see larger organizations opening up to being more inclusive. For example, they are prepared to look at their policies, funding, outreach and procurement strategies, and think about how they design and market products and services. This will leverage and amplify the investments by the government in the WES by providing access to the massive investments across the ecosystem. [Being inclusive] is understood to link to our economic growth, social development and global competitiveness more today than ever before. And from talking to my counterparts in other parts of the world, I know that Canada is well positioned to lead internationally.

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IMMIGRATION REALITIES

Partnerships and technologies providing insights into migration and integration

As issues around migration, nationalism and multiculturalism play out around the world, Canada, largely a nation of immigrants, continues to advance its leadership role in developing innovative research that will impact policy and practices in these critical areas.

At the forefront of this work is Ryerson University and professor Anna Triandafyllidou, who was recently named the Canada Excellence Research Chair (CERC) in Migration and Integration. The federal government announced the prestigious appointment in April – the first CERC for Ryerson will come with \$10-million in research funding for over seven years.

Dr. Triandafyllidou, a world-class researcher and international expert in migration and settlement, arrived in Toronto in August to accept the new position. She relocated from Italy, where she was Robert Schuman Chair of the Global Governance Programme at the European University Institute. She was attracted to Canada and Ryerson, which hosts the Ryerson Centre for Immigration and Settlement and is committed to building on established research strengths in immigrant, migration, integration, refugee and diaspora studies, “because at Ryerson, you have the world in one place.”

“I knew that Ryerson has built strong relationships with its stakeholders,” she says. “I think the CERC is the perfect platform for making the work we do here known at a global level.”

The ambitious program will centre around a number of streams of research, including studying migration trends and migrant agency. It will conduct comparative analysis of public policy, focusing on Canadian realities while also embracing a global perspective. It will examine cities and diversity, considering impacts on infrastructure and services, and the program will gaze into the future, contemplating societal challenges in a rapidly changing world.

Engaging Canada’s academic community in this work is an essential component of the program.



Inquiries into migration and integration are very timely, as questions around citizenship abound, along with the local and worldwide rise of nationalism, xenophobia and populism. ISTOCK.COM

“The CERC has been given to Ryerson but we feel that it should be an added value for universities across Canada,” notes Dr. Triandafyllidou.

Her strategy is two-fold. The approach examines existing research to identify gaps, as well as using that research as a springboard leading to innovative inquiry. For example, Ryerson has a track record in Indigenous studies. Dr. Triandafyllidou would like to build on that and identify the implications of the Truth and Reconciliation process on migrants.

Analyzing new types of data, gauging the impact of disruptive technologies and considering ethics in the use of IT in migration management are also on her radar.

“If you look at a Facebook account, you can trace a migration

trajectory,” she says. “But what we want to do is explore the potential of new technologies together with colleagues in engineering or social media data analysts for assessing and fine-tuning integration policies, seeking supplementary interdisciplinary research to inform our work.”

In considering shifts in migration patterns, there’s an emerging need to research environmentally induced migration, Dr. Triandafyllidou adds. “Some might say, ‘We’re not going to be really affected any time soon.’ But there is a lot of secondary movement that is caused by environmental degradation or climate change.”

The trend of developed or more affluent countries towards attracting temporary migration also presents a

new scope of inquiry, she says. “We need to look at how both skilled and less-skilled migrants transition to more long-term stays, and consider what hurdles they are facing.”

Researchers will attempt to gain a better understanding about the “suburbanization of migration,” now that many satellite and medium-sized cities have become hubs of migration, says Dr. Triandafyllidou. “These are places where significant social innovation and migrant entrepreneurship are thriving.”

The timeliness of the inquiries is evident, as questions around citizenship abound, along with the local and worldwide rise of nationalism, xenophobia and populism, she says. “We need to look at how multiculturalism is being recon-

sidered in Canada. In the election we heard a lot about ‘conservative multiculturalism.’ What does this mean?”

Dr. Triandafyllidou suggests, “We need to link up these processes with the general processes of transformation of our societies. Oftentimes, anti-immigration attitudes actually have more to do with how our work and welfare are changing. But migration somehow becomes a catalyst for popular resentment.”

Dr. Triandafyllidou sees the CERC as a commitment from the Government of Canada and Ryerson to more clearly understand these phenomena. She says, “We want to provide evidence of why certain things are happening, and that migration is not the problem but rather the opportunity.”



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UNIVERSITIES HAVE NEVER BEEN MORE IMPORTANT as catalysts for positive change. We live in a world filled with incredible innovation but also one facing serious and complex challenges. We need globally educated citizens able to work across traditional boundaries to build their own success and that of their communities. We are very pleased to be recognized by *Times Higher Education's* Impact Rankings as a world leader in building multisector partnerships and pioneering new educational approaches. From confronting climate change to building more inclusive and equitable communities, York is leading the type of community engagement needed to tackle society’s most pressing concerns.

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