Urban Innovation

MaRS Discovery District

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INNOVATION IS THE FUNDAMENTAL QUEST FOR HUMAN PROGRESS

BY ILSE TREURNICHT, CEO, MaRS DISCOVERY DISTRICT

"Innovation is a word one hears often these days — perhaps too often. It has been so widely applied that it no longer drives excitement. But it should not be discounted. What the 21st century has taught us so far is that there is no more powerful driver of positive economic and social change than innovation.

At MaRS, we view innovation as a fundamentally human quest for progress — a quest to find new and better ways to create things of value. These could be modest improvements to daily life or massive breakthroughs that reorder entire sectors, but in every instance, innovation is the key to success. More than ever before, innovation is pervasive — touching and changing every aspect of our lives.

> "Our greatest advantage lies in our cities. We live in one of the most urbanized nations in the world."

With its highly educated population, Canada is well placed to thrive in this innovation age. But we also face challenges. Our long reliance on resource extraction and imported technology has resulted in an economy with low business research-and-development spending and poor performance in commercializing intellectual capital.

On the positive side, Toronto, Montreal and Vancouver have all been drawing international notice as innovation regions. They also deserve domestic attention for two reasons. First, Canada is one of the most urbanized nations of the world, with a massively disproportionate share of national income generated in and around those three major cities. Second, international data shows that innovation is a process that runs best with an urban engine. In particular, urban regions have a huge scale advantage in convergent innovation, exemplified by various fields, such as precision medicine, advanced materials, financial technology, artificial intelligence and green technology.

Above all, urban regions are magnets for ambitious, well-educated young people from diverse backgrounds. For all of Canada's bountiful natural resources and unspoiled natural spaces, its future depends on our human resources. That means our single biggest social advantage, arguably, is our vaunted pluralism. And Canada's biggest structural advantage may well be our widely admired, ethnically diverse and highly livable cities. ■

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Shot on the MaRS Centre rooftop: (left to right) Curtis VanWalleghem, CEO of Hydrostor; Lindsey Goodchild, Co-founder and CEO, Nudge; Marie Chevrier, Founder and CEO, Sampler; Jinzi Zheng, co-founder, Nanovista; Mike Andrade, CEO, Morgan Solar; Tom Rodinger, co-founder and CTO, Nanoleaf; Kelly Shaw, President and CEO, OOKA Island.

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PUBLISHERS
Karen Mazurkewich & Kara Collins

EDITOR
Steve Tustin

ART DIRECTOR
Erik Mohr

CONTRIBUTORS
Mary Gooderham, David Israelson, Marjo Johne, Jeff Kirk, Margaret Mulligan, Shelley White

GLOBE EDGE

Sean Stanleigh
Managing Editor

Liz Massicotte
Program Manager, Globe Edge

Isabelle Cabral
Production Co-ordinator, The Globe and Mail

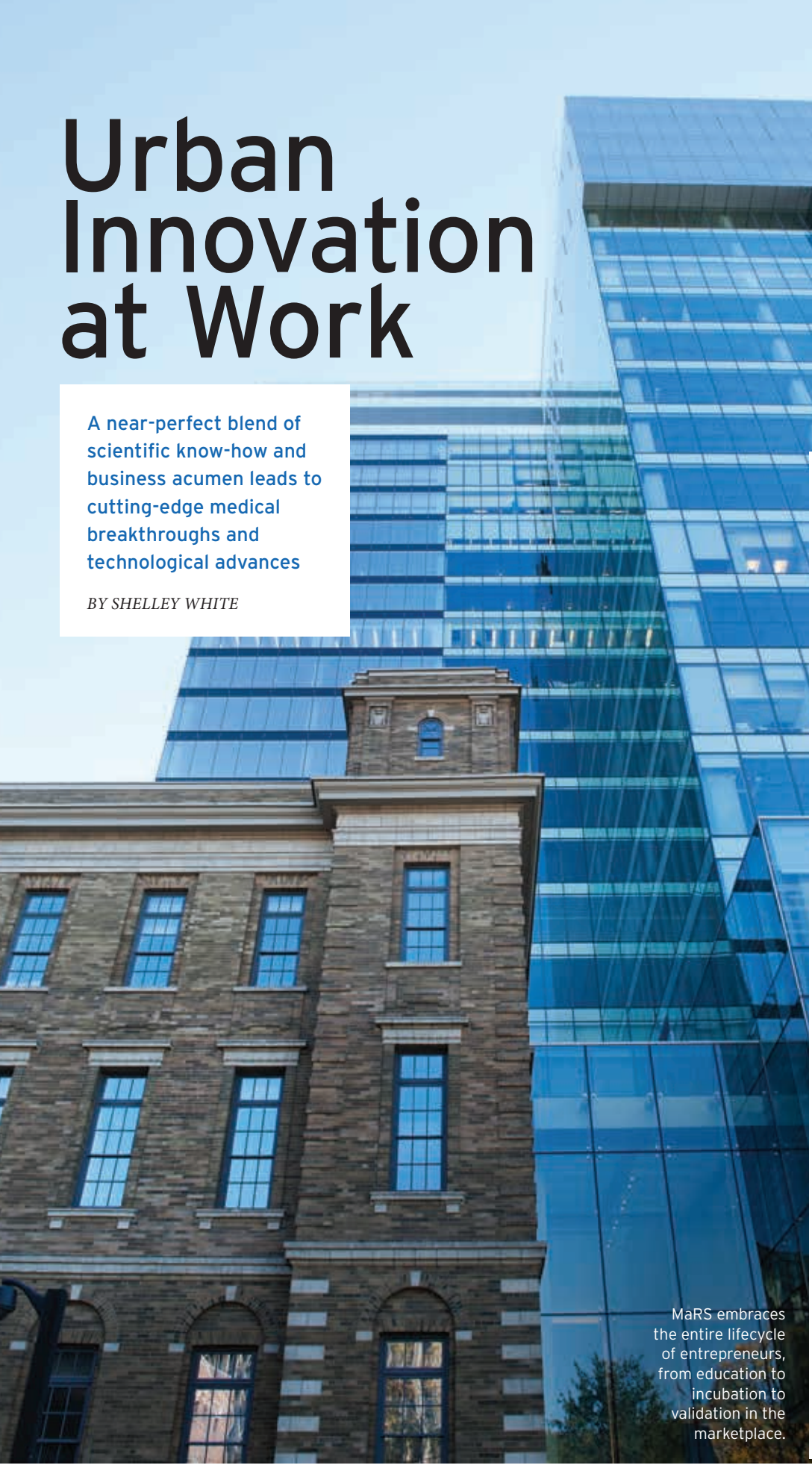
Printing and pre-press by dm digital+1

All Correspondence:
MaRS Discovery District
101 College St, Suite 401
Toronto, ON M5G 1L7
www.marsdd.com

Urban Innovation at Work

A near-perfect blend of scientific know-how and business acumen leads to cutting-edge medical breakthroughs and technological advances

BY SHELLEY WHITE



MaRS embraces the entire lifecycle of entrepreneurs, from education to incubation to validation in the marketplace.

The geography of innovation is changing. Cities are becoming the leading engines of entrepreneurship and commercialization, surpassing the suburban office parks that were once the gold standard.

Smart governments everywhere are rethinking the innovation model exemplified by Silicon Valley. The new paradigm borrows from Jane Jacobs' vision of the importance of urban community, only in this case, an entire innovation ecosystem — scientists, entrepreneurs, investors, and corporate partners — shows up for work every day, under one roof, to collaborate in unexpected ways. Downtown density is the driving force of the new economy.

No city has exploited that potential more successfully than Toronto, which is home to MaRS Discovery District, the largest urban innovation hub in the world. In this 1.5-million-square-foot property — which houses more than 200 organizations — scientific know-how and business acumen meet to create the cutting-edge medical

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THE STORY OF THE WEST TOWER

NO ELEMENT OF MaRS HAS GARNERED MORE SCRUTINY THAN THE WEST TOWER – PHASE 2 OF THE INNOVATION HUB'S DEVELOPMENT. HERE'S THE REAL STORY BEHIND THE HEADLINES

It was 2007 and MaRS needed more room.

With the original towers of Phase 1 fully leased, demand was high from companies and research groups, like the Ontario Institute for Cancer Research (OICR), which was outgrowing its existing space at MaRS, and Public Health Ontario, which, in the wake of the SARS outbreak, needed to move its facilities closer to the hospitals.

To meet demand, MaRS embarked on a plan to launch Phase 2 — building the West Tower, which would add 780,000 square feet.

"In 2007, when we were considering the Phase 2 expansion, we ran an international RFP [request for proposal], and Alexandria Real Estate Equities [ARE] out of the U.S. won the contract to do the development," says Ilse Treurnicht, CEO of MaRS.

With that original agreement, the funding to build Phase 2 would have been entirely private. ARE, a Pasadena, Calif.-based property developer active in constructing some of North America's leading innovation and technology hubs, agreed to lease the land from MaRS, paying for the development of the property and getting the benefit of revenue from companies that would lease the space.

ARE started construction, excavating and building to ground level. Then in November 2008, the global financial crisis hit and ARE halted construction — indefinitely.

"It presented a very real challenge for us," recalls Ms. Treurnicht. "What followed was a very difficult three-year period where we looked at every single [financing] option."

MaRS exerted pressure on ARE to restart the project, but the developer had decided to let the project "sit." "We were now also sitting with a project that was stopped for three years [through] Canadian winters," notes Ms. Treurnicht.

The innovation hub engaged in discussions with the Province of Ontario, and by August 2011 it was agreed that MaRS would step into ARE's shoes as developer. ARE would retain a passive interest in the project. Infrastructure Ontario provided a fully secured, repayable loan of up to $235-million to complete the core and shell of the building.

"It wasn't our first choice, but as a non-profit, with no balance sheet, we had limited options," says Ms. Treurnicht of the deal.

The loan enabled MaRS to complete the building by 2014, but roadblocks remained. Because ARE retained an interest in the West Tower as consideration for its invested funds, it had residual rights — and over time a misalignment of interests stalled the leasing process.

"It became really clear to us that in order to execute on our mission and make sure this infrastructure was put to use for the innovation community, [we had] to regain control over the project," says Ms. Treurnicht.

In September 2014, the provincial government appointed an expert panel to evaluate the project and they concluded that additional lending should be provided to complete a buyout of ARE's interest. Ontario's Ministry of Research and Innovation stepped in as sole lender to the project, providing a combined lending facility of up to $379-million.

"MaRS has been an integral partner, as Ontario carves out a reputation as one of the world's most dynamic and welcoming places for research and innovation," says Reza Moridi, Minister of Research, Innovation and Science.

A substantial portion of the loan will be repaid within five years and the balance in 20 years.

"That's the path we are on at the moment, well ahead of schedule," says Ms. Treurnicht, who points out that the University of Toronto also became an equity partner in the building in August 2015.

Today, over 93 per cent of the building has been leased, with the remaining 7 per cent in final negotiations.

"We had a really big problem to solve. Our private developer stopped the project in the middle of an unprecedented global recession. But we fixed it and we are now positioned in a much better place for the future, because we control our destiny fully," says Ms. Treurnicht. **SHELLEY WHITE**

breakthroughs and technological advances of tomorrow.

The founders of MaRS bet on the power of location by constructing an innovation hub right across the street from the top Canadian research university, next to an enormous hospital complex and close to one of North America's leading financial districts.

By creating the conditions for serendipity, this group of forward-thinking academics and businesspeople put the institution on course to become a new staging point for economic development.

Most cities are still searching for similar locations with anything like the same degree of concentrated brainpower that Toronto's pioneering innovation hub has assembled in the heart of the city.

And to think it all started with an aging urban building.

MaRS has a vaunted history that spans from 1913 to 2002, when it was the home of the Toronto General Hospital's College wing, a place where Nobel prize-winning Canadian scientists and physicians Frederick Banting and Charles Best first treated a diabetes patient with their miraculous new discovery, insulin. This development would revolutionize medical practice worldwide, as would other medical and surgical treatments pioneered at TGH's College wing, including heparin (an important blood thinner), the first kidney transplant, the first artificial kidney and the pacemaker.

The research legacy continues, but with its expanded footprint, the hub now also serves to commercialize the types of discoveries that have long been associated with the district.

"We took a site that served medical innovation for 100 years and repurposed it for the next century," says Ilse Treurnicht, CEO of MaRS Discovery District.

The mastermind behind MaRS was the late physician, businessman, former president of the University of Toronto and founding dean of McMaster Medical School, Dr. John Evans, who, along with a group of co-founders, came up with the concept in 2000.

"There was a recognition by the founders that Toronto performed with the top peers in the world from a discovery perspective — the productivity of our research engine, the breakthrough activity in the science pipeline — but we had underperformed as a region relative to our peers on the commercialization side," says Ms. Treurnicht, who joined the organization in 2005.

> "We took a site that served medical innovation for 100 years and repurposed it for the next century."
>
> Ilse Treurnicht, CEO, MaRS Discovery District

The idea proposed by Dr. Evans to spark a transformative change was a simple one: in order to get discoveries from bench to bedside, there needed to be cross-fertilization between the research world and the business world.

In addition to mixing the academic with the corporate, Dr. Evans also saw the value of creating a place where different sectors came together. This would be an innovation epicentre focusing on science, on information and communications technology and on social innovation.

In 2002, a "catalytic" event happened to get Dr. Evans' idea off the ground, says Ms. Treurnicht. TGH decided to sell its College wing, which was in close proximity to the University of Toronto and "hospital row" along University Avenue.

The nearly-century-old hospital — so full of history and positioned so dynamically — seemed like the ideal spot to build a forward-thinking new innovation hub.

The co-founders were quickly able to raise $14-million, which ultimately sparked enough private and public funding to make the property a reality. The façade of the old hospital remained as the centrepiece of a modern facility that grew around it, with offices, event space, state-of-the-art labs and everything promising startups could need. (The name MaRS came from Medical and Related Sciences, a file name-turned-acronym that stuck.)

Today, MaRS embraces the entire lifecycle of entrepreneurs — from education to incubation and validation in the marketplace. Its education programs target both early-stage startups and corporate innovation teams, while MaRS

PHOTO: COURTESY OF MICHEL DAUDA

Venture Services works closely with over 1000 companies, including scaling firms spanning key sectors such as health, cleantech, fintech and commerce, and those aimed at improving education and the workplace. Since MaRS opened in 2005, the MaRS network of startups has gone on to raise $2.6-billion in financing and generated $1.3-billion in revenue — due in part to the MaRS team, which offers advisory services, market intelligence, access to capital, talent and partners, as well as connections to customer networks.

In the years since that first spark of an idea, Dr. Evans' vision has proved prescient. The idea of a large-scale urban innovation hub that brings together researchers, entrepreneurs and corporate partners across sectors has become a growing phenomenon, worldwide.

MaRS was ahead of the curve when it came to creating a downtown hub, right in the middle of the city with its major partners nearby.

Innovation moves downtown

In Silicon Valley, the suburbs don't hold the allure they used to.

Traditionally, top tech companies like Apple, Google and Facebook set up campuses in the suburban towns surrounding Stanford University, like Palo Alto, Menlo Park and Mountain View. However, many of the newer tech hotshots, like Airbnb, Uber, Salesforce and Twitter, chose to set up shop in downtown San Francisco instead.

It's a migration from the suburbs to vibrant downtown cores that's leading a trend in innovation, an "innovation densification" trend.

Meric Gertler, president of the University of Toronto (which is one of MaRS's founding partners), says that the trend partly stems from the migration of talent.

"We see increasingly that high-quality urban environments are offering the sorts of amenities and quality of life that highly educated talent is seeking when they are deciding where to live and work," says Mr. Gertler.

Cameron Piron is president of Synaptive Medical, a startup that is part of the MaRS network. His company develops medical equipment and applications for neurosurgical procedures, including a life-like simulated brain for practising neurosurgeons and high-definition 3D imaging tools for use before and during surgery. The company began as a MaRS startup four years ago, and it has been successfully selling its products for about 18 months, mostly in Canada and the U.S.

Mr. Piron says that being located in downtown Toronto has given his company an edge.

"I think it's been important for many reasons — close to the universities, close to the many hospitals and also for talent. We're in a market where there's a lot of companies hungry for experienced people in medtech, particularly in software and medical imaging, and so there's a real battle for talent and having a location that's downtown is very attractive to people," says Mr. Piron. "Toronto is a very livable city. They can walk to work. The quality of life here is hard for other groups to compete with."

While traditional suburban hubs like Research Triangle Park in Raleigh-Durham, N.C., scramble to add more amenities to try and attract talent, more hubs around the world are springing up in urban areas.

A recent benchmarking project conducted by MaRS Data Catalyst compared its hub with other similar entities (in cities of 4.5 million people or more, with a world-leading university within or adjacent to the hub).

It found that Toronto's biggest strength was its entrepreneurial talent — the city has one of the most highly educated, skilled and diverse workforces in the world. Also strong is Toronto's research talent, which is top-ranked globally, and Canada's high rates of consumer-led technology adoption.

But the benchmarking also found there were deficiencies to address. In a Canadian economy dominated by low-tech exports, there's low business-led R&D (research and development) expenditure. "Commercialization culture" is still developing in Toronto, with a lack of sophisticated investor networks at the scale required to be globally competitive.

The report concluded that MaRS is well positioned to compete in the top tier of urban innovation hubs, leveraging the innovation capacity of the Toronto region. However, as Canada's market size and availability of capital will always be modest, MaRS needs to be better at creating connections, at home and abroad, and getting innovations into global markets effectively.

"This is a huge quest for cities right now — How do I make sure that I harness the brainpower that's in my city and create an environment that's attractive enough, so that the brainpower goes to work for the economic growth of my city?" says Ms. Treurnicht. ■

DRUG DISCOVERY 3.0

BY SHELLEY WHITE

At JLABS in Toronto, the startups are moving in.

On the 14th floor of the West Tower of MaRS, chemists, biologists, software engineers and immunologists are settling into the 40,000-square-foot incubator that will be their new home base.

JLABS will eventually house up to 50 companies, and the first 24 setting up now come from diverse areas — Avrobio is developing gene therapies targeting cancer and rare diseases; SYNG Pharmaceuticals is working on a blood test for endometriosis; Neutun is

developing a seizure-tracking tool for people with epilepsy; KalGene Pharmaceuticals is working on a therapeutic for people with Alzheimer's to bring back their memories. But these startups all have one thing in common: each is working on how to turn promising science into products that will improve the health and well-being of patients in Ontario and beyond.

JLABS is the brainchild of Johnson & Johnson Innovation, a branch of 130-year-old multinational Johnson & Johnson (J&J), a company with global sales of $74.3-billion (U.S.). The MaRS site is JLABS' sixth — the others are located in San Francisco, San Diego, Houston and Cambridge, Mass. — but it's the first one outside of the U.S.

Today JLABS Toronto's new inhabitants are busy setting up their new office and lab space, supplied with leading-edge, state-of-the-art equipment. Some gather in clusters in JLABS' expansive common area. Here, comfortable purple couches and warm-toned wood tables are surrounded by floor-to-ceiling windows and a killer view of University Avenue's "hospital row," the University of Toronto campus and the stately Ontario Legislative Building.

At MaRS, the traditional drug model is being turned on its head, as corporate players become more open to outsourcing, earlier engagement, collaboration and partnerships with academic institutions.

"We want to create a space where people come and talk, where different sectors are talking together," says Rebecca Yu, head of JLABS Toronto.

Yet for everything these promising startups get, J&J isn't asking for any equity in return.

"We don't own any intellectual property, we don't have first rights, we do not seek confidential info," says Ms. Yu. "The company doesn't have to sign with us."

It's an intriguing example of how the traditional model of drug discovery is being turned on its head, as corporate players become more open to outsourcing, engaging earlier in the innovation cycle, collaborating with early-stage startups and partnering with academic institutions.

Drug manufacturers have been increasingly shrinking away from in-house research because while major internal spending can sometimes lead to a blockbuster drug and billions in worldwide sales, companies can also invest hundreds of millions into developing drugs that ultimately prove ineffective, unsafe and unmarketable. Outsourcing R&D to startups and smaller companies, and working with open source labs, filters out the early mistakes, enabling corporations to make their big investments in the clinical trial and commercialization stages.

The new outsourcing model is good news for Toronto, which is poised to be a super hub in health. With its wealth of world-leading academics and researchers, Toronto has traditionally been a leader in discovery, but less successful when it comes to commercialization. With the rise of urban innovation hubs, however, this trend is starting to reverse because a new model of open innovation has taken shape, drawing together disparate partners in the discovery cycle.

MaRS is an example of this model, housing pre-competitive labs, entrepreneurs and pharma companies under one roof. Step inside and witness the spirit of collaboration hard at work.

"JLABS is a strategy based on the premise that great science and technology is just as likely to come from outside the walls of a big company like Johnson & Johnson as inside," says Melinda Richter, head of Johnson & Johnson Innovation. She's in charge of all six JLABS incubators

and is based at the flagship location in San Diego.

Science scouts

Finances can be a huge obstacle for startups in the life sciences.

"There is so much great science and technology that gets left on the shelf, not because it isn't good but because they hit these obstacles that make it impossible to go forward," says Ms. Richter. "We want to make sure they have everything they need, so that if it fails, it fails for the science, not for other reasons."

While Johnson & Johnson does hope that deals will come out of the incubator — Ms. Richter says the company has specialized "science scouts" that interact with the startups and recommend deals to help the most promising progress further — it is fine with giving its startups the freedom to choose.

Jinzi Zheng is the co-founder of Nanovista, Inc., one of the local startups that has moved into JLABS Toronto. The company develops visualization agents designed to enhance high-precision cancer therapies like surgery and radiotherapy.

Nanovista won a year of free residency through JLABS' "Quick Fire Challenge" competition, and Ms. Zheng says they jumped at the opportunity because they believe in strategic partnerships.

"I knew that JLABS was more than just a pretty space and shiny new equipment. To us, being at JLABS means that we can leverage J&J's network and tap into their expertise both from a commercialization side and from a product development side," says Ms. Zheng.

At the Ontario Institute for Cancer Research (OICR), located in both the South and West Towers of MaRS, analytical chemist Ahmed Aman is using a mass spectrometer to determine the presence of a test compound in a sample. Like everyone else at the OICR Drug Discovery lab, Mr. Aman is working on developing compounds that will hopefully become significant new cancer drugs, but he has to analyze the physical properties of the compound first.

"It's looking at how our drugs permeate the system and whether they actually stay around long enough to do what they are supposed to do," explains David Uehling, group leader of medicinal chemistry at OICR.

Across the room, Richard Marcellus, principal research scientist in the biology group, is using a Biacore T200. This state-of-the-art instrument, which looks a bit like a photocopier connected by tubes to two beakers, provides a highly effective way to see how well a compound binds to a protein.

The Drug Discovery lab is one of the hotspots of discovery at OICR, a not-for-profit organization focused on the prevention, early detection, diagnosis and treatment of cancer. It's a place where the spirit of scientific inquiry meets the drive to see drugs get to market.

Christine Williams, deputy director and vice-president of outreach for OICR, says the program's mandate is translational research — taking the great discoveries made in basic science and biology and moving all that understanding and investment into clinical practice where it will impact patients.

Jeff Courtney is chief commercial officer at Fight Against Cancer Innovation Trust (FACIT), an independent business trust established by OICR to propel commercialization activities. "Our process is trying to take the work that's coming out of OICR and marry that to partners, usually pharmaceutical or large biotech companies," he says. FACIT also provides seed capital if necessary.

OICR is a place where the spirit of scientific inquiry meets the drive to get drugs to market.

Sometimes the technology is innovative enough that they can go straight to a partnership. Mr. Courtney gives the example of a partnership with Janssen Pharmaceuticals, which is part of Johnson & Johnson, to develop a set of novel therapeutic compounds to treat haematological (blood) cancers. The deal includes an option to license the drug, worth about $450-million, which would then be cycled back into research at OICR.

"It was a beautiful example of taking an early idea from academia, working collaboratively with the researcher and OICR, and taking it to a point of partnership," he says. ■

6 BIOTECH FIRMS

ON THE VERGE OF A HOME RUN

There's no doubt that it takes vision, intellect and passion to make a profound impact in the world of new drug development. A supportive community also helps. Here are six MaRS-supported companies whose leading-edge technology and innovative products are poised to revolutionize treatment for patients in Canada and worldwide.

1. ALPHA CANCER TECHNOLOGIES

The side effects of chemotherapy can be debilitating for cancer patients, but Alpha Cancer is hoping to change all that. According to the firm's president and CEO, Igor Sherman, Alpha Cancer is developing novel cancer therapies that are more effective and significantly less toxic than current drugs on the market. He says that in animal models, the company's lead drug candidates – ACT-901 and ACT-902 – were more effective than maximal tolerated doses of chemotherapy and caused no side effects, while animals receiving conventional chemotherapy showed obvious signs of toxicity and appeared generally very sick.

2. SCARX THERAPEUTICS

Over the past three years, ScarX has been developing a topical therapeutic, called SCX-001, which significantly reduces the amount of scar tissue that forms following surgical wound closure. "Apart from aesthetics, many scars can be disfiguring," says ScarX president and CEO Stephen Whitehead. "They can [also] restrict joint motion and can often be quite painful." ScarX has developed SCX-001 into an early-stage clinical drug, and within the next five to ten years, the biotechnology company hopes to have it approved.

3. FORMATION BIOLOGICS

One of the problems with traditional cancer therapies is that they often kill the good cells along with the bad. Formation Biologics engineers immune-based cancer drugs with selective "anti-cancer" activity, preventing the collateral damage to normal tissue that typically occurs with current therapeutics. It has recently transitioned from a discovery firm to a development company, and the most promising of its discovery molecules is about to enter clinical development later this year.

4. PLANTFORM CORPORATION

The goal of PlantForm is to make life-saving medicine more affordable. The two-year-old firm is commercializing a plant-based manufacturing platform, called vivoXPRESS, for lower-cost drug production, using genetically modified tobacco plants to "grow" biopharmaceuticals in greenhouse environments. The company's lead product is a biosimilar version – it's almost identical to the reference medical product but with marked differences due to its biological origin – of an important breast cancer drug called Herceptin. Don Stewart, president and CEO, says PlantForm has demonstrated the effectiveness of its product, and because it will be available at a lower cost than the current drug on the market, patients will have more access to the new drug and the cost burden on the health-care system will be reduced.

5. NORTHERN BIOLOGICS

Dedicated to discovering and developing antibodies to treat human diseases, Northern Biologics is advancing a promising line of targeted therapeutics for cancer and fibrosis. In one recent success, the company acquired the rights to a novel immuno-oncology antibody that it believes has the potential to significantly improve outcomes for patients with several hard-to-treat cancers. CEO Stefan Larson reports that the company will be launching a clinical trial early next year.

6. HIGHLAND THERAPEUTICS

The drug-delivery technology developed at Highland Therapeutics has been called a "game-changer" in the management of ADHD (attention deficit hyperactivity disorder). Using delayed-release and extended-release technology, the team at Highland Therapeutics has developed a drug that is administered at night and is designed to control ADHD symptoms immediately, as soon as the patient wakes up, and throughout the day. The company's founder and CEO, David Lickrish, says Highland Therapeutics has completed the clinical development portion of its program and intends to file a new-drug application shortly. **SHELLEY WHITE**

THE POWER OF THE HUB

BY MARJO JOHNE

It takes more than one label to describe Toronto-based InteraXon Inc. That's because the eight-year-old startup fits not in a single category but rather in an intersection between wearable technology, application development, and health and wellness.

The prongs in that intersection are likely to multiply in the near future, as InteraXon applies its technology to other sectors that could include automotive, public safety and law enforcement.

"There are so many potential applications for our platform," says Derek Luke, CEO of InteraXon, which sells a brain-sensing headband, called Muse, that works with an app to help people meditate better. "For example, our technology can be embedded in a car to detect your eye movement and see if you're not paying attention or if you're falling asleep while driving. So if you're a transportation company with a fleet of trucks, you can see if one of your drivers is getting fatigued and [you] can swap in another driver."

Zayna Khayat, senior advisor of health system innovation at MaRS, says these convergences and "weird pairings" are becoming increasingly common, especially in health care.

"More and more, we're seeing convergence, as software and digital technology bleed into traditional industries," says Ms. Khayat, who is also director of MaRS EXCITE, a program that connects health technology innovators with leading industry

Brendan Frey, left, president and CEO of Deep Genomics, discusses research with co-founder Hui Yuan Xiong.

InteraXon's CEO Derek Luke demonstrates the brain-sensing headband called Muse that works with an app to help people meditate better.

researchers. "We're seeing blockchain and telecommunications companies moving into health care, and even sports companies like Under Armour, which has become a digital health company with its wearables and clothing that can monitor fitness."

This convergence in health and in other sectors is driven largely by digital technology, which has become more prevalent and accessible in recent years, notes Ms. Khayat. This has made it easier for startups and smaller businesses to gain a foothold in the hybrid spaces that have, for years, been the domain of larger companies.

Many startups in the MaRS portfolio of client companies have taken digital technology and overlaid it onto a traditional space — from Law Scout, an online platform where businesses can hire lawyers, to SnapEDA, which accelerates electronics design by giving electronic engineers access to a library of ready-to-use patterns and schematics.

"The tools of digital technology have become so democratized

Deep Genomics: Combining AI and the study of genes in ways that will transform medicine

What do you get when you combine artificial intelligence with the study of genes and their functions? At Deep Genomics, this convergence of disciplines has led to next-generation technologies that can predict the development of disease and lead to highly-precise customized treatment.

"Anyone can combine deep learning with genomics," notes Brendan Frey, president and CEO of Deep Genomics, a Toronto-based startup. "What's different about our approach is that, unlike others that are really just focused on collecting data, we're using artificial intelligence to make sense of that data in a way that's reliable, scalable and trustworthy."

The industry standard, says Mr. Frey, lines up the genomes of people who share a disease and look for mutation patterns. By comparison, Deep Genomics' technology looks inside cells and maps out what will happen when DNA is altered by genetic variations introduced naturally or through medical therapies.

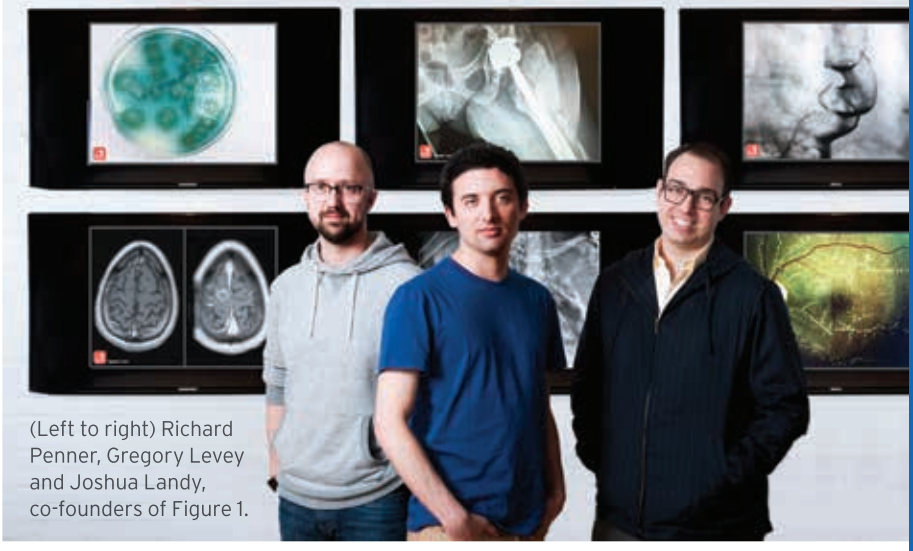
"There are a number of possible ways your genetics can lead to problems," Mr. Frey explains. "That's why we need AI to search through all these possible ways in which things can go wrong."

Deep Genomics is currently testing its technology as part of two research projects and is lining up a third project by this fall.

"Imagine a doctor prescribing you treatment based on your unique genetics," says Mr. Frey. "That's what we're working towards — a technology platform that can really transform medicine."

MARJO JOHNE

PHOTO: MARGARET MULLIGAN (DEREK LUKE), CHRISTIAN SENGER (BRENDAN FREY)



(Left to right) Richard Penner, Gregory Levey and Joshua Landy, co-founders of Figure 1.

[that] the InteraXons of the world can catch up really quickly," notes Ms. Khayat. "I think that's one of the reasons why we're now seeing this volume of technology integrators coming up, and they're smart, hungry, agile and extremely capital-efficient."

Gregory Levey, CEO and co-founder of Toronto-based Figure 1 Inc., says the intersections between digital technology and traditional industries provide fertile ground for innovative companies that can identify and address unmet user needs.

In health care, where Figure 1 is applying its technology, most systems are disparate. Computers and networks don't talk to each other, and institutions lack the platforms that could allow practitioners to share information with their peers in other hospitals or even other parts of the world.

Enter Figure 1, an app which allows doctors to consult with other doctors around the world by posting — with their patients' permission — an image and short summary of the case in question. The app even lets users "page" and solicit input from particular specialists.

"What we're doing is bringing social media and consumer technology to health care," says Mr. Levey, whose company is a MaRS-supported venture. "We're bringing the world of Snapchat to a world that's been generally reluctant to embrace technology."

Mr. Levey says Figure 1 now has more than a million registered users, with up to 10,000 users active during any given time — proof that the company has tapped into a collective need, particularly among millennial health-care workers, who are used to sharing information with a quick swipe on their mobile devices.

"There are the kids who grew up on Snapchat and Twitter, and when they get to the hospital they're told they have to fax something," says Mr. Levey.

Figure 1 sees potential convergences with other sectors. As its user base continues to grow, the company could expand into polling, research and data analytics. Figure 1 is also looking to layer machine learning — a type of artificial intelligence — over its product, notes Mr. Levey.

As today's hybrid startups continue to grow and explore convergence in other spaces, the challenge for some will be how to choose and stay focused on the best opportunities.

"We've created this very powerful platform that has so many potential applications," says Mr. Luke. "What we're doing now is just the tip of the iceberg." ■

LEAGUE

Founder of Kobo creates new mobile platform that gives employees Uber-like access to a network of health and wellness providers

Getting a ride these days is as easy as swiping to Uber. So why is it still so hard for Canadians to use and pay for the health and wellness services provided by their employers?

Mike Serbinis asked himself this question during a talk about the future of medicine, which highlighted cutting-edge innovations such as personalized, DNA-based therapies.

"As I was hearing about all these futuristic Star Trek–like innovations, I thought: I can't even get an appointment at certain clinics and when I finally do, I need to spend so much time filling out all these forms," recalls Mr. Serbinis, a Toronto entrepreneur well known for building two highly successful companies: Kobo and DocSpace.

And that was how Mr. Serbinis's newest business venture began. In June 2015, he launched League Inc., a digital company whose mobile platform gives employees Uber-like access to a network of health and wellness providers.

Need a chiropractor, osteopath or Pilates coach? Just swipe and tap. No forms to fill out and no credit card needed to cover deductibles. With the League app, users get a digital wallet loaded with a preset amount provided through their employer-sponsored health plan.

Using League translates into convenience and cost savings for both employees and employers, according to Mr. Serbinis. To make this happen, he and his team at League needed to work across multiple sectors, from health care and insurance to mobile applications and financial technology.

"We started out with this idea that we could transform the consumer health-care experience by empowering people to be healthy everyday," says Mr. Serbinis. "I think we've accomplished this with League." **MARJO JOHNE**

Joyce Sou, left, the director of B Lab Canada, and Sarah Prevette, founder and CEO of Future Design School, discuss the value of social-enterprise companies having a B Corp certification.

SOCIAL ENTERPRISE

Unlike corporate social responsibility programs, where good deeds are an add-on to a company's usual revenue-generating business activities, social enterprises do good through their products and services.

BY MARJO JOHNE / PHOTOGRAPHY BY JEFF KIRK

The business of changing the world is more than a calling for Gavin Armstrong; it's a profitable enterprise.

Four years ago Mr. Armstrong founded a company that makes fish-shaped cast-iron ingots that, when used in cooking, can provide up to 90 per cent of the recommended daily iron intake for an entire family.

"People assume we're a charity, but we are, in fact, a for-profit business," says Mr. Armstrong, CEO of Toronto-based Lucky Iron Fish, whose mission is to reduce iron deficiency — a problem that affects about 3.5 billion people worldwide. "Not everyone gets that. Some people think that if you're working towards a good cause, then you can't also be making a profit at the same time."

Lucky Iron Fish is part of a small but growing group of social enterprises — companies that address societal issues through financially viable, and often profitable, business models. While there are no statistics tracking the number of social enterprises in Canada, a 2013 survey by RBC found that 9 per cent of 511 respondents fell into the category.

Unlike corporate social responsibility programs, where good deeds are an add-on to a company's usual revenue-generating business activities, social enterprises do good through their products and services. For instance, Future Design School, a Toronto-based startup founded by Sarah Prevette, fosters creativity and entrepreneurial skills in youth. Its Young Innovators program exposes children and teens to the latest thinking from current entrepreneurs and encourages them to come up with solutions that could bring meaningful change to the world.

"Today's entrepreneurs want to build businesses that reflect what's important to them," says Allyson Hewitt, who leads the social innovation programs at MaRS Discovery District.

The rise of social entrepreneurship is driven in large part by millennials. As business owners,

Gavin Armstrong founded Lucky Iron Fish in order to help reduce iron deficiency around the world while at the same time making a profit.

consumers and employees, today's younger generation shows a marked preference for companies with a social purpose, says Ms. Hewitt.

Her observation is supported by various studies. For instance, a 2015 survey of millennial business owners by American City Business Journals in Charlotte, N.C., found that more than half are committed to baking sustainability into their products and services.

But being good isn't always easy, especially when that mandate runs parallel with commercial and financial goals. Like other types of businesses, social enterprises face a number of challenges, including a constant shortage of money to fund growth and the need to measure performance against non-traditional metrics.

MaRS has rolled out a number of programs to address these challenges. It has partnered with Sir Richard Branson's foundation, Virgin Unite, to create the MaRS Catalyst Fund, which invests only in businesses doing good for society or the environment. The MaRS Catalyst Fund recently became lead investor in the seed-stage financing round for Future Design School.

MaRS also launched the Social Venture Connexion — SVX for short — to connect qualified social enterprises with accredited investors. After three years in operation, the online platform is looking to open its doors to retail investors soon and will be expanding south of the border to California this fall.

For Canadians, this means more opportunities to invest in companies that are making a positive social impact, says Adam Spence, director of the SVX.

"As folks become more interested in purchasing products that match with their values, we believe that more individuals will also be willing to invest their money in the companies that make these products," he says.

Canada is moving in step with global trends, which point to a burgeoning impact investment market. In a survey last year of 156 investors, the non-profit organization Global Impact Investing Network found that respondents had close to $75-billion (U.S.) in impact investment assets under management.

"There are a lot more investment options today," notes Bill Young, an impact investor and president of Social Capital Partners, a Toronto company that connects small businesses to social financing with lending terms linked directly to community hiring. "There is a broader realization that we do need more sustainable solutions."

While investing in a social enterprise can mean sacrificing financial returns, this is no longer the general rule, says Mr. Young. Today, many privately owned and publicly traded social enterprises generate market-level returns for their investors.

To help businesses measure their success as a social enterprise, MaRS brought into Canada the B Corp certification.

Like the Fair Trade initiative for coffee, a B Corp certification signals to the world that a third party — in this case, representatives of the non-profit organization B Lab in Wayne, Pa. — has looked at a company's practices in such areas as community and environmental impact, human resources and corporate governance.

"A lot of companies believe they do great things, but if they're not measuring it, how do they really know?" says Joyce Sou, director of B Lab Canada. "If you believe your customers and employees care about your values, then having a third party validate and measure how you apply those values would be of great benefit to your business."

Raymond Shih, president and co-founder of QoC Health, agrees. Toronto-based QoC Health creates apps that improve patient care. Being a B Corp has boosted his company's credibility and given it an added edge over competitors.

"Health care is one of those industries where there's such a degree of trust necessary to achieve things properly, but everyone is talking about empowering patients and it's hard to verify who's actually living up to it," says Mr. Shih, whose company builds apps that connect patients with the people, resources and knowledge they need to take greater control of their health care. "The B Corp certification proves that we care enough about living up to our core principles."

About 170 Canadian companies, mostly small businesses, are now B Corps, says Ms. Sou.

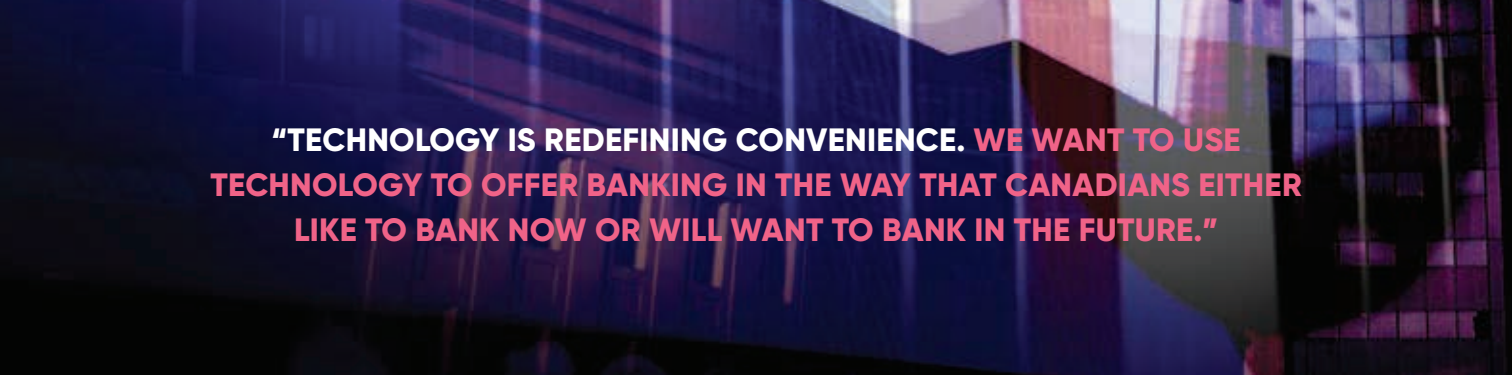
"Bigger companies are starting to ask how they can engage and become a B Corp. Who knows, perhaps in the future every business will be a social enterprise." ■

PHOTO: COURTESY OF LUCKY IRON FISH

Big Financial Firms and Fintech: A Fine Romance

WHEN STARTUPS AND MAJOR PLAYERS COLLABORATE, EVERYONE WINS

BY DAVID ISRAELSON



"TECHNOLOGY IS REDEFINING CONVENIENCE. WE WANT TO USE TECHNOLOGY TO OFFER BANKING IN THE WAY THAT CANADIANS EITHER LIKE TO BANK NOW OR WILL WANT TO BANK IN THE FUTURE."

"When I go into a bank, I get rattled," the legendary Canadian humorist Stephen Leacock once wrote.

Today it's the banks that risk getting rattled, as technology moves financial services to your tablet and smartphone. The movement has given birth to a whole new sector: financial services technology, or fintech. Yet, rather than recoil from fintech, financial institutions are looking for ways to hook up with the innovators. Banks have formed partnerships with groups like the financial technology (FinTech) cluster at MaRS Discovery District in Toronto, which is working with 15 financial services firms, and has inked 50 other partnerships.

MaRS FinTech is working with major players such as CIBC, Interac, Manulife, Moneris, PayPal and Sun Life. Among the startups that the cluster supports are companies deemed to have high growth potential such as BioConnect, Tacit Innovations and Trulioo. There is also the physical space, the MaRS C Suite, where corporate firms such as CIBC, Manulife, Moneris and IBM have embedded teams to collaborate with a range of startups.

"If you're a major institution, it's difficult to do financial technology innovation off the side of your desk," says Adam Nanjee, head of the financial technology cluster at MaRS. "We connect the startups to the financial institutions, the institutions to the startups, and we connect the entire community to the venture capital world."

There is considerable imperative for large institutions to stay up to the moment in fintech; otherwise, they risk being overtaken by new digitally-based competitors.

"There's some real change occurring and, therefore, some real potential threat," notes David Williamson, senior executive vice-president and group head of retail and business banking for CIBC. "Our approach is to see the opportunity.

"Technology is redefining convenience. We want to use technology to offer banking in the way that Canadians either like to bank now or will want to bank in the future."

Fintech's rapid growth and the need to move fast make it more attractive for big finance to collaborate with startups rather than compete.

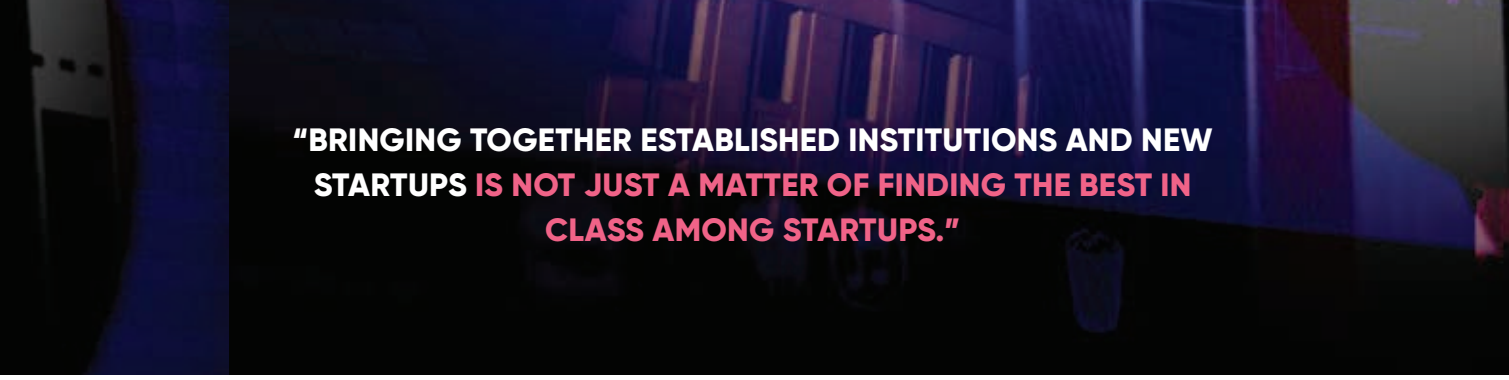
"Big banks and fintech startups have a great deal to offer each other," says Stephen Ufford, CEO of Trulioo, a

MaRS leading the way in digital recognition

With ever more sophisticated transactions occurring through smartphones and apps, improving identity verification is a pressing concern. Here are some of the MaRS innovators taking the lead on digital recognition.

BioConnect has developed an "identity management platform and applications focused on enabling the easy adoption of current and future biometric technologies." What this means is fintech "that can prove that you are really you," explains Bianca Lopes, co-owner and vice-president of strategy, alliances and marketing at the Toronto company. Biometrics platforms are already in place that let users be identified through their fingerprints and eyes; eventually each person's individual heartbeat pattern could be used for logins as well.

"The idea is, you can just be who you are and identify yourself through something that's unique to you," says Ms. Lopes. The goal is to build an "agnostic" platform – something that can accept new identification technology as it comes on board.



"BRINGING TOGETHER ESTABLISHED INSTITUTIONS AND NEW STARTUPS IS NOT JUST A MATTER OF FINDING THE BEST IN CLASS AMONG STARTUPS."

startup that is part of the MaRS network and has developed a new platform for online identification. "Collaboration is fundamental to financial inclusion and international expansion. Banks have a large customer base, stable infrastructure and capital to fund new projects. Startups provide out-of-the-box thinking, technical expertise and agility to adapt quickly to change."

CIBC collaborates with MaRS FinTech across three "horizons." The first is looking at "what is" — how to apply fintech to the core services offered by bankers, such as mortgage applications.

"The second is innovation at the boundary — things like how you hold your phone, how you touch your phone to connect. It's close to what we do now, but just outside 'what is.' The third horizon is further out there — things like cryptocurrencies [which use encryption for security]. MaRS facilitates us across all the horizons," Mr. Williamson explains.

"We started building this type of capability about two years ago," notes Sebastian Blandizzi, senior vice-president, head of global solutions delivery and CIO of the investment division at Manulife. "It lets us explore, research and prototype new ideas to determine [which] are worth investing in."

The idea behind collaborating at MaRS, Mr. Williamson adds, is "to get some really bright people together, give them an idea to work with and unfetter them, see what they can do in a short time."

For example, CIBC worked with a MaRS team to develop a system for clients to negotiate mortgages entirely through smartphones.

Collaboration among the big financial institutions is common, but there are limits, he notes. "We have shared space on the ground floor [with Moneris and Manulife] and we have other space upstairs for when we have some really snappy idea that we're not ready to share."

If anything, collaboration might ensure that the financial sector isn't rattled. Partnerships and collaboration help startups get their starts and help accelerators grow; they help big institutions determine which young companies have the most potential.

"Bringing together established institutions and new startups is not just a matter of finding the best in class among startups," Mr. Nanjee says.

"It's also about finding the best fit, and we help do that," he adds. ■

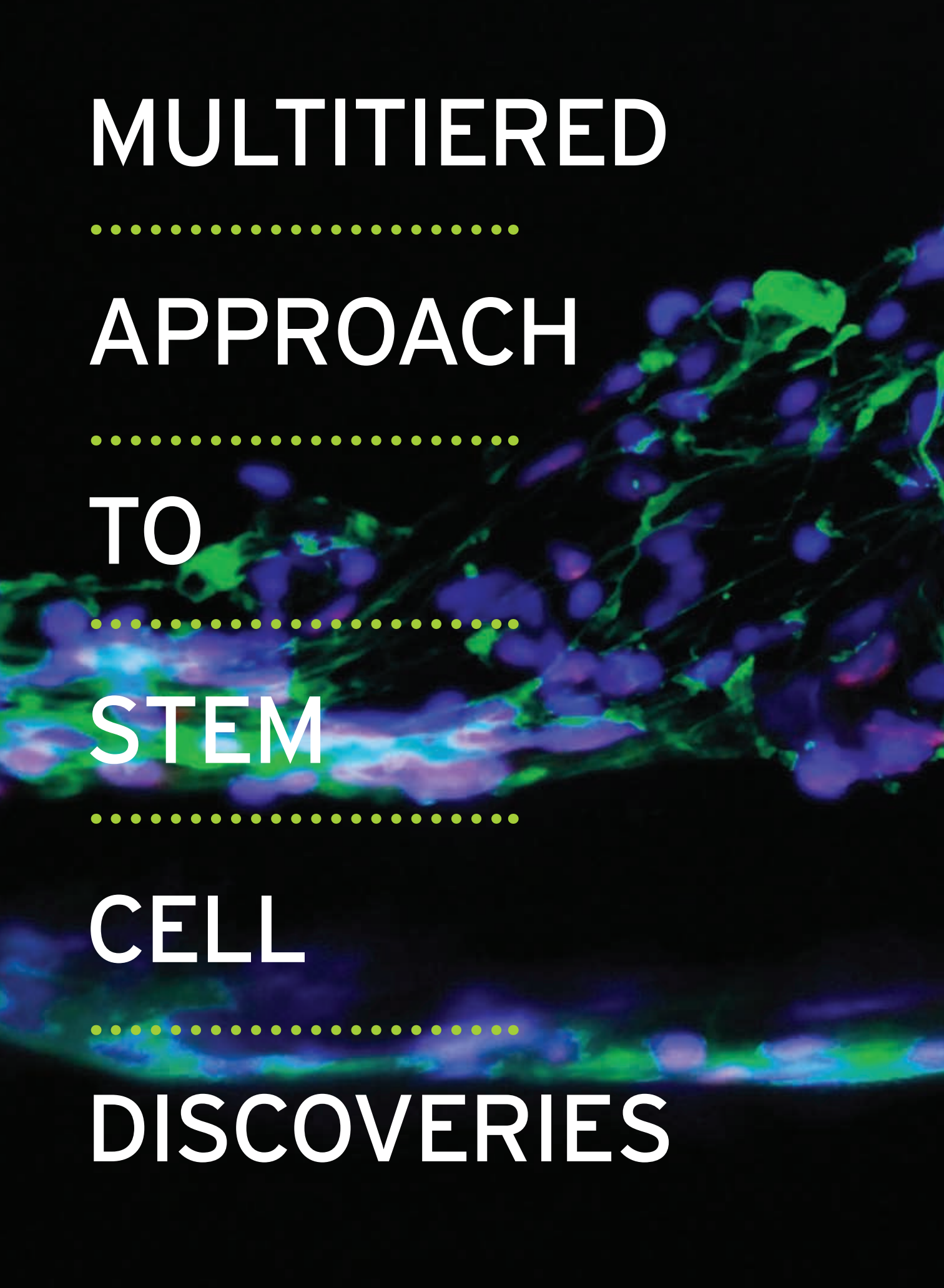
Tacit Innovations developed maegan™, a mobile payment application for restaurants, and worked at MaRS with Moneris, which made it easier to integrate the app into digital payment systems like Apple Pay. "The way our [payment system] works with Moneris is that it gives clients access to their funds immediately – there is no hold on their payments; they don't have to wait two weeks for payouts. This is important for businesses like restaurants that work with really low margins, says Cris Jucan, Toronto-based Tacit Innovations' founder and CEO.

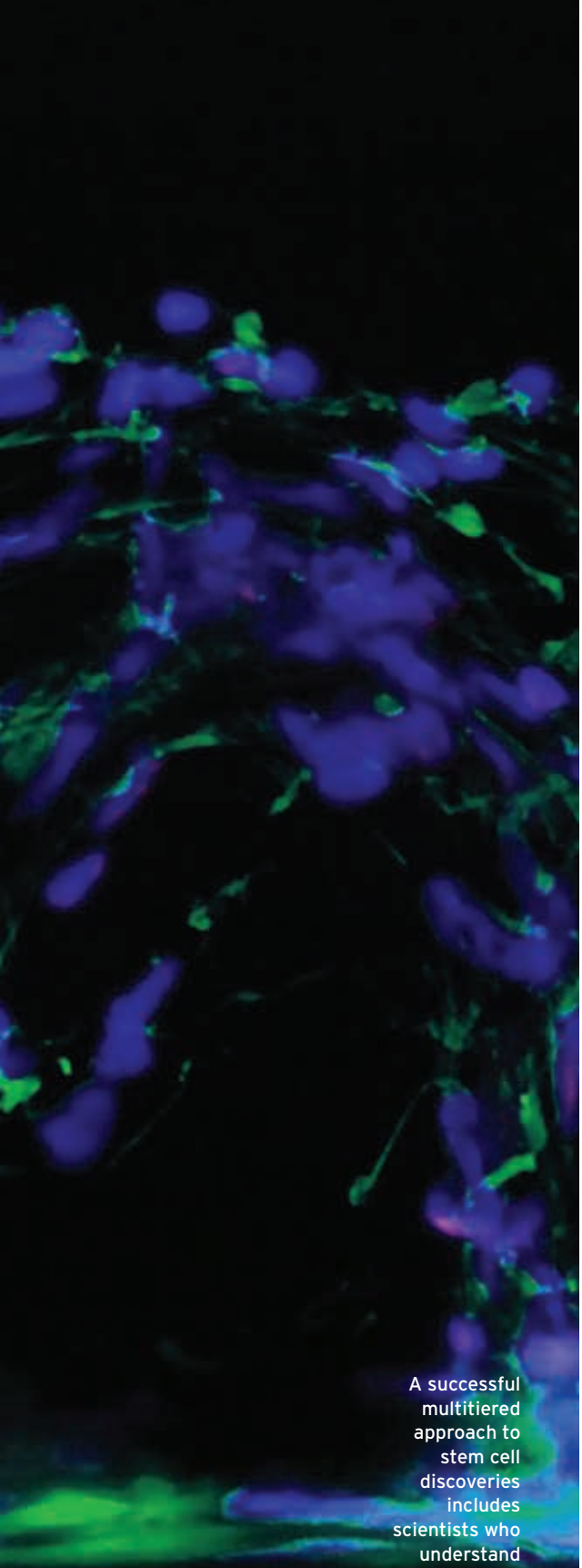
Security Compass helps developers design and build applications and software that are more secure. "We use 'ethical hacking,' which actually breaks into software and looks for deficiencies," says Rohit Sethi, the Toronto company's chief operating officer. Security Compass meets up with financial services companies at MaRS because they have a constant need to make their products more secure.

Trulioo, headquartered in Vancouver, is a global ID-verification company that specializes in scoring online identities as authentic, machine-generated or fraudulent. It provides services to four billion people in more than 40 countries, including coverage for the most challenging demographics in emerging markets, such as China, Russia and Brazil. "We ride that wave between fintech and what's called 'regtech,' or regulatory technology," says Zac Cohen, Trulioo's general manager. "As financial technologies grow, [companies] need to be aware of all the obligations and regulations they must meet." Trulioo helps streamline the labour-intensive work of going through all the rules and regulations that fintech firms must meet around the world.

DAVID ISRAELSON

MULTITIERED APPROACH TO STEM CELL DISCOVERIES





A successful multitiered approach to stem cell discoveries includes scientists who understand biology and clinicians who understand the diseases, says Dr. Duncan Stewart, president of OIRM.

Triathlete reaps the benefit of cross-disciplinary setting and sharing of ideas

BY MARY GOODERHAM

Training for a Half Ironman competition in 2005, Tina Ceroni started experiencing muscle stiffness and spasms — early signs of a rare autoimmune disease called "stiff person syndrome" that, within six years, sent her to hospital on a weekly basis, suffering from life-threatening respiratory distress.

Fortunately, in dealing with this challenge, she reaped the benefits of Canada's leadership in stem cell therapies.

"I was in a deep downward spiral. My future was bleak," recalls Ms. Ceroni, 38, a kinesiologist and personal trainer in Toronto. But then, an experimental procedure at The Ottawa Hospital Research Institute — where chemotherapy was used to eliminate her immune system and purified stem cells were transplanted into her to grow a new one — "restored my old life," she says. "I am in complete remission."

Such breakthroughs date back to the discovery of stem cells in 1961 by doctors James Till and Ernest McCulloch at the University of Toronto.

"We've had leaders in this field doing outstanding pioneering work for decades now. But you can't do anything in isolation," says Dr. Duncan Stewart, president and scientific director of the Ontario Institute for Regenerative Medicine (OIRM), which translates stem-cell and other regenerative medicine research into clinical applications. "Science is complicated, it's multidisciplinary, and it increasingly needs a group effort."

Dr. Stewart, who is also executive vice-president of research at The Ottawa Hospital, explains that this "multitiered approach" to stem cell discoveries includes scientists who understand the biology and clinicians who understand the diseases.

"In Toronto and Ontario, we've got many of these things covered," Dr. Stewart points out, noting that the collaborative activity is particularly centred around MaRS. "MaRS brings us all together. It's enormously helpful," he says.

A cornerstone of this cross-disciplinary setting at MaRS will be the CCRM, a leader in commercializing therapeutic technologies. In January the federal government announced a $20-million grant to set up a new Centre for Advanced Therapeutic Cell Technologies at MaRS, matched by GE Healthcare

with another $20-million.

The facility, which CCRM will operate with the University Health Network, will grow stem cells uniformly and in the numbers and quality needed for clinical trials and eventually for approved medical procedures, says Michael May, president and CEO of CCRM.

"We are creating a unique cluster in regenerative medicine activities," says May. "MaRS is not just a building. MaRS is a collection of minds and companies and facilities that are in close proximity, creating a critical mass of innovation and interaction and connection. There really will be nothing like it in the world."

According to Mr. May, this "ecosystem" of academia, manufacturers and investors makes for successful technologies that are tested clinically, developed and made in Ontario. It will lead to robust, sustainable companies that are "sticky," he says, and thus will remain here, positioning the province as a global cell-therapy hub.

Commercialization and funding are critical to bring groundbreaking research into practice, notes Jon Rogers, chief operating officer of XOR Labs Toronto, which improves viability of organs destined for transplant using gene or stem cell therapy.

And although "we have brilliant scientists and clinicians," Mr. Rogers says it's equally important to have engineers and designers who convert the science into a product, as well as business and commercial expertise to bring it to market.

Prime Minister Justin Trudeau (far left photo) talks with staff on a tour of CCRM. Above, triathlete Tina Ceroni discusses her treatment with Dr. H. Atkins.

These are still early days for regenerative medicine, Dr. Stewart cautions. "The potential is huge, but there's a long learning curve to go through."

Five years after her stem cell transplant, Tina Ceroni sees first-hand the potential for stem cell science to transform lives.

"When you live with a debilitating disease and you have no idea where your future is going, any glimmer of hope is important," she says. "It takes time, it takes research, it takes doctors and scientists coming together to put best practices into medicine. But it's remarkable what they're accomplishing." ■

PHOTO: COURTESY OF CLINICAL TRIALS ONTARIO (TINA CERONI), THE CANADIAN PRESS IMAGES/CCRM/SALVATORE SACCO (PRIME MINISTER JUSTIN TRUDEAU), SOLAR SHIP INC. (OPPOSITE PAGE)

Regenerative medicine

A clinical trial currently underway is testimony to the power of teamwork in regenerative medicine. It uses transplanted stem cells from umbilical-cord blood to treat patients with acute myeloid leukemia.

The trial is being conducted by ExCellThera, a Montreal-based spin-off launched by CCRM and the Institute for Research in Immunology and Cancer — Commercialization of Research. It increases stem cell growth using technology developed by Dr. Guy Sauvageau, a biologist at Université de Montréal, and Peter Zandstra, a biomedical engineer and leader at Medicine by Design, a new initiative by the University of Toronto.

The issue they addressed was that the amount of blood banked from umbilical cords is inadequate to treat an adult leukemia patient. Dr. Sauvageau developed a small molecule to enhance blood stem cell growth, while Mr. Zandstra developed a bioreactor that helps grow stem cells. Combining the molecule and the bioreactor produces up to a 150-fold expansion of stem cells in just 12 days.

"Convergence is critical," says Mr. Zandstra. "The problems we're seeing in biomedical research are bigger than [what] can be solved by any one discipline or any one lab."

MARY GOODERHAM

Solar Ship Inc. has created an amazing hybrid aircraft that can take off and land on any clear surface. The aircraft combines aerodynamics and the buoyant gas used in blimps.

TAKING CLEAN TECHNOLOGY TO NEW HEIGHTS

Connecting cleantech innovators with capital and customers at MaRS Cleantech Venture Services

BY DAVID ISRAELSON

Canadians concerned about the slump in our economy due to a drop in oil prices should take heart. The same forces pummelling our traditional resource sector are creating new opportunities in cleantech, and entrepreneurs are jumping on them.

Canadian innovators are tackling global challenges caused by climate change with new technologies that promise to improve the lives of billions while strengthening our economy. That is precisely the sweet spot targeted by the team of cleantech advisors at MaRS.

"We focus on clean technology as a solution to the energy and environmental problems that the world faces, while bolstering our economy here at home," says Jon Dogterom, managing director of MaRS Cleantech Venture Services.

Brothers Nic (left) and John Paul Morgan are the co-founders of Morgan Solar, a company that uses innovative technology to dramatically reduce the cost of capturing and concentrating solar energy.

The cleantech market is exploding both in Canada and around the world. MaRS Discovery District is one of the leading catalysts for driving new green solutions to the world's eco-woes, supporting more than 160 innovative companies.

One of those firms is Morgan Solar, a company that has developed and markets innovative, cost-effective, solar panels that are translucent so they double as windows. "Everyone talks about costs [within the energy sector], but fewer people talk about efficiency, esthetics and what kinds of products they want to live with and have around their offices," says Mike Andrade, CEO of Morgan Solar.

Today, about 70 per cent of cost is related to distributing power across the grid. Clean energy produced in buildings and at home — close to where it's used — would mean less need for huge power plants and costly electricity grids. But to achieve this goal, says Mr. Andrade, we must produce products that are more attractive and easier for consumers to use, like the consumer-friendly designs that Morgan Solar is working on.

The cleantech sector now employs more Canadians than any of the forestry, pharmaceutical or medical-device industries and has more firms than Canada's aerospace or auto industries, according to the 2016 Canadian Clean Technology Industry Report released by Analytica Advisors.

"The cleantech market is going to rival the size of the oil and gas market by 2020," predicts Tom Rand, managing partner of ArcTern Ventures, the in-house, privately backed cleantech venture fund of MaRS.

"The corporate sector has begun to figure out what [we] climate nerds have known for a decade or so, that the transition to a low-carbon economy is inevitable. It has to happen sooner or later," Mr. Rand says.

In fact, cleantech firms outshine startups in other sectors in early-stage exports. For example, over 74 per cent of the revenue generated by cleantech ventures in the MaRS network comes from exports. Startups such as Hydrostor Inc. are scaling — not just from venture capital investment, but through sales to markets outside Canada.

Hydrostor has developed a prototype system to store energy using compressed air kept in

3 FIRMS WITH A FOCUS ON ENERGY AND THE ENVIRONMENT

The more than 160 companies connected with MaRS Cleantech Venture Services span every aspect of energy and the environment. Here are just three of these firms:

Hydrostor Inc.

The biggest barrier to a lower-carbon, alternative-energy world is how to store clean energy produced when the wind blows or the sun shines. Hydrostor's solution? Take it underwater.

The company's technology takes electrical energy and uses it to push air into giant balloons stored underwater, also capturing the heat generated during this step. When there's power demand, the water pressure on the balloons reverses the airflow, mixing it with the stored heat to drive a generator.

Hydrostor's prototype three kilometres off Toronto Island has

underwater balloons. Its test facility at Toronto Island can produce enough power to serve 300 homes.

MaRS is helping companies such as Hydrostor by connecting them with an international network of potential partners, customers, investors, talent and seed capital.

"We have three different priority areas," Mr. Dogterom explains. "One is supporting the supply side of innovation—helping innovative companies grow and scale by bringing access to customers and capital, providing supporting resources for talent and market research and connecting them to a broader network."

The second priority area is on the demand side, breaking down the barriers to technology adoption.

MaRS is one of the leading catalysts for driving new green solutions to the world's eco-woes.

Cleantech customers tend to be highly regulated outfits, like utilities, that aren't always easily equipped to reach out to nimble new firms. So MaRS is working within the utility system to create a regulatory and cultural environment that embraces these innovative solutions.

The third area is in helping secure funding through ArcTern Ventures and other entities.

"Since 2008 [when the global recession hit], the venture capital community had largely turned their backs on cleantech," Mr. Rand says. "Now we have forces in Canada that are capable of competing on the global stage."

According to Mr. Rand, MaRS-connected companies can now produce some of the world's lowest-cost solar panels and energy-storage units. They also offer the lowest-cost means of producing ethanol and biofuels.

Despite the gains Canadian entrepreneurs are making in this sector, there's still room to grow. According to the 2016 Canadian Clean Technology Industry Report, Canada's share of the global cleantech market slipped from 14th to 19th between 2005 and 2014.

Change can come fast, though, spurred by the collapse in oil prices, new funding and what appears to be a serious commitment by Ottawa and the provinces to a real climate-change policy. MaRS and the companies it's working with aim to make that growth curve take a sharp turn upward. ■

six balloons located about 60 metres underwater. The next step is to scale up the one-megawatt prototype to a system with five times the power output.

Morgan Solar

Imagine solar power without the government subsidies that often draw criticism. Morgan Solar has done more than imagine. Its ultra-thin solar panels, now being tested in Ontario and California, yield industry-leading energy outputs at low cost. It has also made it easier to deploy solar energy.

"Everyone talks about cost, but there are other factors," notes Mike Andrade, Morgan Solar's CEO. "How easy is it to set up and once it is set up, do I want to live with it?"

It appears that people do. "Solar is becoming accepted as a credible alternative to other forms of energy under the right circumstances," says Mr. Andrade. "In any part of the world, solar power already costs less than nuclear, gas or coal."

Solar Ship Inc.

Is it a bird, a plane? It's a Solar Ship — a hybrid aircraft that combines aerodynamics and buoyant gas used in blimps, so it's light and nimble enough to take off and land on virtually any clear space.

With large inflated wings, the design provides a large surface for solar power, though the aircraft can also run on conventional fuel.

The goal of Solar Ship Inc., founded by Jay Godsall in 2006, is to build an aircraft that can fly anywhere without the need for fuel or airports and deliver goods to remote communities.

DAVID ISRAELSON

Data analytics firm OMX, started five years ago by Nicole Verkindt, gradually went from startup to scale-up and now assists 3000 companies.

MEETING THE CHALLENGES OF THE INNOVATION ECONOMY

Supporting innovators is about fostering both supply and demand. Public policy that helps startups to scale up is critical to the future innovation economy.

BY MARY GOODERHAM

The company that Nicole Verkindt started five years ago in Toronto bears little resemblance to the one she heads today. Called OMX, it began as a database where aerospace and defence contractors could identify suppliers. Sometime after year two it made the transition from a "startup" to a "scale-up." Through repeated iterations, OMX has become a data analytics firm, assisting some 3000 companies in aerospace, defence, oil and gas, and mining to track and manage the economic impact of their supply-chain decisions.

"It's another animal now; every two weeks, we release new features," says Ms. Verkindt, 32, the company president, who knows from experience the challenges of the innovation economy. While startups need nurturing and capital to adapt, adopt and commercialize, those at later stages like OMX must open even more doors, with the support of policy-makers and an innovation process more focused on the downstream.

Critical levers that can encourage existing companies to gain better traction in the marketplace include focusing on specific technology clusters, smartening our bureaucracy, eliminating barriers to technology adoption as well as increasing the demand for — rather than just the supply of — innovation.

> "The quality of businesses and the 'pipeline' of ideas driving innovation have grown tremendously in the last five years."
>
> Salim Teja, Executive Vice-President, Ventures, MaRS

"We could be doing a lot more," says Salim Teja, executive vice-president of the Ventures program at MaRS Discovery District.

"These are the companies we really want to double down on," he says, noting that a key focus at MaRS is to get firms to the next stage of development. "Starting companies is not the hard part; the hard part is scaling companies."

Indeed, the quality of businesses in Canada and the "pipeline" of ideas driving innovation "have grown tremendously in the last five years," Mr. Teja says. "We are at a stage where our entrepreneurs are thinking about disruptive and important technologies. They're thinking about big global problems and market opportunities to bring real science and technology-driven innovation."

Tech trends on the innovation horizon include artificial intelligence and machine learning; cyber-security, sensors, networks and the "Internet of things"; data science; advanced robotics; advanced visualization and virtual reality. The goal is to identify industries that will require such technologies, with energy, health care and finance among the prime candidates. Corporations, policy-makers and regulators within these sectors must be prepared to welcome innovation, as well as to lower barriers to its adoption.

"Entrepreneurs may have the latest and greatest breakthroughs, but sometimes they're going to hit a brick wall," Mr. Teja comments. Collaboration and developing an innovation-friendly culture are essential to nurturing new ideas.

Investment, procurement and regulations are needed that promote systems change and

> "THE FUTURE OF OUR COUNTRY IS NOT JUST DEPENDENT ON THE SUPPLY OF INNOVATION, BUT ALSO THE ABILITY OF OUR ECONOMY AND OUR SOCIETY TO RECEIVE THOSE INNOVATIONS."
>
> Joeri van den Steenhoven, director of the MaRS Solutions Lab

technology adoption, says Joeri van den Steenhoven, director of the MaRS Solutions Lab. For example, fostering businesses that are part of the new sharing economy means not just cutting red tape but also helping government interact with them differently. "We need smart regulation to become a smart country," he says.

It's important to future-proof markets that are highly regulated, such as health, education and energy, allowing them to accept waves of new digital technologies that bring rapid change.

"The future of our country is not just dependent on the supply of innovation but also the ability of our economy and our society to receive those innovations," Mr. van den Steenhoven says. This means encouraging institutions to acquire new Canadian technology, from hospitals rethinking their procurement policies to utilities embracing transformation. This way, supply stands a better chance. It's also critical for government to become a customer of innovation.

"Companies absolutely need to sell" in order to be successful, Ms. Verkindt comments. "Sales are your oxygen and the fuel to growth."

The more that entrepreneurs can work on product development with large corporations and sell into their global value chains, the better. International customers and investors are particularly critical; OMX has found markets in countries such as the Netherlands and Denmark and is working on further expansion into Kuwait and India.

"This stuff doesn't get solved with one new program with a fancy name on it," she says. "It's a culture that has to evolve."

The next five to ten years are going to be important "for us to be coordinated and focused on developing good companies and good success stories and getting the world's attention focused on us," Mr. Teja notes. "We need momentum."

It begins with the release, expected this autumn, of the federal government's much-anticipated innovation agenda. Its support for scaling companies will determine if Canada can position itself as a global innovation player.

"There's a role for public policy here," says Dan Breznitz, the Munk Chair of Innovation Studies and co-director of the Innovation Policy Lab at the Munk School of Global Affairs at the University of Toronto. "I would like to see actions that reduce the inherent uncertainty with regard to innovation."

He says it's critical to improve the environment for rapidly growing Canadian scale-ups, so they stay in the country rather than head to the U.S. This means everything — from addressing regulations so that companies that develop products are able to sell them here to marshalling the financial resources to support innovation activities, especially beyond the ICT and biotech sectors. Canada should also be part of the increasing global discussions that are setting rules around innovation, which will affect everything from intellectual property rights to technology standards.

Beyond innovation by entrepreneurs themselves, radical experimentation is needed in terms of policy instruments that help such companies scale up, Mr. Breznitz says. Of course, some policies will fail, so it's important to institutionalize these levers within the bureaucracy or political careers will be derailed. This will also ensure that the commitment to innovation goes beyond the next political cycle.

"Whether we like it or not, innovation is the only agent of long-term economic growth," Mr. Breznitz adds. "If we want our children to have a better life and better life prospects, we need to ensure that Canadian companies grow and that they grow in Canada." ■

Canada's fintech sector is evolving, poised for rapid adoption

Innovation in payments, the future is fintech

Without a doubt, the era of financial technology, or fintech, is upon us with a growing number of Canadian startups and companies operating in this sector. It's one of the hottest trends of 2016 with startups entering this flourishing category to help modernize services and solutons for today's connected consumers, so they can get better access to their money. Many of the building blocks are now in place for this sector to accelerate growth.

Canada enjoys one of the most stable and well-established financial sectors in the world, says Mr. Alexander Peh, PayPal Canada's Head of Market Development and Mobile. That stability means "Canada offers the perfect environment for fintech growth," notes Mr. Peh.

Globally, 15.5 per cent of digitally active consumers have used at least two fintech products within the past six months according to the EY FinTech Adoption Index. "But in Canada, only 8.2 per cent of digitally active consumers have used at least two fintech products within the past six months – in the form of money transfers and payments, or savings and investments. This proves the sector is ripe for bigger growth and innovation," adds Mr. Peh.

"Canada offers the perfect **environment for fintech growth.**"

Alexander Peh,
PayPal Canada's Head of Market Development and Mobile.

Successful fintech clusters have had the benefit of strong support networks. In Canada, banks and large financial institutions are embracing technology to serve their clients. One of the strategies is to place teams in innovation hubs so they both help and benefit from being close to startups.

The recently opened MaRS C Suite offices provide physical space for corporations to work alongside young companies that are looking for the right partners to provide the expertise and experience to get new products to market.

"MaRS is a world-class innovation hub," says Mr. Peh. "Firms that work in MaRS have much more access to partners who can help them innovate with a customer-centric approach," he adds.

This kind of collaboration is the key to the future, says Mr. Peh. "Fintech players that want to succeed longer term will have to offer more than just a slightly cheaper, faster, and more convenient financial product or service. They will have to focus their energy to solve for issues and friction that Canadians face with the current financial services industry."

PayPal Canada, which recently announced its move into the MaRS West Tower, will assist the Toronto startup community by offering strategy development, mentoring and coaching opportunities to help the new breed of fintech startups succeed.

MaRS has seen its fintech hub grow from zero to over 200 startups in less than two years, says Salim Teja, MaRS executive vice-president venture services. "With nearly 18 years of being at the nexus of finance and technology, PayPal is a pioneer in the fintech industry. Our growing community of fintech startups will benefit immensely from PayPal Canada joining us at MaRS," said Mr. Teja.

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