



ROI RETURN ON INNOVATION

ANNUAL REPORT 2018 –19

Ontario Centres of Excellence Inc.



Ontario Centres of
Excellence

Where Next Happens

Ontario





Ontario Centres of
Excellence

Where Next Happens

What We Do

For more than three decades, Ontario Centres of Excellence (OCE) has focused on ensuring the people of Ontario reap the personal and economic benefits of leading-edge research underway at our publicly funded universities, colleges and research hospitals. OCE maximizes the commercial impact of this research and accelerates the commercialization and adoption of emerging technologies that will create employment opportunities and prosperity for Ontario.

As a TRUSTED PAN-PROVINCIAL COLLABORATION PLATFORM, OCE:

- **DRIVES INNOVATION** by creating a marketplace for companies and entrepreneurs to access the research capacity in Ontario's post-secondary institutions, helping move promising technologies from the research lab to the market
- **CONNECTS SUPPLY AND DEMAND**, making navigation of Ontario's emerging technology assets easier for companies and accelerating time to market
- **CATALYZES CAPITAL** and de-risks early-stage investment opportunities for investors, helping make high-potential start-ups investor- and customer-ready

Inside

- Letter from OCE's President and CEO.....2
- Letter from Chair, Board of Directors.....3
- How We Are Different.....4
- Gateway to Ontario's Innovation System.....5
- OCE-Supported Projects.....6
- Supporting SMEs Across the Province.....7
- Return on Innovation (ROI).....8
- Developing the Next Generation of Talent in Ontario.....9
- Commercialization.....10
- De-risking.....10
- Programs.....11
- AVIN.....12
 - *Sensor Cortek Inc.*
 - *Cloud DX Inc. and Faurecia North America*
- ENCQOR 5G.....14
 - *Clickmox Solutions*
 - *Bloom*
- NGNP.....16
 - *SHYFTinc*
 - *Ukko Agro*
- IBM Innovation Incubator Project...18
 - *RoadLaunch*
 - *AirShare*
- Market Readiness (MR).....20
 - *MedStack*
 - *InnerSpace*
- SmartStart Seed Fund.....22
 - *FleetOps*
 - *DNAstack*
- Voucher for Innovation and Productivity (VIP).....24
 - *Chippewas of the Thames First Nation (COTTFN) and Trojan Technologies*
 - *The Growcer*
- Event Highlights.....26
- Governance and Board of Directors.....28
- Our Partners.....29

Vision

OCE's vision is prosperity from innovation – an Ontario where bright minds connect to create prosperity.

How We Do It

Rapidly accelerating technology is having a profound impact on how industry and businesses work. Both large firms and small- and medium-sized enterprises (SMEs) are finding it necessary to adjust their business models to adapt to the impact of disruptive technologies.

To meet this challenge, the province in partnership with OCE launched the Advanced Technology Platforms (ATPs) initiative to provide Ontario's innovators with access to leading-edge technologies to help accelerate company growth and global competitiveness.

ATPs provide SMEs, researchers and entrepreneurs with access to emerging technologies such as 5G and next generation networks, smart and cloud computing, artificial intelligence and data analytics to develop, demonstrate and commercialize new products and services and provide firms with a competitive advantage.

These include 5G and next generation network testbeds for the validation of new technologies, applications and services; advanced computing technology infrastructure and programming; and the Autonomous Vehicle Innovation Network aimed at reinforcing Ontario's position as a North American leader in transformative automotive technologies.

Governance

A not-for-profit organization governed by an independent Board of Directors that includes observers from the provincial government, OCE is funded by the Government of Ontario and is a member of the Ontario Network of Entrepreneurs (ONE). OCE also receives funding from the Government of Canada.

“

Technology is changing the way we live, work and do business — building our digital infrastructure is key to supporting an innovation economy and the next generation of jobs for Ontarians...We are leveraging Ontario's strengths in information and communications technologies and paving the way for future innovation and growth across sectors. 5G access shows Ontario is open for business.

”

Hon. Vic Fedeli,
Minister of Economic
Development, Job Creation
and Trade



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Canada

Ontario Centres of Excellence is a member of



Ontario



The past year has been both exciting and challenging for OCE. Having entered a period of rapidly accelerating technology innovation, we are seeing a profound impact on business, among large firms as well as small- and medium-sized businesses, that are finding it increasingly necessary to adapt.

Recognizing that the development and adoption of advanced technologies is critical to building an economy that is globally competitive, the provincial government in partnership with OCE is supporting a number of initiatives that provide Ontario's high-potential companies with access to advanced technology platforms to help accelerate their growth and improve their competitiveness.

Over the course of the last year under the leadership of former President and CEO Dr. Tom Corr, OCE and our partners have been intently focused on implementing the roll-out of these technology platforms that are of vital importance to Ontario's economic future.

This includes **5G and next-generation wireless network**

testbeds; advanced computing technology infrastructure and programming; and an **innovation network** devoted specifically to securing Ontario's position as a North American leader in transformative automotive and mobility technologies. Establishing a definitive toehold in what has emerged as a global economic opportunity, we are supporting the development and demonstration of connected and autonomous vehicle technologies.

OCE is helping to drive the commercialization and adoption of new technologies by connecting high-potential companies to the research expertise, technology platforms and capital that they need to grow and succeed in the global marketplace. Drawing on our on-the-ground business development force and ability to forge strategic partnerships through our vast network of academic, industry and government stakeholders across the province, we are bringing collaborators together to solve some of industry's toughest challenges and open new and exciting market opportunities.

Through partnerships with industry and research leaders,

SMEs across Ontario are being provided with access to emerging technologies to prototype and test new products and applications. We continue to challenge Ontario's innovators – companies, researchers and entrepreneurs – to embrace the opportunities presented by these powerful new tools.

Our goals are to maximize the commercial impact of research developed in Ontario's colleges, universities and research hospitals, and to accelerate the commercialization and adoption of emerging technologies that will create employment opportunities and prosperity for Ontario.

We work with many hundreds of researchers and companies of all sizes each year, providing support for collaborative R&D projects, catalyzing capital for high-potential start-ups, de-risking new technologies and making navigation of Ontario's emerging technology assets easier for our innovators.

OCE greatly appreciates and values the opportunity to work closely with our industry, academic and government partners.

We are proud to report the outcomes of our efforts from the past year. We invite you to review this record of our performance and join us in celebrating the success of the entrepreneurs, companies, researchers and innovators profiled in this year's Annual Report.

Dr. Claudia Krywiak
President and CEO
Ontario Centres of Excellence



We feel fortunate every day to be supporting the work of many of Ontario's most talented and committed innovators, those who are helping our province realize its enormous economic potential.

Ontario remains home to a workforce whose level of education, talent, diversity and creativity is unmatched anywhere in the world.

OCE has been a witness to that extraordinary blend of strengths for more than 30 years, and we continue to be amazed by the passion and ingenuity of each successive generation of entrepreneurs.

Today's young entrepreneurs, with their sense of unlimited possibilities, bring an unprecedented level of optimistic drive to their ventures. Their confident outlook is contagious, and we are proud to support them in turning their dreams into the tangible breakthrough products and services that help build a strong Ontario economy.

We are grateful, as well, to work with our visionary industry partners who

understand the value of collaboration in an intensely competitive global economy, the need for a long-term outlook and a relentless drive for innovation.

Our thanks to the Government of Ontario for entrusting us with this important mandate of attracting business and investment, creating jobs and helping to build a strong provincial economy.

I would like to also thank OCE's talented and committed staff who displayed unfailing professionalism and commitment to our customers during what was a challenging year as we moved to align OCE's work with the goals and priorities of the provincial government.

In aid of fulfilling the province's commitment to reduce budget spending, OCE – like others across various sectors of the province – needed to reduce programs and staff. We wish our former colleagues well and continue to build on their efforts to create a strong Ontario.

I believe we are well positioned to meet the challenges and embrace the

opportunities that lie ahead. With the recent departure of Dr. Tom Corr, who as President significantly widened the impact and vision of the organization, we enter a new phase.

Dr. Claudia Krywiak – whose strategic leadership and advice in the role of VP, Corporate Development, Planning and Strategic Initiatives, has contributed greatly to OCE's success – has been appointed President and CEO by the Board of Directors. Many in Ontario's business and government circles will already be aware of her exceptional abilities and commitment to the cause of innovation.

As someone who has worked closely with Claudia for many years, I can attest to her outstanding knowledge of Ontario's innovation system and grasp of how industry, government and academia can work strategically and creatively together to generate job growth and economic development while elevating Ontario's standing as a formidable competitor in global markets. The organization is in good hands and well positioned for continued success.

Michael Nobrega
Chair, Board of Directors
Ontario Centres of Excellence

How We Are Different

Experienced Business Development Team



OCE is unique in deploying an on-the-ground, experienced business development (BD) team across the province. BDs identify what is needed by industry and literally explore the halls and labs of academe to discover the latest research breakthroughs. They help build industry-academic collaborations to commercialize innovation and build a pipeline of high-potential companies that can benefit from directed resources, partners and expertise.

Strong Knowledge of Communities



Because no two communities are the same, OCE plays an essential central role in bringing together stakeholders who can work together to meet the economic development needs of each region. We have first-hand working knowledge of the communities we serve – more than 160 across Ontario since 2013. Embedded in the areas it serves, OCE brings together large industry, SMEs, and academic and government partners that are best able to help the most promising businesses grow.

Requirement for Matching Funds



Unlike most other forms of government support, OCE requires matching industry funding. This unique private-sector matching requirement leads to follow-on investments by angel investors and venture capital funds resulting in many multiples of invested dollars, and the creation of permanent full-time jobs in Ontario at very efficient net costs to the province.

De-risking Expertise



OCE's strong expertise in de-risking innovation helps attract private investors and other funders to companies they would otherwise overlook due to the risks associated with early-stage and new ventures.

Unparalleled Network



A gateway to Ontario's innovation ecosystem, OCE continues to expand its powerful network of partnerships with government, large industry, academia, SMEs, entrepreneurs, investors and other key players in the ecosystem.

“The assistance of OCE BD Manager Jeff van Heumen in establishing relationships with various support institutions has been instrumental in allowing us to explore new manufacturing approaches and has resulted in several significant advances in our design and production methodologies. Jeff has made introductions to or facilitated projects with Mohawk College, Lambton College and Western University. OCE's support and advice has helped us obtain and maintain a position of dominance on the world stage for audio capture in sports broadcasting.”

Paul Johnson, CEO
Quantum5X Systems Inc.



Gateway to Ontario's Innovation System

OCE's broad and deep network in the innovation ecosystem uniquely equips us to offer a pan-provincial collaboration platform for commercializing innovation that leads to job creation and long-term economic prosperity.

- Government of Ontario
- Federal government partners
- Global multinationals
- International partners
- Interprovincial partners
- Non-profits
- Offices of research and innovation/technology transfer offices
- Ontario scale-ups
- Ontario SMEs
- Ontario start-ups
- Ontario's universities, colleges and research hospitals
- Private investors (angels/VCs)
- Provincial and national business associations
- Provincial government partners
- Regional and municipal economic development offices
- Regional Innovation Centres (RICs)
- Small Business Enterprise Centres (SBECS)

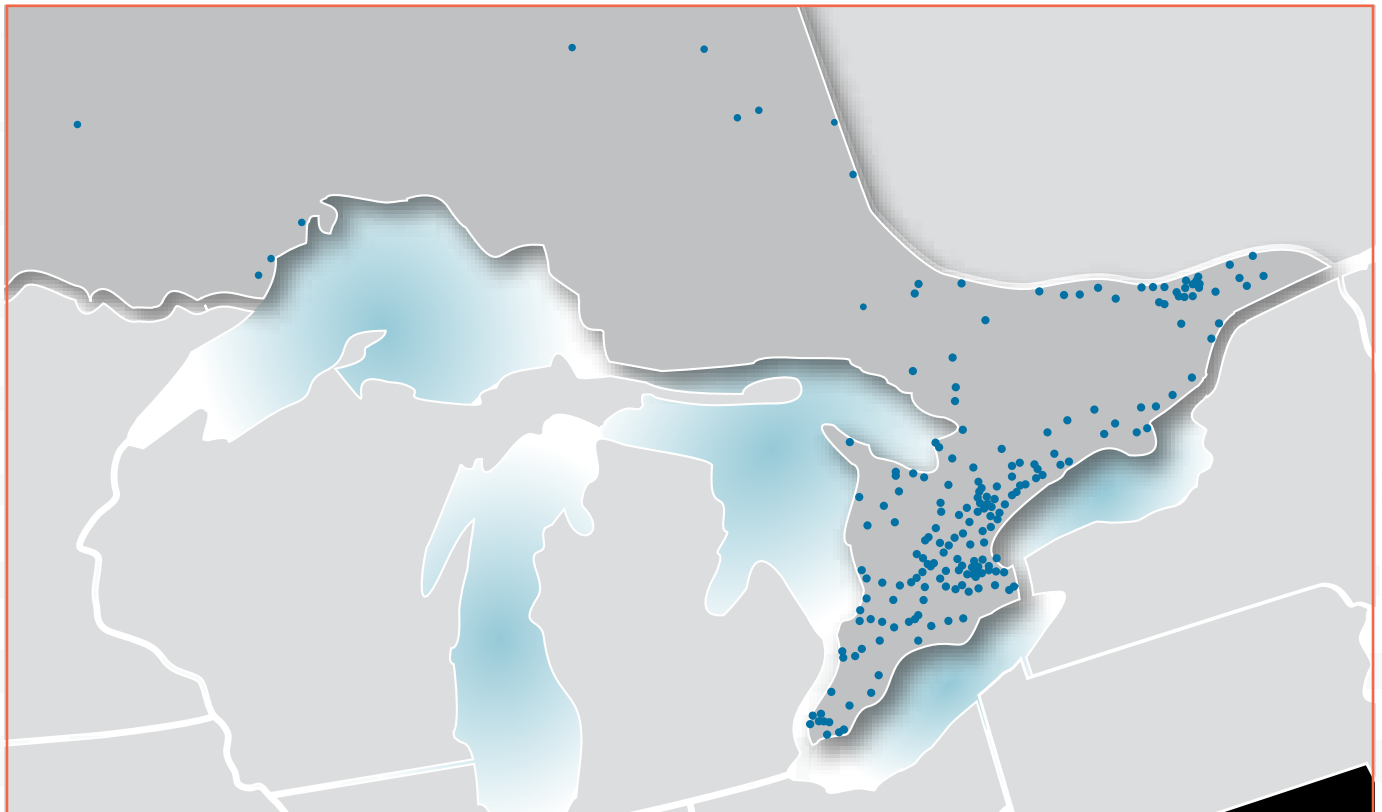
OCE-Supported Projects

During the past five years, OCE funded projects in 160 communities across Ontario.

Our *Projects* page with its interactive map on OCE's website allows users to search our projects by region, economic sector, company/partner, academic institution, company location and project location.

A short description and details related to funding are provided for each project.

This site also provides a view of the distribution of OCE funding by sector, number of projects by university, college or health institute/research hospital, and key metrics related to industry and partner leverage, outcomes such as jobs created and retained, and number of award-winning companies.

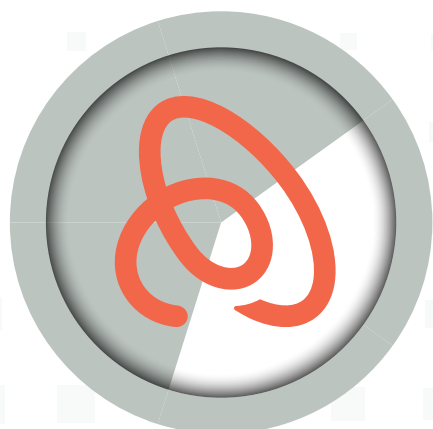


List of communities across Ontario that are recipients of OCE-funded projects

Acton	Bruce Mines	Fergus	LaSalle	Oakville	Renfrew County	Thorold
Ajax	Burlington	Flamborough	Lively	Ohsweken	Richmond Hill	Thunder Bay
Algonquin Park	Caledon	Flesherton	Lindsay	Oldcastle	Ridgetown	Tillsonburg
Almonte	Caledonia	Fort William First Nation	Lion's Head	Orangeville	Rockton	Timmins
Alvinston	Cambridge	Georgetown	London	Orillia	Rodney	Toronto
Ancaster	Carlsbad Springs	Gloucester	Maidstone	Orleans	Sarnia	Troy
Arnprior	Carp	Goderich	Manilla	Oshawa	Sault Ste. Marie	Uxbridge
Ashburn	Cayuga	Grand Bend	Maple	Ottawa	Scarborough	Val Rita
Aurora	Chatham-Kent	Gravenhurst	Markham	Paris	Shuniah	Vankleek Hill
Aylmer	Clarkburg	Greely	Midland	Pembroke	Sioux Lookout	Vaughan
Bath	Cobden	Guelph	Milton	Penetanguishene	Smooth Rock Falls	Wallaceburg
Barrie	Cobourg	Hamilton	Mississauga	Peterborough	Simcoe	Wallenstein
Beamsville	Collingwood	Hanmer	Mitchell	Petersburg	St. Catharines	Waterdown
Belleville	Concord	Hearst	Mono	Pickering	South Porcupine	Waterloo
Bewdley	Cornwall	Huntsville	Napanee	Picton	St. Jacobs	Welland
Big Trout	Delhi	Ingersoll	Nepean	Plympton-Wyoming	St. Marys	Wheatley
Bleazard Valley	Dorchester	Ingleside	New Hamburg	Port Colborne	Stayner	Whitby
Bolton	Dundas	Jordan	New Liskeard	Port Elgin	Stittsville	Willowdale
Bowmanville	Durham	Kanata	Newmarket	Port Perry	Stratford	Windsor
Brampton	East York	Keswick	Niagara Falls	Prince Albert	Sudbury	Woodstock
Brantford	Essex	Kingsville	Niagara-on-the-Lake	Puslinch	Sutton West	Woodbridge
Breslau	Etobicoke	Kitchener	North Bay	Putnam	Tecumseh	York
Brossard			North York		Thornhill	

Supporting SMEs Across the Province

OCE drives the commercialization and adoption of new technologies by connecting high-potential companies to the capital, research expertise, markets and technologies that they need to grow and succeed.



**OCE Connects
SMEs to...**

ONTARIO UNIVERSITY/COLLEGE RESEARCH EXPERTISE

To help solve industry challenges and drive the commercialization of new technologies

ANCHOR FIRMS

To open up global markets for Ontario companies and bring investment into Ontario

ADVANCED TECHNOLOGY PLATFORMS

To give Ontario companies access to advanced technologies and ability to prototype and test new products

INVESTORS

To help high-potential companies accelerate time to market by catalyzing capital and facilitating access to investors

GOVERNMENT

To explore opportunities for government to be an early adopter/first customer of emerging technologies

OCE BUSINESS DEVELOPMENT EXPERTS

To guide application process, identify potential collaborations and advise on company building and market strategy

Return on Innovation (ROI) – 2018–19

OCE is proud to report the following Performance Measurement Outcomes for 2018–19:

\$119
million

Invested by OCE on behalf of the
Government of Ontario in the
province's innovation ecosystem

\$255
million

Matching contributions
from our partners

9,212

High-quality jobs
created or retained directly as a
result of OCE-funded projects

909

New projects

3,110

Start-ups created or supported
directly through OCE seed
financing or indirectly through
other OCE programs

4,188

Highly qualified personnel
who have been trained or had
their knowledge or skills
enhanced through OCE projects

OCE-supported companies

\$271
million

Incremental sales
generated by
OCE-supported companies

\$820
million

Follow-on investment
attracted by
OCE-supported companies

78

Events hosted or
sponsored attracting

16,913 participants

Our metrics are based on a client-based survey involving a comprehensive process that includes attribution, automated and manual verification, validation and analysis. We have a 93 per cent response rate.

Developing the Next Generation of Talent in Ontario



Talent education and training such as internships, fellowships, workshops and mentoring are embedded throughout OCE programs including those focused on industry-academic partnerships, entrepreneurship and advanced technology platforms (e.g., AVIN, ENCQOR 5G and IBM Innovation Incubator Project).

1,812 Individuals have substantively enhanced their knowledge, training or skills through OCE-related initiatives in fiscal 2018-19

Ontario's TalentEdge program generated the following outcomes over the last five years:

1,224
Internships

340
Fellowships

"I was able to refine skills I had acquired in graduate school in a hands-on way and collaborate with people who had vastly different skill sets compared to my own, from a variety of educational backgrounds. I saw first-hand how a diverse set of individuals maximize the potential of a small start-up company."
TalentEdge Intern

Ontario government funding
\$22 million

Additional federal government contributions
\$2.1 million

Matching industry contribution
\$42.1 million

Created or retained
3,660 Jobs

Incremental sales revenues
\$119.5 million

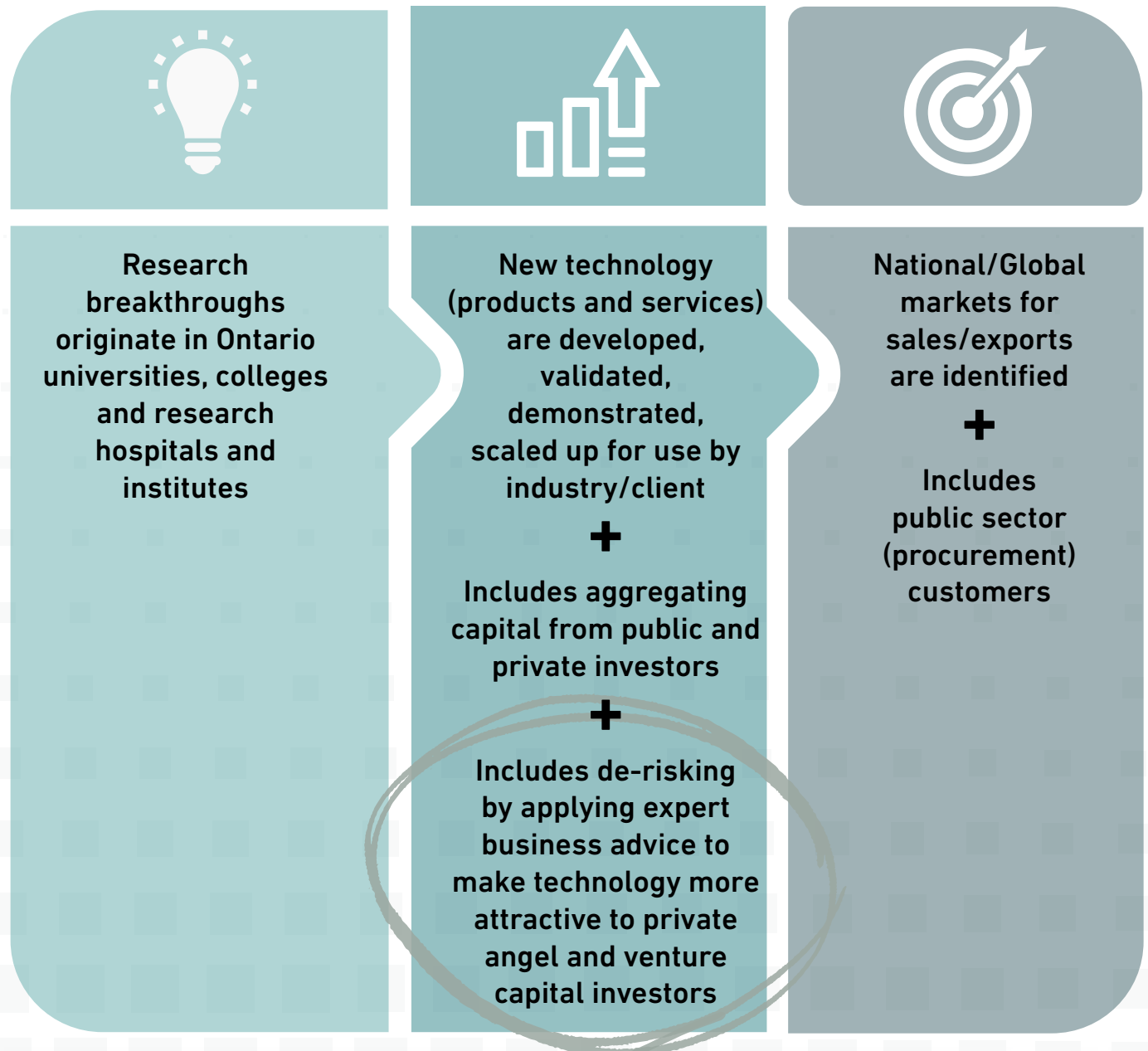
717 Interns and fellows subsequently hired by participating company

>800 Products and services launched

"We were able to use the training/professional advisory funding provided by the SmartStart program to obtain professional legal advice to help us develop an overall IP strategy for our technology and products and corporate brands, and a corporate legal strategy. The legal advisory services have been critical to helping iUGO Health build our brand in the market and enabling us to pursue customers and strategic partners in Canada and abroad."
SmartStart participant

Commercialization

OCE focuses on the critical process whereby creative solutions to societal needs or industry challenges are made workable, cost-effective, investment-ready and commercially available.



De-risking



Programs

In partnership with the provincial and federal governments, OCE delivers a comprehensive suite of programs designed to leverage the full capacity of Ontario's innovation ecosystem.





AVIN forging partnerships that open doors to global markets for Ontario companies

Ontario is well on its way to establishing global leadership in transformative automotive and mobility technologies with the concentrated ecosystem support of Ontario's Autonomous Vehicle Innovation Network (AVIN).

Regional Technology Development Sites (RTDS) across Ontario support SMEs in developing, prototyping, testing and validating new connected and autonomous vehicle (CAV)

technologies. Through these sites, each with a unique area of expertise, companies access specialized equipment and gain valuable technical and business advice.

In fiscal 2018–19, 13 projects and 87 internships and fellowships were approved through AVIN's AV R&D Partnership Fund and Talent Development programs with more than 70 SMEs now leveraging RTDS resources.

SUCCESS STORY – SENSOR CORTEK INC.

Global Company Invests in Ontario

Robust and accurate detection of environmental conditions is vital when developing safe autonomous vehicles. All sensing technologies must be extremely high performance and integrated.

Sensor Cortek Inc., an Ottawa-based company that specializes in the development of leading-edge embedded artificial intelligence solutions for autonomous vehicles (AV), and Valeo, a global automotive supplier and partner to automakers worldwide, are building a new generation of high-definition imaging radars coupled with deep neural networks.

These smarter sensors, which can extract the higher level of information required for self-driving cars and integrate advanced features not available in current radar sensors, will perform even under poor lighting and adverse weather.

AVIN played a key role in bringing us together with a global automotive supplier, says Dr. Robert Laganieri, CEO of Sensor Cortek Inc.

"There's no doubt that the participation of AVIN in this R&D project reinforced by the renowned Canadian expertise in AI was a decisive factor in convincing Valeo to invest in Ontario."

"From the beginning," says Dr. Julien Rebut of Valeo Canada, "the ambitions of AVIN and its means were aligned with the autonomous driving challenge. That could have been enough to convince Valeo to invest in Ontario. But our relationship with OCE, from the first contact and all along the project submission phase, built a



mutual trust which was decisive."

"This project raised a lot of interest and expectations within Valeo. There is no doubt Sensor Cortek engineers and all the support we get from AVIN will help us to succeed," says Dr. Rebut.

AVIN's Ottawa Regional Technology Development Site provides the unique testbed for developing and prototyping the technology.

Sensor Cortek is currently building a large dataset of radar imagery under various urban driving scenarios. The new test track in Ottawa is a unique infrastructure that is particularly helpful to perform real-world data capture in a controlled environment, says Dr. Robert Laganieri, Sensor Cortek's CEO.

Ottawa's diverse climate conditions will test the robustness of Sensor Cortek's AI-enhanced sensor solutions, especially in winter, he says.

"Winter driving conditions are often neglected, probably because most R&D activities in AV are being performed in regions with milder climates such as California."

As a direct result of the AVIN investment, Sensor Cortek has created five new jobs for highly qualified persons.

Through the AVIN Demonstration Zone in Stratford, operated by the Automotive Parts Manufacturer's Association (APMA), Ontario-based companies with CAV technologies test and showcase innovative products to potential customers and partners using vehicle platforms. The first "vehicle integration", completed in June 2019, incorporated technologies from ten Ontario SMEs. The second vehicle integration was completed

in September 2019, with the integration and demonstration of technologies from five SMEs. The automotive and mobility sector received a boost in 2019 when the Ontario government announced \$40 million in new funding for the auto sector under Ontario's Driving Prosperity Plan. This included additional support for the innovation ecosystem through the launch of the AVIN WinterTech program and talent development through AVIN's province-wide network.

"AVIN is creating the ecosystem and infrastructure necessary to build the next generation of mobility companies in Ontario," says Raed Kadri, Senior Director of OCE's Automotive Technology and Mobility Innovation portfolio, and head of AVIN.

"We are helping SMEs develop and prototype their technology and engage with potential customers on a global scale. We are also attracting large companies to invest and partner in Ontario."

SUCCESS STORY – CLOUD DX INC./FAURECIA NORTH AMERICA

Getting Vital Signs en Route

Imagine being able to go to a medical appointment with your blood pressure results, respiration rate and body temperature in hand.

With support from AVIN, a Kitchener-based company with expertise in medical-grade biometric monitoring hardware and software, is collaborating with a global leader in automotive technology to make that possible.

Cloud DX Inc. and **Faurecia North America** are creating vital signs tracking technology that can withstand the uneven and noisy conditions of road travel. The breakthrough tool, which has received positive reviews from medical professionals, saves time for patient and doctor and offers a more accurate reading of biomedical results given a longer period of monitoring.

AVIN enables the partners to develop a prototype and demonstrate and validate the product. It's an important first step in the development of technology that improves the passenger experience in autonomous vehicles and could also greatly enhance emergency medical care.

In bringing Faurecia and Cloud DX together, AVIN created significant advantages for both. As an Ontario SME, Cloud DX gains by partnering with a major technology company that supplies the world's automotive industry. Faurecia is excited about linking up with an innovative company at the forefront of high-quality medical grade wearables and sensors for medical data in non-medical environments.

"Working with a terrific company like Faurecia is a big deal for us," says Robert Kaul, CEO

of Cloud DX. This support from AVIN led to a commercial deal with Faurecia much faster than would otherwise have been possible and to a very strong partnership."

Faurecia's Innovation Director Matthew Benson says the support from AVIN was an incentive and made this project "much more possible to do and do right."

Faurecia is increasingly seeing the benefits of conducting R&D in Ontario. "As a global company, we could be doing work like this anywhere in the world. We are becoming more engaged in working in Ontario and Canada because of the quality of the entrepreneurs and technology companies and the support coming from the provincial and federal government, with programs like AVIN."

Benson and Kaul both see many exciting applications for the technology, which sets the stage for streamlined integration with existing health care and transportation infrastructures.





Canada's first pre-commercial 5G wireless testbed now up and running

The first Canadian pre-commercial fifth generation (5G) wireless network for open innovation is now a reality: The ENCQOR 5G testbed is live and in use by SMEs at all three Ontario hub locations (MaRS, Communtech and Invest Ottawa).

A demonstration program, technology development program and internship program are generating strong

interest and demand from SMEs aiming to develop and test new products and services that are enabled by 5G.

ENCQOR 5G (Evolution of Networked Services through a Corridor in Québec and Ontario for Research and Innovation) is a transformational Canada-Québec-Ontario partnership focused on research and innovation in the field of 5G disruptive technologies.

ENCQOR 5G

SUCCESS STORY – CLICKMOX SOLUTIONS

Operating Underground Drones From the Surface to Keep Miners Safe

As technology advances, machines are increasingly replacing people in jobs that involve dangerous conditions. One such job in the mining industry requires sending miners deep underground without fully understanding the stability of the work environment.

Clickmox Solutions is developing a system that enables unexplored cavities of underground mines to be surveyed before miners begin any work in the area. The Sudbury-based company works with the mining and industrial sectors,

providing product development and service in the areas of three-dimensional scanning robotics, geotechnical monitoring and much more.

Through a project with ENCQOR 5G, Clickmox Solutions is using 5G to test the capabilities of their system and determine whether miners can safely operate underground drones and other machines from the surface. Running the systems over 5G networks, the project is testing underground drones operated from the surface with continuous high-bandwidth and low-latency connectivity of about 10 milliseconds or less.

"This system is a step change in the technology. With this project, we'll be able to demonstrate it to new clients and offer a solution that is currently non-existent," says Syed Naeem Ahmed, President and founder, Clickmox Solutions. "This technology is going to bring a new dimension to the industry and make things a lot easier for the mining industry and potentially other industries as well."

The company expects to add jobs as it continues to develop and demonstrate the breakthrough technology to both existing and new clients.



With Digital Innovation Hubs in Ottawa, Toronto, Kitchener-Waterloo, Montréal and Québec City, the initiative underscores the potential for business collaboration in key areas such as transportation including connected and autonomous vehicles, remote health care, virtual/augmented reality, smart cities, fintech, industry, energy, cybersecurity and the Internet of Things (IoT).

With OCE's business development team driving

industry outreach in Ontario, applications from SMEs are being accepted in both provinces.

ENCQOR 5G is spearheaded by five world-class digital technology companies—Ericsson, Ciena, Thales, IBM Canada and CGI—with support from Canada's federal government and the provinces of Québec and Ontario.

"OCE is excited to be working with these world-class companies and the innovation

hubs supporting Ontario SMEs to develop and commercialize new products and services that leverage 5G wireless disruptive technologies to drive economic growth and the creation of high-quality jobs," says Tim Kostyniuk, OCE's Senior Director, Digital Economy Technologies.

The five-year ENCQOR 5G initiative is expected to create 4,000 jobs including 1,800 specialized 5G jobs.

SUCCESS STORY – BLOOM

Unlocking the Yield Potential of Indoor Crops

Science and technology have made a big difference in how many of today's farmers go about improving crop yields and making their farmland more profitable.

Most existing technologies help farmers by providing data on growing conditions such as light, moisture, pH, air temperature and humidity.

Bloom, a Toronto-based software company and subsidiary of Normative Inc., is focused on extracting data about the crop itself.

"In the ecosystem of farming sensors and IoT devices, this is the only one that continuously scans the entire crop," says Jon Tirmandi, COO of Normative Inc.

"A sensor technology, it tells farmers how the crop is responding to its growing environment and, combined with other available information about growing conditions, allows them to optimize yields or reduce losses."

A subsidiary of Normative Inc., Bloom relies on powerful computer vision applications attached to thermal imagers whose algorithm analyzes millions of data points at a time, then processes and delivers them to farmers in a form they can use to improve production. Measuring how moisture is processed by the plant and the rate of photosynthesis in crops, Bloom offers coveted information unlocking the yield potential of indoor crops, allowing farmers to grow more with less.

Through its participation in ENCQOR 5G and the promise of 5G's low-latency, high-bandwidth connection, Bloom aims to remove expensive,



error prone hardware and accelerate research that will help lower the cost of hardware components, making its product more accessible to farmers.

"We are very excited about being able to offer a product to any grower or technology provider of indoor agriculture that gives them the ability to receive continuous feedback on their crop," says Tirmandi. "This data helps to ensure that the growing environment for plants is always optimal. While farmers are the immediate beneficiaries of our product, the consumer benefits from a higher quality product as well."

Bloom is in its first round of commercial piloting. Lab-scale testing and commercial R&D tests have been completed and the technology is now entering a pilot roll-out to scale the platform, develop new features and integrate it with more technology partners.



Ontario SMEs now accessing open next-generation network and cloud testbed

As the world moves increasingly toward cloud applications, the changing needs of business are now being met with the successful roll-out of the Next Generation Network Program (NGNP). The NGNP provides SMEs with access to a state-of-the-art, open multi-vendor network and cloud testbed and technical services to support

the development of new digital technologies, products and services.

Fifty-five projects are underway in Ontario as OCE's business development team in collaboration with the Centre of Excellence in Next Generation Networks (CENG) continues to drive a strong pipeline of applications.



SUCCESS STORY – SHYFTINC

Validating Next Generation Management of Mining Materials

The proper management and coordination of mine materials through safe storage is a common and costly challenge in the mining industry.

Sudbury-based mining technology company **SHYFTinc** has developed an innovative technology to fully automate the management of materials. Their Automated Delivery of Mine Material and Inventory Technology (ADMMIT®) system is comprised of separate components, the SmartCube® and PAC™, that will allow for just-in-time delivery of required materials and goods.

SHYFTinc is testing and validating the integration of the SmartCubes into the ADMMIT system. SmartCubes are enhanced containers that will employ IoT sensors that allow for live monitoring and feedback of consumption and real-time tracking of mine materials. This is especially critical for materials that are prone to spoilage such as concrete mix, or that need careful or controlled handling, such as chemicals or biohazardous materials.

"Working with OCE greatly helped in the acceleration of time to market. By working with OCE and CENG through the NGNP project, we were able to perform scale-up testing and simulate system performance with increasing numbers of field devices," says Trang Tran-Valade, President of SHYFTinc. "This information allows our organization to confidently speak to system performance, server requirements and known limitations. Also, access to the CENG

testbed enabled current issues and limitations to be identified quicker and addressed sooner."

The ongoing project will demonstrate the capabilities of the ADMMIT system when installed in a cloud data centre, and scaled up both to test the responsiveness of the system with large numbers of field devices and to identify any performance limitations. With the results from this project, SHYFTinc will be able to continue testing on industrial sites and refine the SmartCube technology so that it becomes commercially available in the near future.

"Our organization is passionate about helping clients meet production targets through advanced automation of the mining value chain," Tran-Valade says. "With ADMMIT, we are focusing on the development of new and cutting-edge technological solutions that can reach every corner of the globe. The growth potential is unlimited!"



Addressing the needs of SMEs for more flexible and agile networks to support the virtualized servers and storage infrastructures of modern data centres, NGNP delivers a centralized, programmable network that supports rapid deployment of new applications, services and infrastructure.

The program, with matching industry and partner contributions, is offered through a partnership between

CENGN, OCE and the Ontario government.

Working with three Digital Innovation Hubs (MaRS, Commitech and Invest Ottawa), the NGNP offers SMEs access to the CENGN testbed to support the development of new digital technologies, products and services. Also, the CENGN testbed is integrated with the Ontario Research and Innovation Optical Network (ORION) to ensure SMEs have virtual access to the testbed

from anywhere in the province including rural and northern Ontario.

NGNP also has dedicated funding for innovative projects across Ontario that demonstrate new technology solutions that offer flexible, lower cost, higher performance residential broadband access for northern and rural communities.

There is also funding to support the development of new products and services for smart mining and agriculture.

SUCCESS STORY – UKKO AGRO

Taking the Guesswork Out of Farming Methods

For many farmers, correctly determining what their crops need to grow or predicting diseases that may harm their fields has depended on a combination of experience and gut feeling. As farmers move toward being more sustainable, they are seeking more precise means of making these decisions.

To help farmers transition to more sustainable farming methods, Toronto-based technology company **Ukko Agro** is developing a technology-enabled solution that equips growers with solid information for using and tracking pesticides. The company's smart agriculture solution is an infrastructure that uses IoT, machine learning and cloud computing to predict the onslaught of pests and diseases. The IoT sensors collect field-specific weather data that is analyzed by the back-end software solution to predict the probability of a disease attack on the field. With this prediction, the software solution will suggest optimized pesticide spray cycles to a grower.

Building off the first scaled-down version of their solution, Ukko Agro worked with OCE and CENGN through the Next Generation Network Program (NGNP) to demonstrate the second version, which is a scaled solution to handle more

complex scenarios and a wide variety of crops. This version was then expanded to support more sensor units to cover more surface area and apply to a wider variety of crops.

"We're a small company, and with support from OCE and its programs, we were able to leverage the grants to take our solution to the next level and attract talent to our company," says Ketan Kaushish, CEO and co-founder of Ukko Agro.

As the company continues to develop its solution throughout the progression of the project, Ukko Agro is setting its sights on the third generation of the product, which will add new features based on feedback from growers. The company is looking to expand the platform by 2020.





IBM Innovation Incubator Project

SMEs access globally disruptive, advanced computing technology

With the emergence of big data, data analytics, artificial intelligence and smart computing, companies can incorporate new information and knowledge when developing new products and services.

The IBM Innovation Incubator Project levels the playing field for SMEs and provides a platform for ongoing productivity and economic growth by offering them an integrated suite of globally disruptive, advanced computing

SUCCESS STORY – ROADLAUNCH

Streamlining Shipping for Land, Air and Sea

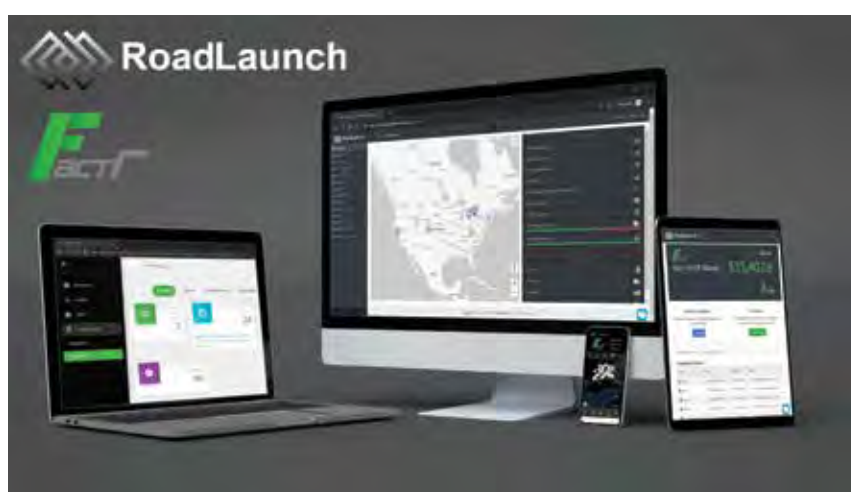
Companies that ship products now have a way to address all the usual logistical and accounting headaches and create a streamlined process for shipping freight anywhere in the world.

RoadLaunch, headquartered in Paris, Ontario, uses locations, freight, permissions-based Smart Contracts, and intelligence tools to optimize end-to-end Logistics Supply Chain workflows in real time. This enables a company to manage its fleet, save time and connect securely with trusted freight partners, then process cross-border settlement in seconds.

Through RoadLaunch, a company is connected to a central dashboard that provides fleet visibility, smart matched loads, inventory, order replenishment, automated tasks, instant documents, order management and instant payments.

"We start by digitizing capacity, whether a truck is full or empty or somewhere in the middle. We then work with a company to remove all the frictions in their supply chain, digitize documents and update the entire process of final delivery," says Cory Skinner, the company's CEO and co-founder.

RoadLaunch has been able to enhance its business success through its participation in the IBM Innovation Incubator Project, where companies gain access to advanced technology platforms. The program has helped RoadLaunch expand into several new markets and operate in 12 countries.



"Working with the Ontario government, OCE and IBM as a partner, as well as Canada's Trade Commissioner Service, we have been able to develop new products to go global. We have been able to take advantage of funding, and to also gain platform support like Watson or IBM Blockchain," says Skinner.

Through OCE, RoadLaunch was approved for a customer demonstration project, TalentEdge, ENCQOR 5G, as well as support for scaling up, pursuing new markets and accessing advanced platforms including IBM Cloud and IBM Watson.

"The future is going to be a lot of fun for us," says Skinner.

The company is now moving from being solely a platform for supply chain logistics to also being a partner in transactions and financing.

"We are now able to move from the realm of ground freight to air freight and sea freight and to providing credit facilities, instant transactions and instant payment settlements. It's very exciting."

technology infrastructure and programming.

Founded in 2015, the program has, as of September 2019, helped 921 SMEs gain access to technology and services to scale their companies.

Through the Program, qualifying SMEs can receive funding for customer demonstration projects and access to tools such as IBM

Watson, Blockchain and IBM Cloud, access to advice and workspaces at IBM and MaRS, Communitech, DMZ, Invest Ottawa and ventureLAB hubs, and to IBM customers.

The program also funds talent development through internships and fellowships.

This initiative enables SMEs to develop, demonstrate and commercialize new products

and services that leverage smart computing and artificial intelligence to drive economic growth and create jobs.

Through open innovation and access to new technology platforms, SMEs can commercialize emerging models and solutions and grow to meet the needs of global customers.

SUCCESS STORY – AIRSHARE

Safely Intercepting Dangerous Drones

There is growing concern about the increasing use of drones, especially near airports that report more than 250 incursions per month in North America. Halting air traffic due to drones takes an average of 60 minutes and costs the local economy about a million dollars (USD) a minute. Drones are also a problem over stadiums, prisons, nuclear power facilities and other critical infrastructure.

Threats posed by drones are difficult to detect and safely mitigate. The solution must be aggressive enough to defeat small drones, but safe enough to use directly over people and assets. **AirShare**, an Ottawa-based counter-drone equipment maker, has the solution.

It detects, tracks and mitigates drones by intercepting them with a steerable hobby rocket. Instead of hitting the drone or exploding, the rocket pops off its nose cone and releases a cloud of latex strips that get entangled in the drone's propellers and bring it safely to the ground on a parachute.

AirShare was aware that as technology advanced, their solution would need to become "an autonomously operating response to autonomously operating threats," says Rick Whittaker, founder and CEO of AirShare.

They applied to the IBM Innovation Incubator Project to use IBM's Watson and high-speed, cloud-based data repository and processing engine, enabling them to develop and train two AI models used in the missiles, on-board flight computer and to develop a lightweight, AI-enabled optical seeker, whose future 5G compatibility is being explored through an ENCQOR 5G iPaaS Access Project.

"Customers have expressed a need to add AI-based optical sensing to AirShare's offering," says Whittaker. "The OCE project has been instrumental in enabling us to add this capability. Without OCE, AirShare would be delayed by at least a year and may have missed the opportunity to commercialize this in Canada, and maintain our company and jobs in Ontario."

This development has led to a new hire with more in the pipeline, a \$1.09-million contract with the Canadian government, and a \$200,000 contract with the Department of National Defence. AirShare was selected as one of only five start-ups to present at the Chicago Midwest Corporate Venture Forum and the US Army Soldier Systems Center in Natick, MA. It was also accepted into the U.S. Air Force AFWERX/Techstars new technology accelerator in addition to being named one of Techopia's Top 5 Companies to Watch in 2019.





Investing in Ontario's up-and-coming companies

OCE is the most active pre-seed stage investor in Ontario, strategically investing in companies across all technology sectors.

The Market Readiness Co-investment Fund invests

directly in companies to accelerate their early-stage commercialization and support their growth into a scalable business.

These young companies are raising pre-seed and seed

SUCCESS STORY – MEDSTACK

Overcoming the Challenges of Developing Apps for Healthcare

In order to commercialize innovations, entrepreneurs must go to the market to find potential customers who are able to successfully adopt the technology. In the health care industry, the path to commercial success is more difficult. Successfully integrating an app into various health care systems (hospitals, insurance companies, public health organizations, clinic networks, etc.) involves navigating data management expectations and ensuring the app not only takes into account user experience and medical efficacy but also complies with privacy standards.

Seeing the problems of innovators when it comes to gaining traction for health care apps, Balaji Gopalan and Simon Woodside co-founded Toronto-based **MedStack** to make the transition

from development to commercialization more smooth, specifically in the health technology sector. Their system configures cloud-based hosting for digital health applications with customized tools and infrastructures, along with built-in privacy and security protocols and real-time auditing and monitoring.

With support from Market Readiness, MedStack focused on using the constructive feedback they received on their product proposition to scale their brand and product deployment, grow their team to provide more support to their clients and bring their next-generation product to market.

"What excites me most about what we are doing is the impact we are having on digital health adoption," says Natalie Calderon, Director of Brand and Community Marketing at MedStack.

"Our customers' success is our success, and they are seeing real and tangible results."

Having raised \$2.4 million in an oversubscribed seed round and currently supporting more than 60 digital health companies across North America, MedStack is continuing to expand, growing to a team of 15 employees and launching their next-generation platform MedStack Control, which empowers health tech developers with more flexibility and power to deploy their applications in a compliant manner.



investments, with total round sizes ranging from \$500,000 to \$2 million.

A competitive co-investment fund, Market Readiness considers more than 300 companies for funding each year and approves 30 to 40 investments a year. The Fund, which has invested

in 160 companies to date, supports Ontario companies that demonstrate early evidence of a scalable, repeatable business model serving an identified need in their market.

In fiscal 2018–19, Market Readiness companies attracted more than 4,600 customers

and generated \$4.1 million sales in Canada and \$2.1 million in sales worldwide.



SUCCESS STORY – INNERSPACE

Making the Best Use of Precious Space

In an era when the price of corporate office space in desirable locations can be astronomically high, businesses are actively looking for ways to reduce costs.

With its innovative hardware-enabled software platform, **InnerSpace** is addressing this need. The company delivers indoor location services to commercial buildings far faster and at a lower cost than existing competitive solutions.

Their platform makes it simple and fast to deliver useful applications for the workplace. For example, it allows companies to determine how many desks relative to employees they would need with a shared workplace model to right-size their footprint without a lot of wasted effort and loss of productivity.

“We help businesses understand how their space is being used by the people that occupy it, and this is broadly applicable across a lot of verticals including retail or commercial real estate,” says James Wu, CEO of InnerSpace.

InnerSpace partnered with a global foodservice and support services company on projects supported by both the IBM Innovation Incubator Project and the Market Readiness Fund.

InnerSpace was able to demonstrate how their technology could help the provider, which operates cafeterias in 50,000 commercial buildings, identify opportunities to optimize operations, improve

customer satisfaction and reduce labour costs through workflow optimization. With the location intelligence platform, InnerSpace’s partner gains access to data about where people spend time within the commercial spaces they manage and can make active and informed decisions about resource deployment to help manage payroll costs.

“Participating in OCE’s programs significantly contributed to our ability to close a large commercial partnership deal,” says CEO Wu. “That partnership deal was core to our ability to raise \$2.1 million at the end of 2018 and has led to date to \$250,000 in incremental sales, with more to come.”

The company has created six new jobs and secured six new customers for its technology.





Supporting Ontario's next generation of entrepreneurs

The SmartStart Seed Fund (SmartStart) supports new ventures led by Ontario's next generation of entrepreneurs to help transition their start-ups from product development to market entry and company building.

The program provides seed funding and support for entrepreneurship

skills training and professional advisory services to for-profit start-ups that are based in southern Ontario and less than four years old, helping them grow their start-up and make them investment- and customer-ready.

SmartStart is supported by the Federal Economic Development

SUCCESS STORY – FLEETOPS/FLEETROVER

Empowering Small Trucking Companies



Given the traditional structure of the shipping industry, **FleetOps** CEO Chris Atkinson saw an opportunity to empower small trucking companies with fleets of five trucks or less. Smaller outfits rely on brokers to book their shipments because they lack the industry resources to book with big shippers like Pepsi or Nestlé. This means they pay an average of 20 per cent per shipment to third parties.

Based in Toronto, FleetOps is levelling the playing field with a software platform that provides connections for truck drivers looking for a load when their trailers are empty on a return trip. Using artificial intelligence and machine learning, the software helps drivers manage complexity by doing the logistics for them.

FleetOps, which also provides access to major shippers, enables companies to make time-saving decisions to improve efficiency, increase revenue and decrease costs, putting that 20 per

cent back into the pockets of small and nimble trucking companies.

As word about FleetOps's unique offering spread, with 75 per cent of leads coming from peer-to-peer sharing via owner/operators, the company needed capital to meet growing customer demand. With a massive opportunity and technology that gave them a competitive edge in the marketplace, FleetOps wanted to capture market share quickly. That's when the company applied to OCE's SmartStart and Market

Readiness Co-investment Fund.

The MR investment was put toward expanding the FleetOps team by bringing in salespeople and marketing experts all focused on driving growth and sales and acquiring as many new customers as possible.

"We are talking about upward of 300 per cent ROI on that investment for sure," says Atkinson. "If you wanted to equate what the funds did to the company growth, those would be the numbers."

FleetOps expects to continue its dynamic growth and be part of more than 200,000 shipments across North America. With the company now double the size and having recently raised \$1.5 million in follow-on investment, FleetOps is expanding its artificial intelligence and working to embed the technology in autonomous vehicles and other additional solutions for drivers.

Agency for Southern Ontario (FedDev Ontario), which has supported the program through \$12 million in contributions since 2015 including \$3 million in 2019.

Over the past five years, with both provincial and federal support, SmartStart has assisted nearly 400 start-up

companies, attracted more than \$150 million in investments to advance the companies' technologies, and created and retained more than 2,800 jobs and led to incremental sales of more than \$33 million. As a part of the \$3 million in new federal funding, 88 additional start-ups received support in the spring of 2019.

At this year's Discovery conference, the SmartStart Entrepreneur Zone exhibited the work of more than 80 SmartStart companies that included innovations in clean technology, health sciences and information and communications technology.

SUCCESS STORY – DNASTACK

Stacking the Odds in Favour of Improving Lives

With advancements in health technologies, doctors and researchers have come closer than ever to uncovering what genetics can tell us about our health. Understanding and identifying the sources of many diseases requires delving in at the molecular level. But decoding the DNA involves downloading massive amounts of data that are difficult to store and to make sense of.

When co-founding **DNASTack**, Marc Fiume was inspired by a personal connection to someone living with a genetic disorder. He was determined to address the challenges researchers face examining genomics, primarily the issues of storing and deciphering large amounts of data. Building on the search and storage technologies of the Google Cloud Platform, DNASTack expanded its capabilities with standard application program interfaces (APIs) to enhance the discovery, access and workflow abilities.

First supported by OCE through the SmartStart Seed Fund, the DNASTack team focused on enhancing the search and analysis of the MSSNG genomic database that houses the genetic information of about 10,000 families affected by autism spectrum disorder. DNASTack's platform allowed authorized researchers to explore data that met industry standards and minimized the risk of counting data twice. This led to a re-analysis of genomic samples in the MSSNG database to improve accuracy of identifying

genetic material.

Over the years, DNASTack and OCE have continued their partnership with additional projects, most recently one under the Customer Demonstration Program that connected the company with researchers from the Hospital for Sick Children to assist with a transition to cloud-based computing and analysis of data in the cloud.

"OCE has provided support that is perfectly aligned with what companies need to break through the various stages of building a company," says Fiume, CEO of DNASTack. "From generating the first version of a product to getting the first customer to going global, OCE has been there to support our company."

Now, a team of 20, DNASTack is currently working on making their software accessible for use by a wider audience.

"We're very excited about breaking down technological barriers to data sharing and collaboration and improving outcomes for the millions of people affected by genetic diseases," says Fiume. "We see ourselves as leaders and advocates for the standards and technologies that allow researchers and clinicians to efficiently find, access and analyze the world's exponentially growing volumes of genomic and biomedical data."





Supporting industry–academic collaborations

Ontario's Voucher for Innovation and Productivity (VIP) program helps the province develop and commercialize new technologies by supporting industry partnerships with Ontario's publicly funded

post-secondary institutions. Projects funded through VIP leverage skills and resources at post-secondary institutions to address company challenges. These include supporting the development of

SUCCESS STORY – CHIPPEWAS OF THE THAMES FIRST NATION (COTTFN) / TROJAN TECHNOLOGIES

Improving Water Quality for First Nation Communities

An investigation into water quality on First Nation reserve lands southwest of London is expected to lead to treatment technologies that can be applied to indigenous communities with similar water supply systems in Canada and around the globe.

The project team includes environmental and hydrologic modelling experts from Western University and the **Chippewas of the Thames First Nation (COTTFN)** and **Trojan Technologies**, a global leader in water treatment technologies.

Biweekly water samples are being collected from seven locations to identify potential environmental impacts of neighbouring areas on drinking and surface water quality in the First Nation community.

Samples are being analyzed for temperature, acidity, dissolved oxygen levels, electro-conductivity, loss of transparency due to dissolved solids such as minerals, salts and metals, and amount of phosphorus and nitrogen.

"COTTFN can now collect meaningful data that enables the team to develop statistical and physical models to calculate the extent

to which various factors contribute to water quality," says Dr. Mohammad Reza Najafi with Western University's Department of Civil and Environmental Engineering. "This will paint a picture for what may be potential threats to our source water."

The phosphorus data gathered from this project has also led to a three-year partnership with the Phosphorus Reduction Collaborative, concerned with land management and drainage solution for agriculture, and the piloting of two technologies in COTTFN for removing phosphorus from the source before it can enter the local waterways.

Under the Voucher for Innovation and Productivity, OCE introduced Trojan Technologies to the project to provide feedback on sampling and modelling results and help to develop suitable treatment technologies.

"This project complements the values of COTTFN and our commitment to protecting and being stewards of our environment. Under our holistic philosophy, this includes having water for drinking but also protecting fish and other animals in the ecosystem. Now we will have the science that we need to move forward in ensuring water quality and protecting our source water," says Emma Young, Senior Environment Officer with COTTFN.

COTTFN has been able to create a new job position of environmental technician. Other indigenous communities with similar water supply systems in Canada and beyond will be able to apply the procedures and treatment technologies developed through this project.



new products and processes or increasing productivity.

Projects help generate new revenues and high-value jobs for Ontario companies. In fiscal 2018–19, the program created or helped retain 1,204 jobs and supported 191 start-ups. OCE-supported companies

generated \$8.6 million in sales nationally and \$21.2 million internationally.

As part of OCE's whole-of-government approach, VIP enables applicants to simultaneously apply for funding with program partners including the federal Natural

Sciences and Engineering Research Council (NSERC), the Industrial Research Assistance Program (IRAP) and Mitacs.

SUCCESS STORY – THE GROWCER

Growing Fruits and Vegetables North of 60

In northern communities, even a head of lettuce can be not only expensive but also difficult to find. Due to harsh weather, these communities must import certain produce for purchase year-round.

Two University of Ottawa students became determined to find a solution to the food security challenges that many Canadians face daily. Corey Ellis and Alida Burke co-founded start-up **The Growcer** to develop technology that creates year-round growing conditions.

Enclosed in redesigned shipping containers, their hydroponic system provides the four essentials for plant growth (water, CO₂, nutrients and light), enabling operators to grow up to 12,000 pounds of produce efficiently and in varying environmental conditions. The company's Arctic Growing System (AGS), created specifically with northern communities in mind, links to satellites for remote connectivity and can operate in temperatures as low as -52 degrees Celsius.

The Growcer received funding through the SmartStart Seed Fund (SSSF) program during its first year of operation when the start-up team needed business and advanced hydroponics training.

"OCE provided us with the foundation that got us to where we are today," says Alida Burke, Growcer's COO. "They worked with us to polish our proposal and business plan and continued to connect us with the resources and support we

needed to grow and develop our company."

As a result of the SSSF, The Growcer received \$110K in follow-on investment from traditional and Angel investors.

The team is expanding both its farmer network across Canada and internationally and the range of produce that can be grown. Currently supported through a Voucher for Innovation and



Productivity (VIP), which helps companies expand into new markets, The Growcer is adapting its hydroponic systems to grow strawberries, a highly coveted fruit in northern communities.

The Growcer has since struck a deal with Chartwells, Canada's largest educational foodservice provider, to bring the '100-foot farm' to campuses across Canada. It has also been awarded a contract with the Build in Canada Innovation Program, appeared on *Dragon's Den* and doubled sales for the third year in a row.

Event Highlights

Collaborations and Networking





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REGIONAL TECHNOLOGY DEVELOPMENT SITES & DEMONSTRATION ZONE



in collaboration with the Ontario Tech University (OTU), OTU's Automotive Centre of Excellence (ACE), Durham College and the Region of Durham.



in collaboration with Carleton University, University of Ottawa, Algonquin College and the City of Ottawa.



in collaboration with the University of Toronto, Ryerson University, York University and Guelph University.



in collaboration with the University of Waterloo, Waterloo Region Economic Development Corporation and Canada's Open Data Exchange.



in collaboration with McMaster University, Mohawk College and the City of Hamilton.



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