

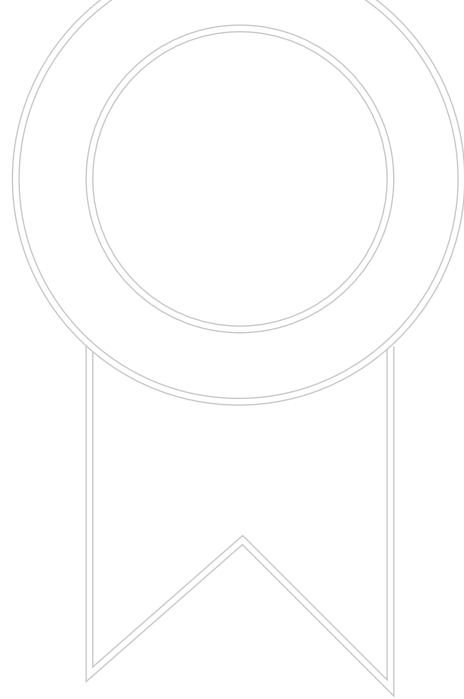


# Annual Report

2017  2018

# 2017-2018 milestones

New initiatives, new partnerships,  
new opportunities in support of globally  
competitive hardware innovation.



CMC concludes deployment of advanced infrastructure for micro-nanotechnology research to **37 Canadian universities** under the \$50M CFI-funded Embedded Systems Canada (emSYSCAN) project.

CMC's biennial **Lab2Fab** workshop held in Montréal and Bromont, QC.

CMC marks the **500<sup>th</sup> project prototyped** at a university-based nanofabrication lab through support from its Micro-Nanofabrication Financial Assistance Program, established in 2009.

**Gordon Harling**, microelectronics industry executive and serial entrepreneur, becomes President and CEO of CMC Microsystems.

CMC marks the delivery of the **700<sup>th</sup>** photonics/optoelectronics design prototyped for a client; **500** of these prototypes are in the emerging field of silicon photonics.

CMC and NanoCanada co-host **Innovation 360**, Canada's largest annual gathering of micro-nano innovators from industry and academia.

**Mohawk College** joins Canada's National Design Network®.



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## Letter from the Chair of the Board

The past year has been one of challenges and opportunities for CMC Microsystems. Funding uncertainty and a transition to new leadership have been accompanied by new initiatives, new partnerships, and new insights into CMC's role in, and value to, Canada.

As CMC continues to seek new funding sources, it is exploring new directions to ensure that its portfolio of critical tools and services reaches the companies and individuals who are developing transformative technologies for our global digital economy.

One such opportunity is diversification – of funding sources and of our client base. We're looking at diversifying and focusing our operations by region to leverage provincial support, as well as piloting market-rate services to industry and to academic users outside Canada. We're also sounding out service opportunities with superclusters as these new industry-academic entities take root.

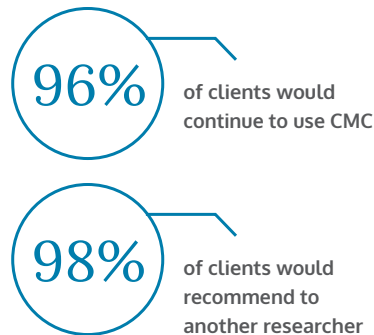
Another approach is simplification. Streamlining our governance and operations and realigning our activities are helping us find new ways to live up to our mission of removing barriers to technology adoption by researchers and industry.

Collaboration with industry and related entities is key and we're continuing to build strong working relationships with valuable partners – NanoCanada and Singapore's Advanced Micro Foundry being just two recent examples. And we're continuing to refresh our technology portfolio to support world-leading R&D.

CONTINUED //

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At the same time, the past year has returned some strong signals that our infrastructure and services continue to be essential to the future of hardware innovation, the drivers of smart technologies, in Canada. An independent survey has shown us that despite the funding uncertainty, 96 percent of clients would continue to use CMC and 98 percent would recommend it to another researcher. According to these clients, there are few alternatives to CMC.



We've also continued to see how providing industrial-grade tools and advanced manufacturing technologies to students makes them valued talent: in the past year industry recruited at least 780 of these highly trained researchers.

Canadian innovators are tackling challenges across the technology product landscape in every sector. Continued support for the work enabled by CMC ensures that this globally competitive micro-nanosystems research continues to thrive in Canada.

As our new President and CEO, Gord Harling notes,

**“We have created an innovation network that is the envy of many other countries. Nowhere else in the world has this.”**

Over the coming months he will be carrying this urgent message to university and business leaders across Canada.

**Bozena Kaminska, PhD**

Chair of the Board of Directors, CMC Microsystems





## Mapping the future

The Technical Advisory Committee (TAC) guides CMC's strategy and forecasts the technologies needed by researchers and students working at the leading edge of science and innovation.

CMC, with its TAC, hosted a national seminar in November 2017, to explore the opportunities and broad drivers motivating researchers and their partners and to review the technological and supply chain feasibility of securing anticipated technology. More than 50 innovators from industry, academia, and government influenced CMC's update to its Technology Roadmap.

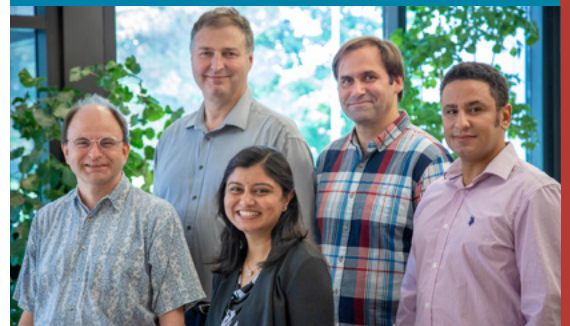
### The TAC's insights are reflected in five-year technology roadmaps (2018-2022) for:

- ✓ Embedded Systems and Machine Learning Demonstrators
- ✓ Microelectronics/MEMS/NEMS
- ✓ Photonics: Silicon-Photonics, III-V, Optics
- ✓ Packaging and Multi-scale Integration
- ✓ Nanofabrication Labs: Quantum Nanotechnology, Processes

## Building on strategic strengths

Drawing on the deep-domain knowledge of staff experts in the areas of photonics, microelectronics, embedded systems, nanofabrication and packaging, we established a CTO Office.

These individuals are responsible for technology and product and service roadmapping, engaging directly with industrial and academic peers, and providing advice to the President.



*Front row:* Dan Deptuck, Staff Scientist, Optoelectronics Engineering; Gayathri Singh, Senior Engineer, Microelectronics *Back row:* Gord Harling, President & CEO; Hugh Pollitt-Smith, Senior Engineer, Systems Design and Yassine Hariri, Senior Engineer, Platform Design *Not shown:* Andrew Fung, Client Technology Advisor, Microsystems and Nanotechnology and Robert Mallard, Senior Engineer, Optoelectronics

# Board of Directors

## Dr. Bozena Kaminska, Chair

Canada Research Chair in Wireless Sensor Networks, School of Engineering Sciences, Simon Fraser University

## Mr. Gordon Mein, Vice-Chair

Senior Director, Strategic Partnerships, Ciena

## Mr. Shawn Blakney

Senior Director of Global Technology and Innovation, Celestica

## Dr. Paul Chow

Professor, Department of Electrical and Computer Engineering, University of Toronto

## Mr. Gord Harling

President and CEO, CMC Microsystems (from February 12, 2018)

## Mr. Paul Kempf

## Dr. Mary Ann Maher

Chief Executive Officer, SoftMEMS

## Dr. Ian McWalter

President and CEO, CMC Microsystems (to February 12, 2018)

## Dr. Richard Oleschuk

Professor, Department of Chemistry, Queen's University

## Dr. Yvon Savaria

Professor, Department of Electrical and Computer Engineering, Polytechnique Montréal

## Mr. François Vachon

OEM Business Development Manager, IBM

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## Dr. Douglas Colton - Director Emeritus

## Ms. Andrea Benoit - NSERC Observer

Manufacturing, Communications and Technologies Division Research Partnerships, Natural Sciences and Engineering Research Council of Canada

## Mr. Dan Gale – Officer of the Corporation

## Ms. Nancy A. Marlow – Officer of the Corporation

## CMC and Canada's National Design Network acknowledge the contributions of the following agencies:



Alberta Ministry of Enterprise and Advanced Education – Alberta Science and Research Investments Program

British Columbia Ministry of Small Business, Technology and Economic Development – British Columbia Knowledge Development Fund

Manitoba Ministry of Innovation, Energy and Mines – Manitoba Research and Innovation Fund

New Brunswick Innovation Foundation

Opportunities New Brunswick University of New Brunswick

Research and Development Corporation Newfoundland and Labrador – Industrial Research and Innovation Fund

Nova Scotia Research and Innovation Trust

Ontario Ministry of Research and Innovation – Ontario Research Fund- Research Infrastructure

Québec Ministère de l'Éducation, du Loisir et du Sport

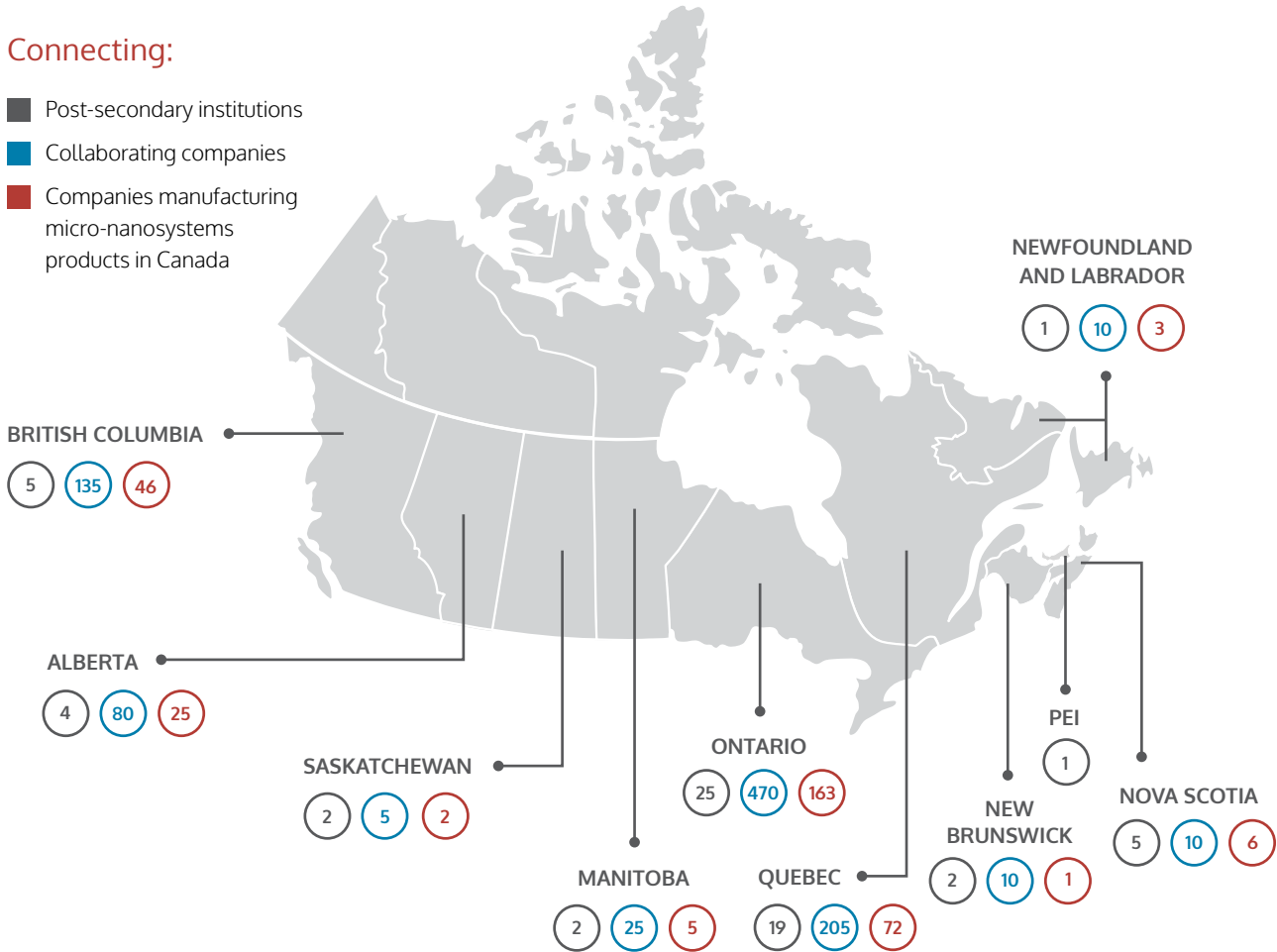
Saskatchewan Ministry of Advanced Education, Employment & Immigration

# Canada's National Design Network

A national, collaborative network for developing innovations in microsystems and nanotechnologies. CNDN is managed by CMC Microsystems.

## Connecting:

- Post-secondary institutions
- Collaborating companies
- Companies manufacturing micro-nanosystems products in Canada



## Participants

**66** Post-secondary institutes      **950** Collaborating companies

**323** Companies manufacturing micro-nanosystems products in Canada



# Research excellence

In the past year, 10,000 academics at 66 universities and colleges in Canada and their collaborators used CMC-enabled, CAD, Lab and Fab infrastructure to conduct excellent research, design and create novel technologies, and take part in extraordinary training opportunities leading to industry-ready graduates.



3,780 publications



110 national and international awards



8,820 students trained

## Resolving a quantum conundrum

Nanomechanics specialist John P. Davis (left) and his students Pearse Doolin and Callum Doolin developed the first digital photodetector capable of measuring the quantum properties of nanomechanical systems. Their instrument, now on the market through their startup company Resolved Instruments, opens up new opportunities in the emerging field of **quantum technologies**.



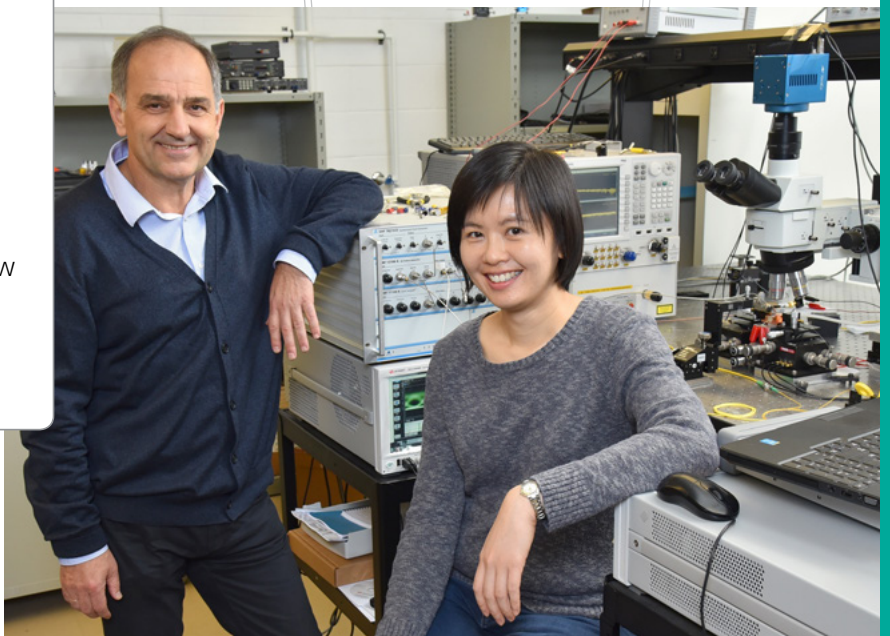
## Channeling new approaches to assisted reproduction

**Microfluidics**, extremely powerful microscopy, and fabrication technologies are helping Dr. Reza Nosrati, an NSERC Postdoctoral Fellow at Queen's University, develop simple, inexpensive and functional technologies for making assisted reproduction more successful.



## Solving a short-distance challenge

Joyce Poon (right) and Sorin Voinigescu (University of Toronto) were globally recognized at OFC 2017 for solving a significant problem in short-distance communications. Their 3D integrated **silicon photonic** electro-optic transmitter offers high performance at low power, with potential for cost-effective, high-volume manufacturability.



“Our work is all related, and it paints an amazingly strong picture of how CMC’s investment in silicon photonics over the past several years, from training to technologies, is making an impact today. And that impact is a direct result of us having access to technologies and expertise at a reasonable cost. It means we can take risks and try out new ideas.”

– JOYCE POON, CANADA RESEARCH CHAIR IN INTEGRATED PHOTONIC DEVICES, UNIVERSITY OF TORONTO

# Industrial impact

CMC links Canadian academics, their students, companies and collaborators with industry-grade tools, technologies and services, helping them to create the inspired hardware that drives technology innovation, and to train highly skilled people. Enabled in 2017:



25 licensed technologies



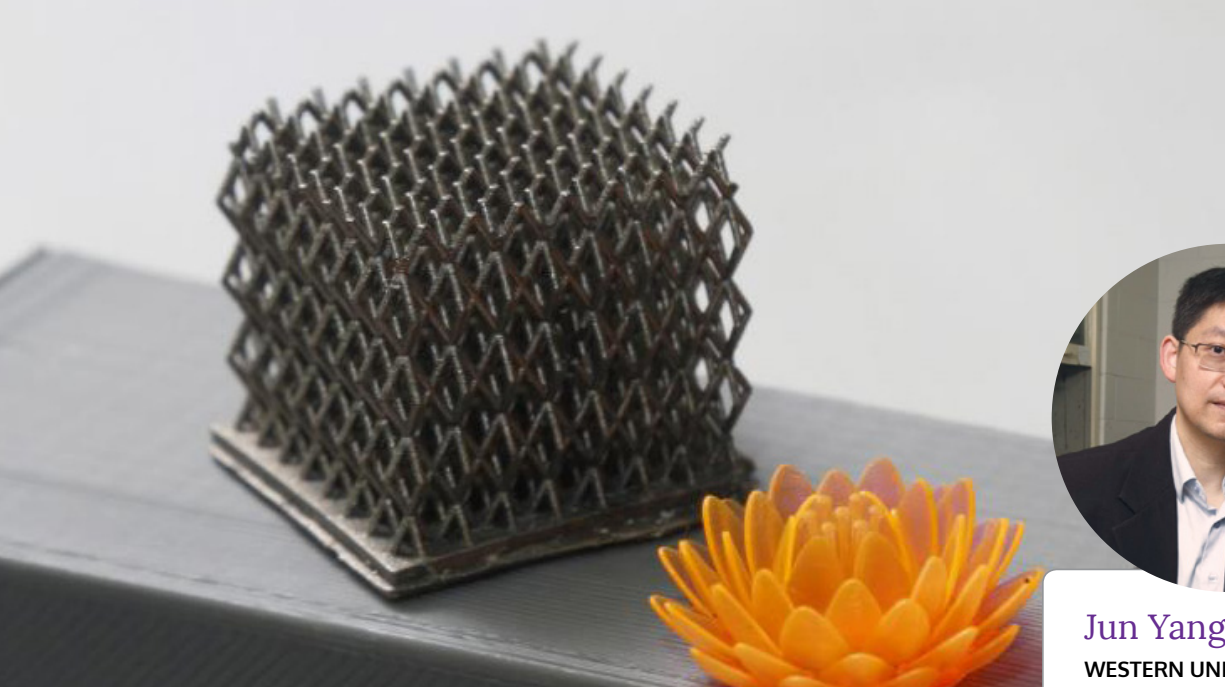
15 startups



160 patents  
(applied for/issued)



780 HQP moved to industry in Canada



**Jun Yang**  
WESTERN UNIVERSITY

## Spawning the ‘stem cells’ for circuitry

Professor Yang uses surface chemistry to modify and add functionality to materials through initiator-integrated **3D printing**. Formi 3DP, his startup company, uses this novel, low-cost process to develop polymer “stem cells” capable of creating 3-D objects with user-defined properties, and holds promise for the efficient production of complex electronic circuitry.



**Sofiane Bounaffaa**  
ÉCOLE DE TECHNOLOGIE SUPÉRIEURE

## Wireless innovation, from the battlefield to the boardroom

A novel wireless communication solution developed for the Canadian military by Sofiane Bounaffaa of École de technologie supérieure with his graduate supervisor François Gagnon formed the basis of a **microelectronics** startup company that is helping companies and institutions improve the performance of their own communications systems.

“CMC provided us with hardware and documentation that gave us the deep understanding we needed to go as far as we wanted to go. The tools provided were industry standard, the best on the market, and they showed us what industry needed.”

– JEAN SAMUEL CHENARD, FOUNDER AND PRESIDENT, MOTSAI INC.



**Jean Samuel Chenard**  
MOTSAI INC.

## Integration innovation

Dr. Chenard’s graduate student research at McGill University into integrated, networked technologies anticipated the Internet of Things. Today, Motsai Inc., the company he founded on his **embedded systems** research, develops specialized, sophisticated technologies for wearable device and telecommunications markets.



**Frédéric Nabki &  
Dominic Deslandes**  
ÉCOLE DE TECHNOLOGIE SUPÉRIEURE

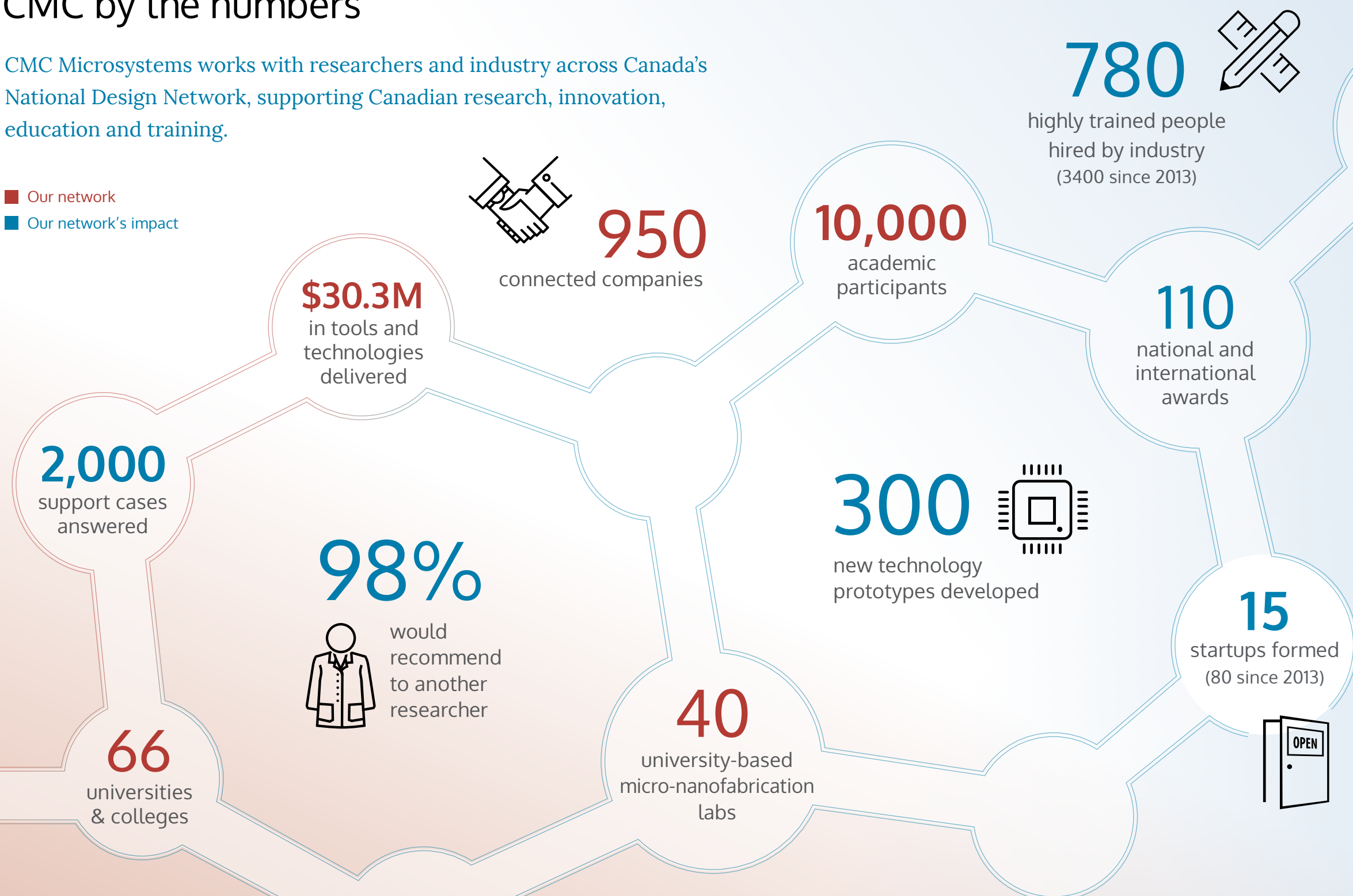
## Making way for a batteryless future

A fresh approach to wireless transceiver design enabled Professors Frédéric Nabki (right) and colleague Dominic Deslandes to develop a new **microsystems** technology with dramatically lower energy requirements, offering potential for devices that never need recharging. Their chip is now being commercialized by their startup, SPARK Microsystems.

# CMC by the numbers

CMC Microsystems works with researchers and industry across Canada's National Design Network, supporting Canadian research, innovation, education and training.

- Our network
- Our network's impact



# Developing next-generation innovators

In 2017-18, tools and technologies provided to postsecondary institutions across Canada enhanced students' learning:



440 graduate courses



600 undergraduate courses



10 training courses and workshops



# Work-integrated learning

Experience using industry-class methodologies to design, make and test micro-nanosystems leads to highly qualified personnel for Canada's innovation economy. These individuals are uniquely equipped to enter industry and be immediately productive.

Over the past year, 780 of these experienced individuals moved to industry in Canada.

17%

increase over last year in number of trained HQP moving to related industry in Canada

Hiring companies included, among hundreds of others:

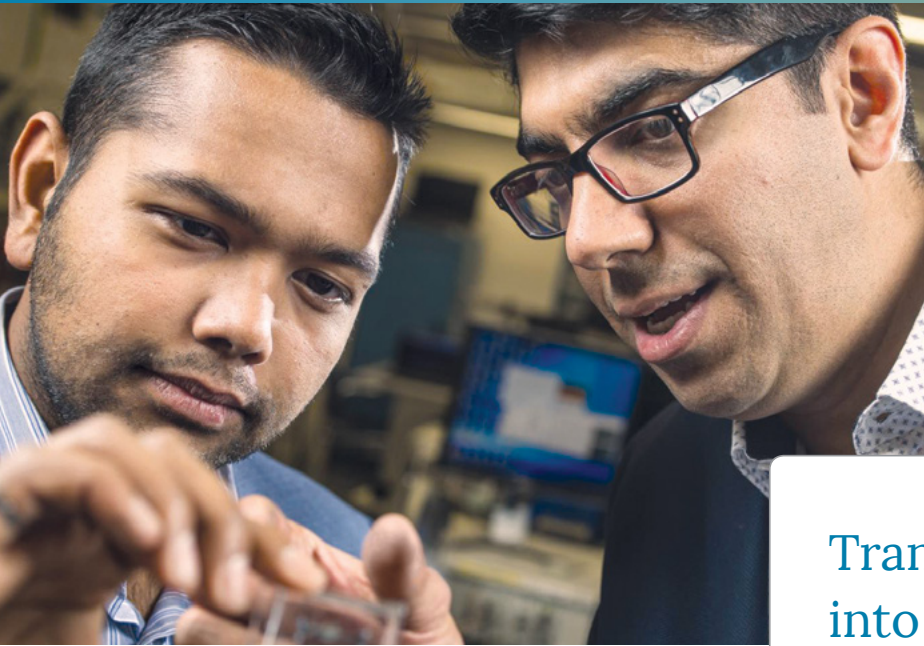
- ✓ Bombardier
- ✓ AMD Canada
- ✓ Thales Canada
- ✓ Ericsson Canada
- ✓ Ciena
- ✓ MDA Corporation
- ✓ General Motors Canada
- ✓ Teledyne DALSA

## Nanofab experience, award-winning technology

Nanofabrication capabilities and hands-on training helped Queen's University Chemical Engineering researchers and PhD candidates Hannah Dies (shown) and Josh Raveendran develop a novel, highly sensitive portable biosensor that can be manufactured simply and inexpensively. Their **nanotechnology** now forms the basis of an award-winning startup company, Spectra Plasmonics.

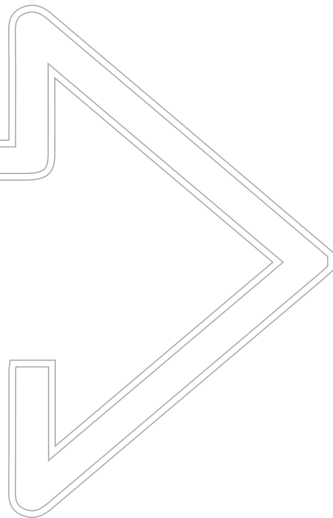


This year marked a milestone for SiEPIC, the world's first silicon photonics training program. Established in 2008 by CMC and University of British Columbia, enrolment in this program has surpassed 400 students who now possess industry-grade skills and experience in silicon photonics design, fabrication and test.



## Translating learning into opportunity

Experience with industrial tools, gained through CMC Microsystems, enabled Concordia University graduates Neil Roy Choudhury (left) and Hamid Sadabadi to create their Calgary-based startup, Frontier Fluidics, developing next-generation **labs-on-a-chip**, customized for innovators doing a broad range of research and experimentation.



# From idea to manufacturable prototype

Industry-grade tools, technologies and support give researchers the capabilities they need to design innovative micro-nanotechnologies:



560 CAD tools and modules



600 development systems




80 pieces of test equipment for loan in lab




450 design flows, user guides and application notes

# Proving ideas work

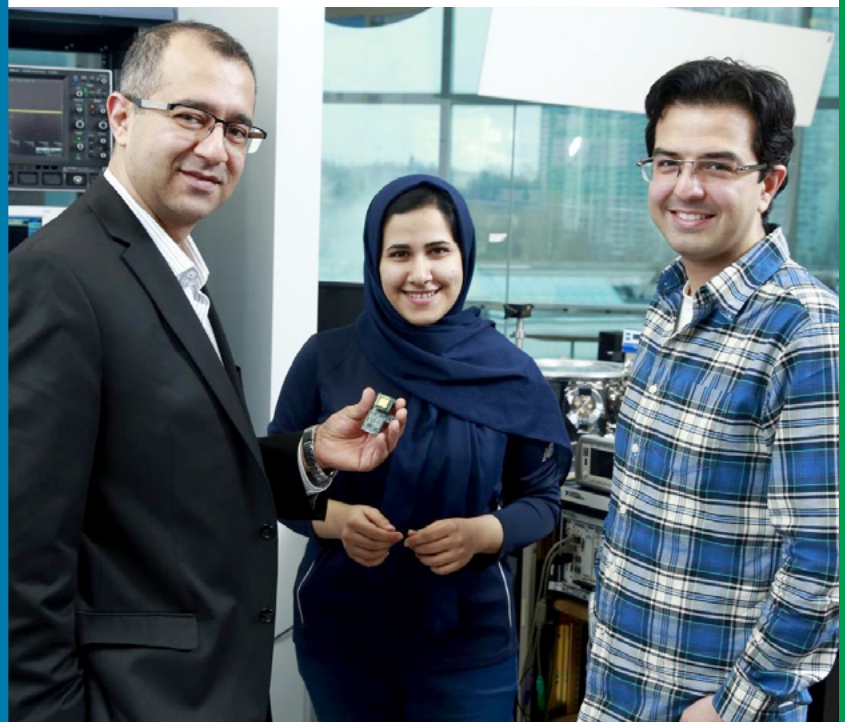
Prototyping is a critical but costly step towards demonstrating that a technology works. Through its national and international partnerships, CMC offers researchers affordable access to:

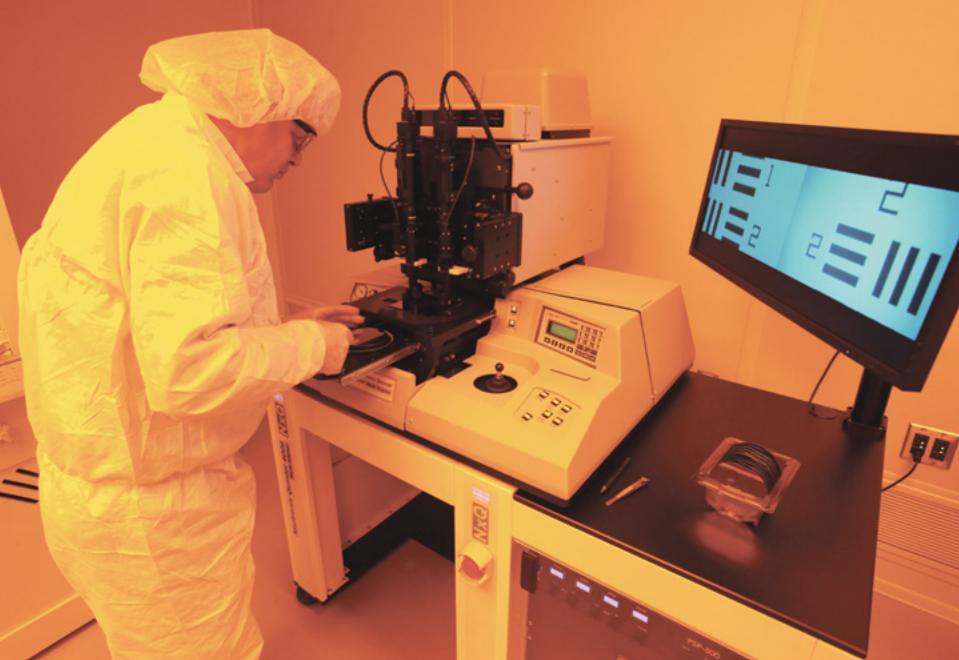
**25**  multi-project wafer services available through nine foundries worldwide, offering industrial-scale manufacturing

**40**  university-based micro-nanotechnology (MNT) fabrication labs across Canada, helping researchers customize their designs

## Tiny sensors sound out new markets

Microsensor innovator Dr. Behraad Bahreyni (left) and his team at Simon Fraser University developed hyper-sensitive underwater vibration sensors for global defence company Ultra, creating next-generation sound detectors. Now his award-winning startup company axSense Technologies is advancing its technologies into civilian applications such as earthquake detection and pipeline integrity monitoring.





## The power of prototyping

Over the past year, researchers created nearly:

300

physical prototypes of their technology ideas

## Advancing capabilities for researchers

Developing new technologies often spawns the need for new, future-oriented tools and platforms to undertake that exploratory work.

200 of these prototypes were fabricated through CMC's global network of fabrication foundries. The remaining 100 were developed through Canada's MNT network of labs.

### Over the past year researchers were able to 'test-drive' new R&D capabilities made available through CMC:

- ✓ Heterogeneous cloud/edge computing platform for machine learning
- ✓ Design platform for silicon photonics
- ✓ Nanofabrication process design environment
- ✓ Open-gate silicon JFET platform
- ✓ Flip-chip assembly for full 2.5D integration

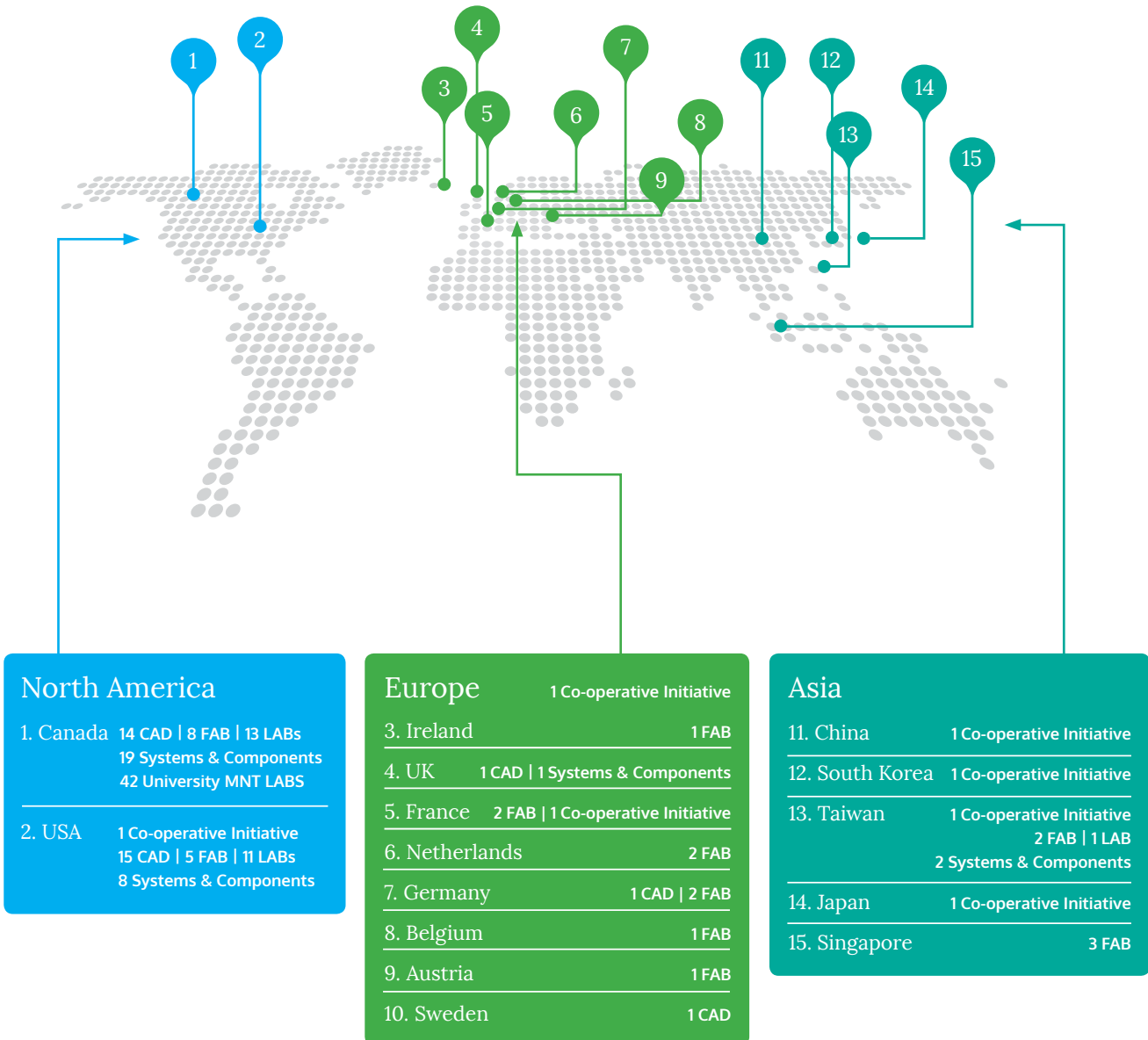


[CMC.ca/WhatWeOffer](https://www.cmc.ca/WhatWeOffer)

# Strategic engagements, global partners

CMC builds relationships with companies and organizations worldwide, resulting in supply chains and access to manufacturing capabilities for innovative R&D.

## Global sources of essential micro-nanotechnologies for CNDN:



# Manufacturing success through global partnerships

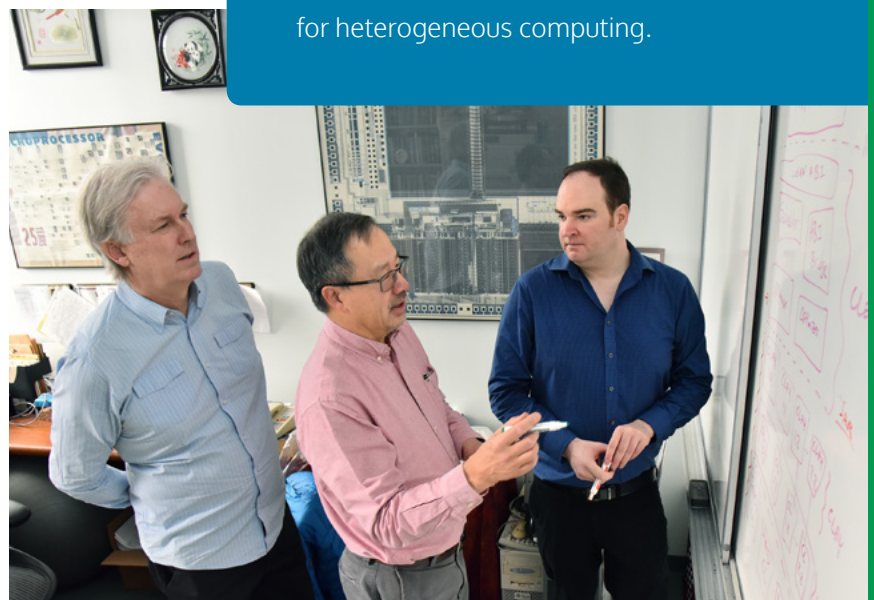
In June 2017, CMC convened the annual meeting of its international peer organizations to exchange insights, gauge progress and initiate joint projects. This meeting took place at the Design Automation Conference (DAC) in Austin, TX.

We have worked with the following organizations for more than 20 years to advance the global potential of microsystems and nanotechnology:

- ✓ CIC – National Chip Implementation Center (Taiwan)
- ✓ CMP – Circuits Multi-Projets (France)
- ✓ EUROPRACTICE
- ✓ ICC – Shanghai National Integrated Circuit Design Industrial Center (China)
- ✓ IDEC – Integrated Circuit Design Education Centre (S. Korea)
- ✓ MOSIS (U.S.)
- ✓ VDEC – VLSI Design and Education Center (Japan)

## A novel solution for heterogeneous computing

Through his work with global standards consortium Khronos, Al Guillon (right) and John Reynolds (left), founders of YetiWare Inc., partnered with University of Toronto's Dr. Paul Chow (centre), a specialist in computer architectures, and CMC to create a novel operating system that enables faster, simpler development of programs for heterogeneous computing.



# Working together on real-world problems

Over the past year our micro-nano innovators in academia engaged in nearly 1,000 CMC-facilitated collaborative initiatives:



500 collaborations with industry  
valued at \$26M



350 inter-university collaborations  
in Canada and abroad



90 collaborations with government  
and not-for profit organizations



# National infrastructure for accelerating R&D



Open discussion with the community helps establish requirements for infrastructure development and deployment. Last year, a series of regional seminars exploring heterogeneous computing implementations from small,

low power sensor nodes and network edge devices, to the cloud attracted 90 participants from 15 universities and 20 companies. Further to this, CMC is delivering commercial and open-source software and processor technology, and a heterogeneous computing cluster, to CNDN.

## The FACT Network

CMC facilitates a cooperative ecosystem of service-oriented labs, offering expertise and industry-compatible services for fabrication, assembly, characterization, and test of micro-nanotechnologies.

- ✓ 4D LABS  
Simon Fraser University
- ✓ GCM Lab  
Polytechnique Montréal
- ✓ Interdisciplinary Institute for Technological Innovation (3IT)  
Université de Sherbrooke
- ✓ The nanoFAB  
University of Alberta
- ✓ Toronto Nanofabrication Centre (TNFC) University of Toronto



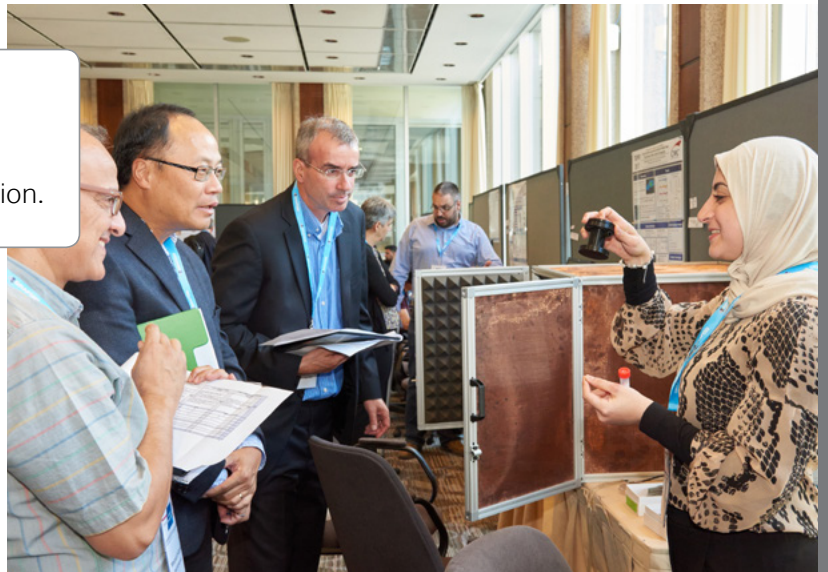
## Boosting expertise and competitiveness in nanofab

In September 2017, 70 participants from academia, industry and government took part in the biennial Lab2Fab Nanofabrication Workshop. The two-day event focused on addressing R&D challenges and working towards more competitive Canadian manufacturing of micro-nanotechnologies.

# Celebrating innovation

In 2017, CMC Microsystems and NanoCanada held their first jointly hosted event at Centre Mont Royal in Montréal, where more than 250 micro-nano innovators from academia, industry and government shared insights and ideas on nanotechnology and nanomanufacturing.

This event included CMC's TEXPO student competition and exposition (right) and NanoCanada's poster session and competition.



Dr. Marc André Tetrault was celebrated as the 2017 recipient of the Colton Medal for Research Excellence. As a graduate student and doctoral candidate at Université de Sherbrooke he developed a novel, integrated 3D digital detector leading to a new generation of PET scanners ("LabPET").

# TEXPO 2017

A unique opportunity for graduate students in Canada's National Design Network to demonstrate their novel applications of micro-nanosystems to industry representatives and academic peers.



Brian L. Barge Award for Microsystems Integration sponsored by CMC Microsystems presented to **Gabriel Gagnon-Turcotte**, Université Laval (supervisor Benoit Gosselin), for research on a high resolution CMOS neural interface for synchronized electrophysiology and optogenetics.



Industrial Collaboration Award sponsored by Teledyne DALSA presented to **Suraj Sharma**, École de technologie supérieure (supervisor Frédéric Nabki), for research on a rotating MEMS platform for optical switching.



Micro-Nanosystems Design Award sponsored by Cadence presented to **Siba Moussa**, McGill University (supervisor Janine Mauzeroll), for research on a micro-litre temperature-controlled flow cell for small scale studies of CYP 3A4.



Award for Excellence in Nanofabrication sponsored by Raith America presented to **Thomas Jones**, University of Alberta (supervisor Mojgan Daneshmand), for research on the development of monolithic miniaturized ridged half-mode waveguides for the next generation of millimeter-wave communication systems.

“We are excited to co-host our first national conference with CMC and its Innovation 360 event. It aligns perfectly with our goal of bringing together industry, academia and government to translate nanotechnology research and development into safe products for the marketplace. The focus on nanomanufacturing bridges the gap between technology demonstration and product development.”

– MARIE D'IORIO  
PRESIDENT, NANOCANADA

# Community involvement

CMC Microsystems regularly supports local charitable initiatives, such as the Frontenac, Lennox and Addington Science Fair and the Kingston Terry Fox Run.



Its primary focus has been on activities in support of Alzheimer's disease, and this year its annual staff Alzheimer auction raised \$10,560. Since 1997, CMC staff have donated almost \$120,000 to the Alzheimer Society of Kingston, Frontenac, Lennox and Addington.



## A fond farewell

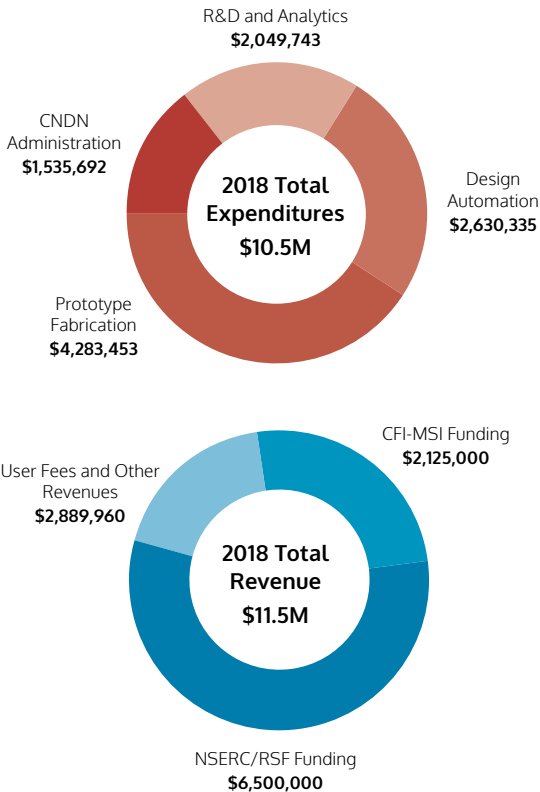
In March 2018 CMC Microsystems bid farewell to Dr. Ian McWalter, President and CEO, and Dan Gale, Vice-President and CTO. Dr. McWalter was a board member of CMC for many years before assuming its leadership in 2007. Mr. Gale, CMC's first staff member, helped to guide CMC through its subsequent growth, and was instrumental in establishing its leadership in the area of silicon photonics. We thank them for their contributions.



# Financial summary

CMC is able to achieve its mission through support from several financial stakeholders. In 2018, total revenues of \$11.5 million came from a variety of sources including federal government grants, user fees and contract management services. In addition to continued federal government support from NSERC and the Research Support Fund (RSF), CMC has been awarded \$7 million over three years under CFI’s Major Science Initiatives (MSI) program. The CNDN has been recognized as a Major Research Facility and the MSI grant will offset operating costs and enable us to develop, support and manage the network. CMC also continues to earn contract management revenues, reinvested in the CNDN, by delivering and implementing CFI-funded infrastructure projects (emSYSCAN and ADEPT).

CMC’s total expenditures remained comparable to prior years at \$10.5 million. Current year operations resulted in a \$1 million surplus, which will be used to fund future activity as well as provide stability as we pursue and transition to new funding sources.



## Statement of Financial Position as at March 31, 2018

| Assets           | 2018               | 2017               |
|------------------|--------------------|--------------------|
| Current Assets   | 7,437,869          | 6,348,803          |
| Long-term Assets | 584,236            | 526,901            |
|                  | <b>\$8,022,105</b> | <b>\$6,875,704</b> |

| Liabilities & Net Assets | 2018               | 2017               |
|--------------------------|--------------------|--------------------|
| Current Liabilities      | 2,519,264          | 2,386,267          |
| Net Assets               | 5,502,841          | 4,489,437          |
|                          | <b>\$8,022,105</b> | <b>\$6,875,704</b> |

## Statement of Revenue & Expenditure for Year Ended March 31, 2018

| Operations   | 2018               | 2017             |
|--------------|--------------------|------------------|
| Revenues     | 11,514,960         | 10,788,632       |
| Expenditures | 10,501,556         | 10,257,958       |
|              | <b>\$1,013,404</b> | <b>\$530,674</b> |



[CMC.ca/AboutCMC/CorporateReports](http://CMC.ca/AboutCMC/CorporateReports)  
for our complete audited financial statements



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