Annual Report

2022 2023

CMC MICROSYSTEMS

Highlights from 2022-23

More than 480 semiconductor prototypes submitted to fabrication

80% of these are for Canadian researchers and entrepreneurs, 20% for international clients

Record 178 photonics designs were fabricated – a globally recognized Canadian strength

Arranged first-time access new quantum device fabrication service with VTT Technical Research Centre (Finland) to give emerging Canadian researchers an edge in an area set for explosive growth.

CMC had another record year of prototype manufacturing, working more intensively with Canadian partners Applied Nanotools and Teledyne MEMS

Expanding international reach: Collaboration agreement signed with Australia's Semiconductor Sector Service Bureau (S3B)

Welcome to our newest members

nscc

UNIVERSITY of Prince Edward ISLAND

Welcome to over **2,300** clients across Canada who are first time users of services.

CMC Services now available in the USA and Mexico for both academics and industry

CMC's Virtual Incubator Environment (VIE) program showed over **60%** growth in its third year – now supporting 28 start-ups in Canada.

Thanks to Our Funders!

Major Partners

Government of Canada

Québec

Canada Foundation for Innovation (CFI)
Major Science Initiatives (MSI) program

Major Research Facility:
Canada's National Design Network

INNOVATION.CA
CANADA FOUNDATION FOR INNOVATION | FONDATION CANADIENNE POUR L'INNOVATION

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Joint letter from the Chair of the Board & CEO

Keeping Canada at the forefront of semiconductor innovation was a driving force for CMC in 2022-23. New projects were launched, and services were delivered to lower the barriers faced by researchers and entrepreneurs developing high tech innovations and to train HQP with critical skills needed by industry.

CMC is seeing benefits from our strategic decisions to focus on and grow our five core technologies:

- Microelectronics
- Photonics
- Micro-Electro-Mechanical Systems (MEMS)
- IoT & Edge AI
- Quantum

These are areas where CMC – and Canadian innovators more broadly – have both longstanding experience and emerging talent that is shaping the semiconductor market. For example, CMC has nearly 40 years of experience in microelectronics, and we are expanding our contribution to Canada's leadership in superconducting and photonic quantum technologies, opening up new areas of research and commercial opportunities.

Despite headwinds from disrupted supply chains in the semiconductor industry and major disruptions in the global economy, CMC had its best performance in over a decade delivering chips and wafers for more than 480 designs through our global network of manufacturing facilities. Each one of these fabricated designs is an entrepreneurial possibility with huge potential and they are also important elements in training the semiconductor designers of the future making students 6 to 18 months faster time to productivity when they enter industry.

By lowering barriers and making chip design and fabrication more accessible, we give highly qualified graduates tan edge to join existing Canadian companies or start their own firms

It has become clear that the semiconductor industry needs a huge influx of Highly Qualified Personnel (HQP). This is an area where Canada has a significant advantage, and where CMC is having an impact. First, by lowering barriers and making chip design and fabrication more accessible, we give highly qualified graduates an edge to join existing Canadian companies or start their own companies. Our partners in industry report that CMC's graduates were some of the finest minds they could hire. Our BaseCamp series of training courses adds to our services that keep Canada's HQP among the best in the world by providing them with a complete design, build, and test experience in many different advanced technologies.

Preparing the next generation of chip designers and tech leaders in Canada is true to CMC's mission and core values. As the Canadian semiconductor ecosystem is at a crossroads, CMC is proud to be putting Canadian innovators, researchers, and entrepreneurs on the path to success.

Thanks for taking the time to learn more about CMC.

Ian Roane
Chair of the Board of Directors
CMC Microsystems

Gordon Harling
President and Chief Executive Officer
CMC Microsystems

Board of Directors

Mr. Ian Roane, Chair
Former President and Chief Executive Officer, Micralyne Inc.

Mr. Steve Bonham, Vice-Chair
Plant Manager, Teledyne Micralyne, Inc.

Dr. Vincent Aimez
Vice-President Partnerships and Knowledge Transfer, Université de Sherbrooke

Dr. Douglas Barlage
CTO, Zinite

Dr. Charles Despins
Vice-president, Research and Partnerships Professor, Electrical Engineering Department, École de technologie supérieure

*Sadly, **Dr. Charles Despins** passed away in March 2023. Charles was an active supporter of CMC and served on our Board of Directors from October 2019 until his passing. We remember his excitement for research, innovation, and developing the next generation of microsystems students in Canada.*

Mr. Gordon Harling
President and Chief Executive Officer, CMC Microsystems

Ms. Amy Karam
Principal and Founder, served Karam Consulting

Ms. Vanessa Little
Global CTO – CloudConverge Technology Solutions

Dr. Michel Pioro-Ladrière
Director of Partnerships and Strategy, Nord Quantique

Dr. Madison Rilling
General Manager, Optonique

Ms. Chunfang Xie
Associate Director of Process Engineering, Microchip Canada

Mr. Marco Blouin
Board Observer
Économie et Innovation Québec

Officers of the Corporation

David Lynch
Vice-President, Technology

Peter A. Stokes
Secretary

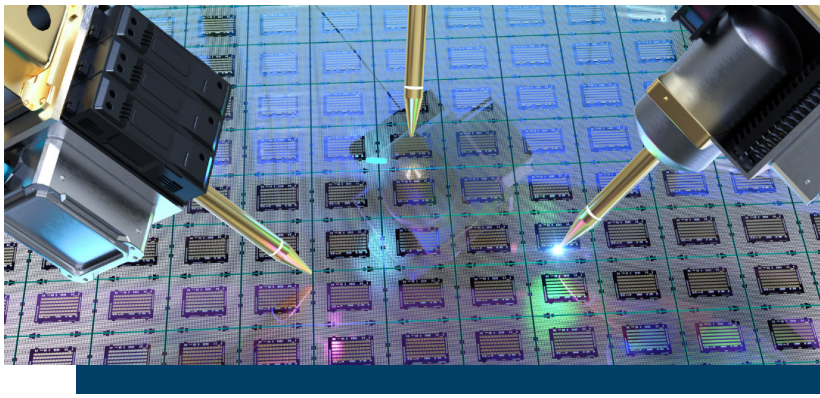
Marie Thiele
Treasurer

Technology and Strategic Direction

Foundational Technologies

Microchips - chips, integrated circuits, semiconductors - are at the heart of electronic devices essential in virtually all industries.

CMC's strategies focus on the technologies driving semiconductor innovation.



SELECTED MICROELECTRONICS R&D PROJECTS

- Edgewater – RF design
- ThinkRF – RF design

Microelectronics

Leading-edge microelectronics technology is critical to researchers with applications from data centres to mobile edge applications, with AI integrated in every aspect from product development to service delivery.

CMC enables affordable access through our established Multi-Project Wafer (MPW) model and our deep partnerships with world class suppliers and foundries.

Our Guiding Principle

Benefits to Canada

Microchip (chip) technologies are critical in Canada's technology ecosystem and CMC has recognized the critical importance of semiconductors. Semiconductors power digital economies and are enablers of economic growth and productivity improvements. Canadian innovators compete best in fast-growing niche technologies where we have significant capability and can dominate globally such as compound semiconductors, silicon photonics, microelectromechanical systems, and quantum devices.

Photonics

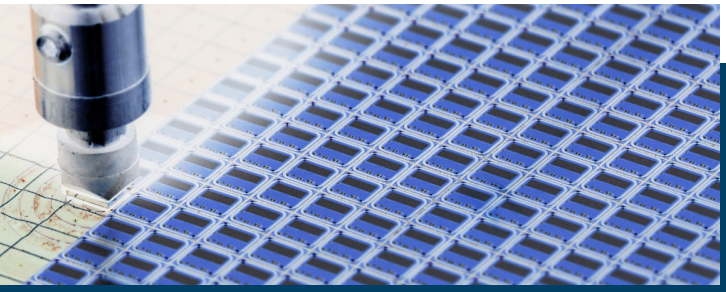
Photonics is a systems-enabling technology widely used in modern systems requiring functionality ranging from data transmission for the data centre and telecom industry to environmental and life science sensing.

CMC enables more technology integration putting more photonic functionality onto each chip, and integrating photonics with other technologies, such asmicroelectromechanical systems (MEMS), and microelectronics.

Photonic integration is also a key step to embracing sustainability, as it is critical to reducing Size, Weight, and Power (SWaP) requirements of components.

SELECTED PHOTONICS R&D PROJECTS

- Laser integration with silicon photonics
- High speed modulator packaging demonstrator
- Development of silicon photonics library cells
- IBM polymer connector
- MEMS post-processing for photonics
- Optical Logic Gate



MEMS

Microelectromechanical systems (MEMS) and sensors are gaining popularity across the entire advanced technology ecosystem. Improvements in accuracy, reliability, and miniaturization have seen MEMS devices integrated into applications from wearables and IoT-connected devices right through to Industry 4.0 applications in the automotive sector.

SELECTED MEMS R&D PROJECTS

- Interposer MPW
- Electronic Sensor Platforms (ESP) for
  - Microfluidic integration
  - 3D printed package
  - COVID-19 sensor
- Protopak 3D packages
- Quantum Sensing
- Diamond substrate (photonics as an example)
- MEMS hearing aid device

IoT & Edge AI

The rise of the Internet of Things (IoT), artificial intelligence (AI) and machine learning (ML), and 5G network capability have driven demand for power-efficient, secure computing at the network edge.

Applications such as wearables, biomedical monitoring, autonomous driving, and precision agriculture are producing an unprecedented amount of data from sensors.

Academic and industrial researchers use these foundational technologies to create innovations in electrified transportation, smart solutions for climate change, healthcare, and more.

SELECTED IOT & EDGE AI R&D PROJECTS

- Wireless electrochemical sensing platform (Acuity-QC)
- Swiftmote open source IoT sensor platform
- Untether AI tsunAImi Accelerator deployment
- BARVINN: A RISC-V Neural Network Accelerator

Quantum

Quantum computing is exploding, powered by significant increases in investment and technological breakthroughs. Industrial applications are almost limitless, with the pharmaceutical and financial services industries being early adopters.

CMC's strategy is to democratize access to state-of- the-art quantum hardware and software technologies.

Our quantum programming experts have access to state-of-the-art quantum platforms from IBM, Xanadu, PasQal, Anyon, D-Wave, and IonQ to serve Canadian researchers and entrepreneurs.

On the hardware side, CMC offers Multi-Project Wafer (MPW) fabrication services, including PDK development, for superconducting and photonic quantum devices, a crucial step to accelerate innovation in this emerging space.

SELECTED QUANTUM R&D PROJECTS

- Implementation and testing of quantum encryption algorithms
- Characterization of quantum computer noise
- Reservoir simulation with quantum computer
- Solving combinatory optimization problems with quantum computers
- Quantum computing for software engineering
- Complex quantum kernel models for classification problems
- Process design kit for superconducting quantum processes
- Distributing entanglement between remote photonic quantum networks
- Magnetic-field quantum sensors based on superconducting devices

By the Numbers

A Growing Research Community

A national network of 10,000 academic participants and 1,200 companies developing innovations in micro-nanotechnologies.

Over 40% of the companies we collaborate with are manufacturing advanced technology products in Canada

CMC Connects:

- Post-secondary institutions
- Collaborating companies

Collaborative Initiatives

420 academic collaborations with industry valued at $28M

575 university collaborations in Canada and abroad

100 academic collaborations with government and not-for profit organizations

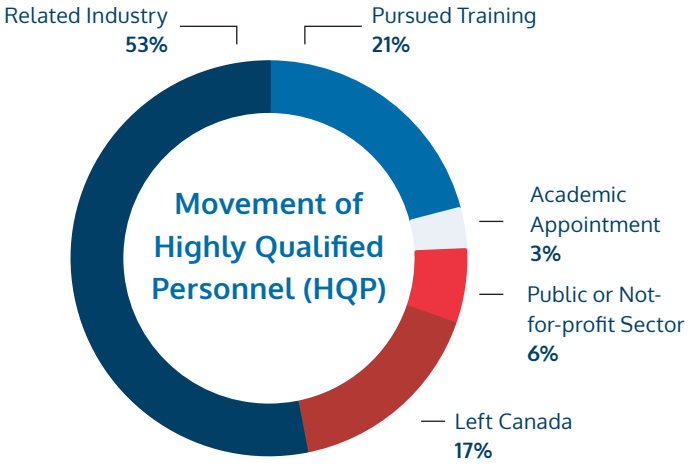
Research Excellence

3,300 publications

160 national and international awards

1,475	4,770	630	975	4,065
Professors	Graduate Students	Post-Doctoral Fellows	Research Staff	Undergrads

Developing Semiconductor Skills Needed in Canada

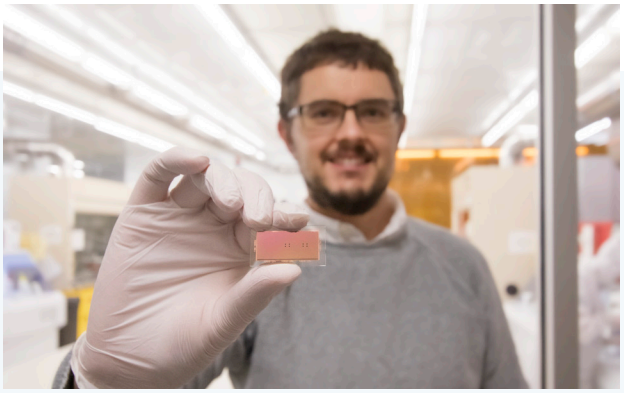


83%
of HQP Stayed in Canada

785
(53%) HQP entered Industry in Canada

Success Stories

Greater Bandwidth for Next-Generation Mobile Communications



An Edmonton-based start-up is developing a light-activated switch that controls microwaves at high frequencies and could increase the bandwidth of mobile devices and other communications equipment.

Dr. Thomas Jones, founder, director, and CEO of Jones Microwave Inc., says the component will allow cell phones and other devices to access higher bandwidths, speeding up downloads and enabling future applications such as extended reality.

High-frequency bands, such as millimeter-waves in the 30 to 300 GHz spectrum, are challenging to control. But as these bands become more congested, millimeter-wave bands are expected to be essential for 5G and IoT applications. The fabrication lab nanoFAB located at the University of Alberta is producing the switch, which has been patented.

"This has been a 10-year journey. CMC supported me throughout my PhD and post-doc and now as I build my own company."

- Dr. Thomas Jones

Jones began his research as a doctoral student working with the late Professor Mojgan Daneshmand, who led the Microwave to Millimetre-Wave (M2M) Lab at the University of Alberta. This was the beginning of a long relationship with CMC.

In 2022-2023 CMC Delivered:

- **17 training courses** including four highly-specialized, intensive CMC Basecamp™ training courses delivered to over 380 participants.

- **We offered training on the entire Design-Fabricate-Test cycle of superconducting devices used in quantum computer hardware – a unique offering in the world**

In partnership with the NSERC CREATE programs of Quantum BC and QSciTech, 25 trainees implemented their own superconducting designs.

Participants tested their chips at their home institution or used cryogenic equipment at the Quantum FabLab at L'Institut quantique de l'Université de Sherbrooke.

Trainees interacted with experts from Canada and used CMC- provided design tools to submit designs for fabrication by VTT Technical Research Centre (Finland)

- **Active Silicon Photonics Fabrication Course**
- **Passive Silicon Photonics Fabrication Course**
- **Analog/Mixed-Signal Design Methodology and FinFET Layout Training**

These courses provide a unique combination of theory and lab work and a trainee experiences the entire design/fabrication/test cycle of their very own microchip.

Industrial Impact

Geared for Growth: Path to Commercialization for Academic Research

12
Start-ups Launched

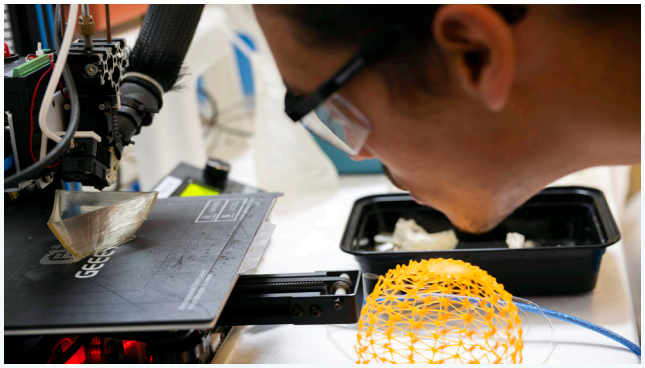
28
start-ups in Canada are now VIE Clients

200
Patents (applied for/issued)

30
Licensed Technologies

Success Stories

Game changing 3D industrial printing technology inspired by a 19th-century invention



An Edmonton startup company's 21st-century innovation is taking 3D industrial printing to a new level, using a simple bonding process that mimics the mechanism of fabric zippers, a 19th-century invention.

ZiprPrint, the brainchild of COO Mohammad Khondoker, can print multiple materials, from polymers to metals, and then bond them together using a zipper-like interlocking of parts.

Using CAD software made available through CMC Microsystems, they developed a embedded intermixer technology that can mix rigid plastics with stretchable rubber in a single, rapid printing process.

ZiprPrint's breakthrough is its single-nozzle system, capable of layering multiple materials and changing their composition continuously while printing.

The firm is working with the Rehabilitative Research Centre at the University of Alberta to produce sensor-integrated prosthetics that can improve the quality of life of patients.

"We aren't competing with printers to make items such as bottle caps or key chains," he explains. "Our target market is any plastic industry with a low-volume production of a high-value product."

Serving Industrial and International Customers

67	37	7	64	9
Academic Institutions in Canada	Academic Institutions in the US	Other Academic Institutions	Companies	Other Organizations

Success Stories

Making Better Batteries for the EV Revolution

A Université de Sherbrooke start-up has developed a thin, lightweight thermal management system that can improve battery performance in electric vehicles (EV) and other applications. It is based on heat pipe legacy, a component of many heating and cooling systems. Calogy Solutions uses the same concept in its Uni.T, a flexible metal module that is shaped like the letter "L" and can fit almost any battery pack. "We believe there is beauty in simplicity," says Mahmood Shirazy, CEO of Calogy Solutions.

They are working with automotive OEMs and tier one vendors on how to integrate the Uni.T into

their battery modules while also exploring other markets and applications with the goal of making lithium-ion batteries that charge faster, last longer, and stay at temperature where they perform optimally.

'Thanks to CMC we have the tools to do things right and keep moving ahead.'

- Mahmood Shirazy, CEO, Calogy Solutions

Capability to Keep Researchers at the Leading-Edge

CAD

High-performance Computer Aided Design (CAD) tools and environments for successful design from over 20 vendors

- **85 CAD tool suites available** via desktop or through CMC Cloud
- **8,330 users**
- **310 user guides, design flows, and training materials**
- **20 training courses and events**
- **15 webinars**

FAB

Multi-project wafer services, value-added packaging and assembly services and in-house expertise for first-time-right prototypes

- **65 technology runs through eight foundries worldwide**
- **Over 480 designs fabricated** – a new record
  - Of these, over 400 were MPW
  - 178 photonic designs
  - 15 quantum designs fabricated – in just our third year offering quantum services

LAB

Device validation to system demonstration

- **680 programmable development systems**
- **80 pieces of test equipment for rent**
- **Online support system with more than 2,200 cases closed annually**
- **RISC-V processor design & prototyping**
- **Electronic Sensor Platform (ESP)**
- **SwiftMote Sensor Platform (wireless sensor)**
- **8 PetaFLOP Atlas 800 AI training server installed at the University of Waterloo to accelerate research projects**

A Supply Chain for Key Economic Sectors

Global partners'

CMC's international technology alliances enable access to accelerate innovative research in Canada.

>100

suppliers are a part of CMC's supply chain.

North America

CANADA
Over 50 suppliers & 40 university-based labs

USA
Over 30 suppliers

Europe

20 suppliers & 6 collaborative organizations*

- **AUSTRIA**
- **BELGIUM***
- **FINLAND**
- **FRANCE***
- **GERMANY***
- **IRELAND***
- **NETHERLANDS**
- **SWEDEN**
- **SWITZERLAND**
- **UK***

Asia

6 suppliers & 3 collaborative organizations*

- **JAPAN***
- **SINGAPORE**
- **SOUTH KOREA***
- **TAIWAN***

Australia

AUSTRALIA
1 supplier
1 collaborative Organization*

*Collaborative organizations have similar mandates to accelerate advanced technology research and innovation.

A Thriving Advanced Technology Supply Chain in Canada

CMC is Building Capability in Canada and is Proud to Play a Vital Role in the Thriving Canadian Ecosystem

A National Supply Chain of >50 Organizations, for example:

CAD

- CROSSLIGHT
- DESIGN WORKSHOP TECHNOLOGIES
- Javelin A TriMech Company
- NANOACADEMIC TECHNOLOGIES
- Optiwave

FAB

- 3IT
- Achray Photonics
- ANT APPLIED NANOTOOLS INC.
- C2MI
- Celestica
- DREAM PHOTONICS
- INO
- NRC·CNRC NRC-CPFC
- TELEDYNE Teledyne MEMS
- SiEPIC

LAB

- C2MI
- cmrsummit TECHNOLOGIES
- PINC²
- solaxis Ingenious Manufacturing
- thinkRF

>50%

of supply chain vendors are Canadian firms.

MADE IN CANADA • FABRIQUÉ AU CANADA

Working with International Peers to Advance the Global Potential of Micro-Nanotechnology

Australia

Canada

Japan

South Korea

Taiwan

USA

Europe

Belgium

France

Germany

Ireland

United Kingdom

Success Stories

Electronic environmental explorers set sail

A Université de Sherbrooke start-up has developed a thin, lightweight thermal management system that can improve battery performance in electric vehicles (EV) and other applications. It is based on heat pipe legacy, a component of many heating and cooling systems. Calogy Solutions uses the same concept in its Uni.T, a flexible metal module that is shaped like the letter "L" and can fit almost any battery pack. "We believe there is beauty in simplicity," says Mahmood Shirazy, CEO of Calogy Solutions.

'Thanks to CMC we have the tools to do things right and keep moving ahead.'

- Mahmood Shirazy, CEO, Calogy Solutions

They are working with automotive OEMs and tier one vendors on how to integrate the Uni.T into their battery modules while also exploring other markets and applications with the goal of making lithium-ion batteries that charge faster, last longer, and stay at temperature where they perform optimally.

Facilitating Ecosystem Development Through Membership in Strategically Aligned Organizations

Celebrating Innovation

Lighting Up a New Understanding of the Brain

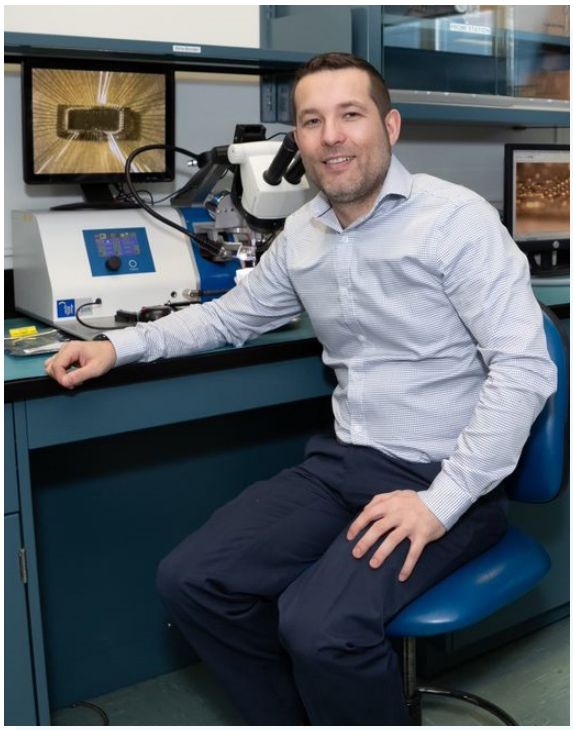
Dr. Gabriel Gagnon-Turcotte of Université Laval won the 2022 CMC Microsystems Douglas R. Colton Medal for Research Excellence for his work which is opening up a new way of studying how the human brain works while helping researchers better understand diseases such as Alzheimer's, Parkinson's, and epilepsy.

For his graduate and postgraduate research, Gagnon-Turcotte's motivation was to develop a machine that interfaces with the brain to learn more about its functions and better understand diseases that impact so many lives.

Gabriel applied his expertise in microelectronics to a relatively new technology – optogenetics – to better understand how the brain works. Developed in 2005, optogenetics is a method for controlling the activity of neurons, the fundamental building blocks of the brain and nervous system, using light and genetic engineering.

He designed the first wireless microsystem, or bioimplant, to study the development of Alzheimer's disease using closed-loop optogenetics in animal models. The bioimplant uses on-chip artificial intelligence (AI) to analyze the neural data in real time and has a high recording resolution for detecting complex neural firing patterns in many brain regions simultaneously.

The microsystem can create and bypass neural connections in the brain. This provides researchers with data that can lead to breakthroughs in understanding how diseases of the brain work, and how they can be treated.



"CMC services and expertise were vital to bring the design to life and take my research to the next level. CMC also helped me integrate the algorithm and AI directly on the chip for better performance at lower power consumption, and an overall smaller piece of equipment."

- Dr. Gabriel Gagnon-Turcotte

Hardware designs inspired by the human brain

Queen's University's Bhavin Shastri builds optoelectronic hardware inspired by the architecture of the brain and nervous system.

His interdisciplinary work combines silicon photonics and machine learning to build photonic integrated circuits for computing. It provides a framework for a new class of information processing machines that use light instead of electronics and mimic, in a basic way, the neural networks that allow humans to process information and make decisions.

His goal is to develop a new type of photonic computing that is faster, more adaptive, interconnected, and energy efficient.

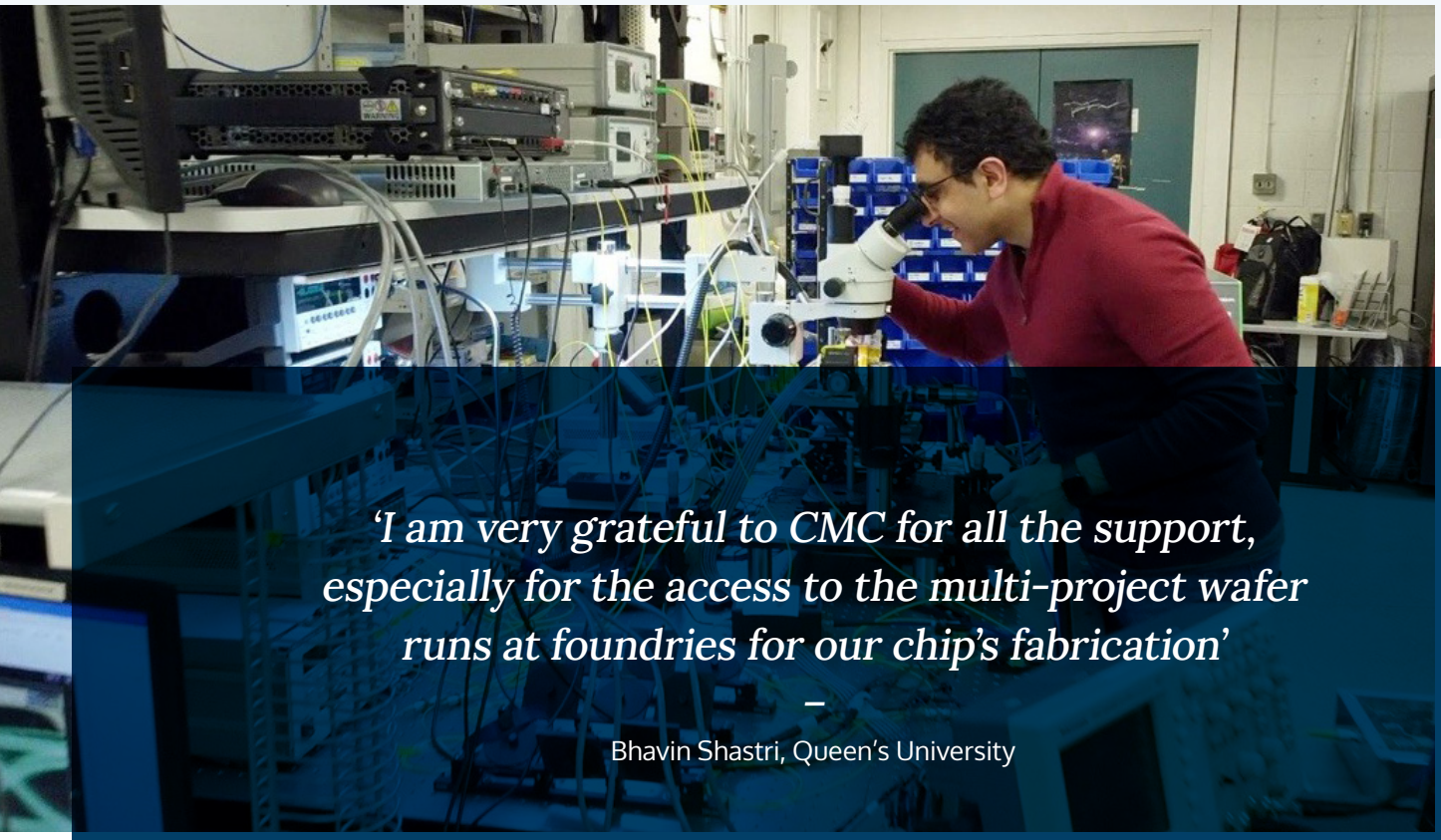
Shastri is working on hardware-based AI – neuromorphic processors that hold the potential to work six orders of magnitude faster than conventional electronic processors while consuming much less energy.

In the short and medium-term, neuromorphic photonic processors could provide intelligent signal processing.

In the long term, neuromorphic photonic computing could lead to breakthroughs in fundamental physics, or advances in understanding the mysteries of the human brain, says Shastri.

He says CMC has been critical to his success.

"I am very grateful to CMC for all the support, especially for the access to the multi-project wafer runs at foundries for our chip's fabrication. That, coupled with access to the software tools and support from engineers, has been instrumental in advancing our research," says Shastri.



'I am very grateful to CMC for all the support, especially for the access to the multi-project wafer runs at foundries for our chip's fabrication'

–

Bhavin Shastri, Queen's University

Financial Summary

CMC delivers on its mission through the support of several financial stakeholders. In 2022-23, total revenues of $16.7 million came from a variety of sources including federal and provincial government grants, user fees, industrial sponsorship, and R&D consulting. The most significant source continues to be CFI's Major Sciences Initiatives (MSI) program. Compared to the prior year significant revenue growth came from non-subscriber fabrication. Total expenditures of $19.0 million increased from the prior year as CMC continues to expand fabrication services and R&D activity.

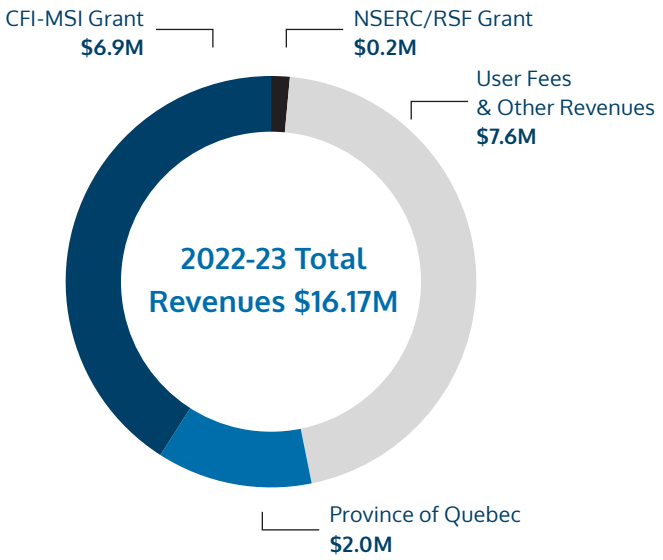
Statement of Financial Position as of March 31, 2023

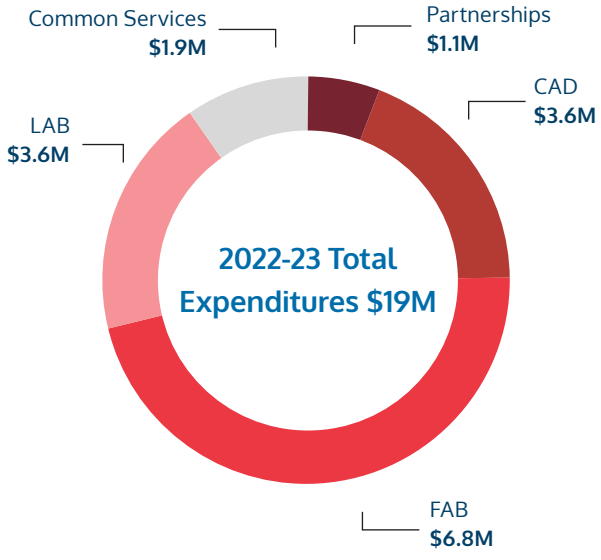
Assets	2023	2022
Current Assets	6,169,796	8,120,313
Long-term Assets	180,354	231,540
	$6,350,150	**$8,351,853**

Liabilities & Net Assets	2023	2022
Liabilities	3,936,783	3,697,783
Net Assets	2,413,367	4,654,070
	$6,350,150	**$8,351,853**

Statement of Revenue and Expenditure for Year Ended March 31, 2023

Operations	2023	2022
Revenues	16,746,411	15,534,163
Expenditures	18,987,114	15,653,837
	($2,240,703)	**($119,674)**





www.CMC.ca/Corporate-Reports
for our complete audited financial statements

Kingston I Montreal I Ottawa I Sherbrooke

www.CMC.ca

Join the Conversation!

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