
Research Partnerships in Manitoba Leverage Innovation



Research
Manitoba



—
Improving Hydroelectric
Energy Conversion

—
**Research and Innovation
Drive our Economy**

“The adoption of technology is critical to improving the competitiveness of Manitoba businesses and industries...

Manitoba must consider how its businesses and industries can advance their technological capabilities, and how all stakeholders can internally and collaboratively align and contribute to that goal...”



—
Saving the Lives of Bees



—
“Government and business both need to change from a risk-averse mindset to one that supports experimentation and innovative solutions...

These transformations point to opportunities, both to improve business performance today and to develop new products and services in the future.”

*Growing Manitoba’s Economy, December 2018

—
Discovering the Cause of
Inflammatory Bowel Diseases



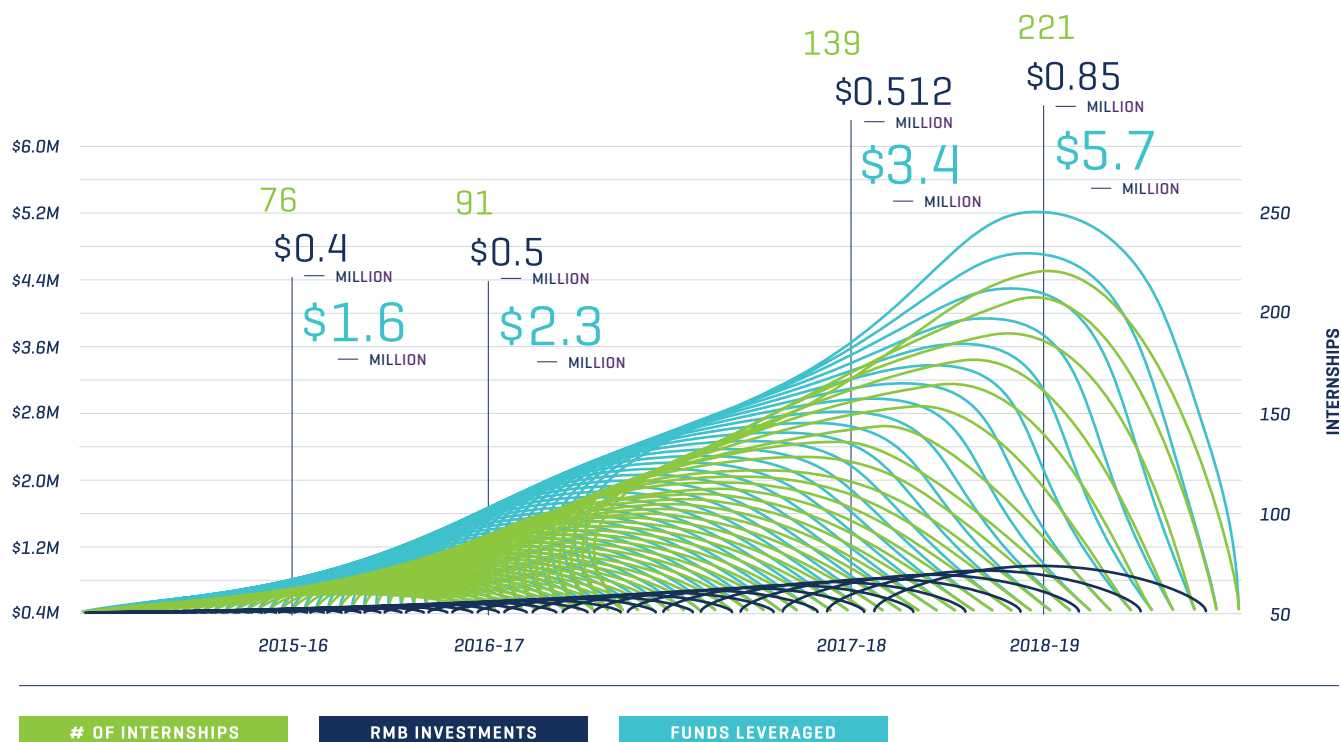
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Binding Gravel Roads

Investment Value

Leveraging Success

The Mitacs program in Manitoba has been successfully linking industry to academia to solve business and societal problems since 1999. Research Manitoba maximizes the Government of Manitoba investment in Mitacs.

Research Manitoba's investment of \$850,000 in 2018-19 was leveraged by Mitacs to generate \$5.7 million of support for research in Manitoba.



Greater Innovation

Creating Future Growth

Mitacs is increasing Manitoba's technology adoption for global competitiveness.

Mitacs is Expanding in Manitoba

Manitoba was the fastest growing province for Mitacs internships in the 2018-2019 year.

Strategic Partnership Development

Three new Manitoba institutions became Mitacs network partners [Red River College, Assiniboine Community College, and Canadian Mennonite University].

To expand Indigenous research engagement, Mitacs has partnered with Indigenous Works a national social enterprise with a mandate to improve the inclusion and engagement of Indigenous people in the Canadian economy.

\$435,000 Mitacs grant with George Weston Limited and the University of Winnipeg was created to lead innovation in agricultural technology.

The Innovation Lever

Mitacs Internships Create Emerging Opportunities for Growth

Mitacs is a national not-for-profit organization that links industry to academia, helping industry solve business challenges by connecting them to some of the best young minds in their fields. The interns then apply their graduate student expertise to meet the real and current research and development needs of business.

In 1999 Mitacs was founded and has since worked with:

70 universities 6000+ companies

Both federal and provincial governments are working with Mitacs to create partnerships that support industrial, social, and health innovation in Canada.

Mitacs internships are made possible by sources including:

Research Manitoba / Government of Manitoba

+

Government of Canada

+

The business or not-for-profit organization involved

In Manitoba, Mitacs provides and oversees three programs:

- 1) **Accelerate** — is the most utilized internship program and provides internships to master’s and PhD students.
- 2) **Elevate** — provides postdoctoral fellowships.
- 3) **Globalink** — provides both Canadian and international graduate students internships to pursue research in a partnered country.

Research Manitoba is committed to expanding the Mitacs internships program in Manitoba.

44 Accelerate Partner Organizations in Manitoba

Professional, scientific and technical services	15
Manufacturing.....	10
Agriculture, forestry, fishing and hunting.....	4
Arts, entertainment and recreation.....	2
Health care and social assistance	2
Educational services	1
Information and cultural industries	1
Management of companies and enterprises.....	1
Public administration.....	1
Retail trade	1
Transportation and warehousing	1
Utilities.....	1
Wholesale trade.....	1
Other services	3

Advancing Agri-Business



Remotely Monitoring Beehives [Apiaries]

Saving the lives of bees while improving the lives of beekeepers.

In Canada and around the world, farmers and beekeepers are seeking best practice models and solutions to invigorate a dwindling bee population.

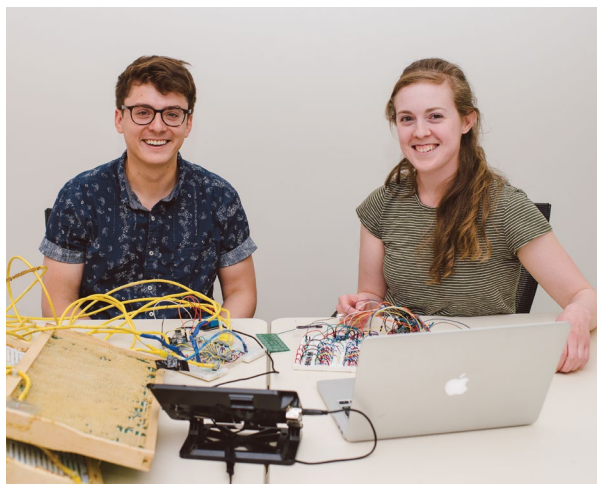
There is high value in honeybees as a primary pollinator for Canada's crops and through export sales of honey.

In commercial beekeeping, beehives should be spread as far apart as possible, usually over large distances in rural areas, making monitoring the hives difficult.

When monitoring the beehives to ensure the health of the colony, a person must physically visit the apiary. Travelling these distances is an added expense and a large time commitment. To increase cost effectiveness and hive support, there has been interest in developing a remote monitoring system.

Bruce Hardy, CEO of the Winnipeg company Function Four, partnered with Durston Honey Farms in Dauphin, MB, and together they worked with Mitacs to develop a remote monitoring system for apiaries. They engaged the expertise of the following researchers:

The Research Team:



Professor Cyrus Shafai
Department of Electrical and Computer Engineering at the University of Manitoba led the team.

Valerie Beynon
was an M.Sc. candidate in Electrical and Computer Engineering at the University of Manitoba during her time as an intern.

William Robinson
is an M.Sc. candidate in Electrical and Computer Engineering at the University of Manitoba.

Partner Organizations:



"These students are applying engineering knowledge to a completely different discipline, they're working with a different department, and the companies they're working with do not have this background. So it becomes a team effort and the student learns how to operate in industry..."

— Professor Cyrus Shafai,
DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING, UNIVERSITY OF MANITOBA.

Impacts

The impacts of Mitacs internships on this project spans innovative technology development and use, creating highly qualified personnel who can use their skills in novel ways, and provides support for increased investment for a company in the early stages of development.

Three interns/graduate students have been involved in this research and they are refining:

- Three deep learning-based object detection models to detect bees and predators;
- A printed circuit board that can regulate temperature;
- An interdigitated capacitor that can measure the location of the bees and honey levels;
- A distributed monitoring platform system.

Students gain real-world experience in the workplace.

Two

Full-time jobs created

"The Mitacs internships are an important ingredient for the advancement of high caliber research that continues to spur our growth."

— Bruce Hardy
CEO OF FUNCTION FOUR

"I was already working in computer programming in industry; in order to decide whether or not to pursue a Master's Degree, I wanted it to be affiliated with a project in industry. Mitacs offered me the opportunity to achieve this."

— William Robinson
(PREVIOUS INTERN)

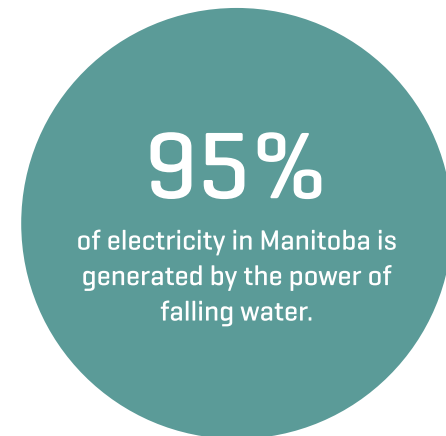
"I was able to use my background in electrical engineering and computer programming to learn about and design technology for problems outside of my field, for entomology."

— Valerie Beynon
(PREVIOUS INTERN)

Creating New Potential:

- Positions Manitoba as an innovative industry leader in a critical agri-business market;
- Aligns with Manitoba's Made-in-Manitoba Climate and Green Plan;
- Demonstrates a path to innovation and the potential for impact to inspire other Manitoba businesses.

Maximizing our Power



Reducing Hydroelectric Energy Losses

Electricity is an integral part of our everyday lives, and research is improving its conversion.

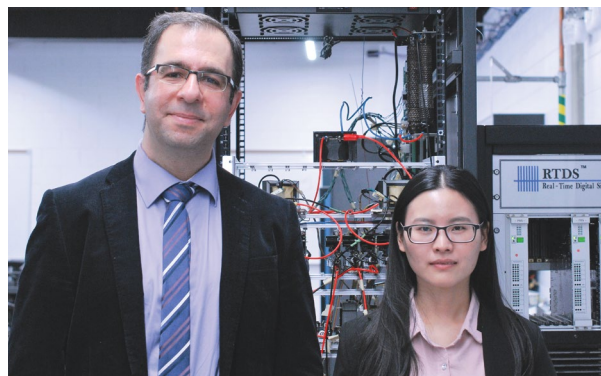
Over 95% of the electricity in Manitoba is generated by using the power of falling water via hydroelectric dams in Northern Manitoba. This electricity must travel hundreds of kilometres south, where most of the population lives, losing great amounts of electricity in the process.

To reduce losses, the Alternating Current (AC) electricity that is produced at the hydroelectric dam is converted to Direct Current (DC) electricity.

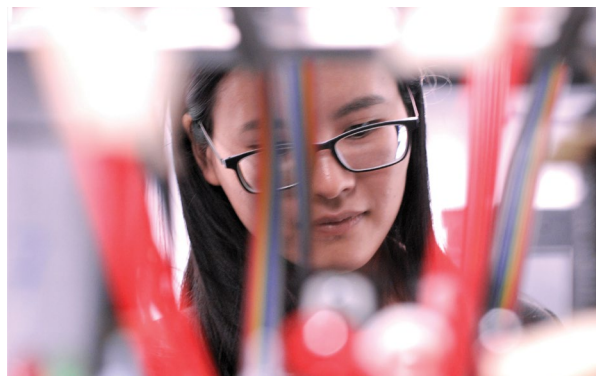
For most Manitobans to use the electricity, the DC current must be converted back to AC through an inversion process. During this process there can again be high losses of energy.

Two researchers took up the challenge to look at how to improve the AC to DC conversion process through better control systems and novel converter topologies.

The Research Team:



Professor Shaahin Filizadeh, Department of Electrical and Computer Engineering, University of Manitoba, has participated with Mitacs to make internships available to his graduate students since 2006.



Dr. Xianghua (Sherry) Shi was a PhD candidate in the Department of Electrical and Computer Engineering at the University of Manitoba during her internships.



Partner Organizations:

“During long-distance electricity transmission even a 0.5 percent energy loss translates into megawatts of electricity that could have supported hundreds of homes. Through research, we are trying to reduce these losses using advanced techniques.”

— Professor Shaahin Filizadeh,
DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING, UNIVERSITY OF MANITOBA.

Building Partnerships

This research project involved three partner organizations:

- RTDS Technologies Inc.
- Manitoba Hydro
- Manitoba HVDC Research Centre (Manitoba Hydro International)

Working at each partner organization allowed the intern to learn and contribute to different aspects of this project. The partnership also benefited the companies through the expertise and knowledge that came from the intern’s expertise. Bringing together the three partner organizations for the Mitacs internship provided opportunity for multiple areas of expertise to be combined.

Impacts

In reducing energy losses:

- The team invented a voltage-regulation method that reduces semiconductor losses;
- Converter typology has been modified and demonstrates lower losses;
- They created a hybrid cascaded modular multilevel converter with newly developed variants that have noticeably lowered switching losses;
- At RTDS — development of real-time digital simulator;
- At MB Hydro — development of energy processing hardware;
- At HVDC — modeling and loss analysis for improved efficiency.

One

PhD dissertation

One

Full-time job created

To reduce faults in the protection system:

- The team developed a generalized independent-phase control scheme for various voltage source converters;
- Created special algorithms to enable fast recovery from faults.

A Brighter Future

- Greater efficiency will continually pay dividends for Manitoba Hydro customers;
- Strengthening the capabilities of Manitoba Hydro International enhances our reputation as leaders around the globe;
- RTDS Technologies continues to grow, exporting knowledge and technology and improving power systems worldwide.

Seeking a Cure

Discovering the Cause of Inflammatory Bowel Diseases (IBD)

Canada has the highest prevalence of Inflammatory Bowel Disease in the world.

Over 270,000 people, or 0.7% of the population, are affected.

People with IBD experience bouts of intense abdominal pain and chronic diarrhea that strikes multiple times per day.

- The cause of IBD is unknown, resulting in current treatments addressing symptoms rather than prevention or cure;
- This leads to increased healthcare costs and less effective treatment outcomes;
- Evidence suggests that the cause is an inflammatory process within the gastrointestinal tract, but what causes the inflammation is unclear;
- To find out what causes the inflammation, a better understanding of immune cell regulation in the intestinal tract is needed.

The Research Team:



Dr. Jean-Eric Ghia, Associate Professor in the Department of Immunology and Internal Medicine at the University of Manitoba, took on this challenge by partnering with Crohn's and Colitis Canada for multiple Mitacs internships.

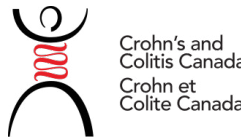


Dr. Laëtitia Kermarrec came to the University of Manitoba for her postdoctoral fellowship under the supervision of Dr. Ghia.



Dr. Nour Eissa came to the University of Manitoba to pursue his second PhD under the supervision of Dr. Ghia.

Partner Organization:



376,000

Canadians are estimated to develop IBD by 2030.

"There was a 50,000 increase in child (IBD) cases over the last couple of years...[IBD cases are] actually developing really quickly and rising really quickly, what we have to do is we have to find a cure."

— Dr. Jean-Eric Ghia
DEPARTMENT OF IMMUNOLOGY AND INTERNAL MEDICINE,
UNIVERSITY OF MANITOBA

"Thanks to Mitacs, we made scientific discoveries and we were able to connect and learn from patients and families."

— Dr. Kermarrec
(PREVIOUS INTERN)

Impacts

The research project initiated by Dr. Ghia is the first to investigate the role of semaphorin-3E during the development of inflammation that can cause IBD. Semaphorin-3E is a membrane-bound protein that regulates cell trafficking and immune cell to cell interactions. Semaphorin-3E is found in the inner lining of the colon and rectum.

The Mitacs team discovered that:

- Semaphorin-3E is lower in patients with ulcerative colitis and in experimentally induced colitis;
- Pharmacological manipulations or deletion of semaphorin-3E can regulate experimental colitis.

Leading to real change

- The University of Manitoba has become well known for its research in IBD;
- The University of Manitoba partnered with Crohn's and Colitis Canada to host an educational evening for persons with IBD.

Seven

Peer-reviewed publications

One

PhD dissertation

One

Postdoctoral Fellowship

17

Conference presentations

One

M.Sc. thesis

"The funding from Mitacs helped me to later receive a CIHR [Canadian Institute of Health Research] Post-Doctorate Fellowship."

— Dr. Eissa
(PREVIOUS INTERN)

Chromogranin-A [a protein]

Dr. Ghia and his team were also the first to examine the role of chromogranin-A in ulcerative colitis.

Chromogranin-A plays a critical role during a colitis flare up. There is a significant increase in CgA-positive cells in patients with IBD:

- Chromogranin-derived peptides regulate intestinal inflammation.

"Crohn's and Colitis Canada's promise is to find the cure[s] and to improve the quality of life of those living with Crohn's disease and ulcerative colitis. Fundamental to our promise is to support researchers."

— Dr. Kate Lee,
VICE PRESIDENT OF RESEARCH AND PATIENT PROGRAMS,
CROHN'S AND COLITIS CANADA

People living with IBD can begin to hope for a cure rather than treatment alone.

\$2.3 Billion

may be saved in future health care costs in Canada resulting from continued research.

Driving our Economic Growth

80%
or 67,000 kilometres of the roads in Manitoba are made from gravel.

Clay Binding of Gravel Roads

"We do not have cohesive clays on our roads, this presents both a challenge and a great opportunity to engineer the entire process."

— Professor Hamid Mumin,
CHAIR OF THE GEOLOGY DEPARTMENT, BRANDON UNIVERSITY

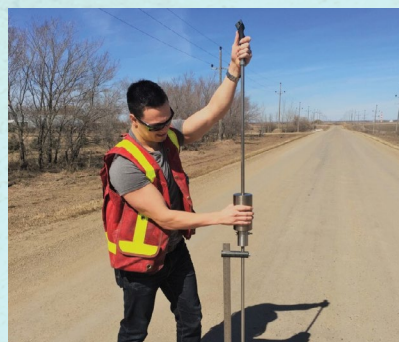
- Gravel roads are transient and quickly become loose, rough, dusty, and lose strength, all of which can lead to dangerous driving conditions;
- Current ways to mitigate the degradation of gravel roads is through regular and expensive maintenance, often requiring the application of chloride salts or other toxic materials;
- There is a great need for an environmentally safe and low-cost product and construction techniques for their stabilization.

In partnership with Winnipeg's Cypher Environmental, two Mitacs-supported researchers took up the challenge to find the right type of cohesive clay that, in combination with catalysts and polymeric agents, acts as a cementing agent and creates durable gravel roads.

The Research Team:

Professor Hamid Mumin, Chair of the Geology Department at Brandon University.

Riley Cram is an M.Sc. candidate in the Department of Geology at Brandon University.



Partner Organization:



“We were able to get some phenomenal research done. It’s added significant value to the company in terms of strengthening our value proposition through accredited third-party research, but also through the internship program we were able to actually develop talent for the company, Riley Cram [intern], we have created a job for him. The fact that we’ve actually created jobs over the internship speaks for itself.”

— President Todd Burns,
CYPHER ENVIRONMENTAL

Research is improving our gravel roads, the under-appreciated lifeline for many communities and industries.

Impacts

The laboratory and field research during the Mitacs internship moved quickly into innovative territories within geotechnical engineering. Professor Mumin and his team had to develop their own methods and standards for testing which included:

- Binding and bearing strength of local materials with different clay-aggregate mixes, catalysts, and polymer applications;
- Curing times;
- Moisture content and reabsorption;
- Dust reduction and environmental mitigation;
- Road durability.

Industry representatives and government delegations from across Canada and internationally, including Japan, Honduras, and India [with more arriving each year], travelled to examine the test roads created in the Brandon area that were developed during the Mitacs internships. They are learning from the technology and how they can apply it to their own situations.

Cost Comparisons

\$75,000–\$100,000

per mile for gravel roads made with specialized technology created during the internship

V.S.

\$1 Million

per mile for pavement

All roads lead to economic growth

Top-class researchers from across Canada and globally are coming to Brandon to learn about the innovative work taking place here.

Cypher International has increased its revenue and company growth.

Another successful business contributing to our Made-in-Manitoba Climate and Green Plan.

One

M.Sc. thesis in progress

One

Full-time job created

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SOURCES

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