PROJECT INSIGHTS REPORT

Accelerating the smooth adoption of smart systems

<u>Tech and Automation</u>, <u>Sectors in Transition</u>

EXECUTIVE SUMMARY

Given the widespread and rapid changes in technology impacting workplaces across sectors in Canada, there is increasing demand for professionals skilled in automation, artificial intelligence, and digital technologies.

Through modifications to existing engineering programs, McMaster University sought to expand the work-integrated learning opportunities offered to students in two of its engineering programs. The goal was to provide students technical skills via projects provided by industry partners in hopes of accelerating their adoption of digital technologies.

The work-integrated learning opportunities supported by this project led to 120 projects, including but not limited to the development of industrial robots, smart home technology, portable CNC machines, and ground stations for satellite communication. The project also resulted in various research projects and publications covering topics such as 3D printing, 5G Internet of Things, autonomous vehicles, industrial robotics, and IoT communication.

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April 2024

PARTNERS

<u>McMaster University – W Booth School of Engineering Practice & Technology</u>

LOCATIONS

Ontario

INVESTMENT

$906,917

Evaluation Report: Evaluation of Accelerating the Smooth Adoption of Smart Systems

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This project's success at instilling in-demand technical skills in students and accelerating the adoption of digital technologies among industry partners can serve as a template for other post-secondary institutions seeking to better coordinate their engineering programs with industry needs. Policymakers and funders can also review this project's success and consider how to better support post-secondary institutions to modify curriculum and offer work-integrated learning opportunities.

KEY INSIGHT #1

120 work-integrated learning projects were implemented with a network of 60 industry partners.

KEY INSIGHT #2

More than 20 learning modules were developed to upskill students and employees of industry partners on topics like: machine learning, predictive analytics, Internet of Things, and artificial intelligence.

KEY INSIGHT #3

Enrollment in the Systems & Technology Master's in Engineering program went from 21 students in 2020, to 109 students in 2023 with a waitlist of 50 people.

The Issue

The Fourth Industrial Revolution, also known as Industry 4.0, is characterized by rapidly increasing connectivity and technology-enhanced work environments. These changes are increasing demand for professionals skilled in automation, artificial intelligence, and digital technologies. Future generations of workers need to develop digital ability and lifelong learning capacities at an early age, alongside skills such as self-organization, self-motivation, problem solving, management, teamwork, and communication skills.

Many Canadian companies are still struggling with how to adopt digital technologies. Many small-and-medium-sized enterprises, start-ups, and municipalities have misperceptions, a lack of skills, and face challenges to implementing Industry 4.0, and risk getting left behind, which will affect Canadian productivity overall.

In response to these evolving needs, McMaster University developed and continues to evolve bachelor's and master's degree programs to respond to industry needs for workers who can help them adopt advanced technologies and automation. Most recently, this included a smart systems option in the bachelor's of technology automation program and a brand-new systems and technology master's in engineering program. Together, these programs aimed to support the accelerated adoption of digital technologies in various sectors, including manufacturing, healthcare, transportation, smart cities, and others.

What We're Investigating

This project sought to provide students with skills in demand via work-integrated learning (WIL) opportunities and to accelerate the adoption of Industry 4.0 and smart systems in Canadian industries and communities.

This project served working or recent graduates in engineering and technology and those undertaking a one-year master's in engineering, who wanted to enhance their career aspirations or gain knowledge in emerging technologies. The project also sought to create pathways for new immigrants and international students looking for a hands-on, practical program in smart and digital technology systems that offers co-op opportunities to get Canadian experience.

Industry partners were matched with undergraduate and graduate students with skills and capabilities to kickstart the industry partner's digital transformation projects. Students worked on projects as part of their degree completion requirements at no cost to the partners and, if required, took up further co-op placements with the partners. From these experiences, it was expected that students would gain skills in solving real problems and become ready for full-time placement in accelerating adoption of these technologies upon graduation.

With the assistance of a community engagement co-ordinator and assistant, the project worked with a network of partners in the Greater Toronto and Hamilton area from industrial, municipal, and other community groups such as hospitals, professional organizations, rotary clubs, startups, and relevant campus units. This network supplied digital technology challenges that could be addressed by the students.

Alongside WIL opportunities, the project also:

- Sought to develop learning modules aimed at students and industry partners for hands-on experience of key topics relevant to Industry 4.0.
- Support campus engineering and technology teams and projects.

What We're Learning

The project effectively combined WIL projects, co-op placements, and curriculum development to accelerate the adoption of Industry 4.0 technologies. This approach resulted in a higher likelihood of students securing full-time employment earlier than their peers, and SMEs benefited from the expertise and insights of these students.

This project resulted in:

- A network of 60 partners
- 120 WIL projects
- More than 20 learning modules on topics including, but not limited to: circuit board design, microcontrollers and electronics, AI and machine learning, IoT implementation, PowerBI, predictive analytics, 3D printing, and introduction to drones
- More than 101 lab experiments and prototypes developed
- 16 special project-application prototypes, some of which have won international awards
- Support for five campus teams with a total membership of 281 students.

Engaging industry partners: Actively involving industry partners was crucial to the project's success. Their participation provided students with valuable insights into real-world industry needs and practices, bridging the gap between academia and the professional world. These collaborations fostered a mutually beneficial relationship, where industry partners gained access to fresh perspectives and innovative ideas from students, while students gained practical experience and hands-on learning opportunities. Industry partners provided in-kind contributions such as providing access to facilities, equipment, or expertise, which significantly enhanced project's impact while minimizing financial constraints. The project's experience highlights the value of academia and industry working together to address common challenges and drive innovation.

Developing learning resources and prototypes: The development of comprehensive learning resources and prototypes served as a cornerstone of the project's success. These resources provided students with a solid foundation in Industry 4.0 technologies, allowing them to apply their theoretical knowledge to practical applications. The prototypes, in particular, showcased the tangible outcomes of the project and demonstrated the potential of Industry 4.0 technologies to address real-world challenges.

Challenges faced by SMEs. Many SMEs lack the necessary human resources and expertise to adopt these technologies, and lack understanding of the technologies and their potential applications. Increased funding for WIL projects and co-op placements for SMEs to support their adoption of Industry 4.0 technologies is necessary to help overcome these barriers.

Empowering students as partners. Engaging students as active partners in the project, not just as passive recipients of knowledge, fosters a sense of ownership and responsibility, enhancing their learning experience and preparing them for future employment opportunities.

Why It Matters

More workers are needed with specialized skills so Canadian companies can leverage the rapidly evolving digital technologies that characterize the Fourth Industrial Revolution. This project is an excellent demonstration of industry partners and a post-secondary institution working together to ensure students acquire in-demand skills, and employers accelerate their adoption of cutting-edge technologies.

Using the project documentation, other post-secondary institutions, especially those offering engineering programs, can use the findings from this project to guide their own efforts to implement work-integrated learning opportunities and deepen connections with employers.

To effectively prepare the workforce for the digital era and accelerate the adoption of Industry 4.0 technologies, educators, policymakers, and funders of post-secondary institutions should:

- Review academic programs and models to ensure they adequately prepare students for the adoption of digital technologies.
- Support the development and implementation of effective WIL models across academic institutions to provide students with valuable hands-on experience in real-world industry settings, bridging the gap between academia and the professional world.
- Allocate sufficient funding to support hands-on education and training initiatives in new technologies. This funding should cover the development of learning resources, equipment, and facilities, as well as the costs associated with WIL programs.

By implementing these recommendations, policymakers and funders can create an environment that fosters innovation, collaboration, and the widespread adoption of new technologies, ensuring a future workforce equipped with the necessary skills to thrive in the digital era.

What's Next

McMaster University's School of Engineering Practice and Technology is committed to continuing to offer its M.Eng. and B.Tech. programs, and to continuing to offer students in those programs robust WIL opportunities that benefit students and the businesses they work with.