

Applied Research in Post-Pandemic Canada

Alexandra Apavaloae, PhD, and Cody McKay
Polytechnics Canada

Abstract

Though Canada's immediate priority is finishing the fight against COVID-19, we must not lose sight of other persistent national challenges. From an aging population to climate change, advancing Indigenous reconciliation to supporting businesses grappling with technological change, polytechnics are providing pragmatic and industry-aligned solutions through applied research. This paper explores how polytechnic applied research mitigates some of Canada's most pressing challenges, highlighting partnership and project outcomes, examining existing policy gaps and proposing bold new solutions.

Keywords

COVID-19, applied research, innovation, polytechnic, college, healthcare, climate change, Indigenous, reconciliation, technology, adoption, adaptation, productivity

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Author Note

Alexandra Apavaloae PhD is a Policy Analyst at Polytechnics Canada.

Cody McKay PG Certificate is a Policy Analyst at Polytechnics Canada.

Introduction

Although Canada's immediate priority is finishing the fight against COVID-19, we must not lose sight of the challenges on the horizon. An aging population will require new approaches to and solutions for healthcare. Achieving net-zero emissions to

fight climate change will impact every sector of the economy. Indigenous reconciliation requires an intentional effort and the resources to support it. Layered across these issues, technological disruption is rampant in an increasingly digital world.

Meaningful progress to address these challenges must make use of capacity in every corner of the country. For the network of Canadian polytechnic institutions, this means looking within to see what we are doing to address these challenges today and where we are well positioned to do more. For governments both federal and provincial, it means recognizing pockets of activity that could be scaled for greater impact, particularly in areas of identified priority.

Healthcare

When the World Health Organization declared the novel coronavirus (COVID-19) a global pandemic, few could have anticipated the tremendous impact it would have on the world's population, economies, and healthcare systems. Even as vaccines are administered and businesses reopen, Canada should not rush to put the pandemic into history books. Instead, the time is right to take stock of the lessons learned and plan for what comes next.

From the mental health of healthcare workers (Wu, Styra, & Gold, 2020) and hospitals operating over capacity (Galasso & Mitchell, 2021) to delays in non-urgent surgeries (Dudevich & Froot, 2021) and weaknesses in long-term care (Clarke, 2021), the impacts of the pandemic will continue to reverberate. The pandemic illustrated the fragility of the Canadian healthcare system and should be viewed as a wake-up call.

Going forward, the system will need to both adapt to existing realities and address future needs, some foreseen—like an aging population—and others unknown. This will require creativity and innovation, efficiency and resilience.

Pre-pandemic, the Canadian Institute for Health Information estimated health expenditure at \$11,599 per capita for seniors

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***Innovation Spotlights** These are contributions that highlight innovative practices, approaches, or tools and provide accompanying evidence that speaks to the effectiveness of the innovation, including but not limited to an innovative teaching practice or an innovative methodology benefitting academia, industry, and community partners.

aged 65 and older, and \$3,131 for those aged 15 to 64 (CIHI, 2021). With Canada's senior population expected to increase from 17 per cent in 2018 to 21 per cent in 2028, an estimated \$98 billion in added healthcare costs are imminent (Gibbard, 2018).

Keeping these costs in check will rely on our ability to prevent and treat illness. Whether COVID-19 or another ailment, the national capacity to develop vaccines and other treatment options is critical. During the early days of the pandemic, researchers at Fanshawe were focused on reducing the body's inflammatory response to the virus (SONAMI, 2020). The research showed such promise that it was provided to the U.S National Institutes of Health for pre-clinical trials (De Bono, 2020). Such applied research efforts build practical capacity and talent in Canada to respond to existing and emerging diseases.

Polytechnic applied research is also well-positioned to support the healthcare sector as it joins the digital revolution. At Sheridan's Centre for Mobile Innovation, researchers are leveraging modern technology to transform and improve the efficiency of doctors' offices. Using augmented reality, the research enables doctors to view patient vital signs, test results and medical history, medications and allergies in real time (Kataoka, 2019).

At Algonquin, digital solutions to improve frontline care and patient/family engagement are also being developed. These include the Community Paramedics Continuing Medical Education App, the Healthcare Messenger App for Caremeda and the Patient Engagement Platform (Algonquin College, 2021).

While technology stands to make healthcare delivery more efficient, it is a fundamentally people-focused sector. Applied researchers at Conestoga are working to improve the outcomes of patients with complex needs, such as dementia. The initiative focuses on novel approaches to bridge skills gaps for unregulated care workers to improve outcomes, reduce turnover, and ensure greater job satisfaction (Conestoga, 2021).

That people-focus must extend even further, helping individuals navigate their healthcare decisions. During the pandemic, an unforeseen challenge was the spread of misinformation about COVID-19. Through a partnership with MediaSmarts, BEworks and leading misinformation researchers, Sheridan designed, tested, and disseminated creative interventions to combat the spread of misinformation using behavioural science and digital and media literacy research (Atkinson, 2020).

By supporting technology adoption, building talent and capacity, and responding quickly when new challenges emerge, polytechnics have proven their capacity to both solve current healthcare

challenges and anticipate those of tomorrow.

Climate Change

The latest report from the Intergovernmental Panel on Climate Change is an indictment of the global record, noting that, "it is unequivocal that human influence has warmed the atmosphere, ocean and land" (IPCC, 2021). The warning has been accompanied by unprecedented global climate emergencies, prompting renewed calls for action. In Canada, commitments have included reducing emissions and energy waste, making clean, affordable transportation and power available in every community, and building a clean industrial advantage (ECCC, 2020).

This ambitious plan relies on contributions from and cooperation among all economic sectors, the general population, and all levels of government. We also see opportunities for polytechnics to play a key part given their experience with industry-academic partnerships, delivery of pragmatic solutions and central role training the green collar workers needed to implement solutions.

Given Canada's size and climate, it is of little surprise that its transportation sector contributes 25 per cent of the country's total annual emissions (Government of Canada, 2020). At Red River College Polytechnic, located in Winnipeg—one of Canada's heavy equipment hubs—they are actively working on green transportation solutions.

Between 2010 and 2017, RRC Polytech partnered with the Government of Manitoba, Mitsubishi Heavy Industries, Manitoba Hydro and New Flyer Industries to prototype and test the feasibility of electric buses in the region. Whereas previous electric public transit options have been tethered to overhead wires, this project sought to develop advanced lithium-ion batteries that would power city buses. In addition to RRC Polytech's expertise working with heavy equipment, Manitoba presented the ideal testing ground for global deployment given its weather conditions—very hot summers and frigidly cold winters. Partners involved in the research believed buses successfully deployed in Manitoba could be used anywhere in the world.

The project proved a resounding success, with the prototype introduced as part of Winnipeg's transit fleet. At the time, the prototype was the only modern, battery-based electric bus developed by a domestic manufacturer (Hoemsen, 2017).

Buildings are another significant contributor to Canada's greenhouse gases, accounting for 13 per cent of total emissions (Government of Canada, 2020). Making offices, buildings, and homes more efficient will both reduce emissions and

save consumers money. Here again, polytechnics are making meaningful contributions.

In Calgary, the Southern Alberta Institute of Technology's Green Building Technologies team is transforming the way we think about building homes. In March 2021, the team worked with Woodpecker European Timber Framing to build a home to meet the Living Building Certification, the world's most rigorous green-building rating program. The home allowed SAIT researchers to pilot a dashboard to monitor building performance and consult on the design of high-performance, energy-efficient wall panels (SAIT, 2021).

At Kwantlen Polytechnic University's Wilson School of Design in BC's lower mainland, efforts are also underway to help industry reduce their carbon footprint through a project called NetGain. Researchers and students are turning recovered fishing nets into filaments for 3D printing. Through this work, the team contributes to the environmental effort, incentivizes the return of old nets, and taps into the 3D printing industry, which is expected to be valued at more than \$20 billion by 2030 (KPU, 2019).

In the oil and gas sector, cooperation with major industry players is critical. For example, Inter Pipeline, a major petroleum business, has invested more than \$10 million in the Northern Alberta Institute of Technology's Plastics Research in Action (PRIA) initiative. PRIA draws on NAIT's expertise in process engineering, process automation and environmental sustainability, with a portion of the funding dedicated to improving sustainability practices at Inter Pipeline's Heartland Petrochemical Complex. Support from the federal Strategic Innovation Fund highlights how government dollars can support innovation and drive change.

As people around the world grapple with their impact on the planet, it is critical that governments use all available resources to develop and implement pragmatic solutions. Applied research at Canada's polytechnics offers practical, incremental, and impactful options, addressing climate issues as varied as greenhouse gases and water contamination. Furthermore, by involving students in cutting-edge projects, polytechnics are training the workforce needed to implement the broader transition to a green economy.

Indigenous Reconciliation

Canada is beginning to acknowledge its fraught history with Canada's Indigenous communities. As part of its report in 2015, the Truth and Reconciliation Commission issued 94 calls to action. Post-secondary education has an important role to play in reconciliation, from integrating Indigenous knowledge and teaching methods into classrooms to "building student capacity for

intercultural understanding, empathy, and mutual respect" (TRC, 2015). Polytechnic institutions are doing their part.

One of the most painful and enduring legacies of Canada's relationship with its Indigenous people is the residential school system. Over the summer of 2021, Saskatchewan Polytechnic worked closely with Cowessess First Nation on an applied research project called the Remote Sensing of Residential School Cemeteries. Institutional experts used technologies drawn from other sectors to survey an area identified by the Cowessess First Nation as a potential site of unmarked graves. The partnership stands to inform and support reconciliation by helping the First Nation tell their story (Bergeron, 2021).

In addition to acknowledging the past, post-secondary institutions must consider how best to empower and support Canada's Indigenous population going forward. Based on a recent survey, Indigenous Works suggests that "85% of corporate Canada are 'disengaged' and have no credible plans to work with Indigenous people, businesses and organizations" (Malatest & Associates Ltd., 2017). In the absence of these relationships, full Indigenous participation in the Canadian economy will remain elusive.

Yet, the National Indigenous Economic Development Board estimates that closing the opportunity gaps between Indigenous and non-Indigenous Canadians stands to increase national Gross Domestic Product (GDP) by \$27.7 billion annually (NIEDB, 2019). Polytechnics are enabling and supporting this process.

Because polytechnics are deeply embedded in their communities, understand local issues, and have a history of partnering with Indigenous groups, they are positioned to bridge gaps and boost opportunity for Indigenous business owners.

For example, researchers at Seneca's School of Biological Sciences & Applied Chemistry partnered with the Indigenous-owned Cheekbone Beauty Cosmetics Inc. to develop a mist formulation for a face primer. The primer mist contains Canadian-sourced, bio-based raw materials used in traditional, Indigenous medicine. As part of the project, Seneca is helping to devise a process to scale up manufacturing and commercialize the product, enabling Cheekbone to expand their product line, adapt to industry trends and meet customer demand for eco-friendly, "mindful" beauty products (Seneca, 2021).

Community challenges are also being targeted. The British Columbia Institute of Technology partnered with Denesoline Corporation, the business development arm of the Lutsel K'e Dene First Nation, to deploy green solutions for the remote community.

BCIT's Smart Microgrid Applied Research Team is developing a front-end engineering and design study for a hybrid renewable energy platform for the community, which is not currently connected to the North American electricity grid. If successful, the project could be replicated in 200 other diesel-powered Indigenous communities (BCIT, 2021).

Reconciliation is a national effort, and the education sector has a significant role to play. Polytechnic applied research offers pragmatic ways to connect students to Canada's Indigenous history. It also supports entrepreneurs and business owners in the burgeoning Indigenous economy. These approaches stand to support reconciliation and build a stronger economy along the way.

Technology Adoption and Adaptation

Innovation, "the development and application of ideas and technologies that improve goods and services or make their production more efficient," has long been thought to have great economic benefit (ECB, 2021). Yet, Canada's most recent innovation report card from the Conference Board of Canada found the country continues to exhibit relatively weak innovation performance, ranking tenth among 16 peer countries. The Conference Board reports that, although entrepreneurial ambition is high, Canada lags on metrics such as business research and development and labour productivity (Nadeau & Gresch, 2021).

This is of particular concern among small businesses. As of December 2019, there were 1.23 million registered Canadian businesses. Of these, 1.2 million (97.9 per cent) were small and 73.6 per cent had fewer than 10 employees. These small businesses employed 8.4 million workers, or 68.8 per cent of the total private sector labour force. Yet, the contribution of small- and mid-sized enterprises (SMEs) to Canada's GDP between 2012 and 2016 was just 51.1 per cent (ISED, 2020).

The productivity gap could well be attributed in part to slow technology adoption. In fact, a recent Brookfield report found that Canadian SMEs lack the ability to capitalize on digital technologies, with challenges that included lack of data, limited access to infrastructure and supports, and lack of the necessary confidence to implement digital transformation strategies. Culture and level of digital awareness were also factors. The report argued that without supports to help SMEs better understand the benefits of digital investments and reduce uncertainty and risk, they are likely to see the earnings gap continue to grow over time (Goldsmith, 2021). From blockchain-enabled access to digital agriculture solutions (Seneca, 2021) to assisting local software

developers transition their code to newer technology (NAIT, 2021), polytechnics have the capacity to offer a spectrum of solutions across sectors to help Canadian businesses improve their productivity.

Polytechnic applied research has long helped businesses overcome production hurdles, scale up using innovative technologies, and commercialize new products. State-of-the-art facilities within the institutions provide businesses access to dedicated labs and equipment where they can produce prototypes and test new processes. Partnering with institutions is particularly important for SMEs that may not have in-house capacity but can make considerable advances when they have opportunities to explore new concepts and ideas.

Such a partnership between George Brown College and Quantum Robotic Systems allowed the small company to improve a stair-climbing, domestic service robot. The robot has capacity to move heavy loads, with great potential as an assistive device for seniors and persons with disabilities (George Brown College, 2020).

Many of these research projects are led by faculty who themselves have considerable industry experience. As researchers, they are ideally positioned to add insights into both project development and the broader business environment. For example, Humber's Georges Livanos is an award-winning, patent-holding instructor with more than a decade of practical experience in his field (Livanos, 2021). He brings that expertise to projects, such as the collaboration with Martino Contractors Ltd., which sought to detect and warn people about potentially fatal furnace malfunctions (Shetty, 2017).

An ancillary benefit of this innovation activity is student involvement. By participating in applied research projects, learners not only acquire hands-on, practical experience but also foster creativity and build problem-solving skills. An innovation-enabled talent pipeline is critical to Canada's future productivity and growth.

For example, Saskatchewan Polytechnic's Innovative Manufacturing Centre has the capacity to assist industry in biomaterials testing, research, additive manufacturing, and prototyping (Bergeron, 2018). The centre also allows students like Luke Dombosky to follow their entrepreneurial passion. A graduate of the Innovative Manufacturing program, Luke started a custom solutions design and manufacturing business while he was still in school. The business now includes a team of multi-skilled tradespeople, including several other Innovative Manufacturing

alumni (Bergeron, 2021).

Closing the productivity gap will require precisely the kinds of support available via polytechnic applied research. Access to facilities, labs, and equipment can enhance the research and development activities of SMEs without requiring extensive investment in their own capacity. Students and faculty stand at the ready to support technology adoption efforts and business development, offering follow-on benefits for the talent pipeline and ensuring faculty remain in touch with industry challenges and realities. This ecosystem provides immediate benefit to the private sector and builds home-grown talent for the future.

Conclusion

As Canada builds back from the COVID-19 pandemic, there are a number of ways that polytechnic applied research stands to contribute. Existing facilities, equipment, and expertise are ready to help businesses and organizations, private enterprises and public sector institutions address some of the preeminent innovation challenges of our time. This capacity is too important to ignore or under-utilize in today's environment.

There are also ways to super-charge this capacity and enable even bigger contributions. This relies on revisiting government investment in applied research projects, infrastructure, and business development. It means recognizing how polytechnic institutions are currently contributing to healthcare innovation, Indigenous reconciliation, technology adoption, and business productivity, then scaling that capacity to have even greater impact. It is equally important to consider how pragmatic exposure to and involvement in applied research is providing key skills in the next generation of employees and entrepreneurs. These are the ingredients of practical innovation.

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