Bouncing Back:

How to Spur Innovation in Nova Scotia Post-COVID-19

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Bouncing Back:
How to Spur Innovation in Nova Scotia Post-COVID-19

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Highlights

Importance of Innovation

- Innovation is critically important to Nova Scotia's economy as it is a key factor behind productivity growth.
- Canada trails many leading countries in the adoption of new technologies and spending on innovation. Nova Scotia lags Canada in key measures of innovation, including investment in machinery and equipment and research and development.
- Countries that are succeeding in adopting new technologies often share an emphasis on acquiring appropriate skills and instilling a culture that sees new technologies as critical to business success.
- There are multiple barriers, especially for small firms, to adopting new technologies including skill shortages, lack of understanding of the technology, uncertain returns and high costs.

Impact of COVID-19

- Companies across Canada are cutting spending during COVID-19, including on machinery and equipment.
- Automation and digitization are expected to accelerate globally to support physical distancing and reduce future shutdown risk.
- Skilled workers, especially those who can support the transition to a more digital and automated economy, are in short supply.
- Industries most likely to lose jobs to automation are largely those currently impacted by COVID-19. Low wage workers have lost the most jobs due to COVID-19 and are most at risk from automation.
- Firms in Nova Scotia should be prepared to accelerate investments in automation, and governments should support this transition.

The Importance of Innovation

This research note was prepared for Nova Scotia Business Inc. (NSBI) to examine the key role technology and process adoption can play in sharpening the competitiveness of Nova Scotia businesses.

Innovation is critically important to Nova Scotia's economy as it is a key factor behind productivity growth which in turn boosts an economy's standard of living. There are many different types of innovation, including adopting new technologies for production, investing in research, improving supply chains or marketing goods and services. New technologies can lower production costs and increase productivity while allowing firms to create innovative products.

COVID-19 risks slowing innovation in Nova Scotia and around the world. Companies are cutting capital spending, including on machinery and equipment. They are delaying investments until there is more certainty and stability in the economy. Research and development (R&D) and technology adoption are also expected to be hampered as companies look for ways to preserve cash flow. A resurgence of the disease in the province would slow spending on innovation, impacting the province's future productivity.

Technology Adoption:
Canada's Performance

The Global Innovation Index is an annual ranking of countries by their ability and success in innovation. **Canada ranks 17th on the 2020 Global Innovation Index**, well behind Switzerland, Sweden and the United States. Canada ranks poorly in several human capital indicators including spending on education per capita (32nd), graduates in science and engineering (60th) and spending on R&D as a % of gross domestic product (23rd).

Canada trails in several 'business sophistication' indicators including R&D performed by business, females employed with advanced degrees, import of information and communication technologies (ICT) services and inward investment. The country also has low rankings for high-tech manufacturing and low relative levels of high-tech and ICT exports. Canada does perform well in overall business environment, ease of credit and investment and venture capital deals. Canada ranks 6th in computer software spending as a % of GDP, a positive sign of digital adoption.

Global Innovation Index, 2020
Ranking of Selected Innovation Indicators

	SWISS	SWED	US	UK	CAN
Overall	1	2	3	4	17
Knowledge intensive employment, %	3	4	9	7	20
University/research collaboration	2	7	4	11	17
R&D, % of GDP	4	3	9	21	23
Venture capital deals	7	14	10	9	6
Business R&D, % of GDP	5	4	8	18	29
High-tech manufacturing, %	3	14	11	18	27
Computer software spending, % of GDP	3	10	1	4	6

Source: Global Innovation Index, 2020

Canada trails leading countries in many important innovation measures

The Global Competitiveness Index measures how productively a country uses its available resources. In the 2019 edition **Canada ranked 14th in global competitiveness**. In the technology environment category Canada did not fare as well, ranking 35th in ICT adoption, 20th in digital skills among the active population, and 28th in commercialization of research.

The rate of **productivity growth has long been a concern for Canada**. While Canada has seen an increase of 18% in manufacturing productivity since 2002, productivity has risen 49% in the United States and 94% in South Korea. This effect is attributed to Canada's slow adoption of new automation technologies. Canada is also trailing in expected robot adoption compared to other countries, ranking 14th overall.

In a report by Deloitte comparing different countries' adoption of artificial intelligence (AI), Canada's approach is characterized as 'cautious'. Canada is described as lacking urgency when it comes to adopting new technologies. In contrast to the idea that manufacturing adoption and automation destroys jobs, countries with low rates of adoption, like Canada and the UK, have seen the highest rates of job loss in manufacturing over the last twenty years.

Technology Adoption:
Global Leaders

The **global leaders in technology adoption have some common attributes**. Countries that are succeeding in adopting new technologies often share an emphasis on:

1. Training talent to work with new technologies and
2. A belief that new technologies are critical to business success.

These two characteristics are in addition to various other policy measures put in place by successful countries. These include public programs to help the adoption process, specifically for small- and medium-sized firms, and tax policies that encourage advanced technology adoption.

Reskilling the existing workforce is imperative as technologies like artificial intelligence (AI) will change more occupations than they eliminate. The U.S. has the highest rate of experienced AI early adopters, and its success is bolstered by strong internal training programs for the workforce. Germany takes a universal approach to AI with significant efforts to develop and retrain its existing workforce to address the AI talent gap.

Switzerland, which leads the Global Innovation Index, has world class research institutes and universities, a highly skilled workforce and multinational firms that focus on research like Novartis and Roche. Collaboration between government funding, universities and the private sector fosters adoption of technology.

The US has strong federally supported programs through the Digital Manufacturing and Design Innovation Institute and the U.S. Manufacturing Extension Partnership (MEP). Both connect manufacturers with the resources they need to succeed. The U.S. is a leader in AI and training programs: it ranked second in a global survey of CEOs by Deloitte in 2016 on manufacturing competitiveness. By contrast, Canada ranked 9th. Canada performs better in terms of automation and ranked 5th in the Economist's Automation Readiness Index in 2018.

China, with the second highest number of AI companies after the U.S., benefits from high levels of investment in AI from both private and public sources. China also provides generous national and provincial subsidies for robotics and other automation technologies. Large numbers of Chinese companies believe that "AI is very or critically important to their business success" in addition to believing that AI will help them widen their lead or surpass their competition (Deloitte, 2019).

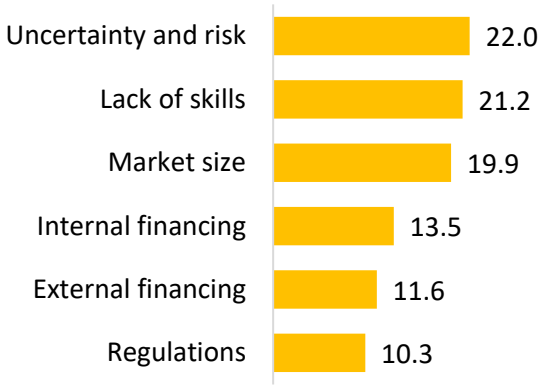
Leaders in robotics and automation have put policies in place that encourage new technology adoption. Japan and Slovenia have accelerated depreciation rates on new equipment and South Korea has investment tax credits for new equipment. South Korea ranks first in the Economist's readiness index with strong worker retraining and vocational programs, reform of teacher training and the school curriculum, and large investments in AI-related research and development.

Technology Adoption:
Barriers

There are multiple barriers to adopting new technologies including labour and skill shortages, lack of understanding of the technology, uncertain returns and high costs. These barriers are interconnected and are often most challenging for small- and medium-sized enterprises that tend to have fewer resources than large firms.

- The **lack of workers with the relevant skills** needed to implement and operate new technologies and the need to reskill the workforce are challenges that have repeatedly been identified as barriers to the adoption of new technologies. Although there are immigration programs aimed at recruiting workers with needed skills in Canada, an approach that also focuses on developing and training the existing labour force is needed.

Barriers to Innovation, Atlantic Canada, 2017 (% of total)



Source: Statistics Canada, Survey of Innovation and Business Strategy

- In manufacturing, there are labour and skill shortages that prevent firms from maximizing the use of new technologies. **To fill this skill gap**, governments could encourage new forms of technology-enabled entrepreneurship and to help workers develop new skills which are required for the successful use of automation. Firms can also seek out partnerships to fill their internal talent gaps. A report from OECD (2019) suggests moving away from front-loading education models to a focus on continuously developing new skills to match changing skill needs.

- **Poor or uncertain returns** have been cited as the main reason firms do not adopt new AI technologies, especially small firms (Bughin et al., 2017). Similar sentiments exist among Canadian manufacturers, which paired with the high purchase cost of new technologies, causes firms to hesitate when making new investments. The development of lower business taxes and more comprehensive investment tax credits may overcome this barrier (Canadian Manufacturers & Exporters, 2019).

- **Understanding new technologies** is imperative to successful implementation. In Canadian manufacturing firms, many believed that there was no immediate need for new technologies. Technical assessment programs would provide opportunities for firms to witness how new technologies could provide benefit (Canadian Manufacturers & Exporters, 2019). It is critical to have leadership buy-in and understanding to successfully adopt new technologies. Conducting smaller-scale tests to demonstrate value is a good step in order to convince leadership of the value of innovation (Deloitte, 2020).

- **Cost** is often cited as a barrier to adopting new technologies, especially for small firms. Canadian manufacturing firms tend to be small with 75% of companies having fewer than 10 employees or no permanent payroll (Canadian Manufacturers & Exporters, 2017). This is exacerbated by what is viewed as an unconducive tax and regulatory environment for investment in Canada.

Technology Adoption:
Impact of Automation on Employment

Automation will have far-reaching affects on employment patterns in Nova Scotia, as it already has in other parts of the world. Among the patterns that are emerging:

- An estimated 49% of paid activities in the global economy have the potential to be automated using current technologies but less than 5% of occupations are estimated to be fully automatable.
- The OECD estimates that 14% of jobs are at a high risk of automation (OECD, 2019).
- Statistics Canada found recently that 10.6% of Canadians are at high risk (70% and above) of "automation-related job transformation".

Demand is rising for advanced technological skills like programming and social, emotional and higher cognitive skills such as creativity, critical thinking and complex information processing

Industries with high automation potential include accommodation and food services (73%), manufacturing (60%), agriculture (58%), transportation and warehousing (57%), and retail trade (53%). These industries are also among the hardest hit by COVID-19. As of September, the accommodation and food industry in Nova Scotia had recovered only 57% of the jobs lost earlier in the year. Segments of transportation and retail continue to struggle. Manufacturing and food production remain in the doldrums due to high levels of global cases, lower productivity due to COVID-related measures, and the scaling back or closing of restaurants.

The industries most likely to lose jobs to automation are largely those currently most impacted by COVID-19

Sectors with low automation potential include educational services (27%), management (35%), professionals (35%), information (36%), and health care and social assistance (36%). These occupations make up about 37% of Nova Scotia's employment. This is consistent with the World Economic Forum's prediction that jobs in the "care economy" are slated to make up 37% of emerging jobs in the next three years.

Most analyses on the effects of automation and other advanced technologies on employment do not factor in the new jobs likely to be created by new technologies which results in a potential overestimation of the negative effects of new technologies. Estimates show that more occupations will change due to automation than will be automated into oblivion.

It is unlikely that automation and digitization will result in mass unemployment, but **low skilled and low-income individuals are most at risk** and will bear the brunt of the adjustment costs. The OECD estimates that participation in training by low-skilled workers is 40 percentage points below that of high-skilled workers.

COVID-19 has taken a much heavier toll on lower-wage workers. Employment levels for those with below-average wages in Atlantic Canada were still 12% lower in July than at their February peak. Those with above-average wages were only down 2%.

Low wage workers are most at risk from automation and have seen the heaviest jobs josses due to COVID-19

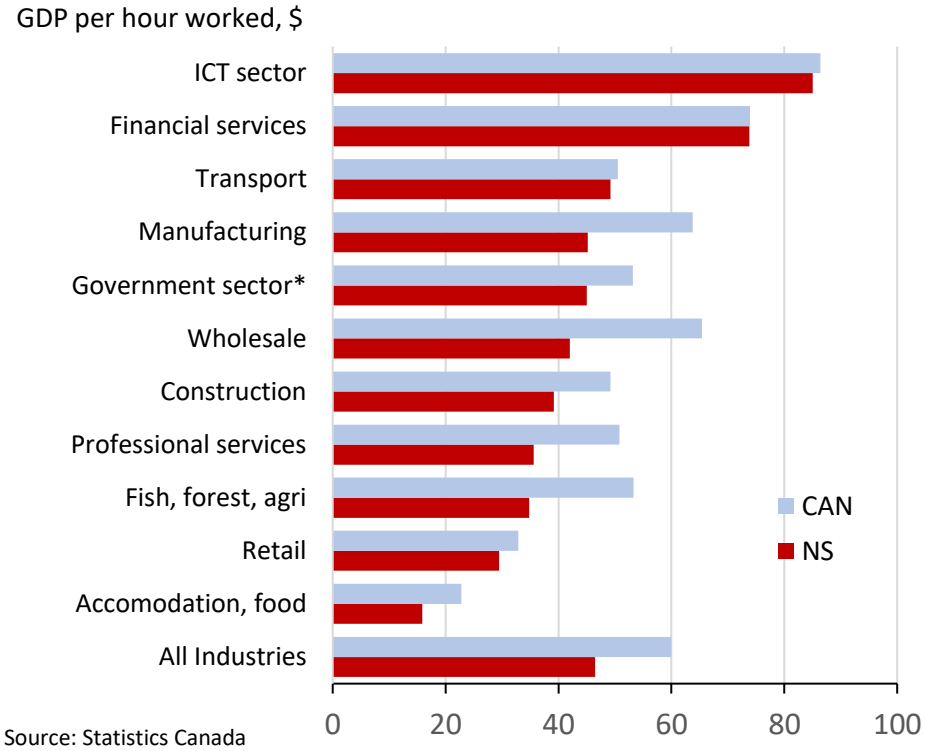
Indicators of Technology Adoption:
Productivity

Labour productivity in Nova Scotia trails Canada by 29%, due to the lower levels of machinery and equipment (M&E) investment, slower research and development (R&D) expenditures, and lower adoption of advanced and emerging technologies. A key reason is that firms are smaller in Nova Scotia. Studies by Statistics Canada, and others have shown the clear link between productivity and firm size.

Manufacturing productivity in Nova Scotia trails national levels by 41%. Most industries trail national rates with the widest gaps in manufacturing, wholesale trade, primary industries and professional services. While Nova Scotia's manufacturing productivity trails national rates, the province has improved at a faster rate over the last decade. Productivity from tire manufacturing at Michelin has improved by 10% annually over the last decade due to several key investments. Growth in forest product productivity is due to maintaining output while scaling back employment. Shipbuilding productivity increased by 20% per year between 2015 and 2019 as work expanded on the Arctic Offshore Patrol Ships at Irving Shipbuilding. But productivity in the seafood sector, the largest employer in manufacturing has declined steadily over the last decade.

Highly productive sectors including the information and communications technology (ICT) sector, financial services and transportation, which are close to the national rates. The latter two outperformed productivity growth nationally from 2009 to 2019.

Labour Productivity by Select Industries, 2019



Source: Statistics Canada

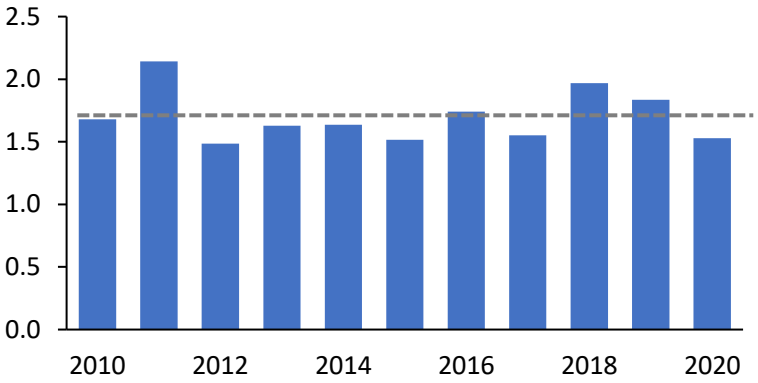
Nova Scotia's productivity lags in most industries

Indicators of Technology Adoption:
Machinery and Equipment Investment

Machinery and equipment (M&E) investment is a strong indicator of innovation. Nova Scotia typically sees M&E investment on a par with the national level. Over the last decade both Canada and Nova Scotia have averaged about the same level of M&E investment as a share of GDP. The private sector makes up over 80% of M&E investment in Nova Scotia.

Investment in M&E in Nova Scotia is led by real estate (new construction), manufacturing, transportation, information tech and the public sector. Statistics Canada's latest survey of capital spending intentions shows that investment in Nova Scotia is expected to be down 17% in 2020, slightly larger than the national decline. This is largely due to the uncertainty caused by COVID-19. However, manufacturing M&E investment is expected to be down 33% this year in Nova Scotia, more than double the drop nationally.

Machinery & Equipment Investment, Nova Scotia, $billion



Source: Statistics Canada

Machinery & equipment investment in Nova Scotia is expected to be down 17% in 2020 largely due to COVID-19

Investment in M&E can help boost productivity and economic growth. A recent study by Innovation, Science and Economic Development Canada highlights the positive impacts between investments in M&E and R&D and fast-growing firms. For slower growth firms, investments in machinery and equipment and training for employees can also have a positive effect. Encouraging such spending should be a critical part of measures to sustain the recovery.

A 2016 study by Canadian Manufacturers and Exporters asked firms what governments should do to attract investment in manufacturing. The top response was: "provide tax credits and other incentives to support investment in new machinery and equipment" followed by "reducing the business tax burden".

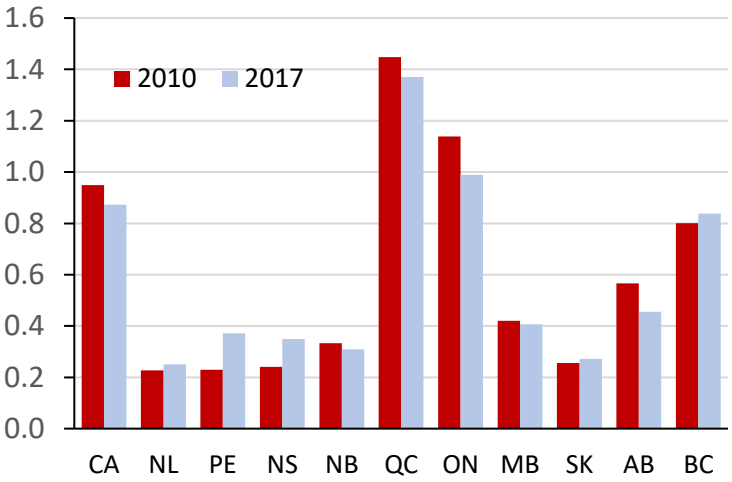
Indicators of Technology Adoption:
Research and Development

Research and development (R&D) spending is another important indicator of innovation. Nova Scotia has had a strong track record of R&D activity thanks to research in the post-secondary education system. However, the **business sector has lagged** well behind national rates. There has been some improvement over the last decade with business R&D spending rising from $89 million in 2010 to $150 million in 2017. While positive, Nova Scotia business R&D spending amounts to 0.35% of GDP which is well below the national rate of 0.87%.

Canada's business outlays on R&D as a share of GDP have been fairly flat over the last two decades. As a result **Canada has fallen from 14th to 22nd among OECD countries** in this measure. Nova Scotia has a long way to go to reach the national figure and ranks poorly compared to many developed countries.

Data on research and development spending is only available until 2017. Since that time the level **of venture capital** in Nova Scotia has been stable through 2019 at approximately $70 million. A high proportion of venture capital funding goes toward research and development.

Business R&D Spending as a % of GDP



Statistics Canada

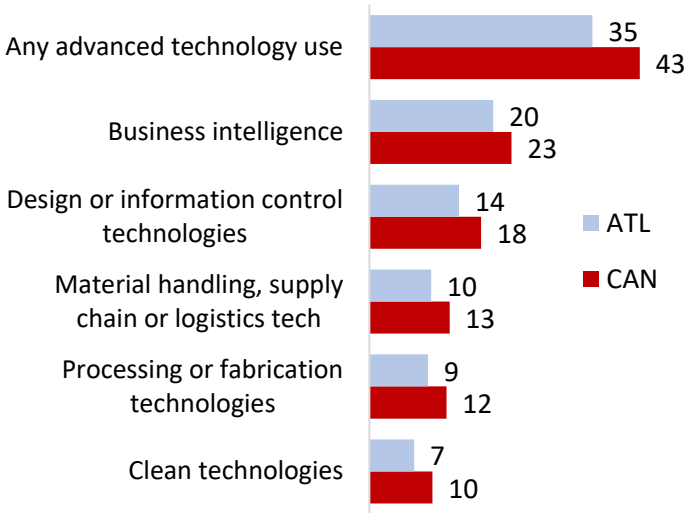
Business R&D spending in Nova Scotia has grown as a share of GDP but still trails national rates

The impact of COVID-19 on R&D is still unclear. As with investment in capital equipment, companies may be delaying spending on R&D. Certain types of research may also be hampered by social distancing measures and decisions to continue working remotely. Future waves of COVID-19 would slow the growth of R&D in the province.

Indicators of Technology Adoption:
Use of Advanced & Emerging Technologies

Atlantic Canadian firms trail the rest of Canada in terms of every type of advanced and emerging technology. About 43% of firms nationally are using some form of advanced technology compared to 35% in Atlantic Canada. About 19% of national firms are using emerging technologies, compared to 12% in Atlantic Canada. **This low rate is partly due to the small size of firms** in Atlantic Canada. National figures show that the rate of adoption of these technologies increases along with firm size.

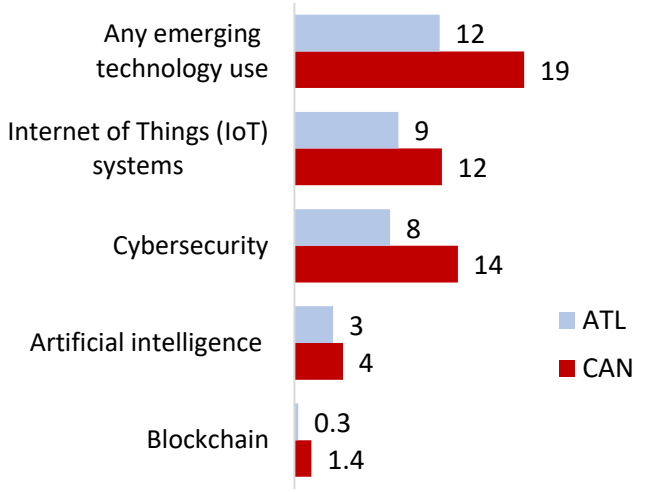
Share of Firms Using Advanced Technologies, 2017



Source: Statistics Canada, Survey of Innovation and Business Strategy

Atlantic Canadian firms trail in the adoption of advanced technologies such as design and material handling technologies and business intelligence tools

Share of Firms Using Emerging Technologies, 2017



Source: Statistics Canada, Survey of Innovation and Business Strategy

Note: Data is unavailable for Nova Scotia

Atlantic firms also lag in the adoption of emerging technologies including artificial intelligence and sensor technologies (IoT)

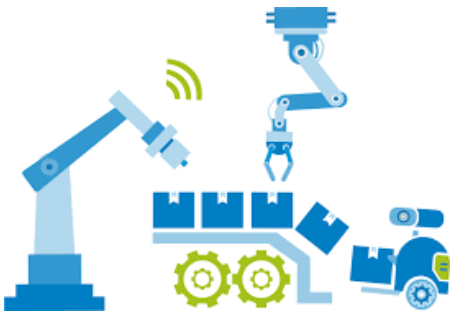
Indicators of Technology Adoption:
Use of Advanced & Emerging Technologies

Certain industries in Atlantic Canada are better than others at adopting technologies. **The transport and information and cultural industries** are among the leading adopters and are ahead of the national average. On the other hand, resource and construction industries are the weakest adopters and are well behind the rest of Canada. Professional services and financial services firms are also laggards.

Share of Firms Using Advanced or Emerging Technologies, 2017 (%)

	CAN	ATL
Information and cultural	63	64
Transportation	48	52
Professional services	64	47
Financial services	57	44
Manufacturing	54	43
Wholesale trade	57	39
All Industries	**46**	**37**
Retail trade	30	34
Agriculture, forestry, fishing	44	33
Mining and oil & gas	46	31
Construction	40	27

Source: Statistics Canada, Survey of Innovation and Business Strategy



Share of Firms Using Artificial Intelligence (AI) in Their Business, 2017 (%)

	CAN	ATL
All Industries	4.0	3.2
Information and cultural	16.8	22.3
Professional services	11.5	6.5
Agriculture, forestry, fishing	1.8	5.0
Retail trade	2.1	4.7
Transportation	1.7	4.2
Financial services	19.1	4.1
Mining, oil & gas	3.7	3.3
Construction	0.8	1.5
Manufacturing	2.8	1.3

Source: Statistics Canada, Survey of Innovation and Business Strategy

Atlantic firms are behind the national rate in emerging technologies including the adoption of AI technologies. Use in the information and cultural sector is strong. Professional and financial services are well behind national rates of adoption.

Accelerating the Recovery from COVID-19

COVID-19 presents a number of challenges to Nova Scotia's economy

- Innovation will be a key factor in the survival of firms in sectors hard hit by COVID-19. The status quo in tourism, restaurants, health care and other sectors is unlikely to meet the needs of many customers even once a vaccine is available. COVID-19 is changing manufacturing, retail and other sectors as new social distancing measures reduce productivity. Canada trails many leading countries in the adoption of new technologies and spending on innovation. Nova Scotia already lags Canada in key measures of innovation. It cannot risk falling further behind.

- Automation is expected to accelerate globally to support physical distancing and reduce the risk of future shutdowns. Disruptions to worker mobility will likely continue. The number of people working from home rose from 11% to nearly 40% in Canada at the height of the pandemic. While many will return to offices, working from home will remain popular. Firms will need to rethink the way they do business.

- The COVID-19 crisis is expected to spur innovation in many sectors. Companies will need to improve their competitiveness in the face of lower demand for products and services. We expect that the overlap between jobs lost to COVID-19 and those in line for automation will lead to a shift in the types of jobs available. Low-income workers are most at risk.

These challenges call for targeted responses

- Skilled workers, especially those who can support the transition to a more digital and automated economy, are in short supply. A 2019 report by APEC highlighted the shortage of computer science graduates in Atlantic Canada. Training, immigration and expanded enrollment in computer science and other technology focused programs will be needed to make the transition. Workers who can understand the technology as well as the way a company operates will be crucial to success.

- It is important to focus on how companies can remain competitive if the COVID-19 pandemic lingers or other threats emerge. Policy makers must find ways to support innovation through financial incentives for training and investments in technology. Firms must be committed to investing in technology, training and have buy-in from management and employees on new ways of doing business.

- Some rural areas in Nova Scotia still lack access to high-speed internet. The Province invested $193M into a Trust to help address the issue. To date, the approval of $110M worth of projects will increase access to more than 95% of Nova Scotia by 2022. Funding for improvements to rural high-speed internet is increasingly important during COVID-19. A more robust internet service will bring many health, social and education benefits. It will support businesses with people working from home and enable companies in rural areas to have more confidence about investing in technologies that require a reliable internet connection.

Action Items

Business Takeaways

- Prioritize investments in machinery and equipment, research and development, and general technology adoption.

- Commit to training existing employees in new technologies. Encourage buy-in from management and employees on new ways of doing business.

- Explore all avenues for upgrading technology skills, including training, hiring recent information technology graduates, collaborating with post-secondary institutions, consulting with technology experts and immigration.

Policy Advice

- Encourage companies to invest in machinery and equipment, and research and development. Incentives for investment and improvements to the overall tax environment should be priorities. This should be part of the economic recovery plan as firms require certainty in their investments.

- Consider an information campaign to make businesses aware of financial, training and other incentives offered by all levels of government, as well as the benefits and necessity of investments in new technologies.

- Continue to broaden access to high speed internet across the province. This is crucial to technology adoption in manufacturing, tourism and other rural industries.

- Develop a plan to support the redeployment of low-wage workers as automation takes hold. Many lower income workers may struggle to adapt as repetitive jobs shift to technology-driven employment.

Appendix: Nova Scotia Support for New Technology

Nova Scotia Programs

- **Nova Scotia's Innovation Rebate Program** supports businesses looking to increase their global competitiveness. The program provides financial incentives on projects that enable a company to increase innovation capacity through private-sector capital investments or the adoption of new technologies and business processes. The program has provided over $34 million in incentives to 26 firms, resulting in planned total investment of $153 million.

- The **Digital Adoption Program** supports Nova Scotia businesses to rapidly adopt digital tools and innovations to support overall competitiveness and to manage through impacts related to COVID-19.

- The province also offers other programs to support innovation and productivity improvements including the **Productivity and Innovation Voucher Program** the **Forestry Innovation Rebate Program** and the **Small Business Development Program**

- Nova Scotia has a goal of providing **high-speed internet** access to as close to 100% as possible of Nova Scotia homes and businesses and is on track to achieving 95% coverage by 2022, up from 70% in 2019. The province has committed $193 million through the Nova Scotia Internet Funding Trust. The $110M committed from that Trust has been leveraged with $120M of additional funding, $102M of which is from the private sector. With approximately $82M remaining in the Trust, Develop Nova Scotia is actively seeking solutions to address as many of the remaining unserved and underserved Nova Scotia as possible.

- Tourism Nova Scotia's **Tourism Digital Assistance Program,** offered in partnership with Digital Nova Scotia, provides eligible tourism businesses with the services of qualified digital consultants to enhance or develop effective digital marketing and e-commerce tools.

- The federal government offers several programs that support technology adoption including through ACOA, Global Affairs Canada and Export Development Canada.

- Organizations that support technology adoption include InnovaCorp, Digital Nova Scotia, Halifax Chamber.

Appendix: NS Innovation Rebate – Selected Projects

Nova Scotia Innovation Rebate Program – Selected Projects

- **Pratt & Whitney Canada** is a global aerospace leader with an operation based in Enfield. The company will invest $5.1 million to replace four aging machines with one larger automated, high performance machine for the case line pre-operating department.

- **Cabot Manufacturing** is a drywall manufacturer based in Richmond County. The company is investing $6.5 million to expand the plant's capacity to include a 54-inch wallboard product and to upgrade and automate equipment.

- Middleton-based **den Haan Greenhouses** is a high-technology greenhouse business. The company will be proceeding with a $5.9 million capital investment to implement the latest in LED lighting technology and control software to enable year-round growing of summer quality tomatoes and cucumbers, add more acreage in the future, and become more competitive in the produce market.

- **MacKenzie Atlantic Tool and Die / Machining Ltd**. based in Musquodoboit Harbour is investing $2.2 million to implement more robotic machinery adding two computer numerical controlled machines and two inline machines to its facility. The modernization will help meet domestic demand and expand exports to the U.S.

- **Scotia Harvest Inc.** of Digby will be proceeding with a $14.3 million investment for a 43,000 square foot production facility. The facility will have new processing equipment which will be more efficient. The expansion will allow the company to process additional groundfish species and enable the company to implement greener technologies.

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