The Conference
Board of Canada

Responding
to Automation

Technology Adoption in Canadian Industries

![Future Skills Centre logo]

The Future Skills Centre – Centre des Compétences futures (FSC-CCF) is a forward-thinking centre for research and collaboration dedicated to preparing Canadians for employment success. We believe Canadians should feel confident about the skills they have to succeed in a changing workforce. As a pan-Canadian community, we are collaborating to rigorously identify, test, measure, and share innovative approaches to assessing and developing the skills Canadians need to thrive in the days and years ahead.

The Future Skills Centre was founded by a consortium whose members are Ryerson University, Blueprint, and The Conference Board of Canada.

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Key findings

- A combination of industry-specific trends and attitudes is shaping how Canadian organizations adopt automation. Some common influences include the following:

  – digital applications are becoming common;
  – mobile devices are changing the way employees work;
  – organizations are increasingly experimenting with automation.

- Most managers feel confident about how open their organizations are to adopting new technologies. But they feel less prepared to take full advantage of the potential benefits. These managers are also less confident about compatibility issues with existing technologies.

- The majority of frontline workers feel they have at least some of the resources, skills, and support they need to adopt new high-tech tools and processes. However, nearly one-third reported not feeling any pressure to upgrade their skills.

- Some key barriers deter companies and organizations from investing in new technologies. These include:

  – reactive responses toward new technologies, rather than proactive;
  – inadequate workforce know-how for operating new technologies due to labour shortages;
  – insufficient testing opportunities;
  – inconsistent regulations within their industries.

- In the coming years, employees will need the right technical skills and complementary social and emotional skills to meet emerging trends head-on.

Introduction

Canadian industries have experienced rapid technological change with the advent of several transformative innovations over the past decade. Different technologies pose different re-skilling and occupational transition challenges across industries. Business leaders need to be mindful of which technology they adopt.

Up to 47 per cent of jobs are at risk of being lost to automation or being radically transformed by technology.[1] These estimates depend on various methodological choices—including modelling assumptions, time frames, and the countries analyzed. Generally, occupations are at higher risk of automation if they lack complex interactions with other people, involve repetitive tasks, and require relatively low formal education levels.[2] Beyond these fundamental characteristics, however, there are other important factors, such as employee attitudes and expectations.

Similarly, the degree to which people can freely move between different occupations (i.e., occupational mobility) can affect how automation occurs across industries. For example, career transitions must be technically possible with varying degrees

of training. They should also be acceptable from individual and societal perspectives.[3] In an associated issue briefing,[4] we identified and examined occupations that require one year or more of training to pivot into roles less susceptible to automation. There are 92 of these "high-risk, low-mobility" (HRLM) occupations in Canada, representing approximately one in five Canadian workers.[5]

Objectives

Through a survey of management and frontline workers, we examined some of the determinants of automation and its impact on Canadian occupations and industries. We supplemented this with an in-depth view into especially vulnerable (i.e., HRLM) industries via interviews

1   Frey and Osborne, "The Future of Employment," 1.
2   Frontier Economics, *The Impact of Artificial Intelligence on Work*, 39–40.
3   Bechichi and others, *Occupational Mobility, Skills and Training Needs*.
4   Gresch, *Responding to Automation*.
5   Ibid.

with key stakeholders from accommodation and food services, manufacturing, retail trade, construction, and health care and social assistance. Specifically, we examined:

- major technological developments and how organizations have responded to them, with a specific focus on HRLM industries;
- worker attitudes and expectations toward technology use and adoption;
- major barriers affecting technology adoption;
- how workers can better prepare for future job transitions and transformations.

See Appendix A for a discussion of our methodology.

Technology trends in recent years

Different technologies have penetrated industries to varying degrees and changed the way employees work. Frontline workers in our survey consistently cited computers, various software, online and communications technology, and electronics (such as cell phones and laptops) as some of the most important technologies used in day-to-day operations. For managers, cloud computing, business intelligence systems, and artificial intelligence were the most cited technologies.

Despite the variation in levels of technology adoption across organizations, some commonalities exist that can help us understand why some industries are more vulnerable to automation than others.

Digital applications are becoming commonplace

Organizations are increasingly trying to incorporate digital technologies into their day-to-day operations. In some cases, the technology allows them to navigate the inherent complexities of the business. For example, building information modelling (BIM) has been a breakthrough in the construction industry in recent years. It allows architects and contractors to examine digital representations of buildings in 3D instead of relying on traditional blueprints. With the suite of supporting tools and technologies, they can incorporate historical data to enhance the project planning process. Having a digital model also helps builders better anticipate obstacles that they may encounter in the field.

Digital applications also tend to increase overall productivity. Evidence of this can be seen in the health care industry as organizations start to digitize information and legacy processes to improve communication flows and service delivery. This digitization aims to establish a patient-centric information system that harnesses real-time data at the point of care to provide more accurate diagnoses.

Other applications include the use of digital platforms to modernize employee training and onboarding process. The accommodation and food services sector exemplifies this trend, as companies are increasingly using YouTube and other online tools to make training sessions more accessible. This push toward digital platforms has been especially important, considering that the workforce is getting younger and is used to absorbing information via digital applications.

In the retail industry, there is no better example of the impact of digitization than the rise of e-commerce. Consumers are forgoing traditional brick-and-mortar establishments for online shopping, thanks to smoother shopping experiences and faster delivery speeds. E-commerce platforms that offer a larger range of products at more competitive prices and door-to-door delivery (e.g., Amazon) have shifted consumer preferences.

Lastly, digital technologies vastly improve an organization's data processing and analytical capabilities. The manufacturing industry is a prime example of a push to digitize assets, with companies leveraging cloud computing to efficiently distribute data to geographically dispersed facilities.

Mobile devices are changing the way employees work

Just as smartphones and tablets have become ingrained into our daily lives, they have also become a prominent part of day-to-day operations in the workplace. Smart devices are now ubiquitous on construction sites because they allow personnel to access more information. They also expedite data sharing across vast geographies. For instance, building inspectors can identify deficiencies, take pictures, file reports on mobile devices, and then upload them to their back-end systems for tracking.

In the accommodation and food services industry, larger hotel brands are increasingly booking via smartphone apps. These apps also allow customers to bypass the front desk and check in directly using their devices. The customer also has access to smartphone-enabled room services and digital remote controls (e.g., adjusting the thermostat, ordering room service).

In health care, mobile devices are enabling the rise of telemedicine, which has been gaining traction in recent months. The easing of government regulations has led to an explosion of virtual care, remote patient monitoring services, and patient access. This is especially important in rural and isolated communities, which tend to be underserved.

Organizations are experimenting with automation

Canadian organizations have introduced elements of automation into their operations to varying degrees. Interviewees consistently discussed how organizations are using a range of automation solutions to solve various business problems. These solutions are increasing productivity, enhancing worker safety, and combatting unpredictable labour shortages.

In the construction industry, labour shortages have been a major impetus for adopting automation-enabling technologies. An aging workforce, combined with the younger generation's lack of willingness to work the same jobs, will precipitate "huge shortfalls of skilled labour in the next 10 to 15 years," according to one respondent.[6] This has pushed companies to incorporate technology—such as excavator grading and control systems—to enhance productivity and improve land clearing precision. Other companies use drones for tracking progress. This replaces physical inspections, especially in areas that are a higher safety risk or are harder to reach.

Companies are also using automation applications to enhance the customer experience, as seen in the accommodation and food services and retail industries. Restaurants are experimenting with self-serve kiosks and draught beer dispensers where provincial liquor laws allow it. Grocery, hardware, and drug stores have integrated self check-out counters, as well as chatbot-assisted online query tools. Some hotels have taken things a step further to enhance the

guest experience—moving beyond self-check-in and reservation assistance tools to offer robotic luggage assistance and robot concierges.

Robotics also play a prominent role in the manufacturing industry. Collaborative robots can be programmed to operate 24/7 in almost any situation. Manufacturers can boost productivity and throughput by seamlessly integrating robotics into existing processes.

Our survey results substantiate these observations. When asked about the use of automation-enabling technologies, 94 per cent of managers said they are already using, or are planning to adopt, these types of technologies. (See Chart 1.) In comparison, 62 per cent of frontline workers reported that they either are, or will be, using such technologies.

Canadian organizations plan to use automation-enabling technologies
(percentage of respondents; frontline workers, n = 225; management, n = 223)
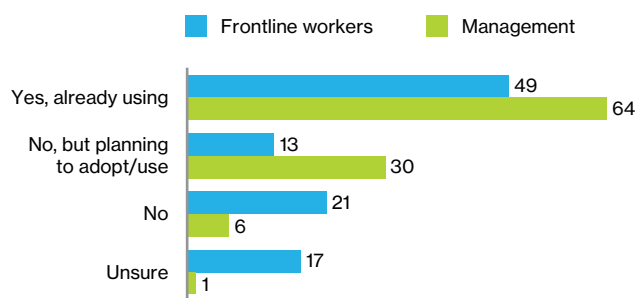
Source: The Conference Board of Canada.

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6   Confidential phone interview by Sheila Rao, January 31, 2020.

While the two subsamples come from a different mix of companies and industries, this gap could indicate diverging expectations between management and frontline workers on the new types of tools and processes they'll be using in the future. For workers to be as effective as possible, they should have a clear idea of the new technologies that their employers are adopting, as well as the skills they'll need to use them.

Perceptions of, and attitudes toward, technology adoption

Industries are ripe for disruption, thanks to digitization, the proliferation of mobile devices, and the advent of increasingly sophisticated automation applications. Alongside these developments, there are a variety of factors influencing the decision to adopt new technologies.

However, organizations and their employees' attitudes toward these changes will ultimately determine their long-term viability. Specifically, the expected level of effort required must be reasonable, the boost to productivity must be adequate, and the necessary resources and support need to be present.

Deciding to adopt

Our survey asked managers whether adopting technology is important to their company's success—unsurprisingly, most respondents (80 per cent) said it was.
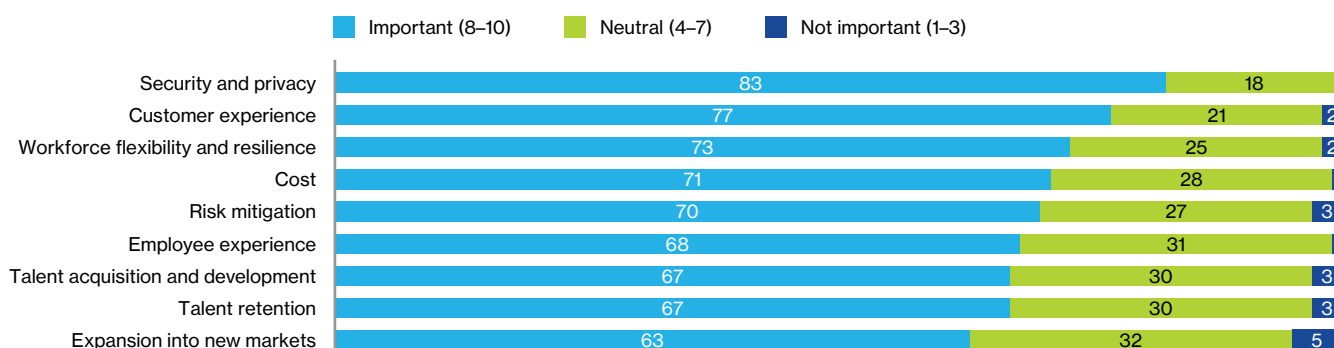
To better understand what is driving their organizations' decisions to adopt new technologies, we asked management respondents to rate several factors. Security and privacy concerns were the most important. (See Chart 2.)

When asked to identify general barriers to adopting new technologies, budgetary constraints were the most frequently cited. (See Chart 3.)

Chart 2

Security and privacy is the most important factor driving technology adoption
(percentage of respondents; n = 219)

Legend: Important (8–10) | Neutral (4–7) | Not important (1–3)

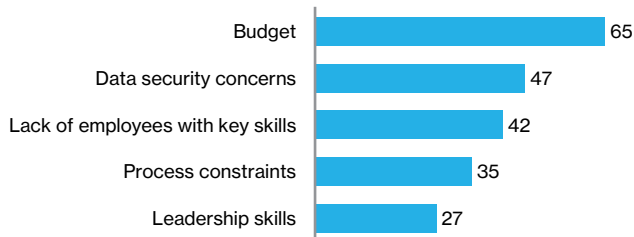|	Important (8–10)	Neutral (4–7)	Not important (1–3)
Security and privacy	83	18	
Customer experience	77	21	2
Workforce flexibility and resilience	73	25	2
Cost	71	28	1
Risk mitigation	70	27	3
Employee experience	68	31	1
Talent acquisition and development	67	30	3
Talent retention	67	30	3
Expansion into new markets	63	32	5

Note: Totals may not add to 100 due to rounding.
Source: The Conference Board of Canada.

Chart 3

Managers feel their budgets often don't allow for new technologies

(percentage of respondents; n = 223)

Budget	65
Data security concerns	47
Lack of employees with key skills	42
Process constraints	35
Leadership skills	27

Source: The Conference Board of Canada.

We also evaluated management's outlook regarding the future of technology within their organizations and assessed this along three dimensions, including whether:

- their organization is open to adopting new technologies;
- their organization is prepared to take advantage of emerging technologies;

- the new technologies under consideration for adoption are compatible with existing technologies.

Fifty-eight per cent of our management respondents said that their organizations are open to adopting new technologies. However, they feel less prepared to take full advantage of the technologies' potential benefits. (See Chart 4.) The respondents are also less confident about compatibility issues with existing technologies.
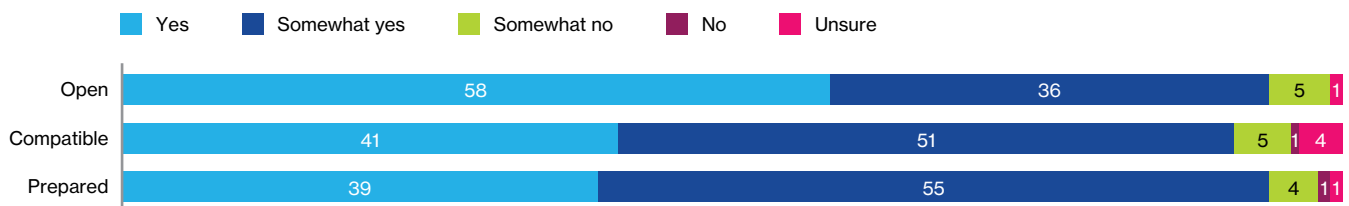
Succeeding at adoption

Although managers and frontline workers disagree on the degree of automation that has already taken place, they agree on these technologies' utility. Most respondents in both groups indicated that the most important in-house technology was at least somewhat easy to use. (See Chart 5.) When technologies are easy to use, it increases the likelihood that employees will use them as intended.[7]

Chart 4

Most managers believe their organizations are open to adopting new technologies, but are they ready for them?

(percentage of respondents; n = 220)

Legend: Yes | Somewhat yes | Somewhat no | No | Unsure

	Yes	Somewhat yes	Somewhat no	No	Unsure
Open	58	36	5		1
Compatible	41	51	5	1	4
Prepared	39	55	4	1	1

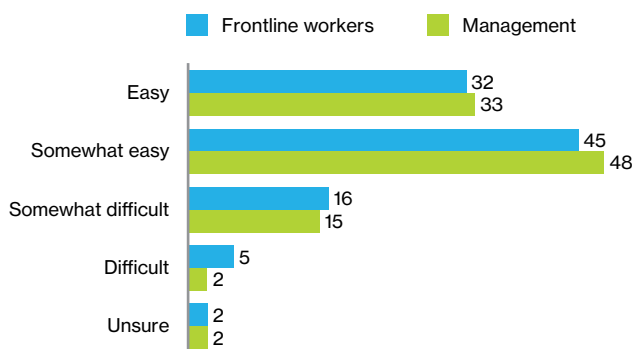Note: Totals may not add to 100 due to rounding.
Source: The Conference Board of Canada.

7   Venkatesh and others, "Unified Theory of Acceptance and Use of Technology."

Chart 5

Frontline workers and managers largely agree on ease of use

(percentage of respondents; frontline workers, n = 267; management, n = 334)

Legend: Frontline workers | Management

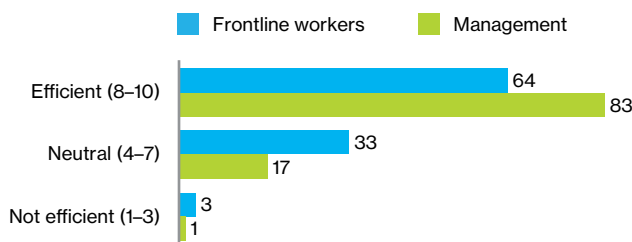|	Frontline workers	Management
Easy	32	33
Somewhat easy	45	48
Somewhat difficult	16	15
Difficult	5	2
Unsure	2	2

Source: The Conference Board of Canada.

Similarly, most managers and frontline workers rated their technologies as efficient. (See Chart 6.) However, frontline workers were less likely than management respondents to rate their organizations' technologies as efficient. Organizations may fail to effectively incorporate a new technology if workers do not fully understand the performance benefits resulting

Chart 6

Most respondents felt in-house technologies are efficient

(percentage of respondents; frontline workers, n = 225; management, n = 223)

Legend: Frontline workers | Management

	Frontline workers	Management
Efficient (8–10)	64	83
Neutral (4–7)	33	17
Not efficient (1–3)	3	1

Source: The Conference Board of Canada.

from its use. Conversely, management-level respondents may be overconfident in how efficient these technologies are, especially if they're not the ones using them on a day-to-day basis. If the benefits of technologies don't meet management expectations, this could lead to hesitancy around adopting new ones in the future.

We also assessed whether organizations were enabling their employees to adopt and use these technologies along four dimensions. These include whether workers:
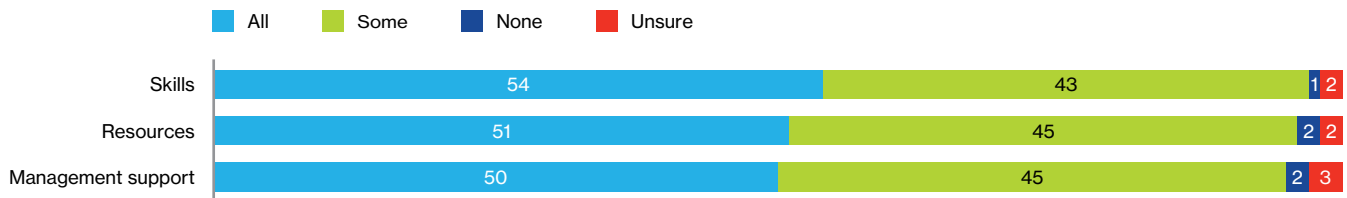
- have the necessary resources to facilitate technology adoption;
- have the requisite skills to adopt the necessary technologies;
- feel there is management support to adopt the necessary technologies;
- feel pressure from management to upgrade their skills.

Chart 7

Roughly half of our frontline respondents have what they need to adopt new technologies

(percentage of respondents; n = 225)

Legend: ■ All ■ Some ■ None ■ Unsure

	All	Some	None	Unsure
Skills	54	43	1	2
Resources	51	45	2	2
Management support	50	45	2	3

Note: Totals may not add to 100 due to rounding.
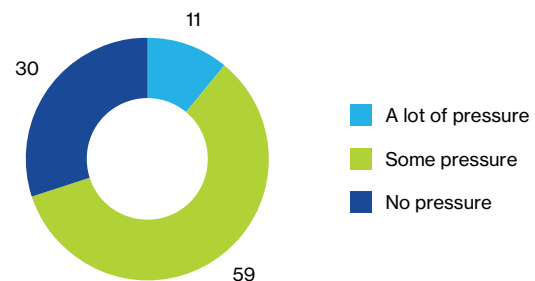Source: The Conference Board of Canada.

Overall, most frontline respondents reported that they have at least some of the resources and support required to adopt new technologies; but only half said they have all of them. (See Chart 7.)

Interestingly, almost half of the respondents said they only have some of the skills required to adopt new technologies. However, almost a third of respondents said they feel no pressure from management to upgrade their skills. (See Chart 8.) Without adequate training programs from employers, workers could face greater difficulty adapting to transforming occupations, thereby increasing the risk of job displacement. This is especially true in HRLM industries.

Chart 8

Only 11 per cent of frontline workers said they felt a lot of pressure to upgrade their skills

(percentage of respondents; n = 225)

11
30
59

■ A lot of pressure
■ Some pressure
■ No pressure

Source: The Conference Board of Canada.

Without adequate training programs from employers, workers could face greater difficulty adapting to transforming occupations, thereby increasing the risk of job displacement.
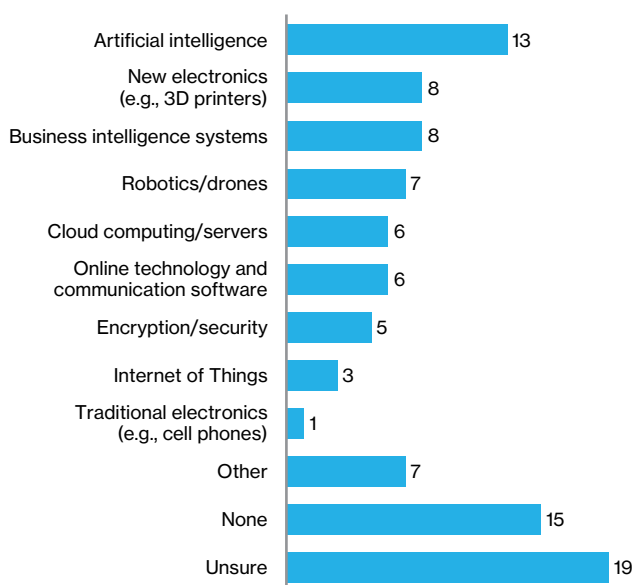
Looking to the future

Respondents looking to implement new technology in the next five years were interested in a variety of tools. (See Chart 9.)

AI is the most common technology that managers would like to adopt in the next five years
(top mentions; percentage of respondents; n = 203)

Technology	%
Artificial intelligence	13
New electronics (e.g., 3D printers)	8
Business intelligence systems	8
Robotics/drones	7
Cloud computing/servers	6
Online technology and communication software	6
Encryption/security	5
Internet of Things	3
Traditional electronics (e.g., cell phones)	1
Other	7
None	15
Unsure	19

Source: The Conference Board of Canada.

Emerging technologies in the coming decades

Beyond the next five years, interviewees expected several technologies to become more prevalent, including the Internet of Things, 3D printing, and augmented and virtual reality. However, interviewees mentioned one technology almost universally: artificial intelligence (AI). Labelled as the "apex predator," one interviewee stated that "to the degree that frontline jobs can be automated, they will be."

As health care organizations increasingly digitize their information, AI will prove to be a transformative agent to glean meaningful insights from unwieldy data sets. Similarly, manufacturing companies hope to use AI and machine learning for data analytics to enhance operational efficiency and product quality.

Retail industry stakeholders anticipate using AI applications for demand forecasting, merchandise planning, and loss prevention. Furthermore, reservation assistance tools (e.g., chatbots) in the accommodation and food services sector could eventually replace call centre workers altogether.

Which skills will be in greater demand?

With the advent of digital platforms, we will see an increase in demand for programming and system design skills. Similarly, data analytics skills, including the ability to parse through unstructured data and synthesize it into ideas, will also be in greater demand. Regardless of the specific technology, however, frontline workers need to be familiar and comfortable with it. One respondent called this a "technology quotient."
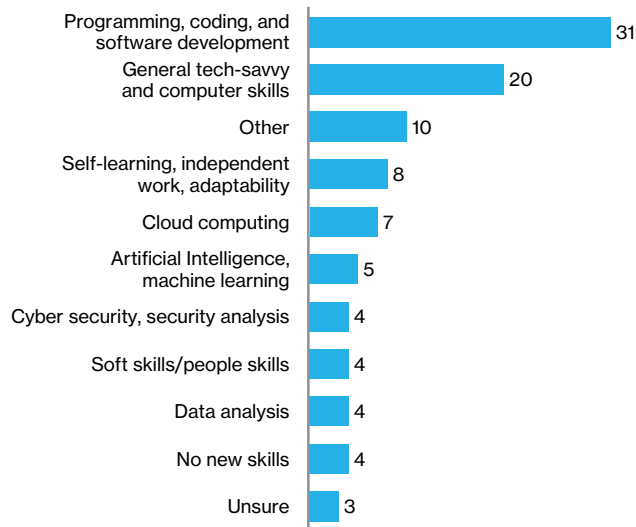
The survey results agree with this perspective, with "programming, coding, and software development" and "general tech-savvy and computer skills" as the top two specifically mentioned skills. (See Chart 10.)

Chart 10

**Managers expect future employees
to understand programming**

(top mentions; percentage of respondents, n = 212)

Category	Value
Programming, coding, and software development	31
General tech-savvy and computer skills	20
Other	10
Self-learning, independent work, adaptability	8
Cloud computing	7
Artificial Intelligence, machine learning	5
Cyber security, security analysis	4
Soft skills/people skills	4
Data analysis	4
No new skills	4
Unsure	3

Source: The Conference Board of Canada.

Beyond these technical skills, interviewees expressed the need for a shift in attitude—from resisting change for fear of being replaced to a willingness to embrace and wield technology to derive new insights. As one interviewee put it: "Of course, we don't always get it right, but at the end of the day, I don't believe that any of our employers want to hurt their employees." As such, there will be a premium on soft skills like empathy, communication, and personal resilience. (See "soft skills/people skills" and "self-learning, independent work, adaptability.")

A recent impact paper by The Conference Board of Canada dubs these as "social and emotional skills."[8] They are synonymous with transferable, professional, and soft skills. Additionally, they

are the least likely to be replaced by technology, allowing workers to adapt to an ever-changing labour market.

The impact paper identifies communication, problem-solving, leadership, resiliency, collaboration, and cultural competence as the most in-demand social and emotional skills. However, these skills must evolve and add value in unique ways as organizations add new technologies to the mix. There needs to be a willingness to iterate, learn, and adapt to feedback. Workers also must be able to deal with, and be comfortable with, ambiguity.

Management and leadership must be open to investing in new technologies that they might not have considered in the past. Ultimately, organizations cannot implement new technologies effectively without the requisite know-how. Generating this knowledge requires experimentation and the ability to identify the right technologies quickly. Overall, a premium on soft skills in an era of increasing automation suggests that, even as technologies become more advanced, the "human touch" remains the differentiating factor.

It's important to note that, in keeping with this paper's scope, these findings are from a macro, industry-wide perspective and not specific to any occupations. For a more granular perspective, another recent impact paper published by The Conference Board of Canada investigates the future of work from an occupational lens— specifically, within the skilled trades ecosystem. It takes a closer look at three of the five HRLM sectors (i.e., construction, manufacturing, and accommodation and food services). The impact

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8   Giammarco, Higham, and McKean, *The Future Is Social and Emotional.*

paper also examines the specific skills that tradespeople will need to adapt to the changes brought on by the digital trends specific to these sectors.[9]

Unsurprisingly, the need to learn programming and human-machine interface skills in the face of future work trends, such as automation and artificial intelligence, is also important. Such technical skills are only one part of a group of seven core 21st-century digital skills—including social and emotional skills like communication, creativity, and collaboration—that are required to thrive in digitally connected workplaces.

Is anything slowing adoption?

Interviewees agreed that some common barriers are preventing organizations from fully realizing the benefits of automation.

Canadian HRLM industries exhibit reactive responses toward technological changes

Multiple interviewees in construction, manufacturing, retail, and health care organizations stated their industry was slow to respond to changes and lags behind their international counterparts in adopting new technologies. For example, one interviewee stated: "In Canada, everything is so rigid for health care, and it's very difficult for hospitals to take risks and implement something new." In other industries, like construction, this slowness is due to the varying complexity

of projects, stringent industry safety standards, and building processes that do not lend themselves as easily to technology integration as in other industries. However, as the upfront costs decrease, technology is becoming more easily adopted in various industry pockets.

Other industries that have relatively more straightforward implementation pathways attributed the lag to risk-averse attitudes. Some participants said that this arises from a pervasive cultural attitude that is not interested in pushing the boundaries.

Employing a "wait and see" attitude, however, can prove detrimental. For trade-intensive industries like manufacturing, this approach can reduce competitiveness and ultimately lead to lost market share. Companies are hesitant to adopt because of uncertain returns on investment, expensive implementation costs, and a lack of testing opportunities. As an interviewee said: "It's just harder if you're a small manufacturing firm, even to understand what technology's out there, and how you would apply it to your own production process."[10]

Still, others noted that Canadian consumers are not early adopters, which discourages companies from adopting newer technologies. A stakeholder from the retail industry stated that the "industry is really responding not to the technology, but to the consumer adoption of it." However, if the retail industry responded effectively and truly met customer needs, it's reasonable to believe that Canada would have a lower incidence of cross-border e-commerce shopping.[11]

9   Bieler, *Bridging Generational Divides*.
10 Confidential phone interview by Sheila Rao, January 24, 2020.
11 Flow, "Shipping to Canada."

Government intervention is needed to remove roadblocks and to level playing fields

Interviewees from manufacturing, retail, hospitality, and health care organizations all noted that the government has a key role in facilitating technology adoption. The nature of intervention varied, with some calling for financial incentives (e.g., tax credits) to reduce costs. Others called for training programs and technology demonstrations to increase awareness and provide testing opportunities to alleviate the risks of adopting new technologies. Others cited a need for a level playing field to compete effectively. This meant asking the government to hold new products and services to the same regulatory, tax, health, and safety standards as established technologies.

Participants in accommodation and food services and retail organizations stated that their industries were taxed inconsistently, leading to unfair advantages. Airbnb, for example, has different operating margins than hotels because of this inconsistency. The resulting loss of customers and revenue for the regulated businesses discourages these industries from considering new technologies.

In other cases, outdated regulations and antiquated laws have effectively handcuffed industries. For instance, in the health care industry, legal regulations require that essential information be communicated by fax. Moreover, rules around sharing information and data restrict organizations from even considering many digital technologies.

However, there is hope. One interviewee stated that "there are some major regulations, standards, or policies that, if they were liberated,

could really open up the floodgates to allow this to move faster." Another noted that "government is changing these regulations, and they recognize the impediment it's causing." For instance, Ontario recently passed a law that allows doctors to bill OHIP for telehealth services. This is a gamechanger for practitioners who did not want to venture into remote monitoring services because of insurance and cost issues.

Labour shortages discouraging industries from considering new technologies

Lastly, interviewees cited the workforce as a key factor in delaying technology adoption within the manufacturing sector. They expressed hesitancy in investing in new equipment because they were not confident that they could find adequate workers with the operational know-how. Organizations also reported a lack of interest among younger talent to perform the same kinds of tasks currently being filled by an increasingly aging workforce. In some industries, organizations face year-round shortages.

Where does that leave us?

For employers

Encouragingly, most frontline workers in HRLM industries seem to have positive attitudes toward technological change. They find that technologies in their workplace are easy to use and increase the efficiency of their roles. This positive attitude could mitigate some of the potential friction that could result from unaligned expectations with management.

Ultimately, technology will continue to shape Canadian industries in the future. However, certain occupations and industries are more vulnerable to this transformation than others. Workers at higher risk of automation with few options to transition into other occupations must upgrade their skills to adapt to these changes. Employers must find ways to facilitate this upskilling to ensure they have access to a deep pool of skilled labour.

For policy-makers

According to our survey, budgetary constraints and security and privacy concerns are the top barriers to adopting automation-enabling technologies. Overarching industry trends,

such as risk-averse attitudes toward technology adoption, a lack of government support, and inconsistent regulations, further inhibit technology adoption. Despite these challenges, companies continue to pursue automation to remain competitive. Governments should consider both direct support (e.g., by providing more testing opportunities) and indirect support (e.g., by updating and removing inhibitive regulations).

Importantly, as industries change, employees must upskill accordingly. If they are unable or unwilling to, they could face greater difficulty adapting to a transforming occupation. Or, worse yet, they risk being replaced. Aside from encouraging firms to adopt technology, governments must try to help the most vulnerable portions of their workforces adapt to the changes—or transition into less vulnerable occupations. This could involve subsidies for on-the-job training, specific education programs, or other targeted support (especially for HRLM workers).

Next steps

A one-size-fits-all approach is rarely effective, and regional vulnerabilities require tailored solutions. We are currently applying the HRLM methodology across Canada to better understand the geographic variations in skill gaps from the national level down to the census division level. Not only will this allow us to pinpoint concentrations of HRLM occupations, but also compare regional vulnerabilities to provincial and national averages. This research will enable us to equip decision-makers at all levels to address skills gaps and occupational transition challenges.
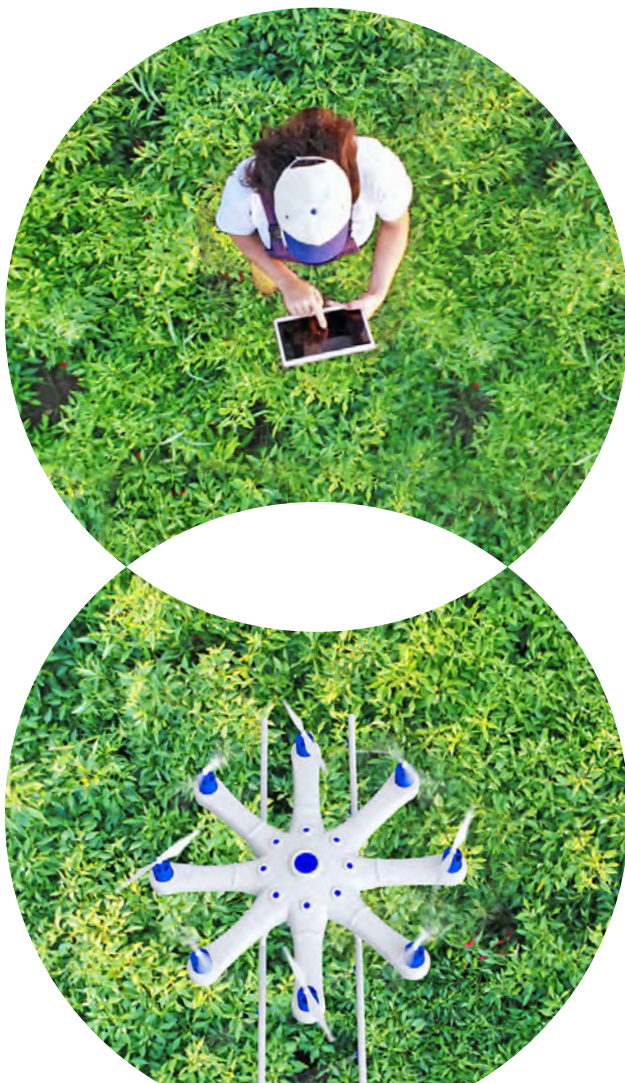
Appendix A
Methodology

The findings of this impact paper are informed by:

- a survey of frontline workers and management personnel to better understand the attitudes of workers across organizations from the top five HRLM industries, as well as other industries;
- semi-structured interviews with stakeholders from the top five HRLM industries to gather more granular insights around the status of technology adoption within their industries.

The themes and questions for the survey and interviews were developed using principles from the Unified Theory of Acceptance and Use of Technology (UTAUT) Model and STEEPV framework. The former is widely considered one of the more accurate models to describe technology adoption among organizations. It evaluates the core determinants of intention and usage by assessing performance expectancy, effort expectancy, social influence, and facilitating conditions.

STEEPV is a popular foresight framework and brainstorming tool that guides people through discussions about the social, technological, economic, environmental, political, and values-based dimensions of any topic. Questions related to each letter of the STEEPV acronym ensure that interviews cover a breadth of issues.

Survey

We collected 223 management responses from executives and mid-level IT directors from a mix of small and medium-sized (SMEs) and large enterprises between February 12 and March 30, 2020. We also collected 225 responses from frontline workers employed full time between February 16 and April 1, 2020, for a total of 448 responses. We administered the survey online.

Eighty-four frontline workers and 134 managers responded from the top five HRLM industries. (See Table 1.) Across all industries, most respondents (67 per cent) were from private sector organizations, followed by government organizations (27 per cent).

The survey assessed technology adoption from two angles. The first group of questions elicited the current experiences of all personnel. The second group focused on future adoption expectations from a managerial perspective.

Table 1

**Industries of survey respondents
by respondent type**
(number of respondents)

Industry	Frontline	Management
Other	141	89
Health care and social assistance	40	23
Manufacturing	7	48
Retail trade	13	29
Construction	18	23
Accommodation and food services	6	11
Total	**225**	**223**

Source: The Conference Board of Canada.

Interviews

Semi-structured interviews took place between August 14 and October 3, 2019, as well as between January 8 and February 20, 2020. We conducted the interviews over online video chat and telephone: on average, they lasted between 30 and 60 minutes. The interviews were recorded with each participant's explicit permission, transcribed, and analyzed in NVivo.

Interviewees received a questionnaire in advance, covering four broad topics:

• the biggest technological changes in the past decade;
• the industry's response to these changes;
• expected changes to the industry in the coming decade;
• new skills and attitudes that workers might need in light of all these trends.

In total, we interviewed 28 individuals from organizations across the five HRLM sectors. We mostly interviewed executives (e.g., presidents, vice-presidents, and executive directors), but also other professionals (e.g., professors, research chairs, journalists). Examples of the types of organizations interviewed include industry associations, not-for-profit member associations, innovation hubs, and private companies.

Appendix B
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