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# Bridging Generational Divides:

Advancing Digital Skills in Canada's Apprenticeships and Skilled Trades Ecosystem

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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

- Improving digital skills will be a crucial factor in adapting Canada's skilled trades to the future of work.
- Generational differences, such as workplace and communication preferences, between younger and older workers are slowing the shift, as are challenges related to time, cost, geography, outdated training technologies and curricula, and Internet access.
- Digital trends specific to the automotive, construction, and food service sectors are driving change in the skilled trades.
- Tradespeople will need seven core digital skills: technical, information management, digital communication, virtual collaboration, creativity, critical thinking, and problem-solving in digital environments.

- Additional barriers include limited breadth of on-the-job training, technology changes in industry outpacing training and curriculum standards, difficulty recruiting staff with relevant digital skills knowledge, and paper-based logbooks.
- Overall, the apprenticeship ecosystem is still struggling to develop the digital skills and culture of lifelong learning needed for the skilled trades to keep pace with the future of work.



Bridging Generational Divides Advancing Digital Skills in Canada's Apprenticeships and Skilled Trades Ecosystem

## A digital revolution is coming to the skilled trades

Tradespeople will need a range of new digital skills to keep pace with the future of work. These are the technical and non-technical skills needed to thrive in digitally connected workplaces. The next generation of tradespeople will need them to operate computerized equipment, access blueprints on digital devices, and use digital diagnostic tools, among other tasks.

In Canada, skilled tradespeople typically receive their training in the form of apprenticeships. These involve approximately 80 per cent on-the-job learning and 20 per cent in-class training at a technical institute (e.g., college, union, private institute). But the next generation of tradespeople will use digital technologies and skills that don't yet exist and aren't yet being taught.

### For this reason, we examine how Canadian apprenticeship training can adapt to the future of work by asking the following questions:

- What digital skills will tradespeople need to adapt to changes in their industry?
- To what extent do stakeholders (e.g., apprentices, tradespeople, employers, educators) perceive digital skills as a priority in adapting their trades to the future of work?
- What barriers do tradespeople-from apprentices to fully certified journeypersonsface in learning digital skills?



To answer these questions, we spoke to 175 apprenticeship stakeholders from across Canada. We engaged tradespeople, educators, employers, and other stakeholders in the automotive, construction, manufacturing, and food service sectors.

What we found is a generational divide. The Canadian trades workforce is aging at a faster pace relative to the workforce with a university degree.<sup>1</sup> (See "Aging quickly.") The retirement of older tradespeople and the declining labour force participation rate is expected to contribute to labour shortages in multiple sectors.<sup>2</sup> Meanwhile, the number of new apprenticeship registrations has declined in recent years.<sup>3</sup> Responding to these trends, several efforts are under way to recruit young people to the trades.

Young people entering the trades, however, are encountering classrooms and workplaces undergoing social and technological disruption. These changes are being exacerbated by outdated training and assessment models and by persistent structural barriers to digital upskilling.

Young newcomers to the trades are encountering challenges neither they nor their mentors have experienced before. As both apprentices and journeypersons adapt to these changes, they will need a range of digital and lifelong learning skills. Beyond technical skills, tradespeople will need a more extensive set of digital competencies, including creativity, collaboration, and information management, in order to adapt to the future of the trades.

### **Aging quickly**

According to Statistics Canada, 26.1 per cent of workers with a trade certification were 55 years and older in 2016, which is up from 23.2 per cent in 2011. Meanwhile, the share of workers with a bachelor's or a higher university degree in this age bracket increased by less than 1 percentage point over that period.

Source: Statistics Canada, "Pathways and Earnings Indicators for Registered Apprentices in Canada."



- 1 Statistics Canada, "Pathways and Earnings Indicators."
- 2 Canadian Apprenticeship Forum, Apprentice Demand in the Top 10.
- 3 Statistics Canada, "Pathways and Earnings Indicators."

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## Digital skills for the future of work

Digital skills are in demand and understood as growing in priority,<sup>4</sup> not just in Canada but in the global labour market.<sup>5</sup> The tradespeople, employers, and educators we spoke to described digital skills as a top priority in the following ranking of emerging skills:

- Digital skills, which are the technical and nontechnical skills needed to thrive in digitally connected workplaces;
- Social and emotional skills, which describe a person's ability to build relationships, regulate their emotions, and work with others;
- 3. Green skills, which are needed to improve energy efficiency, reduce waste, and support low-carbon economies;
- Other emerging skills (i.e., those not captured in the first three) that are needed to adapt specific trades and/or sectors to the future of work.



- 4 Royal Bank of Canada, Humans Wanted.
- 5 Organisation for Economic Co-operation and Development, *Skills for a Digital World.*

Find Conference Board research at conferenceboard.ca.

## Many hats

Manufacturing stakeholders identified the ability to wear many hats beyond their traditional trade as an emerging skill. Welders are often asked to complete tasks typically done by fabricators, even though they are not formally trained in that trade. Many stakeholders saw this ability as an emerging and in-demand ability in their sector.



These rankings offer some clarity about stakeholder priorities. Participants also underlined the important overlaps between these skills, especially in digital environments. Finally, they identified a need to adapt our training systems to keep up with the pace of change.

To date, national and international research on future of work trends has focused too narrowly on technological change related to automation, artificial intelligence (AI), and information and communication technologies (ICT). There is also a need to assess the implications and impacts on training and developing the next generation of workers.<sup>6</sup>

What this means is that limited attention has been paid to the impact of recent industrial changes on Canadian apprenticeships.<sup>7</sup> (See Table 1.) The implications for Canada's skilled trades are far-reaching. For instance, automotive service technicians will soon need to understand the human–machine interface of the autonomous vehicle.<sup>8</sup>

The rise of the gig economy is also beginning to transform everyday work in the trades. In the gig economy, individuals operate as contractors and interact with mobile or web-based applications. This shift to non-standard forms of employment poses risks and opportunities for skilled tradespeople. Since apprenticeships traditionally require an arrangement with an employer, the replacement of employers with mobile platforms in the gig economy could pose an existential challenge to the current system.<sup>9</sup> If apprentices are independently completing jobs assigned by

6 Smith, "Apprenticeships and 'Future Work," 69–88.

7 Ibid.

8 Cutean, Autonomous Vehicles and the Future of Work in Canada.

10 Ibid.

a mobile platform, it is unclear who should take responsibility for the many duties of sponsorship. These duties include monitoring on-the-job training and ensuring that the apprentice is able to attend in-class training.

With a growing number of young people doing gig work without a traditional employer, there is also the risk that youth will be exposed to fewer opportunities to find a sponsor. In this context, there may be an increasing role for shared apprenticeship models, wherein a third-party agency sponsors apprentices and facilitates the rotation of apprentices among employers in a training network. By guiding apprentices through on-the-job and in-class training, shared apprenticeship models could help support apprentices in the gig economy.<sup>10</sup>

Mobile applications like Jiffy and Skip the Dishes are creating new kinds of opportunities for skilled tradespeople. They are opening up new forms of customer interaction and allowing tradespeople to fill gaps in their work schedule. Mobile applications can also help employers accommodate younger tradespeople's desire for greater workplace flexibility, with applications like Staffy beginning to change recruitment trends in the food service sector. To adapt, tradespeople will need a wide range of digital skills. These skills are often narrowly defined as proficiency in the use of ICT.<sup>11</sup>

<sup>9</sup> Smith, "Apprenticeships and 'Future Work," 69–88.

<sup>11</sup> Van Laar and others, "The Relation Between 21st-Century Skills and Digital Skills."

Mobile applications like Jiffy and Skip the Dishes are creating new kinds of opportunities for skilled tradespeople. They are opening up new forms of customer interaction and allowing tradespeople to fill gaps in their work schedule.

## Table 1Impact of digitalization on the trades

Future work trend	Possible impacts on apprenticeship and skilled trades	Example	Skills needed to adapt to future work trends
<b>Industry 4.0</b> The multiple impacts of automation, artificial intelligence, and information and communication technologies on employment and training systems.	Need for upskilling to repair and maintain automation systems, especially in the motive power and manufacturing trades.	Automotive service technicians will need to understand the human-machine interface of the autonomous vehicle.	<ul> <li>Programming skills.</li> <li>Human-machine interface skills.</li> <li>Ability to use digital diagnostic tools to uncover a vehicle's problems.</li> <li>Safe installation of digital technology requested by clients, such as thermostats and humidity monitoring tools.</li> <li>Programming and setting up IP addresses for equipment so it can communicate with other equipment.</li> </ul>
<b>Gig economy</b> Shift toward independent contractors and flexible jobs instead of full-time employees.	Risk that youth will be exposed to fewer opportunities to enter apprentice-able trades, given the growing number who are working flexible gigs. Mobile trade applications are transforming everyday work.	The "Jiffy" home maintenance application allows tradespeople to fill in gaps in their schedule with small gigs while taking a cut of the homeowner's payment.	<ul> <li>Use of digital and mobile communications for work orders, parts ordering, and video explanations for clients.</li> <li>Information management skills to find and access vehicle manuals, troubleshooting tips, and other information on a smartphone or tablet.</li> </ul>

Source: The Conference Board of Canada.

Our research suggests there is more to it, however. A tradesperson's human skills – their ability to manage information, virtually collaborate with colleagues, and solve complex problems – have a larger impact on their ability to thrive in a digitally connected workplace than simply being able to use hardware or software. In a trade environment, digital skills involve not only technical skills to use ICTs, but also the application of wide-ranging cognitive and social and emotional skills in a digital context. Apprentices' digital problem-solving skills are lagging those of other students. According to the Organisation for Economic Co-operation and Development's Programme for the International Assessment of Adult Competencies (PIAAC), problem-solving in technology-rich environments is defined as "using digital technology, communication tools, and networks to acquire and evaluate information, communicate with others, and perform practical tasks."<sup>12</sup> On a 0-to-500-point scale, Canadian students obtained an average score of 300, while apprentices and interns obtained an average score of 282.<sup>13</sup>

<sup>12</sup> Council of Ministers of Education Canada, "Frequently Asked Questions."

<sup>13</sup> Organisation for Economic Co-operation and Development, "PIAAC Data Explorer."

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Recent consultations in Australia confirmed a need for stronger integration of digital skills in the apprenticeship pathway.<sup>14</sup> Similarly, we have found a need for stronger attention to 21<sup>st</sup>-century digital skills in Canada's apprenticeship systems.

## **21st-century digital skills** for apprentices

Canada's Essential Skills Framework, developed in the 1990s, identifies digital skills as one of the nine essential skills that are crucial for work, learning, and life. The framework characterizes digital skills as the ability to use computers and other forms of technology. The framework's definition of digital skills is now too narrow to account for the range of digital skills needed in the 21st century,<sup>15</sup> though it continues to inform the Essential Skills Summary in the Red Seal Occupational Standards and is widely used by workforce agencies in the skilled trades sector.<sup>16</sup>

Fortunately, Canada's Essential Skills Framework is being renewed to address rapid changes in the labour market and mounting evidence of the importance of social and emotional skills. The revised framework includes both foundational skills, such as numeracy and digital skills, and social and emotional skills, with an understanding that all of these skills overlap and interact with each other. Beyond technical abilities to operate a device, digital literacy involves a wide range of the cognitive and social/emotional skills required for solving problems in digital environments. To diagnose a problem with an advanced vehicle, for example, automotive service technicians not only need to know how to use diagnostic tools and software, they also need to combine their vehicle knowledge with potential solutions to solve problems. In other words, they need to apply social and emotional skills in a digital environment. This points to the complex mix of technical and non-technical skills that tradespeople need if they are to work in digitally connected 21st-century workplaces.<sup>17</sup>

Existing digital skills frameworks, however, tend to focus on student skill levels, as opposed to skills needed in the workforce. To get us closer, we've adapted van Laar's well-known synthesis of 21stcentury digital skills frameworks, combined it with a systematic literature review and cross-Canada consultations, to identify the core skills required to complete new and emerging workforce tasks in a range of skilled trade occupations.<sup>18</sup>



- 14 Loveder, Australian Apprenticeships.
- 15 Employment and Social Development Canada, "Understanding Essential Skills."
- 16 The Red Seal Occupational Standard (RSOS) was introduced in 2015 and replaces the National Occupational Analysis. One of the new products introduced in the RSOS is an Essential Skills Outline, which describes the essential skills required for a particular trade.
- 17 Van Laar and others, "The Relation Between 21st-Century Skills and Digital Skills."
- 18 Ibid.

Through our work, we heard from tradespeople that the following seven 21st-century digital skills are not only central to their ability to perform their roles effectively, but are drivers of change and organizational effectiveness. (See Table 2.) These core digital skills are crucial for tradespeople at all stages of their career—from first-year apprentices to established journeypersons and trade instructors. Through cross-generational knowledge sharing, apprentices, journeypersons, and trades stakeholders can work together to advance 21st-century digital literacies.

#### Table 2

21st-century digital skills	Definition	Example
Technical	The skills to use computerized machinery and ICTs to accomplish practical tasks.	The ability to use digital diagnostic hardware and software to uncover a vehicle's problems. As one tradesperson in the automotive sector said, "What's needed in our business is basically how to use a diagnostic tool in order to repair engines and transmissions now."
Information management	The skills to use ICT to effectively search, select, and organize information to make informed decisions about the most appropriate sources of information for a specific trade task.	The ability to find and access manuals, troubleshooting tips, and other information on a smartphone or tablet. An apprentice in the construction sector noted, "Something I use a lot is my smartphone. It's much faster than to look up a manual from a boiler from years ago. Better use of technology."
Communication	The ability to use ICT to share information and ideas with others, ensuring that the meaning is fully conveyed.	The skills to use a smartphone to send information to others, ensuring that the meaning is conveyed effectively. One apprentice in the automotive sector said, "We do use smartphones as a resource. Our messaging systems are through our smartphones where, if another person has to get hold of us, they message us."
Collaboration	The skills to use ICT to develop a social network and work in a team to exchange information, negotiate agreements, and make decisions toward achieving a common goal.	The ability to use AutoCad to share views and blueprint information and to work with colleagues on related tasks toward achieving a common goal. As one apprentice explained, "We have a lot of AutoCAD at work and now everyone's got a tablet with drawings on it-blow them up anywhere, any time."
Creativity	The ability to use ICT to creatively represent trade products, transcend traditional trade processes, or imagine new forms, ideas, or ways of working.	The ability to use a smartphone to create photos or videos that creatively represent a trade product or service for social media advertising. One cook said, "Social media is a huge thing. I take pictures of the food I make and send it to the person doing social media."
Critical thinking	The skills to use ICT to make informed judgments and choices about obtained job information and communication using reflective reasoning and enough evidence to support the claims.	Critical thinking skills are important for assessing and mitigating health and safety risks. For example, construction tradespeople often need to decide when to exercise the right to refuse unsafe work. Smartphones can be used to look up safety information or document safety hazards in the workplace.
Problem-solving	The skills to use ICT to cognitively process and understand a problem situation, in combination with the active use of trade knowledge to find a solution to a problem.	During service calls, the ability to use ICT and trade specific knowledge to problem solve in direct interaction with a customer. One employer noted, "Each job is different. We get service calls and they need to problem solve with the customer and help them figure out what is going on."

#### Core 21st-century digital skills in the trades

Note: The definitions in this table are adapted from Van Laar's framework, as found in Van Laar and others, "Twenty-First Century Digital Skills for the Creative Industries Workforce."

Source: The Conference Board of Canada.

## Sector trends and digital skills needs

## Digital skills in the automotive trades

For automotive tradespeople-service technicians, heavy-duty equipment technicians, auto body and collision technicians, and related motive power trades-the importance of digital skills is underlined by a shift toward more computerized systems and away from mechanical work. Compared with other large Red Seal trades, automotive service technicians report the largest impact of technological change in their workplace.<sup>19</sup> The increasing use of computers and digital tools in automotive trades reflects the emerging shift to electric, hybrid, and autonomous vehicles, which is expected to transform the sector.<sup>20</sup>

Automotive service technicians are also expected to need human–machine interface skills to repair autonomous vehicles. Although industry leaders expressed interest in these skill trends, apprentices and journeypersons were relatively more concerned about working on the electric and hybrid vehicles that are already in their shops. These vehicles require advanced skill levels, including technical skills, information management, and digital problemsolving. Although trade-specific technical skills are starting to appear in the latest Red Seal Occupational Standards (diagnosis and repair of electric and hybrid vehicles is integrated in the most recent standard for the automotive service technician), there is a need to think more comprehensively about the essential digital skills required to work on these vehicles.

Tradespeople underlined the importance of technical, information management, creativity, and problem-solving skills. **The ability to use mobile communications for work orders and parts ordering, to manage information from vehicle manuals and online forums, and to use digital diagnostic tools to solve vehicle problems is increasing in importance.** The successful application of these 21st-century digital skills can be described as "digital literacy," in the sense of a "mindset that enables users to perform intuitively in digital environments."<sup>21</sup>



<sup>19</sup> Canadian Apprenticeship Forum, The Impact of Digital Technologies.

<sup>20</sup> Cutean, Autonomous Vehicles and the Future of Work in Canada.

<sup>21</sup> Van Laar and others, "The Relation Between 21st-Century Skills and Digital Skills."

## Digital skills in the manufacturing trades

Digital technology tasks are increasing for industrial tradespeople. Welders, machinists, industrial mechanics, and other industrial tradespeople increasingly rely on sophisticated technologies. They work with digital thermostats, digital control systems, sensors, digital measuring tools, and automation systems.

Stakeholders underlined the need for technical, collaboration, and information management skills. New technical skills frequently discussed include programming, setting up IP addresses for equipment so it can communicate with other equipment, and safely installing digital technology requested by clients. As in the automotive trades, stakeholders discussed the need for tradespeople to improve their digital literacy to achieve work objectives.



Given the current shortage of workers with the necessary technical skills to operate computer and automation systems in the manufacturing sector,<sup>22</sup> apprenticeship stakeholders expressed frustration with the challenge of attracting and retaining young people in the trades. Participants expressed the view that young people are not sufficiently exposed to the skilled trades in secondary school and tend to be more interested in technology-related jobs without realizing that these exist in the skilled trades as well.

## Digital skills in the construction trades

Digital technology trends are impacting the everyday work of construction electricians, plumbers, carpenters, ironworkers, refrigeration and air conditioning mechanics, and other construction tradespeople. There is a growing reliance on smart technologies, building information modelling, automation systems, and the Internet of Things, such as custom home lighting systems that are accessible via a smartphone.

To respond to these trends in the construction trades, a range of digital skills are becoming more important. Tradespeople underlined technical, information management, collaboration, communication, critical thinking, and problemsolving skills as especially important in adapting their trades to the future of work.

22 Wilson and Poirier, We're Hiring.

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For instance, tradespeople need to be able to use smartphones to find directions and communicate with supervisors while working on remote job sites. They also need the technical skills required to use mobile applications for safety, payment, diagnostic, and monitoring purposes (e.g., Field2Base). **Collaboration skills are needed to share blueprints on the job site, and information management skills are needed to use ICT to access and organize trade-specific and product information on the job site.** 

Digital skills in the food service trades

Stakeholders identified digital skills as the second most important skillset in adapting their trades to the future of work. Aside from social and emotional skills, which were ranked first, stakeholders underlined the importance of both digital and green skills in the service trades.

Cooks, bakers, and chefs are using digital apps and computerized systems in their daily work. Operations are becoming digitized. Payroll and scheduling is increasingly done on apps, POS technology makes service faster, and orders are done on websites or through electronic chits. Food service apps, such as Staffy, make it easier for employers to accommodate younger tradespeople's preference for flexibility in the workplace. Digital ordering apps, like UberEats and Skip the Dishes, are making it easier for customers to order online, thereby changing customer relations and impacting the pace of work in kitchens. At the same time, employers and tradespeople are using social media to manage customer relations and promote their businesses, meaning that social media and digital photography skills are becoming more important.

Technical, information management, communication, collaboration, and creativity were underlined as important skills in adapting food service trades to industry trends. Employers discussed the need to train people on technical skills to use the new digital ordering apps, which help businesses access new customers, but also involve costs for the restaurant and can be a significant learning curve for staff.



## Barriers to digital upskilling for apprentices and journeypersons

Stakeholders emphasized **time, cost, geographic, and technological barriers** to digital upskilling in all sectors. These systemic barriers impact everyone from first-year apprentices to established journeypersons. (See Table 3.)

Generally speaking, tradespeople are looking to employers to fund digital upskilling. But employers are hesitant to make these investments, while educators are caught in the middle.<sup>23</sup> Employer support for employees to pursue essential skills training during the workday varies by sector, with manufacturing employers (62 per cent) more willing than employers in the construction (46 per cent) or service sectors (50 per cent).<sup>24</sup>

Beyond these overarching barriers (see Table 3), we identified specific barriers to both workplace and in-class components of apprenticeship training, as well as post-certification upskilling for journeypersons.



#### Table 3

## Digital upskilling barriers for apprentices and journeypersons

Barrier	Sectors impacted
Cost: Employers may not have the finances to pay for continuous staff training, and employees may not have the ability to pay for upskilling courses.	All sectors
Time: Employers are often unwilling to let tradespeople use business time to learn new skills, since it diminishes productivity; and employees don't want to take time off work because it would diminish their income.	All sectors
Geographic proximity: Courses may not be available in a convenient location, which could make the course too costly and time-intensive.	All sectors, but construction stakeholders underlined this barrier.

Source: The Conference Board of Canada.

## Workplace training barriers to apprentices' digital skills development

We identified several barriers to apprentices' digital skills development during workplace training, which accounts for around 80 per cent of apprenticeship training. These include:

- intergenerational communication gaps
- mobile distraction on the job site
- · limited breadth of training
- outdated assessment platforms.

23 More research is needed on the economic return on investment that employers receive from digital upskilling for tradespeople. 24 Canadian Apprenticeship Forum, *Apprenticeship Analysis*. The Conference Board of Canada

## Intergenerational communication gaps

Intergenerational communication is a challenge for workplace training. Whereas older journeypersons may prefer verbal communication over the phone or in person, apprentices often prefer text message or e-mail communication. When apprentices have questions about how to perform a task, these generational differences can result in miscommunication and can be a barrier to apprentices' on-the-job learning.

As union representatives explained,

journeypersons are accustomed to in-person communication, hands-on practice, and a slower process, which can be met with resistance from apprentices and, for some, an unwillingness to learn. In this context, there is clearly a need to improve communication skills on the part of both apprentices and journeypersons. Specifically, there is a need for stronger proficiency in the use of ICT to convey information to others in a manner that is responsive to their personal and generational preferences.

Poor communication skills can negatively impact apprentices' on-the-job learning. If journeypersons lack these skills, apprentices might not receive adequate information about a task. If apprentices lack these skills, they may not be able to adequately convey follow-up questions to their supervisor.

Journeypersons also expressed concerns that apprentices are distracted by mobile phone usage on the worksite. Apprentices may need to use a phone to perform a calculation or to search online for information about a task, but can become distracted by personal text messages. This finding points to the need for apprentices to develop stronger information management skills, a core digital skill that involves effectively managing online information without becoming distracted. This skill involves not only managing information but also attention and emotions within digitally connected workplaces, underlining the importance of social and emotional skills within digital trades literacy.

## Limited breadth of training options

Stakeholders identified limited breadth of training as a barrier to apprentices' development of technical skills related to computerized equipment. In some cases, apprentices are exposed to a small scope of what they should be taught, which makes it harder for them to work independently when they become certified journeypersons or to work for technologically advanced employers post certification. The inverse scenario was also a concern. Established tradespeople are concerned that younger apprentices are not sufficiently trained on trade fundamentals to work on noncomputerized equipment. Both scenarios can pose challenges for apprentices' progression toward program completion.

Shared apprenticeship models (SAMs) could play a role in improving breadth of training. Shared apprenticeship models involve sharing responsibility for the administration and training of apprentices across multiple employers. By rotating apprentices from one employer to another during their on-the-job training, SAMs can potentially expose apprentices to a greater variety of work environments.<sup>25</sup>

25 By rotating apprentices from one employer to another during their on-the-job training, SAMs can potentially expose apprentices to a greater variety of work environments. Bieler, Joose, Bano, and Jacob, *Final Report on OCWI's Shared Apprenticeship Model*.

Journeypersons also expressed concerns that apprentices are distracted by mobile phone usage on the worksite. Bridging Generational Divides Advancing Digital Skills in Canada's Apprenticeships and Skilled Trades Ecosystem

## **Outdated assessments**

Assessment platforms remain a barrier for apprentices' skills development. (See Table 4.) Apprentices' development of trade-specific skills during workplace training is assessed with a logbook, usually paper-based, which serves as a record of the apprentices' progress through their program. For training purposes, journeypersons observe apprentices' performance and sign off on specific technical skills in the logbook.

The logbook is based on regional curriculum and industry standards, with most jurisdictions requiring employers to track apprentices' on-thejob skills development. Yet, many employers do not discuss the logbook with apprentices. A Canadian Apprenticeship Forum survey of apprentices found that only 54 per cent said their employer used a logbook, whereas 29 per cent said that their employer did not use a logbook and 15 per cent were uncertain about logbook use.<sup>26</sup> Logbook use was more common among larger employers than small or medium-sized employers,27 who may need additional support to fully participate in apprenticeship training.<sup>28</sup> Logbook use also varies across sectors. Manufacturing employers report more logbook use than employers in the construction or service sectors.29

Training leaders spoke to the divide between apprentices' overall preference for digital logbooks and the predominant use of paperbased logbooks. As one training leader explained, "You've got a generation of tradespeople coming up that have grown up on cellphones and the Internet, and you're asking them to do paper-based tracking." Apprentices may lose their paper-based logbook or forget to bring it into the workplace, preventing them from having their trainer sign off on the competencies they have developed.

While digital logbooks on devices may lead to other barriers, especially in rural and remote regions with intermittent and unreliable Internet connectivity, what's clear is that assessment platforms are not keeping up with the behaviour of a new generation of apprentices. Moving forward, some jurisdictions are beginning to digitize apprenticeship services, with implications for assessment and monitoring. Prince Edward Island, Newfoundland and Labrador, New Brunswick, Nova Scotia, and Manitoba are implementing an Apprenticeship Management System that will, among other client services, allow apprentices to log hours and journeypersons to approve apprentices' hours and skills.

27 Ibid.

- 28 Naylor, Raiden, and Morgan, "Constructing Apprenticeships," 635-644.
- 29 Canadian Apprenticeship Forum, Apprenticeship Analysis—The Impact of Technology on Tradespeople.

<sup>26</sup> Canadian Apprenticeship Forum, Quality of Workplace Training.

#### Table 4

### Workplace training barriers to digital upskilling for apprentices

Barrier	Sectors impacted
Limited breadth of on-the-job training: Apprentices may be exposed to a small scope of the trade or may work at shops that are technology laggards, which makes it harder for them to work independently when they become certified journeypersons. This barrier impacts the development of digital technical skills because apprentices may not have sufficient access to computerized machinery or equipment in their trade.	All sectors, but stakeholders in the automotive, manufacturing, and construction sectors were especially worried about this barrier.
Intergenerational communication. Today's apprentices may be digitally savvy, preferring text messaging and e-mail over voice communication. In contrast, older journeypersons may prefer verbal communication on the phone or in person. Since the relationship between journeyperson mentors and apprentices remains at the core of apprenticeship training, these generational differences can result in miscommunication and impede on-the-job learning.	All sectors
<b>Distraction:</b> Smartphones can be a distraction on the food preparation line, so some employers ask tradespeople to keep their phones in their lockers while working. In this context, casual smartphone activity can be a barrier to learning technical skills.	Food service sector. Although food service stakeholders discussed this barrier, similar issues are likely in other sectors.
Paper logbooks: Some jurisdictions use paper logbooks to assess apprentices' on-the-job skill development, which is a barrier to apprentices accustomed to digital communication. Because many apprentices simply don't use the paper logbooks due to inconvenience, tracking technical competencies can be an issue. If apprentices' technical skills aren't tracked in the logbook, it can be difficult for journeypersons to offer appropriate feedback on trade-specific and core 21st-century technical digital skills.	All sectors, but construction stakeholders underlined this barrier.
<b>Limitations on apprentice participation:</b> Apprentices may be keen to participate in courses related to new digital technologies, but some employers may send only senior tradespeople due to the level of financial investment.	Construction sector
<b>Cost of tools:</b> Apprentices pay for their own tools, which are very costly and difficult to finance in the motive power trades. Without access to the right tools, it can be difficult for apprentices to hone technical skills.	Automotive trades

Source: The Conference Board of Canada.



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## In-class learning barriers to apprentices' digital skills development

We identified several barriers impacting apprentices' ability to learn digital skills during technical training (see Table 5), which accounts for around 20 per cent of apprenticeship training:

- lack of up-to-date technology at technical training institutes;
- geographic distance of digital upskilling opportunities;
- staffing and professional development of trade educators;
- adapting curriculum development to the pace of industry change.

## **Tech challenges**

The lack of up-to-date technology at technical training institutes was especially acute in the automotive sector. Tradespeople expressed frustration with the limited access to hybrid and electric vehicles to practise on during technical courses. In some cases, colleges rent advanced vehicles for motive power courses, but these rentals allow for only a limited scope of work for motive power apprentices.

In other cases, deans have developed unique industry partnerships to increase access to training on advanced vehicles. Industry partnerships range from equipment donations to industry committees, where employers can inform training providers about industry trends that should be integrated into training content and delivery. Union training directors have also been working to address technology integration in technical training, including through the support of the Union Training and Innovation Program (UTIP).<sup>30</sup> Through Employment and Social Development Canada, UTIP supports union training providers with cost-shared purchases of new equipment. This type of capital investment in new technology is not readily available for college and private training providers who typically rely on industry partnerships to upgrade classroom technology.

## Geography

The geographic distance to training opportunities is a barrier for rural, remote, and Indigenous apprentices. There are three dimensions to this barrier:

- Accessing training on emerging digital technologies is more difficult in rural and remote regions, especially within trades experiencing major technology impacts.
- Limited access to emerging technologies is a small part of the systemic challenge of basic access to apprenticeship technical training in rural and remote regions.
- Online, hybrid, and other alternatives to apprenticeship technical training are being developed to address accessibility and flexibility concerns but require an integrated consideration of both Internet access and digital literacy, since basic digital skills are needed to participate in online learning.

30 Employment and Social Development Canada, "Union Training and Innovation Program."

In Northern and remote regions, it can be challenging for technical training providers to offer training on trades that are undergoing technological transformation, such as automotive service technician.

Rural and remote apprentices face fundamental barriers accessing technical training. In response, apprenticeship authorities and training providers are experimenting with alternative approaches to technical training delivery. These approaches include mobile training units, mixed reality training using Microsoft HoloLens 2, and online and hybrid training innovations. Online and hybrid training allows apprentices to train without having to take as much time off work, gives employers more scheduling flexibility, and offers cost savings for both apprentices and governments.<sup>31</sup>

The extent to which these approaches could play a role in advancing 21st-century digital skills remains unclear. But the possibilities are there. For example, by requiring apprentices to build relationships with instructors, peers, and workplace mentors on online platforms, alternative training delivery could play a role in the development of apprentices' collaboration skills, assuming apprenticeship stakeholders have the basic digital literacy<sup>32</sup> to participate in online learning platforms in the first place.<sup>33</sup> In addition, alternative approaches would benefit from improvements in high-speed Internet access, the lack of which remains a barrier for many in low-income, rural, and remote regions. This finding aligns with lessons learned from the Flexibility and Innovation in Apprenticeship Technical Training project, underlining the importance of integrating Internet access costs and upgrades in these types of training innovations.<sup>34</sup>

## Trade educators and curriculum standards

Apprentices are looking for teachers who have recent industry experiences. But training leaders find it difficult to recruit highly experienced journeypersons who can use contemporary examples to teach digital skills. Although staff can be highly knowledgeable and well trained on the fundamental skills of their trade, they may be too removed from current industry practice to educate students on emerging digital skills. One possible solution involves connecting faculty members to external industry groups to promote professional development.



- 31 Canadian Apprenticeship Forum, The Impact of Technology.
- 32 When we talk about "basic digital literacy," we refer to level 1–2 in the essential skills framework, which includes understanding how to use the Internet and standard applications at work.
- 33 Burkle, "Apprenticeship Students Learning On-line." See also Hall, Baker, and Nix, "Student Experiences and Perceptions of Digital Literacy Skills Development."
- 34 Employment and Social Development Canada, "Union Training and Innovation Program."

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Training leaders say the occupational and curriculum standards developed by apprenticeship authorities are also out of date. This finding is consistent with other jurisdictions that have identified a need for more agile curriculum development in response to future work trends.<sup>35</sup> But Canada's decentralized postsecondary systems present a challenge for agile curriculum development. The provinces and territories are responsible for the development of occupational standards and related curriculum documents, which are informed by industry stakeholders but require significant time to develop.

At the national level, the Red Seal Program develops common standards to assess the skills of tradespeople from across the country. Within this program, the Interprovincial Standards and Examination Committee (ISEC) is currently working with regional stakeholders to harmonize trade standards and exams across Canada. They take the age of current standards, rate of technological change, and industry interest, among other factors, into account in the development of work plans for standards and exam revisions. In the current work plan, ISEC aims to increase the number of Red Seal Occupational Standards (the Canada-wide common standard for Red Seal trades), which could help to address stakeholder concerns about the age of current standards, at least for trades undergoing harmonization.

In some jurisdictions, apprenticeship authorities say that the extent of digital adoption within industry is a challenge for both standards and curriculum development. But apprenticeship advisory committees, with strong industry representation, will help apprenticeship authorities determine an appropriate balance between traditional and emerging skills within curriculum documents.

Within the regional advisory committees that inform the development of standards, there is typically representation from employers with differing levels of digital adoption in their industry. These advisory committees do not necessarily include representation from employers at the vanguard of digital technology adoption and related future skills needs. As a result, this demand-led curriculum development process typically has a stronger orientation to current skills needs for technology that is widely adopted, as opposed to future digital skills needs.



35 Loveder, Australian Apprenticeships.

## Table 5 Digital upskilling barriers for apprentices during in-class training

Barrier	Sectors impacted	
<b>Temporal lag</b> between the cutting-edge technologies utilized in industry and those that apprentices use during technical training. Some institutions do not keep abreast with new digital technologies, which can hold apprentices back from staying current in their field. Technology updates are resource-intensive and may not always be feasible, but lagging too far behind in adoption poses the risk of being perceived as outdated.	All sectors, but stakeholders in the automotive and manufacturing sectors were especially adamant about this barrier.	
<b>The pace of change</b> is a challenge for both curriculum development and delivery. New technologies are constantly being introduced within the trades that need to be integrated into apprenticeship programs for students to learn relevant skills. However, technical training providers follow curriculum, provided by apprenticeship authorities, that is informed by industry advisory boards but may be out of date.	All sectors	
<b>Staffing:</b> Training leaders find it difficult to recruit experienced tradespeople who can also teach emerging skills. In order to teach apprentices these digital skills, faculty also need to be trained on new technologies.	All sectors	
Lack of high-speed Internet: Regional barriers to accessing high-speed Internet may limit some participants from accessing online courses and videos, and from using mobile applications in their jobs. Without access to online tools and resources, it is difficult for learners to practise such skills as virtual collaboration or digital problem-solving.	All sectors, but construction stakeholders underlined this barrier.	

Source: The Conference Board of Canada.

## **Professional development,** post-certification for journeypersons

Journeypersons are working hard to stay current in their trade. They are willing to commit varying amounts of time to digital upskilling, depending on the complexity of the topic. They generally prefer face-to-face over online learning, although they are not opposed to online or hybrid approaches. Across sectors, tradespeople are using online resources, such as forums and instructional videos, to quickly troubleshoot and learn about new parts and products. (See Table 6.)



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#### Table 6

### Lifelong learning preferences

Sector	Lifelong learning preferences	Training delivery preferences	Time commitment
Automotive	"Online training is a bit like school, sometimes it's theory. Two days later, you won't remember it. Not everyone is the same. I'm visual. If you're just on your screen, you become distracted and you don't listen anymore. You have to be stimulated or you don't learn."	Face-to-face and hands-on learning is preferred, but tradespeople are open to hybrid courses. For troubleshooting and simpler topics, YouTube and online instructional videos are convenient sources of information. Training provided by salespeople is appreciated.	Time commitment varied depending on training topic, ranging from a couple days a month to once every three months. For complex topics, such as hybrid vehicles and new transmissions, tradespeople are willing to invest more time in digital upskilling.
	-Journeyperson		
Manufacturing	"Some of the other courses that are being taught by engineers instead of tradespeople, therefore taught at a higher level than what we need. I would make sure that the right people are teaching it, and try to get more input from actual tradespeople"	Tradespeople are looking for online training while they are on the job. They are looking for refresher classes online for topics that may have been previously taught to make sure they are completing tasks correctly, as their roles continue to change.	Time commitments included half- an-hour per week, lunch-and-learn sessions once a month, and full-day courses with half in-class and half hands-on. For some new topics, one idea mentioned was an orientation versus a course, to quickly familiarize people
	- Journeyperson		with a new area.
Construction	"Teaching is easy online, but interpersonal is not quite as easy. I do well with that kind of training, but that's not the case for a lot of tradespeople, who do better with hands-on training. With a lot of the kids I teach, they only click when it's hands-on learning. Most tradespeople are tactile – we like to touch and feel."	Face-to-face and hands-on training is preferred. Tradespeople are using YouTube and other online resources in their roles to quickly learn about new parts, technologies, and technical skills as they arise.	One journeyperson referenced a company that provides monthly training to find out the latest information. Union-facilitated courses include Saturday morning training and multi- day learning retreats.
	-Trainer		
Food service	"I've watched a lot of online things, and nothing turns out the way it is online for me. If you stand there and teach me how to do something and it's hands-on,	Preference for face-to-face learning, either hybrid or in-person courses. A combination of online and in-class, hands-on training would reach a larger number of people and accommodate different learning styles.	If the training impacted the business and the bottom line, employers and tradespeople were open to devoting more time to training.
	then I can learn." – Apprentice		Examples of time frames include one hour per day, five hours a week, and three hours per month.

Source: The Conference Board of Canada.

Unfortunately, journeypersons experience several barriers to professional development. The relentless pace of digitization, limited scope of firm-specific training, and the tendency to offload digital tasks to apprentices remain barriers to journeypersons' development of digital skills. (See Table 7.)

The pace of digitization is a challenge for journeypersons hoping to stay current with computerized machinery. Journeypersons expressed different views on the challenge of keeping up with the technical skills required to work on new equipment, with some preferring traditional methods and some adapting to digital trends. In some cases, the limited digital literacy among older journeypersons can be an operational challenge. To resolve this challenge, apprentices sometimes support older journeypersons with basic digital tasks on the job site. But by offloading digital tasks, some journeypersons are avoiding important opportunities to hone digital skills.

Journeypersons are forced to upskill on multiple unique iterations of the same technology. For instance, automotive brands offer specialized training on vehicle parts, equipment, and software, but upskilling opportunities are often limited in applicability to similar products and are not enough to keep up with the pace of digitization in the sector more generally. These challenges are especially acute for journeypersons working at independent auto shops who appear to have less access to upskilling opportunities than workers at dealerships. To address this imbalance, some businesses are connecting with others in their region to organize group educational sessions that are less costly and relatively more accessible to tradespeople.

Measures are needed to reduce current barriers and incentivize lifelong learning behaviour among established journeypersons. Although continuous learning is recognized in Canada's essential skills framework for the trades, opportunities to participate are currently limited and it is not built into accreditation and certification systems.<sup>36</sup> For the most part, apprenticeship authorities leave post-certification upskilling to industry. One important exception is the development of Blue Seal programs (offered in a few jurisdictions, including Alberta, Saskatchewan, and the Atlantic provinces) that help journeypersons develop business skills.

Some jurisdictions are beginning to explore the idea that journeyperson certification is not the end of the learning process. For instance, provincial stakeholders in Manitoba indicated interest in micro-credentials for postcertification upskilling of already trained workers and, potentially, to address the needs of rural and remote learners.37 Similarly, provincial stakeholders in British Columbia are discussing the use of endorsements-statements to recognize areas of additional expertise-to encourage lifelong learning in some trades. In Prince Edward Island, there is discussion of a bridging program to help adult learners with prior trades experience upskill to current trade standards and thereby ease their transition back into the trade workforce.

36 Coates, The Future of Trades of the Future.

<sup>37</sup> Micro-credentials are a type of certification that recognizes more granular competencies than a degree or an apprenticeship. They could be used for post-certification upskilling of already trained tradespeople or to recognize workers with specific technical skills but without a certification of qualification. As an example of the latter, Ontario recently launched a microcredentials pilot program focused on industry-driven, short-duration training on a specific set of competencies.

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Journeypersons expressed different views on the challenge of keeping up with the technical skills required to work on new equipment, with some preferring traditional methods and some adapting to digital trends.

#### Table 7

#### Barriers to post-certification digital upskilling for journeypersons

Sectors impacted	
All sectors, but stakeholders in the automotive and manufacturing sectors were especially adamant about this barrier.	
All sectors	
Primary impact on construction, automotive, and manufacturing sectors.	
Automotive sector, with especially strong impacts on tradespeople at independent auto shops, as opposed to dealerships.	
Food service sector	
_	

Source: The Conference Board of Canada.

There are initiatives under way to advance mentorship training in some jurisdictions. SkillPlan, a workforce development organization in British Columbia, launched Mentorship Matters, a program that teaches journeypersons how to be good mentors and apprentices how to be good mentees. Although government stakeholders and training leaders expressed interest in mechanisms to encourage lifelong learning post-certification, there was no commonly identified framework or approach to moving past the idea that journeyperson certification is the end of the learning process.



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## Apprenticeship stakeholders are struggling to adapt

Based on our conversations with front-line apprenticeship stakeholders, digitization is impacting multiple sectors. To adapt, tradespeople at all stages of their career from first-year apprentices to established journeypersons with their own businesses—need seven core digital skills: technical, information management, digital communication, virtual collaboration, creativity, critical thinking, and problem-solving skills. These skills are grounded in human skills and require knowledge of digital technologies that can be applied to tradespecific tasks.

The retirement of older tradespeople and the resulting decline in the labour force participation rate are expected to exacerbate labour shortages in the construction,<sup>38</sup> manufacturing,<sup>39</sup> and automotive sectors.<sup>40</sup> In the food service sector, the projected demand for cooks is a risk for the 2019–23 period, with projected completions lagging required certifications.<sup>41</sup> Near-term demand for certified welders and industrial mechanics is similarly projected to outpace apprenticeship completions over that period. Alongside recent declines in the number of new apprentices and competing sectoral demands, the aging of Canada's workforce is expected to contribute to skilled-trade shortages.<sup>42</sup>

As stakeholders work to recruit young people into the trades in response to these shortages, generational differences between apprentices and journeypersons are impacting on-the-job learning and post-certification upskilling. These generational differences affect the relationships between mentors and mentees, with implications for the development of core digital skills required for the future of the trades.

Apprentices are struggling to adapt to journeypersons' preference for verbal communication and old-school teaching methods, which could significantly impact on-the-job learning outcomes. Apprentices need to be able to communicate their questions to an older generation of tradespeople, manage information in high-speed work environments, and problem solve with digital tools. Meanwhile, journeypersons need to be able to convey lessons to apprentices in a manner that is attentive to the communication and flexible work preferences of more digitally savvy apprentices. Journeypersons are doing their best to stay abreast of digital trends. But all too frequently, they avoid digital tasks by offloading them to apprentices, employers, and other staff. In the process, journeypersons miss important opportunities for digital upskilling.

<sup>38</sup> BuildForce Canada, Construction and Maintenance Looking Forward.

<sup>39</sup> Canadian Skills Training and Employment Coalition, The Future of the Manufacturing Labour Force in Canada.

<sup>40</sup> Lopata and others, Barriers to Attracting Apprentices.

<sup>41</sup> Canadian Apprenticeship Forum, Apprentice Demand in the Top Ten Red Seal Trades.

<sup>42</sup> Ibid.

## So what needs to happen next?

To address general labour shortages, as well as current and emerging digital skills shortages, apprenticeship stakeholders, including employers, tradespeople, training providers, unions, and governments, will need to:

- Identify new funding models to support continuous learning in the trades. Given the cost barriers identified by employers and tradespeople, new funding models are needed to encourage continuous learning in the trades. Efforts should be undertaken to avoid any duplication with existing apprenticeship grants and supports at the federal and provincial/ territorial levels.
- Engage technology innovators in the curriculum development process. Individuals with expertise on AI, robotics, and other digital technologies could be integrated into industry advisory boards to encourage a future skills perspective in the development of occupational standards and related curriculum documents.
- Use reverse mentoring to improve basic digital literacy. In this approach, a senior tradesperson is mentored by a junior apprentice on basic digital skills. The mentee becomes the mentor in relation to the specific area of digital skills, which improves reciprocity in the relationship.
- **Digitize logbooks.** Although some jurisdictions have explored moving to digital logbooks, many trades and jurisdictions still use paper logbooks. Transitioning to digital logbooks across jurisdictions could improve the tracking and assessment of trade-specific technical skills and related digital technical competencies.

- Expand access to continuing professional development in digital skills. Strategic partnerships between provincial/territorial apprenticeship authorities, technical training providers, and industry will be necessary to ensure that continuing education opportunities offer training on the latest technologies and equipment.
- Support programming to address barriers faced by Indigenous people in rural and remote regions. Given the barriers to accessing online resources and culturally relevant training in Northern and remote communities, explore innovative programming that expands access to digital upskilling for Indigenous people.
- Support shared apprenticeship models (SAMs). SAMs involve sharing responsibility for the administration and training of apprentices across multiple employers. By rotating apprentices from one employer to another during their program of training, SAMs could expose apprentices to a greater scope of work and related technologies during their on-thejob training.
- Encourage comprehensive digital upskilling opportunities. Support upskilling opportunities that are more comprehensive and cut across specialized or firm-specific products and software, which could save tradespeople significant time in the process of keeping abreast of technological developments.

## What role will The Conference Board of Canada and the Future Skills Centre play?

Together the Conference Board and the Future Skills Centre will bring together apprenticeship stakeholders to better understand the emerging skills needed to adapt to sector-specific future work trends. We will:

- discover ways to bridge the gaps between the skills that will be needed and how we integrate those skills into apprenticeship training in Canada;
- identify innovations that address emerging digital, socio-emotional, and green skills needs in Canada's apprenticeship systems;
- provide a road map for Canada to bring the best training possible to our newest generation of tradespeople – one that fosters the lifelong learning that will enable them to adapt at all stages of their careers.

As industries navigate labour shortages and emerging trends, we aspire through our work to help foster a culture of lifelong learning and continuous digital upskilling, intergenerational communication, and collaboration among tradespeople at all stages of their careers.



## Appendix A Methodology

## Focus group and interview participants

We conducted in-person and online focus groups that engaged 134 stakeholders with a front-line role in apprenticeship training: 50 apprentices, 40 journeypersons, 32 employers, and 12 instructors. We also spoke with nine workforce development executives, 11 industry association executives, 12 training leaders, and nine apprenticeship authority representatives. In total, we spoke with 175 apprenticeship stakeholders.

We spoke to welders, machinists, construction electricians, plumbers, carpenters, automotive service technicians, heavy equipment operators, and cooks, among other tradespeople. Participants were at different stages of their career, including first-year apprentices, established journeypersons, tradespeople who had gone on to establish their own business, and tradespeople working as educators. We engaged tradespeople from across all 13 provinces and territories, with most participants from Ontario (45 per cent), the Atlantic provinces (18 per cent), Quebec (13 per cent), British Columbia (7 per cent), and Alberta (5 per cent). (See Chart 1.) Participating tradespeople included a relatively mature and diverse cohort of apprentices alongside an older and less-diverse generation of journeypersons. (See charts 2 and 3.)

#### Chart 1

Participant engagement, by region (per cent)



Source: The Conference Board of Canada.

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#### Chart 2



Source: The Conference Board of Canada.

### Chart 3 Age of journeypersons

(share by age group, per cent)



Source: The Conference Board of Canada.

Apprentice participants were mostly white males but did include a higher percentage of visible minorities than would be expected. (See Chart 4.) Twenty-four per cent of participants identified with visible minority groups, including South Asian/Asian (10 per cent) and Caribbean/Black (14 per cent). For Canada as a whole, 8.2 per cent of apprentices identify as being members of a visible minority.43 There was relatively more ethnic diversity among apprentices than journeyperson participants, since only 8 per cent per cent of journeypersons identified with visible minority groups. (See Chart 5.) Participation from Indigenous apprentices was slightly below national trends, with 4 per cent of apprentices identifying as Aboriginal or First Nations. We were unable to engage any Indigenous journeypersons.

#### Chart 4 Ethnic background of apprentices (per cent)



Source: The Conference Board of Canada.

43 Canadian Apprenticeship Forum, Apprenticeship in Canada.

Among participants in male-dominated trades, 5 per cent of apprentice participants were female, whereas 9 per cent of journeypersons identified as female. (See charts 6 and 7.) As would be expected, we spoke to a higher percentage of female tradespeople in the food service trades. (See Chart 8.)

#### Chart 7



#### Chart 5

Ethnic background of journeypersons (per cent)



Source: The Conference Board of Canada.

#### Chart 6





Gender of journeypersons in male-dominated trades (per cent)



Source: The Conference Board of Canada.

#### Chart 8





Source: The Conference Board of Canada.

Source: The Conference Board of Canada.

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## Data analysis and literature review

Focus groups and key informant interviews were recorded, transcribed, and analyzed using NVivo 12 qualitative data management software. We used a thematic coding process to analyze the transcript content.

We undertook a review of 57 documents that were selected through structured and manual searches. Structured searches were completed in the following databases: ProQuest, Education **Resources Information Centre, and Sociological** Abstracts. Search terms included "apprentice"," "skilled trade\*," "lifelong learning," "digital skills," "digital literacy," "information and communication technology," and "future of work," among others. Manual searches were completed in technical education journals and online databases of organizations with a focus on apprenticeship and/or technical and vocational education and training. Via structured and manual searches, a total of 527 articles were obtained. After screening the abstracts for inclusion criteria, we identified 57 articles for inclusion in the review. Although these articles were the analytic focus of the literature review, we also reference articles that were recommended to us during the writing process.



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#### Bridging Generational Divides: Advancing Digital Skills in Canada's Apprenticeships and Skilled Trades Andrew Bieler

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