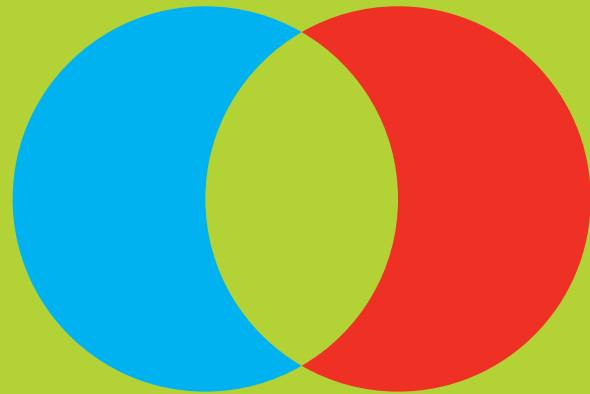


Rising Skills

Digital Skills Needs for Smart and
Connected Vehicles





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 ADE, and The Conference Board of Canada.

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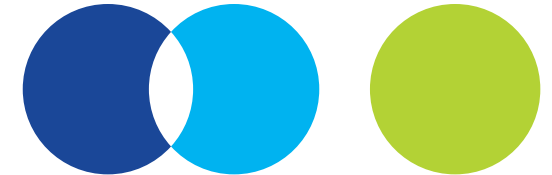
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Key findings

- Automotive tradespeople need digital skills to adapt to the future of mobility as vehicles become connected, autonomous, shared, and electric (CASE). CASE vehicles perform more functions than traditional vehicles and have internet-connected services. Tradespeople in the motive power sector—who service advanced cars, trucks, heavy-duty equipment, and other vehicles—need new skill sets.
- Automotive tradespeople are using mobile technologies in the workplace more than ever. They need 21st-century digital skills such as information management and client communication skills.
- Younger tradespeople work and communicate differently than older tradespeople. These generational differences can lead to tensions, which can get in the way of learning.
- Tradespeople and apprentices in the automotive sector face barriers to upskilling. Financial barriers for automotive service technicians include the cost of tools and training. Those in rural or remote areas may be too far from opportunities to improve their skills. And changes in the industry can happen too fast for occupational standards and curricula to keep up. The industry needs greater attention to digital assessment tools.
- The following actions could help the Canadian automotive sector strengthen apprenticeship training:
 - Promote augmented and virtual reality training on advanced vehicles.
 - Target digital literacy training to older tradespeople.
 - Support lifelong learning for tradespeople at small independent shops.
 - Integrate client relations into apprenticeship training.
 - Develop a knowledge transfer strategy to address CASE technologies.
 - Integrate generational considerations into mentorship training.



Introduction

As the automotive industry shifts toward connected, autonomous, shared, and electric (CASE) vehicles, tradespeople will need stronger digital competencies. To work with new tools on smart vehicles, tradespeople need seven core digital skills. But stakeholders in the automotive sector need to work together to reduce barriers to digital upskilling for both apprentices and journeypersons.



The increasing prevalence of CASE vehicles

Tradespeople are grappling with future work challenges related to CASE vehicles. They need technical, problem-solving, communication, and other 21st-century digital skills to thrive in response to these immediate and near-term trends. But tradespeople face barriers to upskilling, including financial constraints, tech challenges, and age-related tensions.

As the skills required to work on advanced vehicles increase, the status and pay levels for automotive trades appear to be decreasing. They shared a sense that they are being asked to complete technologically advanced work in limited time frames and with less financial reward than in other trades.

For this research, we consulted automotive service technicians, auto-body and collision technicians, heavy-duty equipment technicians, truck and transport mechanics, and others, particularly in the Red Seal trades. Although not all apprentices, journeypersons, and trainers were Red Seal-certified, we primarily consulted trades that are common to most jurisdictions across Canada and approved for Red Seal status.

The [Red Seal program](#) sets common standards to assess the skills of tradespeople across Canada.

Digital skills are a top priority for adapting to future work trends

Tradespeople identified digital skills as a top priority in adapting their trades to digitally connected workplaces, including independent auto shops and dealerships. Digital skills include the technical skills to work on advanced vehicles, as well as the cognitive skills and social and emotional skills involved in working in a digital environment. In total, we identified seven core 21st-century digital skills:

- technical
- information management
- communication
- collaboration
- critical thinking
- creativity
- problem-solving

Automotive service technicians need to be able to use digital diagnostic tools combined with vehicle knowledge to examine a situation and find a solution. In the process, they need to manage information to search and organize vehicle data and think critically to make informed judgments about the job. They also need to be able to use information technology to collaborate with colleagues and to communicate diagnostic results to supervisors and clients.

With the shift to CASE vehicles, technical skills are increasingly crucial. These are the skills to use computerized machinery and information technology to accomplish practical tasks. Tradespeople are currently adapting to a leap from experientially grounded mechanical work to data-driven work on partially automated computerized vehicles.

Looking to the coming decades, fully automated cars are expected to fundamentally change the nature of work for motive-power tradespeople.¹ Automotive service technicians will need human-machine interface skills to repair autonomous vehicles.² Similarly, truck and transport mechanics will require new technical skill sets.³

Industry leaders are interested in the skills needed to work on vehicles with advanced CASE technologies. Tradespeople, however, expressed more interest in the skills needed to work on the vehicles that are already in their shops—partially automated and connected, hybrid, and (to a lesser extent) electric.

Client communication skills will help tradespeople adapt to the increasing use of video and social media in the sector. Digital technology is changing the relationships that tradespeople have with clients. Clients are using online forums and YouTube videos to understand their vehicle's problems, and some auto shops are sharing repair videos with clients. Mechanics may be asked to document repairs with video and to share these videos with clients. They need to be able to build trust and maintain positive relations with clients in a digital environment. Older mechanics may be less comfortable with this digital shift.

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

2 Ibid.

3 Rea and others, "Making the Future of Mobility Work."

Tradespeople also underlined the importance of information management—the ability to find and access vehicle manuals and other information on a digital device. To troubleshoot vehicle repairs, mechanics need to be able to access and assess relevant information on online forums, YouTube, and other sites with troubleshooting information. Access to troubleshooting codes from original equipment manufacturers is a significant challenge due to poor data-sharing practices among dealer networks and original equipment manufacturers.



“What we’re doing is trying to get mechanics trained for the e-vehicles, which is a big leap from going from the old mechanical repairs.... It’s a challenge. People who know the old stuff and they know what they’re doing and they’re licensed mechanics – it’s a challenge to make the leap, but it’s something I’m working on.”

Employer, automotive sector

“When I started in 2018 in a small shop, I got a smartphone. I take pictures of worn-out parts and text [the customers] the old parts and then text them with the brand-new part.”

Journey person, automotive sector

“Every day I use my smartphone ... to take a picture of the VIN number to accurately look up parts. I use it to look up manuals. I use it to Google if I’m having a tough time – even just figure something out.... My phone is probably the biggest tool in my toolbox I use.”

Journey person, automotive sector



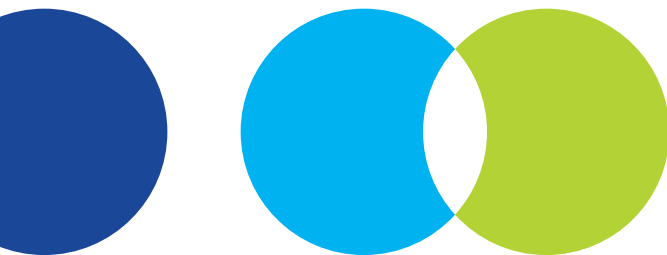
Intergenerational differences in work style and communication

Canada's trades workforce is aging faster than the workforce with a university degree.⁴ In the automotive sector, this workforce aging amplifies the generational divide between established journeypersons and young people entering the trades:

- Work style preferences differ between older journeypersons and apprentices, with tradespeople often preferring mechanical diagnostics and apprentices preferring digital diagnostic techniques.
- Older journeypersons may prefer voice and face-to-face communication, whereas young apprentices may prefer text or email communication on the job site.

- The pace of digitization can be a challenge for journeypersons looking to stay current with computerized machinery. Journeypersons are forced to upskill on multiple unique iterations of the same technology, and upskilling opportunities are often limited in applicability to similar products and not enough to stay abreast with the pace of digitization in the automotive sector. Some journeypersons with limited basic digital literacy (i.e., ability to use the internet and standard applications) report feeling overwhelmed by the pace of change. They may delegate basic digital tasks to apprentices on the assumption that they are “digital natives,” thereby further limiting their opportunity to practise digital skills. While journeypersons may have varying levels of digital aptitude, they all require stronger and more coordinated lifelong learning supports. Both apprentices and journeypersons will need to commit to lifelong learning and 21st-century digital skills to keep pace with CASE technologies.

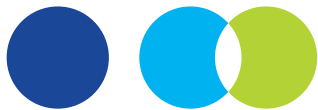
These differences in work and communication styles can impede flexibility for both parties. Younger apprentices may be perceived as entitled, whereas established tradespeople may be protective of their craft and unwilling to mentor properly for fear of losing their job.



4 Statistics Canada, “Pathways and Earnings Indicators for Registered Apprentices in Canada.”

Financial barriers to upskilling

Automotive tradespeople face financial barriers to upskilling. Among male-dominated Red Seal trades, automotive service technicians have one of the lowest median employment incomes: two years after certification, the median income for an automotive service technician is \$54,860, compared with \$71,370 for a construction electrician.⁵ At year of certification, the median income for automotive service technician is \$42,740, compared with \$60,130 for construction electricians and \$76,460 for heavy duty equipment technicians. In addition, some automotive service technicians receive flat-rate pay for jobs that are increasingly complex and feel they are underappreciated for their work.



5 Statistics Canada, Table 37-10-0017-01, Median Employment Income of Apprentices.


“A lot of seasoned technicians have trouble navigating the computer. At the same time, it’s the computer that has the repair manuals most of the time.... It’s basic computer skills. It’s lacking sometimes.”

Journey person, automotive sector

“The vehicles are getting more complicated to work on. That’s frustrating. There’s no compensation for that. You’re told you’ll make it up somewhere else, but that’s not really fair.”

Apprentice, automotive sector



A mechanic wearing blue overalls and a red lanyard with an ID badge is working on a car engine. The mechanic is holding a tablet in their left hand and using their right hand to touch a component of the engine. The background is a blurred workshop. There are decorative circular elements: a green one in the top left and a red and white one in the bottom right.

Work style preferences differ between older journeypersons and apprentices, with tradespeople often preferring mechanical diagnostics and apprentices preferring digital diagnostic techniques.

In this context, tradespeople identified the following barriers to upskilling:

- **Cost of tools:** Tradespeople pay for their own tools, which are costly and difficult to finance. The cost of tools may be tax-deductible, but the upper limit of the tax credit is nowhere near the reality of the spend.
- **Range of diagnostic tools and software:** Access to automotive diagnostic scanners can be costly, and it can be challenging to keep up with vehicle-specific variations.
- **Limited opportunities for upskilling at independent garages relative to dealerships:** Dealerships are more likely to provide employees with free training opportunities and offer greater access to emerging technologies. Tradespeople at independent auto shops say they don't have the same access to new technologies and related upskilling options.
- **Lack of access to advanced vehicles at technical training institutes:** Training institutes may not have access to electric, hybrid, and connected vehicles, something that can limit the technical and digital skills that tradespeople can practise.
- **Barriers to accessing training in northern and remote regions:** Training institutes in northern and remote regions have difficulty offering training on trades that are experiencing technological disruption, such as the automotive service technician trade. Populations in these regions are spread thin, making travel to training locations difficult. Many of these regions have poor or no Internet services, so students may not be able to complete online courses.

What needs to happen?

We have the following suggestions to strengthen apprenticeship training and post-certification upskilling for tradespeople in the Canadian automotive sector:

- **Promote augmented and virtual reality training on advanced vehicles.** Given the challenge of accessing advanced vehicles and the safety risks associated with working on them, augmented reality (AR) and virtual reality (VR) training could play an increasing role in technical education and upskilling. Some technical training institutes are using simulation training. Ford, in partnership with Bosch, is using VR to train technicians on advanced vehicles. Australian-based Tradiebot Industries has introduced WorxAR, AR software that can be downloaded onto a smartphone or tablet and functions as a digital assistant. These types of innovations give technicians context-relevant information and guidance while they work on advanced vehicles. This could help integrate digital upskilling into everyday work processes.
- **Target digital literacy training to older tradespeople.** Given the challenges some older tradespeople in the automotive sector have with digital tools, digital literacy programming should target them specifically. This programming could include reverse mentoring. In this approach, a senior tradesperson is mentored by a junior apprentice on digital skills. The mentee becomes the mentor for digital skills, thereby improving reciprocity in the relationship. Regardless of the approach, digital literacy programming should emphasize the importance of lifelong learning for both apprentices and journeypersons.



- **Support lifelong learning for tradespeople at small independent shops.** Some small businesses are connecting with others in their region to hold group sessions that reduce upskilling costs. These types of consortia should have access to financial support to enable upskilling for tradespeople who have less access to lifelong learning than peers at dealerships.
- **Integrate client relations into apprenticeship training.** Building trust and maintaining positive client relationships should be part of programming for tradespeople at all stages of their careers. Low-cost client relations training would help tradespeople build relationships with clients and grow their business.
- **Develop a knowledge transfer strategy to address CASE technologies.** CASE vehicles require specific skills. Employers should consider ways of passing down knowledge that address the unique learning needs of tradespeople at different stages of their careers. Knowledge transfer methods could include team mentoring on emerging skills. Tradespeople and apprentices would work together to identify learning goals for CASE technologies. Individuals would work with one or more mentors on the team to develop knowledge and skills.
- **Integrate generational considerations into mentorship training.** Instructor or mentorship training for tradespeople should consider different communication and work styles between the multiple generations in the automotive workforce. Cross-generational communication strategies could better prepare older tradespeople to communicate with younger generations.

What are we doing?

Together, the Conference Board and the Future Skills Centre are bringing together apprenticeship stakeholders to better understand the emerging skills needed to adapt to sector-specific future work trends. Through our work we aim to:

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



Appendix A

Methodology

Who we spoke to

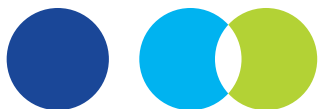
We spoke to 61 stakeholders from across Canada, including 37 automotive stakeholders and 24 apprenticeship stakeholders with responsibility across multiple sectors of the skilled trades. We conducted in-person and online focus groups and semi-structured interviews to consult 13 apprentices, 13 journeypersons, 10 industry leaders, 10 training leaders, 6 workforce development executives, and 9 apprenticeship authority representatives.

Participants contributed to a dialogue on the emerging skills that tradespeople will need so they can adapt to the future of work, particularly in the Red Seal trades. These consultations were part of a larger apprenticeship research project in which we spoke to 175 apprenticeship stakeholders from multiple trade sectors.

We spoke with automotive service technicians, auto body and collision technicians, heavy-duty equipment technicians, and truck and transport mechanics in focus groups. 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.

Most apprentice and journeyperson mechanics were from the automotive service technician trade, which experienced a 10 per cent decline in new Red Seal trade registrations over 2014 to 2017. Projected demand for this trade for 2019–2023 shows balance between required workers and projected certification completions overall in Canada; however, while Ontario has an ample supply of certified mechanics, supply is at risk in Alberta.⁶

Registrations for heavy-duty equipment technicians have declined more dramatically—down 39 per cent between 2014 and 2017. There is a balance between required certifications and projected completions Canada-wide; but British Columbia and Manitoba have an ample supply of certified tradespeople, while supply is at risk in Ontario and Saskatchewan.⁷ We spoke with automotive services and multi-sector apprenticeship stakeholders from Atlantic Canada, Central Canada, the Prairie provinces, Canada's West Coast, and the territories. Most stakeholders were from Ontario (39 per cent), followed by the Prairie provinces (20 per cent) and the Atlantic provinces (18 per cent).



⁶ Canadian Apprenticeship Forum, *Apprentice Demand in the Top Ten Red Seal Trades*.

⁷ Ibid.

Participating apprentices and journeypersons in the automotive services sector represented differing generational perspectives: 85 per cent of apprentices were under age 35, while 75 per cent of journeypersons were 40 or older. Apprentices were more likely to represent millennial and Generation Z perspectives, while journeypersons were more likely to represent baby boomer and Generation X perspectives.

Focus groups and key participant interviews were recorded, transcribed, and analyzed using NVivo 12 qualitative data management software. The dataset for the larger apprenticeship project that informs this report included 59 transcripts. We used a thematic coding process to analyze the transcript content. Following inductive analysis, frequency counts were used to quantify the breadth of representation of particular codes across sources. Word queries, text queries, and matrix queries were used to explore the dataset.

For the larger Bridging Generational Divides project, we reviewed 57 documents that were selected through structured and manual searches. Structured searches were completed in the following databases: ProQuest, Education Resources Information Center, and Sociological Abstracts. Search terms included “apprentice*,” “skilled trade*,” “lifelong learning,” “digital skills,” “digital literacy,” and “information and communication technology,” among others.⁸ 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 these structured and manual searches, we obtained a total of 527 articles. After screening the abstracts for inclusion criteria, we identified 57 articles to include in the review. Although these articles were the analytical focus of the literature review, we also referenced other sources recommended by stakeholders and other advisors during the writing process.

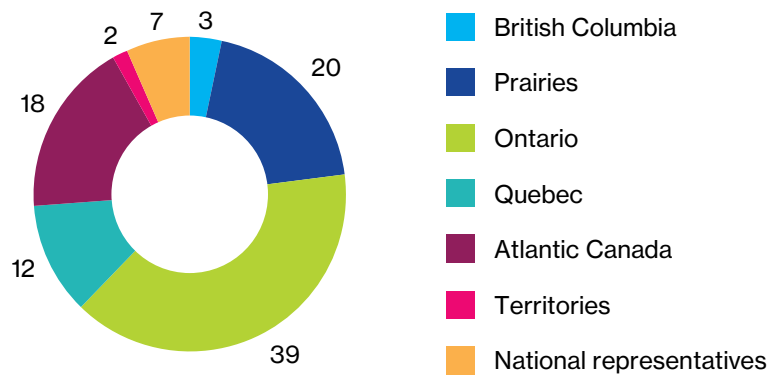


8 Asterisk indicates that we searched for different word endings of each term.

Chart 1

Automotive sector stakeholders consulted by region

(per cent)

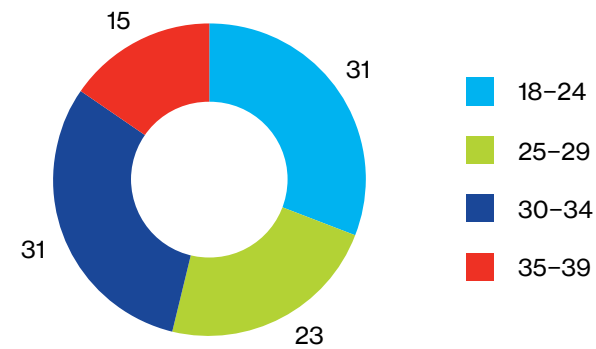


Source: The Conference Board of Canada.

Chart 3

Age of participating automotive sector journeypersons

(per cent)

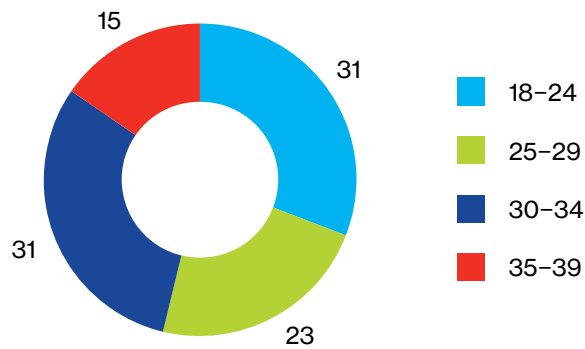


Source: The Conference Board of Canada.

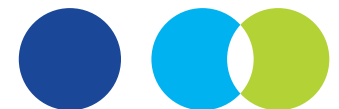
Chart 2

Age of participating automotive sector apprentices

(per cent)



Source: The Conference Board of Canada.



Appendix B

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Rising Skills: Digital Skills Needs for Smart and Connected Vehicles

Andrew Bieler

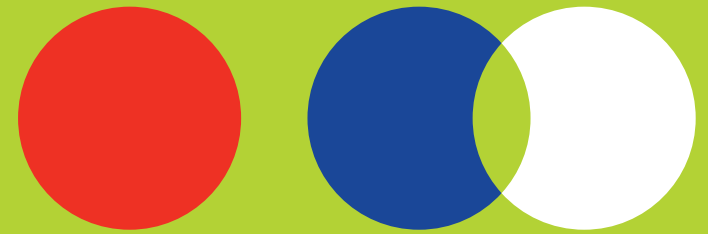
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