Engineers Canada's Submission to the House of Commons Standing Committee on Transport, Infrastructure and Communities on Automated and Connected Vehicles in Canada

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Overview

Autonomous capacities, technology, and artificial intelligence have received attention within recent years as semi-autonomous features have been rapidly built into vehicle features, specifically in the form of lane guidance, collision avoidance, assisted-braking capacities, and cruise control. Rapid connectivity has, in the short term, enabled vehicles to interact with one another and with surrounding public infrastructure. It is anticipated that Cooperative Intelligent Transport Systems (C-ITS) enabled vehicles will be deployed as early as 2019.[1] This style of vehicle has the capability to warn other vehicles of potentially dangerous situations, all while communicating with local road infrastructure. Automotive manufacturers and technology companies, such as Tesla, Ford, Toyota, and Google, have also set 2020 as the target date to launch vehicles with highly automated features.

The potential benefits of autonomous and connected vehicles in Canadian society are vast. Autonomous and connected vehicles have promised to increase highway safety, reduce traffic congestion for better use of consumer time, improve traffic pollution, energy use, comfort, and accessibility for commuters, and reduce fuel consumption. The most prominent benefit of automated vehicles being fewer, if any, vehicle collisions.

According to a 2017 study conducted by the Information and Communications Technology Council (ICTC), there were approximately 1,858 vehicle fatalities reported in Canada in 2015; the majority of which were due to human error. With the inclusion of serious injuries, that number increased to 10,280 in the same year.[2] Automated vehicles in Canada have promised to mitigate, if not eliminate, human errors through artificial intelligence capabilities and advanced technologies.

Autonomous vehicle testing in the United States, specifically by Google's autonomous vehicle unit, Waymo, has demonstrated a promising track record for automated vehicles on public roads. Waymo reported that "of the 635,868 miles driven on California streets during that year, only 124 disengagements [where a human driver takes control of the vehicle] were noted."[3] With this figure in mind, it is evident that automated vehicles have the potential to mitigate the number of vehicle collisions on roads.

However, it is important to recognize that these promises are largely uncertain and come with their own challenges. For instance, the introduction of automated and connected vehicles could have a potentially negative effect on road capacity during the transition period where both conventional and automated vehicles are required to share the roadway and infrastructure. Additionally, "the increased travel demand on roads which could arise with automated and connected vehicles may further worsen the situation and

[1] Car 2 Car Communication Consortium. (2016). "The Car-2-Car Communication Consortium Roadmaps beyond Day-1." Retrieved May 14, 2018, from: http://www.codecs-project.eu/fileadmin/user_upload/pdfs/City_Pool_Workshop_1/CIMEC-CODECS_2016-03-3_Buburuzan.pdf.
[2] Information and Communications Technology Council (2017). "Autonomous vehicles and the future of work in Canada." Retrieved May 15, 2018, from: https://www.ictc-ctic.ca/wp-content/uploads/2018/01/ICTC_-Autonomous-Vehicles-and-The-Future-of-Work-in-Canada-1-1.pdf.
[3] Information and Communications Technology Council (2017). "Autonomous vehicles and the future of work in Canada." Retrieved May 15, 2018, from: https://www.ictc-ctic.ca/wp-content/uploads/2018/01/ICTC_-Autonomous-Vehicles-and-The-Future-of-Work-in-Canada-1-1.pdf.

their introduction may lead to higher congestion levels."[4] With higher congestion levels, it is inevitable that higher levels of pollution and energy, as well as slower mobility rates for consumers, may follow.

With the rise of smart cities and the outstanding technological and automated advancements in vehicle features across Canada's transportation sector, Engineers Canada believes that it is vital for the federal government to be progressive and proactive in it's approach to upholding public safety, the natural environment, and the economy. The development of autonomous vehicles in Canada will require the unbiased and professional expertise of the engineering profession, specifically engineers in the civil, mechanical, and software engineering disciplines. Key decisions and directions regarding the development and deployment of autonomous and connected vehicles must be based on the unbiased, professional, and strategic advice of engineers.

Automated and connected vehicles defined

Autonomous vehicles are currently operating on a range between Level One, where a single function is automated within the vehicle, to Level Five, where all functions within the vehicle are fully automated. Level Five automation within a vehicle is the only level where the vehicle is fully autonomous; dismissing any human assistance while in operation. Several modern vehicles possess some form of automation or connectivity; however, the majority of vehicles still require human supervision and control.

The technology that drives autonomous vehicles forward in Canadian society include Light Detection and Ranging technology, 5G mobile technology, Human Machine Interface technology, and artificial intelligence—a style of technology where algorithms "rely on layers of processing in order to extract characteristic features from pieces of information."[5] The artificial intelligence within modern vehicles allows them to drive on diverse road conditions and within a variety of weather conditions. Automated vehicles can sense their environments independently and can navigate without human input; the technology within automated vehicles works to control the movement of the vehicle. For the Canadian consumer today, the majority of autonomous vehicles fall between Level One and Level Three.

Often, automated vehicles include technological features that enhance the driving experience for both the driver and passenger(s), such as in-car internet access or collision control. These types of vehicles are referred to as "connected vehicles." Connected vehicles are unique from automated vehicles as they extend a vehicle's awareness and can sense external environments independently, as well as promote communication between vehicles, mobile devices, and physical infrastructure.[6] It is important to note that connected vehicles do not necessarily control the movement of the vehicle.

The reality is that the technology within automated and connected vehicles in Canada requires further investigation and research, and must comply with federal and provincial vehicle safety standards. Public

[4] European Commission (2017). "The r-evolution of driving: from connected vehicles to coordinated automated road transport (C-ART)." Retrieved May 11, 2018, from: http://publications.jrc.ec.europa.eu/repository/bitstream/JRC106565/art_science_for_policy_report_1-soa_final_tobepublished_online.pdf.

[5] Information and Communications Technology Council (2017). "Autonomous vehicles and the future of work in Canada." Retrieved May 15, 2018, from: https://www.ictc-ctic.ca/wp-content/uploads/2018/01/ICTC_-Autonomous-Vehicles-and-The-Future-of-Work-in-Canada-1-1.pdf.

[6] Canadian Council of Motor Transport Administrators (2018). "The Future of Automated Vehicles in Canada." Retrieved May 15, 2018, from: https://comt.ca/reports/autovehicle2018.pdf.

safety concerns and consumer discomfort around the technology within automated vehicles, as well as the potential for driverless technology to be hacked, remains high. Consumers across North America remain concerned and hesitant to use an "unproven technology on a regular basis…with concerns revolving around the possible unreliability of the technology and lack of quick response time."[7]

As technology rapidly evolves, the need for engineers in Canada has never been greater; specifically, to uphold public safety while simultaneously upholding public confidence in automated vehicle technology. For this reason, Engineers Canada strongly believes that an engineer must be involved in the development, advancement, maintenance, and overall life-cycle of autonomous and connected vehicles in Canada.

Increased demand for engineers

With the increasing demand for automated and connected vehicle technology within Canada, there has, and will continue to be, a rising demand for engineers, particularly civil, mechanical, and software engineers. Software engineers will be required to develop, maintain, and refine artificial intelligence technology for use within automated and connected vehicles, as well as to manage the cloud computing system that transmits information.[8] Mechanical engineers will be required to design and build pieces of automated vehicles, and civil engineers will be needed to conceptualize transportation and public infrastructure to support automated and connected vehicle technology.

Recommendation #1: Inclusion of engineers in the development of automated and connected vehicles
In 2016, the total number of engineers and skilled workers working within the automated and connected vehicle industry Canada was approximately 213,300. As autonomous vehicle technology continues to grow the demand for engineering talent and skills is expected to rise to a total of 248,000 workers by 2021.

Public safety and public confidence will remain low if engineers are not involved in the development, advancement and maintenance of automated software and technology. In Canada, engineers are held publicly accountable for their work by the provincial and territorial regulators who license them, as well as by their individual employers. These separate and layered stages of accountability within a given engineering project work to uphold public safety and confidence.

The involvement of engineers in the development and implementation of legislation governing vehicle safety will be crucial in upholding public confidence and public safety. For this reason, Engineers Canada believes that engineers must be included in the drafting, reporting, and development of federal and provincial legislation associated with automated and connected vehicles in Canada.

[7] Information and Communications Technology Council (2017). "Autonomous vehicles and the future of work in Canada." Retrieved May 15, 2018, from: https://www.ictc-ctic.ca/wp-content/uploads/2018/01/ICTC_-Autonomous-Vehicles-and-The-Future-of-Work-in-Canada-1-1.pdf.
[8] Information and Communications Technology Council (2017). "Autonomous vehicles and the future of work in Canada." Retrieved May 15, 2018, from: https://www.ictc-ctic.ca/wp-content/uploads/2018/01/ICTC_-Autonomous-Vehicles-and-The-Future-of-Work-in-Canada-1-1.pdf.

Increased demand for science, technology, engineering, and mathematics skills

With the rapid development of automated and connected vehicle technology across Canada, the demand for specific occupations and skill sets will inevitably grow. Science, technology, engineering, and mathematics (STEM) skills will be required to provide a foundation of support to further develop and conceptualize artificial intelligence for automated and connected vehicles. Foundational skills in STEM will prepare Canadian youth by equipping them with the necessary knowledge base to succeed during times of rapid automation.

To ensure Canadians are prepared to meet the growing demands of autonomous and connected vehicle development, the government must support STEM educational programming and initiatives across the country, with a specific focus on engineering.

Recommendation #2: Federal support for paid post-secondary engineering co-operative placements
Across Canada, there is a growing need to replace retiring engineers, particularly in the civil, mechanical, electrical, electronic, and computer engineering disciplines.[9] In the engineering labour market in Canada, approximately 37,000 professional engineers will retire between 2015 and 2019; 23,000 between 2018 and 2020; and over 64,000 between 2018 and 2025.[10] With the increasing demand for qualified and experienced engineers within the automated and connected vehicles sector, it becomes vastly important for paid post-secondary engineering co-operative placements to be supported.

Supporting the transition of experienced post-secondary co-operative engineering graduates into the engineering profession will allow young Canadians to catch-up more quickly to mid-career professionals, allowing for mid-career professionals to progress to more senior roles that will have been vacated by retired engineers. This will be paramount in supporting the reduction of a potential skills gap in the engineering profession during a period of increased demand.

With only 24 post-secondary institutions offering engineering co-operative placements, and only five of those institutions offering mandatory engineering co-operative placements, it becomes clear that the federal government must work with the engineering profession and post-secondary institutions across Canada to support the development of paid post-secondary engineering co-operative placements in institutions where they do not currently exist. Paid engineering co-operative placements are crucial in easing the economic burden that young Canadians may face when entering the labour market.

A first step is to adjust the Canadian Youth Employment Strategy to promote engineering career-focused programs that are affiliated with federal departments and agencies. Currently, the Youth Employment Strategy focuses on connecting young individuals to science and technology programs and initiatives, leaving engineering initiatives all but forgotten.

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[9] Engineers Canada (2015). "Engineering Labour Market in Canada: Projections to 2025." Retrieved May 16, 2018, from: https://engineerscanada.ca/sites/default/files/Labour-Market-2015-e.pdf.

[10] Engineers Canada (2015). "Engineering Labour Market in Canada: Projections to 2025." Retrieved May 16, 2018, from: https://engineerscanada.ca/sites/default/files/Labour-Market-2015-e.pdf.

Recommendation #3: Federal funding on workforce research for the engineering profession
Engineering careers are vast and versatile. Indisputably, the unbiased professional expertise of the engineering profession will be required to transform and advance the automated and connected vehicle industry within Canada. With an increasing demand for engineers to enter into the automated and connected vehicle labour market in the coming years, mixed with the growing retirement rate of engineers across Canada, it becomes imperative for the federal government to work collaboratively with the engineering profession to promote initiatives to attract and retain previously untapped talent pools within the profession; specifically, women and Indigenous peoples.

Women make up more than half of the Canadian population yet comprise less than 13 percent of practising licensed engineers in Canada, and only 20 percent of undergraduate engineering students. Indigenous peoples account for four per cent of the Canadian population, yet it is believed that they make up less than one percent of both the profession and undergraduate students in engineering studies. Although all Canadians have the same opportunities to enter engineering, accessibility and feasibility are not the same for all demographics; largely due to systemic barriers that disproportionately impact underrepresented groups. Facilitating the entry and retention of women and Indigenous peoples into the engineering profession will be imperative to meet the rising demand for skilled engineering labour in this advancing technological field. Having diverse opinions, experiences, and backgrounds will enhance innovative thinking within the automated vehicle sector in Canada. Leveraging the best talent from all parts of society will add value to employers, increase the production of creative solutions to complex problems, and provide deeper understanding of societal needs.

For this reason, Engineers Canada recommends that the federal government support workforce research funding that targets the engineering profession to uncover the reasons why higher numbers of women and Indigenous peoples are not entering the profession. The government and the engineering profession must work together to be proactive in building the relevant talent base that is needed to meet the future demands of the automated and connected vehicle labour market. Doing so will allow us to smoothly and easily serve the needs of tomorrow.

Who we are

Engineers Canada is the national organization of the 12 provincial and territorial associations that regulate the practice of engineering in Canada and license the country's 290,000 professional engineers. Together, we work to advance the profession in the public interest.

Engineers drive much of Canada's economy. Natural resources, manufacturing, transportation infrastructure, technology and other sectors rely on the capability of engineers. As one of the top five exporters of engineering services in the world, the expertise of Canada's engineers contributes to both the Canadian and international economy.