

THE ENGINEERING PROFESSION'S POSITION

- The development of artificial intelligence engineering technology in autonomous and connected vehicles requires the unbiased, evidence-based advice and professional expertise of engineers in Canada.
- Engineering regulators in Canada exist to protect the public. They set high professional and ethical standards, establish and maintain codes of conduct, and administer regulatory processes for engineers to ensure protection of the public and the natural environment.
- Incorporating engineers' accountability into federal legislation and regulations surrounding artificial intelligence engineering technology in autonomous and connected vehicles weaves the engineering regulatory process into the fabric of government and works to keep Canadian consumers safe.
- Maximizing the potential benefits of artificial intelligence engineering technology with respect to artificial intelligence in autonomous and connected vehicles while minimizing the associated safety and economic risks requires the development of standards and regulatory processes by engineers.

The challenge(s)

Artificial intelligence, autonomous capacities, and connected engineering technology have received extensive attention in recent years. The definition of artificial intelligence has many variations as different entities define it in different ways; there is no universally accepted definition for artificial intelligence. Put simply, artificial intelligence is a developed engineering technology that uses algorithms and unique software to emulate and, in some cases, improve on human thoughts and performances such as learning, problem-solving, perceiving, and reasoning.¹ The application of artificial intelligence is widespread throughout Canadian society; specifically, in autonomous and connected vehicles.

Autonomous capacities and 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. The development of artificial intelligence includes the work of multi-disciplinary teams that include various engineering disciplines such as software, electrical, and mechanical, among others.

The potential benefits of artificial intelligence in autonomous and connected vehicles in Canadian society are vast. Autonomous and connected vehicles have

promised to increase highway safety and reduce traffic congestion for better use of consumer time, all while improving traffic pollution, energy use, comfort, and accessibility for commuters. Autonomous vehicles have promised to cause fewer vehicle collisions and have promised to mitigate human errors through artificial intelligence capabilities, advanced algorithms, and engineering technologies.

Although there are several identified benefits to autonomous and connected vehicle engineering technology in Canada, these promises are largely uncertain and come with their own challenges and public safety concerns. A significant concern surrounding this engineering technology is the issue of accountability and liability; legal, moral, and ethical questions regarding the use of this technology have yet to be addressed. Consumers across Canada remain hesitant to use unproven technology on a regular basis and remain concerned about the possible unreliability of autonomous vehicle technology when faced with an emergency. This concern has demonstrated validity given the performance of early autonomous systems in motor vehicles and related accidents.²

Aerospace engineering has significant experience with the integration of human operators with semi-automated systems that suggests the early implementation of such systems will result in accidents that identify problems with the human-machine interface. Similar problems with

semi-autonomous vehicles are beginning to appear. The engineering profession is well-placed to make use of this past learning to mitigate risks as the technology is integrated with motor vehicles.

Gaining the benefits of this engineering technology for Canada and mitigating the risks, especially safety and economic risks, is contingent on the development of standards for the application of artificial intelligence with respect to its use in autonomous and connected vehicles and furthering the development of associated regulatory processes.

Finally, at present, there does not appear to be a thorough understanding that there is an urgent need to introduce comprehensive government policies and standards to regulate the application of artificial intelligence to devices and equipment that will have an impact on humans. Leaving this to the will of the associations of organizations engaged in the development of artificial intelligence for societal applications will lead to regulatory capture that will not serve the public interest.

Engineers Canada believes that it is vital for the federal government to be progressive and proactive in its approach to upholding public safety, the natural environment, and the economy. With the increasing demand for artificial intelligence and autonomous vehicle technology in Canada, there has, and will continue to be, a rising demand for engineers working in this industry. The development of artificial intelligence within autonomous vehicles in Canada will require the unbiased, strategic, and professional expertise of the engineering profession.

How Engineers Canada has contributed

The reality is that the engineering technology within autonomous and connected vehicles in Canada requires further investigation and research and must comply with federal and provincial vehicle safety standards. The need for engineers in Canada has never been greater; specifically, with the rise of public safety concerns around the rapid development of artificial intelligence. To uphold public safety, while upholding public confidence and accountability in artificial intelligence in autonomous vehicles, engineers must be consulted and included in major federal decisions that require engineering work. Further, they must be an integral part of the development and administration of such standards.

In 2016, the total number of engineers and skilled workers within the autonomous and connected vehicle industry in Canada was approximately 213,000³. 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 2021⁴. Mechanical engineers will be required to design and build necessary parts of autonomous vehicles and civil engineers will be needed to conceptualize transportation and public infrastructure to support autonomous and connected vehicle technology. Software and electrical engineers will be required to develop, maintain, and refine artificial intelligence technology for use within autonomous and connected vehicles, as well as manage the cloud computing systems that transmit information.⁵ In essence, fully integrated engineering teams will be essential to the successful design, development, and deployment of autonomous and connected vehicles.

Engineers Canada strongly believes in the importance of demand-side legislation; that is, legislation or regulations that require the certification of projects and work by an engineer. Engineers Canada participates in consultations on legislation and regulations that impact the work that engineers do, and address activities that could involve engineering work; specifically, in relation to the development of artificial intelligence in autonomous and connected vehicles.

In addition, Engineers Canada, in collaboration with the provincial and territorial engineering regulators, developed a white paper on professional practice in software engineering. Software associated with artificial intelligence in autonomous and connected vehicles meets the conditions of an engineering work as there is a reasonable expectation that failure or inappropriate functioning of the system would result in harm to life, health, property, economic interests, the public welfare, or the environment.⁶ The purpose of this white paper is to provide information and guidance to the engineering regulators regarding the discipline of software engineering. It is intended to help enforcement and compliance officials identify software engineering practice that should be regulated—where it is reasonable to expect that an engineer is taking professional responsibility for the work. To protect the public and to prevent unqualified software development practitioners from assuming the responsibilities or the titles of software engineer, regulators need an understanding of the scope of regulated practice in software engineering. This software engineering white paper provides a framework within which software for autonomous and connected vehicles must be developed. It establishes criteria in which economic and safety risks must be managed.

Engineers Canada will continue to work with key federal departments to ensure that the value and benefit of

having engineers involved in the development of artificial intelligence in autonomous vehicles is recognized by Canadians.

Recommendations to the federal government

The federal government should continue to invest in partnerships to establish Canada as a global leader in cybersecurity and automotive software for autonomous and connected vehicles.⁷

The federal government must continue to recognize that the Canadian public is best served when the jurisdiction of the provincial and territorial engineering regulators is recognized and respected, and when it is acknowledged that provincial and territorial governments have delegated the authority to regulate the engineering profession to these 12 regulators.

Provincial and territorial regulators consistently strive to ensure that their admissions and licensing practices are timely, transparent, objective, impartial, and fair. Provincial and territorial regulators also set high professional and ethical standards, establish codes of conduct, and support and oversee the practice of professional engineering to ensure protection of the Canadian public. The engineering regulators and the profession are ready and willing to work collaboratively with the federal government.

The federal government should:

- Ensure that engineers in Canada are consulted in the development of artificial intelligence associated with autonomous and connected vehicles.
- Establish standards and frameworks on the development, maintenance, and use of autonomous and connected vehicle technology in Canada.
- Ensure that any legislation or regulations that refer to engineering work in the development of artificial intelligence or autonomous vehicle technology require the involvement of an engineer in accordance with provincial and territorial engineering acts.
- Ensure that there is a legislative requirement that individuals involved in the development of artificial intelligence and autonomous vehicle technology be engineers who are licensed to do so, thereby encouraging compliance with professional regulatory legislation.

How Engineers Canada will contribute

Engineers Canada will:

- Work with key federal departments to ensure that the value and benefit of having engineers involved in the development of artificial intelligence in autonomous vehicles is recognized by Canadians.
- Work with engineers in the public service to promote the value of appropriate professional involvement in the development of artificial intelligence in autonomous vehicles.
- Monitor the government agenda, legislative initiatives, and proposed regulations to bring recommendations on artificial intelligence in autonomous vehicles to the attention of government.
- Promote the awareness of engineering matters associated with artificial intelligence technology in general and as it applies to autonomous and connected vehicles as part of engineers fulfilling their annual professional development and competency activities.

1 Davenport, T., and Ronanki, R. (2018). "Artificial Intelligence for the Real World." Retrieved July 10, 2018 from: <https://hbr.org/2018/01/artificial-intelligence-for-the-real-world>.

2 For example, refer to National Transportation Safety Board (2019) investigations: HWY16FH018, HWY19FH008, HWY18FH011. Retrieved June 4, 2019 from: <https://www.nhtsa.gov/investigations/AccidentReports/Pages/HWY19FH008-preliminary-report.aspx>

3 Information and Communications Technology Council (2017). "Autonomous vehicles and the future of work in Canada." Retrieved May 15, 2019, from: <https://www.ictc-ctic.ca/wp-content/uploads/2018/01/ICTC-Autonomous-Vehicles-and-The-Future-of-Work-in-Canada-1-1.pdf>.

4 IBID

5 IBID

6 Engineers Canada (2016). "White Paper on Professional Practice in Software Engineering." Retrieved February 27, 2019, from: <https://engineerscanada.ca/publications/white-paper-on-professional-practice-in-software-engineering>.

7 PMO News Release February 15, 2019 "Investment in automotive innovation to make vehicles safer a create jobs for Canadians" Retrieved February 15, 2019, from: <https://pm.gc.ca>