Artificial Intelligence Engineering Technology in Autonomous and Connected Vehicles

The engineering profession's position

- The development of artificial intelligence (AI) engineering technology in autonomous and connected vehicles requires the unbiased, evidence-based advice and professional expertise of engineers in Canada.
- Maximizing the potential benefits of AI engineering technology with respect to autonomous and connected vehicles while minimizing the associated safety and economic risks requires the development of standards and regulatory processes by engineers and the contribution of engineers' knowledge toward the use of AI tools for problem-solving and technical solutions.
- Incorporating engineers' accountability into federal legislation and regulations surrounding AI engineering technology in autonomous and connected vehicles keeps the engineering regulatory process woven into the fabric of government and keeps Canadian consumers safe.

The challenge(s)

AI, autonomous capacities, and connected engineering technology have received extensive attention in recent years. While the accepted definition of AI continues to evolve, one way of understanding AI is that it is a developing 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 AI is widespread throughout Canadian society, and has become a transformative element within many industries, including transportation. For vehicle engineering, AI is the backbone that integrates and enables vehicle connectivity (e.g., vehicle-to-vehicle, vehicle-to-infrastructure, and vehicle-to-everything communication), autonomous driving, and mobility solutions, such as mobility-as-a-service.

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. As the technology evolves further and societal expectations for safety and efficiency increase, demand for vehicles with autonomous, "self-driving" capabilities will increase in Canada. The development of AI includes the work of multi-disciplinary teams that include various engineering disciplines such as software, electrical, and mechanical, among others.

Although there are several identified benefits to autonomous and connected vehicle engineering technology in Canada, including fewer collisions, improved energy use, and reduced GHG emissions, the technology carries uncertainty and raises concerns for public safety. A significant concern surrounding this engineering technology is the issue of accountability and liability; novel legal, moral, and ethical questions regarding the use of this technology routinely emerge, leading to

[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.

a need for caution in the adoption and deployment of the technology. 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] However, expanding the use of AI technology in autonomous and connected vehicles may also help law enforcement efforts to reduce car theft, and could enhance the confidence that drivers have in the safety and security of their vehicles. Engineering expertise will be essential in designing autonomous anti-theft systems. Engineers Canada believes that it is vital for the federal government to be proactive in its approach to upholding public safety, the natural environment, and the economy. With the increasing demand for AI and autonomous vehicle technology in Canada, there has, and will continue to be, a rising demand for engineers working in this industry to ensure that public safety is upheld. The development and implementation of AI within autonomous vehicles in Canada will require the unbiased, strategic, and professional expertise of the engineering profession. This includes ensuring that only engineers who are licensed in the Canadian jurisdiction where their engineering work is taking place are performing engineering work.

For example, aerospace engineers hold significant expertise in the integration of human operators with semi-automated systems. Accidents that occurred during the early implementation of such systems helped to identify problems with the human-machine interface. Similar problems with semi-autonomous vehicles are beginning to appear, and are likely to be even more pronounced as highly and fully automated vehicles become available for purchase in the coming years. The engineering profession is well-placed to make use of this past learning to mitigate risks as the technology is integrated with motor vehicles. Engineers will be especially well-placed to provide solutions for the feasibility of using autonomous, connected and electric vehicles in winter weather conditions. Road conditions vary widely with weather and are more dangerous in Canadian winters than in US jurisdictions where autonomous and connected vehicles have been widely adopted. This challenge is especially pronounced when discussing the integration of AI technologies into vehicles that were designed and manufactured in another country.

How Engineers Canada has contributed

To uphold public safety, while upholding public confidence and accountability in AI 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.

Engineers must be involved in the design, building and integration of the necessary parts of autonomous vehicles as well as conceptualizing transportation and public infrastructure to support autonomous and connected vehicle technology

Engineers Canada, in collaboration with the provincial and territorial engineering regulators, developed a white paper 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

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

expect that an engineer is taking professional responsibility for the work. Software associated with AI 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.[3] Engineers Canada also developed a National Position Statement that outlines the conditions under which a piece of software can be considered an engineering work, and how such work should be regulated.[4] AI deployed for autonomous and connected vehicles will often meet these conditions, particularly in the case of fully automated or connected vehicles in the future. .

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 AI in autonomous vehicles is recognized by Canadians.

Recommendations to the federal government

While it is positive that the federal government has taken multiple measures to support the expansion of automated and connected vehicle technologies in Canada, its current efforts have been focused on setting the conditions for their testing and use.[5] While these guidelines encourage organizations to engage with municipal governments, they make no reference to the need for the involvement of engineers accountable to a provincial or territorial engineering regulator. In Canada, engineers and regulators should play a bigger, if not pivotal, role in addressing the risks. Their expertise and accountability are vital for unbiased, evidence-based decision-making, ensuring that AI technology for use in autonomous and connected vehicles is developed and utilized in the best interest of the public.

Standards and regulatory processes developed by engineers can contribute to addressing safety concerns and realizing the benefit of this technology. In Canada, engineers should play a pivotal role in addressing the various risks associated with the integration of AI in autonomous and connected vehicles. These risks can be regrouped in a few fields where engineers should be involved, such as:

- Safety and reliability, including validation and testing.
- Cybersecurity vulnerabilities, including AI systems as targets and preventing malicious use.
- Ethical and bias concerns to reduce unfair or unsafe outcomes driven by algorithmic bias.
- Legal and liability issues, including helping to determine responsibilities when complex incidents occur, and clarifying regulatory challenges.
- Human-machine interaction, including transitioning control back to a human driver during emergencies and designing for potential driver complacency.

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.

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[3] Engineers Canada (2023). "Engineers Canada Paper on Professional Practice in Software Engineering." Retrieved February 27, 2024, from: https://engineerscanada.ca/guidelines-and-papers/engineers-canada-paper-on-professional-practice-in-software-engineering

[4] Engineers Canada (2022). "Professional Practice in Software Engineering." Retrieved February 29, 2024 from https://engineerscanada.ca/sites/default/files/public-policy/professional-practice-software-engineering-en.pdf

[5] Government of Canada (2021). "Guidelines for Testing Automated Driving Systems in Canada." Retrieved February 29, 2024 from https://tc.canada.ca/sites/default/files/2021-09/automated_driving_system_report_en.pdf

The engineering regulators and the profession as a whole are ready and willing to work collaboratively with the federal government.

The federal government should:

- Ensure that federal programs supporting the development of AI for autonomous and connected vehicles require the involvement and consultation of an engineer in accordance with provincial and territorial engineering acts.
- Continue working with industry and regulators to develop standards and frameworks on the development, maintenance, and use of autonomous and connected vehicle technology in Canada.

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 and utilization of AI 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 and utilization of AI in autonomous vehicles.
- Monitor the government agenda, legislative initiatives, and proposed regulations to bring recommendations on AI in autonomous vehicles to the attention of government.
- Promote the awareness of engineering matters associated with AI technology in general and as it applies to autonomous and connected vehicles as part of engineers fulfilling their annual professional development and competency activities.