Connected and autonomous vehicles in Ontario
Implications for the insurance industry
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Executive summary

The transition to widespread adoption of connected and autonomous vehicles (CV/AVs) is underway in Ontario. Researchers estimate that about two-thirds of vehicles in Canada currently have some connectivity (i.e., embedded telematics); by 2022, approximately 70% – 95% of new cars in Canada will have vehicle to infrastructure (V2I), vehicle to vehicle (V2V), and other telecommunications capabilities (e.g., vehicle to smartphone).\(^1\) Currently, vehicles available to consumers are primarily Level 1 or 2 automation (see Figure 1).\(^2\) While a number of major manufacturers plan to launch autonomous passenger cars in the next year, consensus in the literature is that deployment of Level 4 or 5 vehicles on public roads will not be commonplace until the 2030s or 2040s.\(^3\) In fact, major auto-manufacturers including Ford and GM have indicated their first autonomous fleets will be dedicated to commercial operations.\(^4\)

*Figure 1 - SAE Automation Levels for Connected and Autonomous Vehicles*\(^5\)

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knowledge, and areas requiring further investigation. This research reinforces Ontario’s position as a North American leader in transformative automotive technologies, as well as transportation and infrastructure systems. Filling these important research gaps and making the research public will support Ontario’s innovation ecosystem and enable it to capitalize on the opportunities presented by the projected mass adoption of CV/AVs in the decades to come.

**Context, key themes and implications for Ontario**

Connected and autonomous vehicles generate or transfer data through two primary channels: telematics and “infotainment systems.”\(^6\) Telematics systems employ sensors to detect vehicle operations and condition, driver behaviour, driver location, and related data and can connect with other systems (e.g., emergency or roadside assistance) to transmit this information.\(^7\) Infotainment systems transfer information back to the driver and / or passengers, including navigation, traffic, weather, or entertainment (e.g., audio streaming). This can be done by connecting the vehicle directly to the internet or by pairing with the driver’s mobile device.\(^8\)

Uncertainty around the pace and scope of transition to fully autonomous vehicles means that a number of “future states of mobility” might co-exist over time, depending on two major forces: the extent to which autonomous vehicle technologies become widely adopted and the extent to which vehicles are personally owned, commercially owned or shared. During the transition (over the next ten to twenty years), personally owned and shared, partially automated and fully automated, and somewhat connected to fully connected vehicles will co-exist. Twenty-five or more years in the future, Level 4 and 5 autonomous vehicles will be common as part of a personalized and integrated set of mobility options (including trains, bicycles, etc.) available to travellers.

These transition and end states frame a number of key findings related to the emerging state of connected and autonomous vehicles in Ontario and the implications for insurance:

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\(^8\) Ibid.
Auto insurance premiums are expected to decrease over the long term as connected and autonomous vehicles become more common. In the near to medium term, however, premiums may increase. Premiums could decline due to a range of factors, primarily the relative increase in vehicle safety and the number of personally owned vehicles on the road. Many experts predict a decrease in total number of personally owned vehicles on the road due to the efficiencies of car sharing and ride sourcing, though this is uncertain. The number of vehicles or the vehicle kilometres travelled might actually increase as personalized mobility becomes an attractive option.

Autonomous vehicle technologies are expected to reduce the number of collisions / loss events, with the Insurance Institute of Canada predicting an 80% reduction in auto insurance claims over the next 25 years. Premium prices will begin to reduce as evidence of improved vehicle safety accumulates and risk can be accurately priced. As ride sourcing and / or car sharing transportation options become increasingly common, enabled in part by CV/AV advancement, the number of personally owned vehicles will likely decrease. As result, demand for personal auto insurance products may decline, placing downward pressure on insurance premium revenues. In the near to medium term, however, some insurance experts predict that premium price and revenue reduction may be offset by an increased average costs per claim. Autonomous vehicle technology (e.g., sensors and telematics) is currently very expensive to replace in the event of a collision resulting in an initial increase in average cost per claim. Some insurers estimate that 25-50% of vehicles would have to be equipped with forward-collision prevention systems before collision rates decline enough to offset the elevated costs per claim associated with damaged electronic components. Note that 20 global automakers have already committed to making automated emergency braking (AEB) standard by 2022.

Implications for Ontario: Insurance companies in Ontario will need to proactively prepare for the projected decline in premium revenues. The firms that effectively adjust their strategies to serve the evolving mobility ecosystem will be best positioned for success. This projected decline in premiums may, however, benefit Ontario consumers by reducing the financial burden associated with owning and / or operating a vehicle.

9 Automated Vehicles; Implications for the Insurance Industry in Canada (2016). The Insurance Institute of Canada
10 Insuring the Future of Mobility (May. 2016). Deloitte.
11 Automated Vehicles; Implications for the Insurance Industry in Canada (2016). The Insurance Institute of Canada
12 “To be or not to be” is no longer the question - Insurers confront the “when” and “how” of uneven transition as mobility preferences and capabilities evolve (2017). Deloitte
14 Manufacturers make progress on voluntary commitment to include automatic emergency braking on all new vehicles (Dec. 2017). Insurance Institute for Highway Safety Highway Loss Data Institute
Access to telematics data could allow insurers to more accurately process claims and detect fraud in the event that a collision does occur.

CV/AVs will contain an array of complex sensors (or telematics) that have the ability to monitor and record vehicle activity data. Access to this data presents a significant opportunity for insurance companies. By utilizing analytics to analyze loss event data, insurers would be able to effectively identify the source of operational failure and more accurately assess the determination of fault, leading to a more efficient claims resolution process. This increased access to vehicle data would also allow insurers to accurately assess claim validity thus reducing occurrences of auto insurance fraud.

Implications for Ontario: In Ontario, fraudulent claims were estimated to amount to $770 million - $1.6 billion in excess payments in 2010. In 2017, almost 20% of Ontarians surveyed knew a friend who had made an exaggerated or false auto insurance claim. Access to data from autonomous vehicles could accelerate claims processing and resolution for Ontarians and significantly reduce occurrences of insurance fraud in Ontario.

Significant changes to underwriting tools and methodologies are expected as autonomous vehicles become more common. Telematics data obtained from CV/AVs is considered to be more reliable than driver-reported information and should allow underwriters to more accurately assess risk profiles and determine CV/AV premiums. Underwriters will be required to quantify the reduction in collision risk by analyzing comprehensive CV/AV data sets. As a result, underwriters will need to build out their analytic and technical capabilities (e.g., hire employees with strong analytic experience) and increase focus on personalizing the customer experience.

Implications for Ontario: Regulators and other government agencies will be considering how best to govern CV/AV data privacy, access and ownership. Insurers in Ontario will need to closely monitor the development of these regulations while also beginning to build out new underwriting capabilities. Insurer focus should be on building analytic and AI technology expertise through external hiring and specialized training for existing staff, as well as on strengthening customer service skills to deliver a differentiated customer experience.

As connected and autonomous vehicles become increasingly common, loss liability is expected to shift from the vehicle operator to the

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16 Estimates for the U.S. indicate that every incremental 10 percent reduction in fraudulent claims could mean up to USD $800 million in industrywide savings. Figures are not available for Ontario but the impact is likely to be comparable.
17 Autonomous Vehicles: Considerations for Personal and Commercial Lines Insurers (2016). Munich RE
18 Ibid.
manufacturer / manager of the CV/AV technology. Assigning liability for initial CV/AV models will likely hinge on whether the collision was caused by the driver component / product malfunction or communication error. During the transition phase, connected and autonomous vehicle and component manufacturers, software developers, vehicle operators / owners (either private or commercial), and mobility management / fleet operators may all bear some liability exposure. As customer acceptance of autonomous technology grows and vehicles transition from partially to fully autonomous capabilities, loss liability will generally shift from the vehicle operator to the manufacturer/manager of the CV/AV technology, resulting in a likely increase in demand for commercial and product liability insurance.

Implications for Ontario: Current liability and fault determination regulations in Ontario are comprehensive but may need to be updated to better apply to CV/AVs. The Ontario government will benefit from collaborating with insurers, auto-manufacturers, and other mobility ecosystem stakeholders, as well as sharing learning and progress with government bodies and regulators in other jurisdictions (such as California) to determine how to regulate CV/AV liability and fault determination. Consideration for Ontario’s context as a common law jurisdiction and the application of existing and new case law to questions of liability will be an equally important input to new regulations or standards.

The transition towards autonomous vehicles is expected to cause shifts in the competitive landscape for insurance. Non-traditional competitors are expected to enter and disrupt the market. Key stakeholders such as auto-manufacturers, technology companies, ride sourcing firms and car sharing companies may perceive shifts in the mobility ecosystem as a valuable opportunity to gain market share and begin to offer their own insurance products. Experts predict that there will be widespread consolidation across the insurance industry. Larger, more technologically advanced insurers will benefit from large cash reserves that will allow them to insure larger, commercial customers. Revenue received from these large contracts may partially offset the projected decline in premium revenues for these insurers. To manage the uncertainty associated with the AV market, insurers can partner and / or build relationships with relevant stakeholders in other sectors such as technology, OEM / auto manufacturing, and government to co-develop strategic, autonomous vehicle related initiatives.

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19 Ibid.  
20 Automated Vehicles; Implications for the Insurance Industry in Canada (2016). The Insurance Institute of Canada  
21 Automated Vehicles; Implications for the Insurance Industry in Canada (2016). The Insurance Institute of Canada  
23 Insuring the Future of Mobility (May 2016). Deloitte.
Implications for Ontario: Insurers in Ontario face the same shifting landscape as other jurisdictions and could begin thinking about their value add for potential partners. Regulators will need to consider whether controls are required to maintain consumer choice as insurers increasingly develop exclusive partnerships with automakers and other providers or embed coverage in bundled products (e.g., customer transparency).

The increased adoption of ride sourcing and car sharing platforms (such as Uber, Lyft and ZipCar) will drive a shift in insurance products and services. Stakeholders across the mobility ecosystem (including auto-manufacturers) are developing a range of ride sourcing, car sharing, or hybrid capabilities, in response to increased demand for holistic mobility management. An increase in shared vehicle ownership, likely in the form of large vehicle fleets available for ride sourcing or car sharing, could result in a decline in vehicle production and personal vehicle ownership and will impact the auto insurance market in the following ways: 24

- Demand for personal auto insurance is expected to decrease
- Demand for commercial insurance is expected to increase
- Claims processing complexity and liability / fault determination is expected to shift

Insurers will need to adapt to these shifts by building out cross-sector relationships and developing products tailored towards the shared autonomous vehicle market.

Implications for Ontario: Ontario’s insurers will look to meet new market demands by shifting their product offering mix (e.g., commercial insurance for auto-manufacturers operating new AV or shared vehicle fleets, cyber security insurance, increased emphasis on product liability insurance) or by building or leveraging partnerships with mobility service providers to offer bundled products (e.g., shared vehicle subscriptions with insurance included). Insurers will need to work with regulators to enable responsible innovation in products and partnerships.

While demand for traditional auto insurance products will decline, insurers have the opportunity to develop and promote a range of new product offerings and delivery channels that satisfy evolving customer demands. Demand for traditional auto insurance products such as driver liability and collision coverage is expected to decline as liability shifts away from the driver and as collision risk decreases due to increased vehicle safety. Commercial customers may increasingly look to protect against the increased risk exposure

24 The Driverless, car-sharing road ahead (Jan 2016). The Economist
associated with CV/AV operation. Insurance companies have the opportunity to introduce a range of product offerings to address this shift in consumer and commercial demands, including autonomous vehicle product liability insurance, cyber security insurance, infrastructure insurance and fleet operation liability insurance.

Auto insurance can also be delivered through different channels to align with evolving customer needs. Insurance companies have a number of options for new delivery methods, including subscription, usage based or pay-per-use models. Subscription-based models, where auto-manufacturers offer monthly subscription car “bundles” that typically include the vehicle, insurance and maintenance services, and Usage-Based Insurance (UBI) are emerging models might be delivered by insurance companies or by mobility management providers.25

**Implications for Ontario:** Insurers in Ontario have started to develop new products and channels to accommodate an increasingly digital market and shifting models of ownership (e.g., Intact and Aviva’s ride sourcing insurance policies). The current regulatory framework, however, may present barriers to further innovative product development and delivery (e.g., pay-per-mile insurance) that need to be addressed so the province can compete.

**Insurance companies have the opportunity to help smooth the transition towards connected and autonomous mobility.** The transition period in which fully and semi-autonomous vehicles may share the road with standard vehicles will place strain on the current transportation system, with the need to accommodate a range of vehicle capabilities, risk levels, and technological needs. Insurance companies can work with governments, auto-manufacturers and other key stakeholders (especially at CV/AV testing sites such as the Autonomous Vehicle Innovation Network Demonstration Zone) to encourage the adoption of autonomous vehicles and accelerate the transitionary period.

**Implications for Ontario:** As discussed, autonomous vehicle testing sites (such the Autonomous Vehicles Innovation Network demonstration zone in Stratford, Ontario) will act as collaboration “hubs” for insurers, government bodies, auto-manufacturers and other key stakeholders to collaborate on strategic CV/AV initiatives that enable a smooth transition for the transportation sector in Ontario. Strategies may differ by region depending on vehicle ownership patterns, access to other modes of transportation, and consumer preferences.

**Federal, provincial and municipal governments will play a key role in ensuring the effective development and adoption of autonomous vehicles**

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25 A mobility management provider is “a transportation organization serving the general public that responds to and influences demands of the market by undertaking actions and supportive strategies, directly or in collaboration with others, to provide a full-range of options to the traveller”. Source: Mobility Management. (Oct 2009). AARP Public Policy Institute.
Through regulatory action. To date, there has been limited legislation developed on how to regulate the control, operation and insurance of autonomous vehicles, though the Ontario Government’s AV pilot program is a first step. Insurers, industry associations, and insurance experts have expressed that legislative and regulatory updates are needed to reflect the particular context of connected and autonomous vehicles. Federal, provincial, and municipal governments all have a role to play in ensuring safety, data access and privacy, and an effective auto insurance industry.

Implications for Ontario: Ontario insurers report that the current regulatory framework could be adjusted to better apply to CV/AV technologies. The provincial government could look to other jurisdictions for models that have introduced flexible and responsive regulatory practices and have made data open and accessible in the initial development phases of this ecosystem. The provincial government could also participate and learn from CV/AV testing zone initiatives and results to inform policy and potential regulatory development based on near-real world scenarios.

AV regulation in global jurisdictions has focused on safety; while initial policy discussion in the U.S. and Australia has touched on insurance, AV insurance regulation is still undefined globally. The U.S. National Highway Traffic Safety Administration (NHTSA) recently released “Automated Driving Systems 2.0”, a document providing voluntary guidance to industry, with consideration for the need to allocate liability to vehicle owners, operators, passengers, manufacturers and other entities when a collision occurs. The NHTSA has focused on these guidelines rather than on developing autonomous vehicle insurance regulations. States such as Michigan and Arizona have been liberal in their approach to autonomous vehicle regulation in an effort to encourage technological advancement and economic activity. California, on the other hand, has opted for rigorous and transparent testing and reporting requirements. Australia has also been active in reviewing their legislative and regulatory framework to prepare for and enable connected and autonomous vehicles and related infrastructure, including the suitability of existing legislation regarding liability and driver control.

Implication for Ontario: As demonstrated above, Ontario is not alone in needing to further explore this space. Ontario researchers and academics working in the field of connected and autonomous vehicles have strong relationships with their American counterparts, mirrored by dialogue between provincial and state governments and information-sharing between municipalities. As global jurisdictions, including those with similar structures, similar environments, or shared borders with Ontario, continue to advance research in this space, the

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ontario government and research community should continue to engage with the results and analyze how they might apply to the ontario context (e.g., the benefits of harmonizing cv/av regulation across borders).

**insurers will have to account for an array of ethical considerations as they continue to develop their autonomous vehicle strategy.** all cv/av stakeholders will have to address key ethical considerations surrounding pre-programmed av decision making (specifically in collision events), data privacy and data reporting. insurance companies will likely use decisions on pre-programmed av decision making to determine new liability frameworks and should be involved in early discussions. with respect to data privacy, insurers will need to ensure compliance with data privacy regulation as a baseline and go above and beyond to assure clients of the privacy and security of their data. key stakeholders will also need to address ethical concerns surrounding the data that they choose to report to legislators / insurers when determining collision liability.

**implication for ontario:** ontario regulators should incorporate key ethical concerns such as autonomous vehicle decision making in any legislative, regulatory or policy framework and should consider whether existing data privacy frameworks need to be further customized to the cv/av context.

**gaps in the research and recommended areas for further analysis**
while this report offers a comprehensive look at what is known about the implications of connected and autonomous vehicles on insurance, the report outlines a number of key areas where further research might further clarify this topic, particularly for the ontario context. opportunities are classified, depending on whether organizations should prioritize laying the groundwork in the given area now, monitoring the evolution of the topic before acting, or investing in understanding the gap and its implications over the long-term.

**areas to address now to enable future success**

*positioning for long-term success (recommendation 1):* insurers could analyse how near-term opportunities such as the projected short-term increase in premium revenues might best be positioned (e.g., re-investment in r&d initiatives) for long-term success.

*understanding the impact on premiums (recommendation 2):* through engagement with key stakeholders in the mobility ecosystem (such as auto-manufacturers and fleet operators), ontario insurers could more precisely understand and model the impact of cv/av development on premiums, specifically with respect to the pace of transition to greater levels of vehicle connectivity and automation.
Reviewing the policy for claims resolution (Recommendation 4): The federal and provincial government could include insurers in policy discussions on CV/AV data privacy regulations, specifically as they relate to the claims resolution process, so that any new or amended frameworks appropriately balance consumer privacy with innovation in insurance.

Defining data needs and developing the required data infrastructure (Recommendation 5): In order to obtain relevant data from OEMs / 3rd parties, insurers and their relevant delivery partners (e.g., police and investigators) will need to understand and define what data is important and develop the infrastructure required to analyse it for underwriting, claims processing and other business purposes.

Understanding CV/AV liability and fault determination (Recommendation 7): The Ontario government could continue to engage with insurers, auto-manufacturers and government bodies in other jurisdictions (such as California) to understand relevant considerations and model options for CV/AV liability and fault determination.

Developing CV communication standards (Recommendation 9): Government bodies, network providers, infrastructure operators and other key stakeholders could collaborate on the development of V2V, V2I and I2V communication standards and regulations that provide clarity on collision liability for connected vehicles.

Learning from the U.S. and Australia’s approaches (Recommendation 21): Identify key issues and lessons learned from the United States’ approach to AV regulation and Australia’s regulatory reform initiative to inform similar ongoing or to-be initiated projects in Ontario.

Areas to monitor over the near-term as the industry evolves

Skills gaps and talent strategy (Recommendation 3): Insurers could identify data analysis capability needs and current internal skills gaps to inform talent development strategies and capitalize on the potential for business process improvements such as enhanced claims processing and risk assessment.

Required training / education for the new insurance landscape (Recommendation 6): Industry associations, the provincial government, academia and other stakeholders could coordinate to identify what educational / training programs are needed to train or re-train a robust talent pool for insurers and related industries.

Analyzing coverage mix options (Recommendation 8): Auto-manufacturers, mobility management firms and other key stakeholders could assess the advantages and drawbacks of various coverage options in an environment in
which liability has shifted away from the driver and/or passenger towards commercial entities.

**Factors to succeed in the evolving industry (Recommendation 12):** Insurers could conduct an assessment of the Ontario insurance landscape, including key strengths and competitive advantages, to help determine the success factors of those companies that will survive and thrive in an evolving competitive landscape, as well as options for success in a potentially consolidated market.

**Adoption of new mobility models (Recommendation 13):** Determining the contributing factors influencing acceptance and uptake of ride sourcing (e.g., geography, demographics, gas prices, alternate options), shared vehicle ownership or use, and new mobility models (including AVs) and their relative significance in Ontario will be an important input for insurers, governments, and all other members of the mobility ecosystem.

**The relationship between ride sourcing / car sharing and CV/AV uptake (Recommendation 14):** Insurers could further explore how the adoption of ride sourcing and car sharing (including different scenarios for ride sourcing as well as commercial vs. personal ownership) will influence the uptake of AVs (in terms of level of acceptance, timing, etc.) as well as how AVs will accelerate adoption of ride sourcing or car sharing models, allowing them to efficiently plan investments and assess risk over the short to medium term.

**Impact of new insurance products and channels (Recommendation 15):** Insurers could develop a better understanding of how new products and delivery models will impact auto-manufacturers, government bodies and other mobility ecosystem stakeholders. Strategic partnerships with key stakeholders will allow insurers to develop effective products and delivery models tailored to the CV/AV market.

**Regulatory framework review (Recommendation 16):** The benefits and challenges of the current regulatory regime surrounding insurance (including regulations related to new insurance product approval, liability and fault determination, privacy, data management and protection, transportation-related, and others) could be reviewed by the federal and provincial government, as well as other key stakeholders (e.g., auto-manufacturers) with due consideration for how to balance privacy concerns, competitiveness, and innovation with regard to new insurance products and delivery channels.

**Review in the Ontario context (Recommendation 17):** The government’s regulatory review (including insurance, privacy, data, passenger & commercial transportations regulations etc.) should in particular focus on implications for consumers and insurers in the Ontario context, given the large geographical
range, kilometres driven, and mobility patterns given the mix or urban, suburban, and rural locations.

**Provincial and federal government collaboration on data regulation** *(Recommendation 20):* Provincial entities including the Information and Privacy Commissioner of Ontario, Consumer Protection Ontario, and the Ministry of Government and Consumer Services more broadly could work with federal counterparts (e.g., the Competition Bureau, the Office of the Privacy Commissioner of Ontario) to assess the need for standards with respect to personal data collection and use by insurers.

**Areas for long-term investment**

*Maintaining consumer choice* *(Recommendation 10):* Regulators could further research what may be required to maintain consumer choice as insurers increasingly develop exclusive partnerships with automakers and other providers or embed coverage in bundled products. This could include potential standards for consumer transparency (e.g., whether a customer is buying a bundled product versus having the choice to buy individual products), reporting requirements, etc.

*Addressing competition and consolidation concerns* *(Recommendation 11):* Federal and provincial governments could continue to monitor the competitive landscape of the insurance industry to proactively identify and address monopolistic / oligopolistic patterns as cross-industry partnerships (related to CV/AVs) and overall consolidation emerge and consumer choice is potentially limited. Regulators will also be tasked with determining data privacy implications as industry consolidation occurs.

*Addressing barriers to AV adoption* *(Recommendation 18):* Key stakeholders could establish collaborative partnerships to collectively identify consumer concerns and barriers to AV adoption and develop strategies to address them.

*Understanding CV/AV adoption across varying regions / demographic populations* *(Recommendation 19):* All industry players, including insurers and government researchers, could apply demographic information (e.g., population, vehicle ownership patterns, access to other transportation) to understand how strategies to accommodate, manage risk, and encourage adoption of autonomous vehicles might differ by region, as well as how connected and autonomous vehicles might complement other transportation or city-building initiatives.

*Incorporating key ethical concerns* *(Recommendation 22):* OEMs and other industry players along with federal, provincial and municipal governments, will need to consider a range of ethical considerations such as autonomous vehicle decision making and data privacy when developing CV/AV technology and regulations (respectively). Insurers will need to ensure they are legally compliant
and acting in their clients’ best interest with respect to data privacy and protection while also aligning with regulations on autonomous vehicle decision making when determining liability.

The rise of CV/AV’s will have significant implications on insurance in Ontario. Insurers, as well as the broader transportation sector will benefit from collaboration with key ecosystem players, including all levels of government, a range of traditional and non-traditional automotive companies, and academic and research hubs to ensure a successful transition towards the future state(s) of mobility.
1.0 Introduction and context

Background on connected and autonomous vehicles
Connected vehicles “use wireless technology to connect with other vehicles (V2V), transportation infrastructure (V2I), other connected technology (V2X) and mobile devices to provide information to drivers. There are two broad types of connected technologies: consumer conveniences and infotainment from vehicles connected to the internet and V2V, V2I communications over dedicated short-range communications systems.”27 Automated, or autonomous or self-driving vehicles (AVs), “rely on sensors and computer analytics to sense their environments and perform varying degrees of the driving task.”28 The Society of Automotive Engineers (SAE) International’s J3016 Standard defines six levels of driving automation, a technical standard that reflects the transitional shift underway towards greater levels of automation (see Figure 2).29

Figure 2 - SAE Automation Levels30

<table>
<thead>
<tr>
<th>SAE level</th>
<th>Name</th>
<th>Narrative Definition</th>
<th>Execution of Steering and Acceleration/Deceleration</th>
<th>Monitoring of Driving Environment</th>
<th>Fallback Performance of Dynamic Driving Task</th>
<th>System Capability (Driving Modes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>no Automation</td>
<td>the full-time performance by the human driver of all aspects of the dynamic driving task, even when enhanced by warning or intervention systems</td>
<td>Human driver</td>
<td>Human driver</td>
<td>Human driver</td>
<td>n/a</td>
</tr>
<tr>
<td>1</td>
<td>Driver Assistance</td>
<td>the driving mode-specific execution by a driver assistance system of either steering or acceleration/deceleration using information about the driving environment and with the expectation that the human driver perform all remaining aspects of the dynamic driving task</td>
<td>Human driver and system</td>
<td>Human driver</td>
<td>Human driver</td>
<td>Some driving modes</td>
</tr>
<tr>
<td>2</td>
<td>Partial Automation</td>
<td>the driving mode-specific execution by one or more driver assistance systems of both steering and acceleration/deceleration using information about the driving environment and with the expectation that the human driver perform all remaining aspects of the dynamic driving task</td>
<td>System</td>
<td>Human driver</td>
<td>Human driver</td>
<td>Some driving modes</td>
</tr>
<tr>
<td>3</td>
<td>conditional Automation</td>
<td>the driving mode-specific performance by an automated driving system of all aspects of the dynamic driving task with the expectation that the human driver will respond appropriately to a request to intervene</td>
<td>System</td>
<td>System</td>
<td>Human driver</td>
<td>Some driving modes</td>
</tr>
<tr>
<td>4</td>
<td>high Automation</td>
<td>the driving mode-specific performance by an automated driving system of all aspects of the dynamic driving task, even if a human driver does not respond appropriately to a request to intervene</td>
<td>System</td>
<td>System</td>
<td>System</td>
<td>Some driving modes</td>
</tr>
<tr>
<td>5</td>
<td>full Automation</td>
<td>the full-time performance by an automated driving system of all aspects of the dynamic driving task under all roadway and environmental conditions that can be managed by a human driver</td>
<td>System</td>
<td>System</td>
<td>System</td>
<td>All driving modes</td>
</tr>
</tbody>
</table>

Currently, AVs available to consumers are primarily Level 1 or 2 automation. A number of major manufacturers plan to launch autonomous passengers cars in the next year, with acceleration to occur after 2020 (see Figure 3).

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28 Ibid.
That said, major auto-manufacturers including Ford and GM have indicated their first autonomous fleets will be dedicated to commercial operations. General consensus in the literature is that deployment of Level 3, 4 or 5 passenger and commercial vehicles on public roads will not be commonplace until the 2030s or 2040s (depending on the estimate). Based on experience with previous vehicle technology deployment and considering industry efficiencies and consumer adoption of AVs, the Victoria Transport Policy Institute estimates that AVs may be available “with minimum price premium” by the 2040s, representing 40-60% of new vehicle sales and 20-40% of the total vehicle fleet in Canada. Similarly, a study by David Ticoll at the Munk School of Global Affairs suggests that the rate of deployment could more closely follow adoption rates in consumer technology markets, citing various consultant estimates that predict between 15% - 25% of vehicles in use globally will have Level 3 to 5 automation by 2030.

Connected and autonomous vehicles generate or transfer data through two primary channels: telematics and “infotainment systems.” Telematics systems employ sensors to detect vehicle operations and condition, driver behaviour, driver location, and related data and can connect with other systems (e.g., emergency or roadside assistance) to transmit this information. Infotainment systems transfer information back to the driver, including navigation, traffic, weather, or entertainment (e.g., audio streaming). This can be done by

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Connecting the vehicle directly to the internet or by pairing with the driver’s mobile device. These two systems can also be integrated to provide services to the driver (e.g., estimating arrival time, automated adjustments to sound based on engine noise).

**Background on auto insurance in Canada**

According to the Insurance Bureau of Canada, Canadian auto insurers collected $21.6B in net written premiums in 2016, up from $20.6B in 2015. Auto insurance is the largest business line for property and casualty (P&C) insurers, representing 44.3% of total net written premiums in 2016. The top 20 private P&C insurers dominate the Canadian market (see Figure 4).

**Figure 4 - Top 20 P&C Insurers in Canada by Direct Written Premiums**

In Ontario, the auto insurance industry is privatized and regulated by both the federal and provincial governments. As further detailed in the Role of Government section below, the Ontario provincial government is responsible for regulating market conduct such as determining how claims and complaints are handled and they are also responsible for administering rate approval systems. The federal government regulates the solvency of insurance companies though the Office of the Superintendent of Financial Institutions (OSFI) and determines vehicle safety standards. Ontario’s auto insurance rates are currently the second highest in the country, with an average annual premium of $1,281. This is due to a variety of factors, including:

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37 Ibid.
38 Net written premiums are direct written premium amounts (the total amount of premiums that a P&C insurance company receives in one year) plus reinsurance written premium amounts minus reinsurance ceded premium amounts
40 Facts of the Property and Casualty Insurance Industry in Canada (2016). Insurance Bureau of Canada
41 Insurance Bureau of Canada (IBC) 2017 Fact Book: Canada’s P&C insurance industry, all sectors (2017). Insurance Bureau of Canada
42 Facts of the Property and Casualty Insurance Industry in Canada (2016). Insurance Bureau of Canada
43 Average Car Insurance Rates across Canadian Provinces (Feb 2018). ARC Insurance Brokers; B.C. set to have Canada’s most expensive auto insurance: taxpayers federation (Oct 2017). Global News
• High frequency of claims, lawsuits and injuries, potentially due to high population density and the fact that Ontario has the highest number of drivers in Canada with 9.7 million registered drivers in 2016\textsuperscript{44,45}

• High level of fraud and organized crime relative to other provinces. Fraudulent claims were estimated to amount to $770 million - $1.6 billion in excess payments in 2010; in 2017, 20% of Ontarians surveyed knew a friend who had made an exaggerated or false auto insurance claim\textsuperscript{46}

**Report and purpose**

**Purpose**
The Ontario government, working across a number of ministries, commissioned this piece of research in order to gather more evidence on the implications of CV/AVs for insurance in the Ontario context. This research reinforces Ontario’s position as a North American leader in transformative automotive technologies, as well as transportation and infrastructure systems. Filling these important research gaps and making the research public will support Ontario’s innovation ecosystem and enable it to capitalize on the opportunities presented by the projected mass adoption of CV/AVs in the decades to come.

The purpose of this report is to:

• Identify existing research, key themes and trends on connected vehicles and autonomous vehicles (CV/AVs)
• Comment on the potential implications of findings for Ontario
• Identify gaps in research and/or collected data
• Recommend areas for further research and analysis

**Research process**
Findings were assembled through a combination of qualitative and quantitative research and consultations with a broad range of stakeholder experts (referred to throughout as “experts”), including auto-manufacturers, software providers, insurers, innovation hub partners, community leaders, industry associations and academics. Sources include academic articles, reports from government, industry, and professional services / analysis firms, and news reports.

Research and consultations were structured around six key themes:

1. Opportunities and risks
2. Impact to insurers, government bodies, auto-manufacturers and other key mobility ecosystem players (both financial and non-financial)

\textsuperscript{44} Insurance Bureau of Canada (IBC) 2017 Fact Book: Canada's P&C insurance industry by line of business (2017). Insurance Bureau of Canada

\textsuperscript{45} Average Car Insurance Rates across Canadian Provinces (Feb 2018). ARC Insurance Brokers

\textsuperscript{46} The auto fraud squad: How Canadian Insurance companies are trying to crack down on fake claims (Apr. 2015). Financial Post; Fighting Auto Insurance Fraud: What You Can Do. (2017). Financial Services Commission of Ontario
3. Roles and responsibilities (including the three levels of government, insurers, auto-manufacturers, car sharing and ride sourcing companies, etc.)
4. Insurance implications for Ontarians
5. The transitionary period in which vehicles of varying levels of automation co-exist
6. Ethics of connected and autonomous vehicle decision making, data privacy and data reporting

**Report structure**
This report first summarizes the Ontario landscape and mobility stakeholder ecosystem and establishes an understanding of the timelines and characteristics for the transition to connected and autonomous vehicles.

Key findings from the research are then organized according to a number of key topics:

Findings are organized according to 11 topics:

- Outlook on premiums
- Claims
- Underwriting for autonomous vehicles
- Liability
- A shift in the competitive landscape
- The rise of shared vehicle models
- Insurance products and channels
- Regulatory framework and role of government
- Role of insurers in smoothing the transition towards connected and autonomous mobility
- Jurisdictional approaches
- Ethical considerations

Each theme contains commentary on transition state and end state implications, with description of how particular future states (e.g., mix of automation for vehicles on the road, mix of vehicle ownership models) might impact findings and key stakeholders. Recommendations on next steps for research and analysis on the given topic is included.
The Ontario landscape
Ontario is one of the leading Canadian jurisdictions with respect to the development, testing, and eventual deployment of connected and autonomous vehicles.

Government regulation and initiatives
- Beginning January 1, 2016, Ontario launched a 10-year pilot to allow for the testing of automated vehicles on Ontario’s roads. Ontario is the first Canadian jurisdiction to permit AV testing on public roads.
- In December 2017, the provincial government commenced stakeholder consultations on enhancements to its AV testing regime. These proposed amendments would:
  1) Exclude from the pilot automated vehicles with Society of Automotive Engineers (SAE) Level 3 technology if they are originally manufactured with a driving automation system, and eligible and commercially available for sale in Canada;
  2) Allow the testing of driverless AVs as part of the pilot under stringent conditions;
  3) Allow the testing of cooperative truck platoons on Ontario’s roads under strict conditions as part of the pilot;
  4) Increase the scope and robustness of data reporting required under the AV pilot.47

Research & development
- Ontario is investing $80 million over five years to create the Autonomous Vehicle Innovation Network (AVIN) project, in partnership with the Ontario Centres of Excellence. The main components of the network are as follows:
  o The Demonstration Zone, enabling small- and medium-sized companies to validate and test technologies in live scenarios and weather conditions
  o Up to six Regional Technology Development Sites across Ontario. Each site will have a unique focus to enable small-and-medium sized enterprises (SMEs) to validate new CV/AV technologies, access specialized equipment and obtain business advisory services
  o A Research and Development (R&D) Partnership Fund to foster collaborations between automakers, technology leaders and Ontario-based small- and medium-sized enterprises (SMEs), post-secondary institutions and municipalities in the development and commercialization of CV/AV technologies
  o The Talent Development Program to support student and recent graduate internships and fellowships with Ontario companies in areas strategic to advancing CV/AV technologies

A Central Hub that will act as a resource and focal point to conduct research, share information, build connections and raise awareness.

- Ontario has permitted a number of organizations to test automated vehicles, including Blackberry QNX, The University of Waterloo, The Erwin Hymer Group, Continental Corporation, X-Matik, Magna, and Uber

**Industry**

- The province hosts five top OEMs (FCA, Ford, GM, Honda, Toyota), over 700 automotive parts manufacturers (e.g., Magna, Linamar, Martinrea, Multimatic), and over 500 tool, die and mould makers

- Ontario has over 20,000 IT companies, 44 colleges and universities, and 40,000 yearly graduates in fields of science, technology, engineering and mathematics (STEM)

- Ontario has 24 auto-focused public research facilities

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49 Ibid.
50 Ibid.
Connected and autonomous vehicles in Ontario | 1.0 Introduction and context

Mobility stakeholder ecosystem
A number of sectors, industries, organizations, and individuals will be impacted by the shift to connected and autonomous vehicles and will in turn shape the future mobility ecosystem. Figure 5 illustrates the mobility ecosystem in which connected and autonomous vehicles will function and the key players shaping the landscape.51

Figure 5 - Core groups active in the mobility ecosystem

51 For more information on each segment, please see Force of Change: The Future of Mobility, Navigating a Shifting Landscape: Capturing value in the evolving mobility ecosystem, and The Future of Mobility: What’s Next?
Understanding of transition and end states
There is uncertainty around the pace and scope of transition to full vehicle connectedness and autonomy, meaning that a number of “future states of mobility” might co-exist over time (see Figure 6): 52

Figure 6 - Future states of mobility (Deloitte University Press)

1. Personally owned driver-driven: Private ownership remains the norm. Driver-assist technologies (SAE Level 2) are incorporated incrementally. The number of connected vehicles increases steadily

2. **Shared driver-driven:** Shared mobility serves a great and growing portion of transportation needs. New connectivity services are introduced to accommodate fleet management.

3. **Personally owned autonomous:** Private ownership continues to dominate. Autonomous drive technology (SAE Level 4) is viable, safe, convenient, and economical. V2X connections are ubiquitous and data generation and consumption dramatically increases.

4. **Shared autonomous:** Autonomous and vehicle sharing trends converge, where mobility management companies and fleet operators offer seamless mobility, enabled by advanced connectivity, to meet a variety of consumer needs and preferences.

The balance between these future states depends on two major forces: the extent to which autonomous vehicle technologies become widely adopted and the extent to which vehicles are personally owned or shared. In the period over the next ten to twenty years, Future States 1, 2, and potentially 3 and 4 will co-exist to some degree. Experts expect to see full connectivity and full automation for some vehicles (e.g., agricultural or mining equipment, cargo trucks on the highway, platoons of automated vehicles in particular zones) in risk-controlled environments well within that time. The end state is understood as the period 25 or more years in the future when Ontario has transitioned to a mix of Future States 3 and 4.

Each of the four future states of mobility may disrupt and shape the insurance industry’s stakeholder base, primary coverage, and liability model (see Figure 7).
Each of the four future states of mobility brings a unique set of insurance related opportunities and risks. The following key findings further explore the implications during transition phases and potential end states, developing an understanding that will be critical to defining a clear and balanced governance framework with respect to connected and autonomous innovations.

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2.0 Key findings

Introduction
Major changes to the transportation system are expected to occur as the development and adoption of connected and autonomous vehicles (CV/AVs) continues. Notably, passenger safety and transport efficiency are expected to increase. According to the National U.S. Highway Traffic Safety Administration (NHTSA), over 94% of collisions are caused by human error.\(^{54}\) Connected and autonomous vehicles have the potential to almost completely eliminate the element of human error, likely resulting in increased overall passenger safety. Heightened V2V, V2I and V2X connectivity may also decrease the risk of collision as vehicles become more aware of and reactive to their surroundings (e.g., other drivers’ speed, traffic signals and upcoming collisions). As adoption of ride sourcing programs such as Uber and Lyft increase, in parallel with potential shifts towards platform-owned autonomous vehicle fleets, experts believe that the demand for personal vehicle ownership and potentially the number of vehicles on the road will decline.\(^{55}\) That said, the shift towards car sharing and ride sourcing may result in a range of scenarios. Other experts predict that the rise of car sharing / ride sourcing may result in an increase in road congestion as passengers who typically use modes of public transportation or are unable to drive (due to disability) begin using car sharing and ride sourcing programs.\(^{56}\) According to a study conducted by the Insurance Institute of Canada, these CV/AV trends will also significantly affect the commercial trucking / shipping sector, particularly as autonomous technologies will likely first be adopted by this sector.\(^{57}\)

These major shifts in the mobility ecosystem will significantly impact the auto insurance sector. Insurers will be forced to reassess their current strategy and make proactive adjustments as controlled and autonomous vehicles become increasingly common.

Outlook on premiums
Short term (next 10-20 years): premium prices and revenues
As the rate of adoption of connected and autonomous technologies continues to increase over the long term, insurance premiums are projected to decrease due to a variety of potential factors including increased vehicle safety and a reduced

\(^{55}\) Insuring the Future of Mobility (May. 2016). Deloitte.
\(^{57}\) Automated Vehicles; Implications for the Insurance Industry in Canada (2016). The Insurance Institute of Canada
number of vehicles on the road. In the short term, however, this reduction in premium revenues may be offset by increased average costs per claim. While new autonomous technologies such as telematics have the potential to increase passenger safety and reduce loss events, they are currently very expensive to replace or repair. Research by Deloitte indicates that it is currently five times more expensive to repair damaged sensors / telematics than conventional parts. These sensors are also typically located on vulnerable sections of the vehicle that are prone to damage such as the side-view mirrors and front / rear bumpers. This increased vulnerability can result in frequent repair and / or replacement of expensive electronic components, increasing costs per claim. Some insurers estimate that 25-50% of vehicles would have to be equipped with forward-collision prevention systems before collision rates decline enough to offset the elevated costs per claim associated with damaged electronic components. Note that 20 global automakers have already committed to make automated emergency braking (AEB) standard by 2022.

The transitionary period in which standard, level 2 and level 3 vehicles share the road may result in an increase in collisions in the short term. Initial level 2 and 3 AV models may cause collisions due to initial technical glitches, over-reliance on CV/AV technologies by the driver, and driver underload (lack of stimulation). These vehicles will also likely have to interact with standard vehicles that are less predictable than other CV/AVs due to the full reliance on human decision making. To account for this potential increase in collision risk, insurers may benefit from increased premium revenues in the short-term.

Automotive manufacturing experts predict that the first fully autonomous vehicles will be highly expensive due to exorbitant technology and manufacturing costs. While this will result in an increase in average cost per claim and may present a barrier to AV adoption at first, production costs will decrease as manufacturers gain scale and the technology evolves to become more cost efficient to produce. IHS Automotive predicts that self-driving technology will add between $7000 and $10,000 to a standard car’s price tag in 2025, but that figure is expected to drop to roughly $3000 by 2035. Some auto-manufacturers are proactively trying to reduce repair / replacement costs (resulting in reduced costs per claim) by re-locating sensors to less vulnerable areas of the vehicle. For example, Subaru recently relocated their traffic detection gear to less exposed areas of the car.

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58 Insuring the Future of Mobility (May. 2016). Deloitte.
59 “To be or not to be” is no longer the question - Insurers confront the “when” and “how” of uneven transition as mobility preferences and capabilities evolve (2017). Deloitte
60 Ibid.
62 Manufacturers make progress on voluntary commitment to include automatic emergency braking on all new vehicles (Dec. 2017). Insurance Institute for Highway Safety Highway Loss Data Institute
64 Fully-Autonomous Cars will Cost ‘Hundreds of Thousands’ of Dollars, Silicon Valley Exec Says (July 2017). The Drive
65 Will you ever be able to afford your self-driving car? (2014). Fast Company
such as behind the windshield, to reduce replacement costs in the event of a collision.66

**Long term (20+ years): premium prices and revenues**

Over the long term, insurance premiums are projected to decline as connected and autonomous vehicles become increasingly common.67 Deloitte conducted a comprehensive actuarial analysis to project the total decline in premium need in the U.S. by the year 2040 (outlined in Figure 8 below).

*Figure 8: Premiums – steady state vs. projections*68

Many experts predict that a range of factors, primarily increased vehicle safety and a reduction in the number of personally owned vehicles on the road, are expected to drive this decline in premium revenues. These factors are explained in further detail:

a. Declining premiums due to increased vehicle safety and reduced risk of collisions

Insurance premiums are projected to decline as the transportation sector continues to adopt connected and autonomous technologies that reduce human error and increase road safety. Auto-manufacturers and technology companies will continue to develop driver assistance technologies such as automatic emergency braking (AEB) and forward collision warning systems (FCW) that reduce collision risk.69 As our roads become increasingly safe due to these technologies, the frequency of claims will decrease resulting in reduced premiums. A recent Insurance Institute of Canada report predicts that there will

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66 Will you ever be able to afford your self-driving car? (2014). Fast Company
69 Driver Assistance Technologies (2017). U.S. Department of Transportation - NHTSA
be an 80% reduction in auto insurance claims over the next 25 years.\textsuperscript{70} Deloitte’s “Insuring the Future of Mobility” report projected a similar decrease in claims frequency as the transportation sector becomes increasing autonomous; these projections are outlined in Figures 9 and 10 below.\textsuperscript{71} Importantly, the severity/cost of claims will vary depending on vehicle type; vehicles with more autonomous features will experience greater claims reductions than those without. Furthermore, the frequency of claims will vary by region. More urban regions are expected to adopt autonomous technologies at a faster rate than rural regions, resulting in greater relative claim reduction in urban areas.\textsuperscript{72}

While a decline in premiums presents a risk to insurers, consumers will benefit from reduced auto insurance rates and increased road safety. Ontarian’s auto insurance rates are currently the second highest in the country.\textsuperscript{73} Ontarians recently paid an average annual premium of $1,281 due to a variety of factors, including:\textsuperscript{74}

- High frequency of claims, lawsuits and injuries, potentially due to high population density and that Ontario has the highest number of drivers in Canada with 9.7 million registered drivers in 2016\textsuperscript{75,76}
- High level of fraud and organized crime relative to other provinces.

As connected and autonomous vehicles become increasingly common, auto insurance rates may continue to become more affordable for Ontarians, thus reducing the financial burden of owning and / or operating a vehicle.

\textsuperscript{70} Automated Vehicles; Implications for the Insurance Industry in Canada (2016). The Insurance Institute of Canada
\textsuperscript{71} Insuring the Future of Mobility (May 2016). Deloitte.
\textsuperscript{72} Ibid.
\textsuperscript{73} B.C. set to have Canada’s most expensive auto insurance: taxpayers federation (Oct 2017). Global News
\textsuperscript{74} Average Car Insurance Rates across Canadian Provinces (Feb 2018). ARC Insurance Brokers
\textsuperscript{75} Insurance Bureau of Canada (IBC) 2017 Fact Book: Canada’s P&C insurance industry by line of business (2017). Insurance Bureau of Canada
\textsuperscript{76} Average Car Insurance Rates across Canadian Provinces (Feb 2018). ARC Insurance Brokers
Note: Deloitte’s actuarial practice conducted a comprehensive analysis of the current auto insurance market and developed a model to project future U.S. premium need and claim frequency; based on trends in automation, connectivity, and vehicle ownership to date, Ontario is anticipated to follow a similar trajectory.

b. Declining premium revenues due to a potential decrease in personal vehicle ownership, leading to a decrease in overall demand for auto insurance

Personal vehicle ownership may decline as customer adoption of car sharing and ride sourcing programs increases. A report by the Insurance Institute of Canada states that while personal vehicle ownership is expected to continue to dominate over the next decade, a major shift towards various forms of ride sourcing and car sharing is possible in the next 20 to 30 years as demand for personal

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77 Insuring the Future of Mobility (May 2016). Deloitte.
78 Insuring the Future of Mobility (May 2016). Deloitte.
ownership decreases.\textsuperscript{79,80} A recent study conducted by Barclays bank predicts that the number of personally owned vehicles could decline by 50\% over the next 25 years due to increased adoption of shared self-driving vehicles.\textsuperscript{81} An overall decrease in personal vehicle ownership would decrease demand for personal auto insurance products, placing downward pressure on total auto-premium revenues. The total number of vehicles on the road may be reduced due to the efficiencies of car sharing and ride sourcing, further reducing total need for auto insurance.\textsuperscript{82} This decline in demand, however, may be partially offset by a subsequent increase in demand for commercial insurance products. For more information on this, see the Rise of Car Sharing and Insurance Products and Channels sections below.

Figure 11 below outlines the projected decrease in premium need as the market transitions towards shared autonomous transportation.\textsuperscript{83} Deloitte predicts that the total auto insurance premium need could decrease by up to 30\% from current levels as a result of the shift towards car sharing and increased vehicle safety.\textsuperscript{84} Insurance companies will need to prepare for and adapt to the shift away from personal vehicle ownership to be best positioned for future success.

\textit{Figure 11: Projected premium need by vehicle type}\textsuperscript{85}

\begin{quote}
\textbf{“The potential decline in premium revenues is a major risk for insurance companies. The firms that are preparing for this shift now will be best positioned for future success.”}

- Insurance Industry Expert
\end{quote}

\textsuperscript{79} Automated Vehicles; Implications for the Insurance Industry in Canada (2016). The Insurance Institute of Canada
\textsuperscript{80} Note: the predicted shift towards car sharing is not intended to be a direct result of the rise of autonomous vehicles
\textsuperscript{81} Disruptive Mobility: A scenario for 2040 (2015). Barclays Bank PLC
\textsuperscript{82} Insuring the Future of Mobility (May 2016). Deloitte.
\textsuperscript{83} Ibid.
\textsuperscript{84} Ibid.
\textsuperscript{85} Ibid
While most industry experts and insurers interviewed agreed that premiums will decline over the long term, there were mixed opinions as to when this shift would actually occur and how insurers should prepare for it. Some industry experts believe that insurance premiums will not be materially effected in the next 3-5 years because adoption is expected to ramp up slowly and initial models will account for an immaterial proportion of total distance driven. Autonomous vehicles at Level 3 or above are not expected to have a major market share until the 2030’s at the earliest. As a result, many current insurance company CEO’s are not prioritizing the preparation for this shift in premiums in their 10 year plan.

**Implications for Ontario:** Insurance companies in Ontario will need to proactively prepare for the projected decline in premium revenues. The firms that effectively adjust their strategies to serve the evolving mobility ecosystem will be best positioned for success. This projected decline in premiums may, however, benefit Ontario consumers by reducing the financial burden associated with owning and / or operating a vehicle.

**Areas for further research**

1. Insurers could analyse how near-term opportunities such as the projected short-term increase in premium revenues might best be positioned (e.g., re-investment in R&D initiatives) for long-term success.

2. Through engagement with key stakeholders in the mobility ecosystem (such as auto-manufacturers and fleet operators), Ontario insurers could more precisely understand and model the impact of CV/AV development on premiums, specifically with respect to the pace of transition to greater levels of vehicle connectivity and automation.

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Outlook on claims
As stated above, the frequency and cost of claims is expected to decrease as the mobility ecosystem becomes increasingly connected and autonomous – a decline of 80% in claims is expected over the next 25 years. This is due to a variety of factors, namely the increased safety that the vehicles stand to offer. Autonomous vehicles will also allow insurers to more accurately assess risk, process claims and detect fraud in the event that a collision does occur.

Connected and autonomous vehicles allow for efficient claim processing
Increased access to autonomous vehicle data will allow insurance companies to process claims and assess risk more efficiently and effectively. AVs will contain an array of complex sensors (or telematics) that have the ability to monitor and record vehicle activity. These sensors can be remotely analyzed to capture and assess the details of vehicle performance, specifically during loss events. CVs will be constantly communicating with and collecting data on their surroundings. This presents a significant opportunity for insurance companies if they are able to access this valuable CV/AV data. By utilizing analytics to analyze loss event data, insurers will be able to effectively identify the source of operational failure and more accurately assess the determination of fault, leading to a more efficient claims resolution process. Investigators and law enforcement agencies in Ontario may also benefit from increased access to vehicle data when processing claims (including liability and fault-determination).

Fraud
If able to access the data obtained from telematics and other sensors, insurers would be able to more efficiently and effectively detect fraudulent claims. For example, in the event of a collision, claims investigators could analyze the precise speed of the vehicle at the time of impact to determine if passenger claims of whiplash are legitimate. According to the Insurance Research Council (IRC), 13-17% of all paid claims today are fraudulent, resulting in excess annual payments of $6-$8 billion the U.S. In Ontario, fraudulent claims were estimated to amount to $770 million - $1.6 billion in excess payments in 2010; in 2017, 20% of Ontarians surveyed knew a friend who had made an exaggerated or false auto

“We recognize that telematics data will benefit claims assessment, however, we will be challenged to determine how to obtain data from OEMs / 3rd parties, define what data is important, and develop the infrastructure required to analyze it”
- Canadian Insurance Company

87 Automated Vehicles; Implications for the Insurance Industry in Canada (2016). The Insurance Institute of Canada
88 Insuring the Future of Mobility (May. 2016). Deloitte.
89 Ibid.
insurance claim. Claims can account for up to 80% of an insurance company’s costs. If insurers are able to reduce the amount of fraudulent claims processed, they may be able to alleviate some margin pressure and partially offset an expected decline in premium revenues. Estimates for the United States indicate that each 10% incremental reduction in fraudulent claims could mean up to $800 million (USD) in industrywide savings. Greater access to vehicle data also presents insurers the opportunity to improve their underwriting capabilities which is further explained below.

**Implications for Ontario:** In Ontario, fraudulent claims were estimated to amount to $770 million - $1.6 billion in excess payments in 2010. In 2017, almost 20% of Ontarians surveyed knew a friend who had made an exaggerated or false auto insurance claim. Access to data from autonomous vehicles could accelerate claims processing and resolution for Ontarians and significantly reduce occurrences of insurance fraud in Ontario.

**Areas for further research**

3. Insurers could identify data analysis capability needs and current internal skills gaps to inform talent development strategies and capitalize on the potential for more accurate claims processing.

4. The federal and provincial government could include insurers in policy discussions on CV/AV data privacy regulations, specifically as they relate to the claims resolution process, so that any new or amended frameworks appropriately balance consumer privacy with innovation in insurance.

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92 How can we reduce loss ratios and decrease our loss-adjustment expenses? (2012). SAS
93 Insuring the Future of Mobility (May 2016). Deloitte.
95 Estimates for the U.S. indicate that every incremental 10 percent reduction in fraudulent claims could mean up to USD $800 million in industrywide savings. Figures are not available for Ontario but the impact is likely to be comparable.
Underwriting for connected and autonomous vehicles

Significant changes to underwriting tools and methodologies are expected as connected and autonomous vehicles become more common.96 Currently, underwriters rely on a variety of tools to evaluate driver risk, namely the driver’s record (a.k.a. motor vehicle record / MVR). As standard and autonomous vehicle technologies merge, it is uncertain how driver infractions will change and be reflected on a driver’s MVR. Munich RE predicts that the driver’s record will likely remain a key tool in determining a driver’s risk profile until vehicles are fully autonomous (level 4 and 5).97

Most industry analysts agree that autonomous vehicles will be safer than standard vehicles. When calculating AV premiums, underwriters will need to account for this decrease in collision risk, likely resulting in decreased auto insurance premiums (as explored above). This reduced risk will need to be quantified through analysis of comprehensive data sets. Underwriters will be able to incorporate AV data such as those outlined in Figure 12.98 A major challenge that underwriters will face is how to quantify the increased safety that initial autonomous vehicle models offer without much historic data. According to Munich RE, a typical large insurance company relies on a historical data set of 100-150 billion miles driven in order to produce credible results.99 Historic data sets of that size will not be available to insurers when the first fully AVs are introduced into the transportation system. Insurance companies and underwriters will be tasked with determining the sufficient amount of historical data required to accurately compare with standard vehicle data to justify shifts in premium pricing.100 During the transition period, small to mid-size insurance companies will lack access to significant data sets. Munich RE predicts that these firms will likely pool their own experience data together to conduct credible analysis and drive meaningful insights.101 Underwriters should, however, be able to analyze driver data recorded through the telematics of semi-autonomous vehicles when developing

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96 Autonomous Vehicles: Considerations for Personal and Commercial Lines Insurers (2016). Munich RE
97 Ibid
98 Ibid.
99 Ibid.
100 Ibid.
101 Ibid.
initial AV premium decisions. Telematics data obtained from AVs is considered to be more reliable than driver-reported information and should allow underwriters to more accurately assess risk profiles and determine AV premiums.\(^\text{102}\)

**Talent shift**

As connected and autonomous vehicles become more common and historic telematics data increases, underwriters will require greater levels of analytic sophistication to achieve more effective and efficient risk assessment. Insurers will strive to hire new team members with strong analytic experience, specifically as robotic process automation (RPA) and cognitive intelligence (CI) are increasingly used to streamline many insurance procedures including claims processing and underwriting.\(^\text{103}\) Deloitte predicts that insurer spending on cognitive/artificial technologies will rise to 48% globally on a compound annual growth basis over five years, reaching $1.4 billion by 2021.\(^\text{104}\) See Figure 13 below for a set of future talent trends that insurers will need to consider as CV/AV technology continues to develop. Along with analytic expertise, insurers need to develop technological expertise. Autonomous vehicle models and components will have varying risk profiles and lack standardization as the transition to full AV market penetration occurs over the next 25 years.\(^\text{105,106}\) As new models and components are introduced to the market, underwriters will be challenged to assess their unique risk profiles without access to historic data. Some hardware / software components will perform better than others and underwriters need to understand and account for this. Insurers may build out technological and operational capabilities by consulting with or hiring well-informed experts for each technology type. Through these consultations and other forms of knowledge building, insurers could gain a better understanding of factors such as product performance under extreme conditions and vehicle system shelf-life.\(^\text{107}\)

Automotive industry experts, insurers and other key mobility ecosystem stakeholders agreed that all transportation sector players will need to build out their analytic / technical expertise in order to derive value and competitive advantage from the influx of telematics data.

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\(^{102}\) Ibid.


\(^{104}\) 2018 Insurance Outlook: Shifting strategies to compete in a cutting-edge future. (2018). Deloitte Center for Financial Services

\(^{105}\) Insuring the Future of Mobility (May 2016). Deloitte

\(^{106}\) AV standards will eventually be developed as AVs become more common and stakeholders develop a deeper understanding of the technology

\(^{107}\) Autonomous Vehicles; Considerations for Personal and Commercial Lines Insurers (2016). Munich RE
Figure 13: Future Insurance Talent Trends and How Insurers Can Adapt

<table>
<thead>
<tr>
<th>Insurance talent trend</th>
<th>How insurers can address the trend</th>
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| New technology related skills will be needed in the future\(^{108}\)                  | • Attract and hire new employees with analytic expertise, experience with artificial intelligence (AI) and robotic process automation (RPA) considered an asset  
• Develop the analytic skills of current employee base through specialized training programs |
| As tasks become more automated (e.g., claims processing and underwriting) employees will concentrate on more complex and sensitive tasks where human judgement is required\(^{109}\) | • Hire and retain high-performing employees, specifically those with strong customer service skills to deliver a personalized customer experience                                                                                     |
| Data suggests that 25% of the insurance employee base will retire in 2018\(^{110}\)    | • Ensure that knowledge is effectively transferred from long tenured employees to management team / new hires  
• Identify which skills are most relevant for the next generation of insurance employees and which are obsolete  
• Shift hiring requirements for new hires to focus on next-generation skills                                                                                     |
| Insurers will be required to reduce workforce size to realize cost efficiencies as tasks become increasingly automated\(^{111}\) | • Forecast accurate future hiring / staffing requirements to prepare for the future technological shift                                                                                                                        |

\(^{110}\) 4 Data Points that should be on Every Insurance Executive’s Radar (2017). AIIM; \(^{111}\) 2018 Insurance Outlook: Shifting strategies to compete in a cutting-edge future (2018). Deloitte
Implications for Ontario: Regulators and other government agencies will be considering how best to govern CV/AV data privacy, access and ownership. Insurers in Ontario will need to closely monitor the development of these regulations while also beginning to build out new underwriting capabilities. Insurer focus should be on building analytic and AI technology expertise through external hiring and specialized training for existing staff, as well as on strengthening customer service skills to deliver a differentiated customer experience.

Areas for further research

5. In order to obtain relevant data from OEMs / 3rd parties, insurers and their relevant delivery partners (e.g., police and investigators) will need to understand and define what data is important and develop the infrastructure required to analyse it for underwriting, claims processing and other business purposes.

6. Industry associations, the provincial government, academia and other stakeholders could coordinate to identify what educational / training programs are needed to train or re-train a robust talent pool for insurers and related industries.

Liability

As consumer acceptance of connected and autonomous technology grows, particularly as vehicles transition from semi to fully autonomous capabilities, loss liability is expected to shift from the vehicle operator to the manufacturer / manager of the CV/AV technology. Insurers and litigators will be challenged with the task of determining liability in the event of collisions as connected technologies continue to advance and AVs transition towards level 4 and 5 automation. Initial models of fully autonomous vehicles are anticipated to provide drivers the option to take control of the vehicle at any time. As a result, Munich RE, a large US, based insurance company, believes that assigning liability will likely hinge on whether the collision was caused by the driver or due to component / product malfunction. Insurers and litigators will have to develop a framework / strategy to navigate the complexity of fault determination for initial autonomous vehicle models. The Munich RE study also states that it is largely unknown as to how current product liability case law will apply to autonomous vehicles and auto-manufacturers will have to remain educated on any legislative alterations.

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112 Automated Vehicles; Implications for the Insurance Industry in Canada (2016). The Insurance Institute of Canada
113 Autonomous Vehicles; Considerations for Personal and Commercial Lines Insurers (2016). Munich RE
114 Ibid.
The question of liability has significant implications on common law jurisdictions in the Canadian market as liability for motor vehicle collisions is primarily decided by case law rather than statutory law.\textsuperscript{115} Deloitte predicts that the complexity associated with determining liability and fault for initial AV models will result in higher legal fees for the consumer and other stakeholders.\textsuperscript{116} As liability continues to shift away from the vehicle operator towards the connected or autonomous technology itself, product liability claims are expected to be processed more frequently. These claims also typically result in higher loss adjustment expenses, including legal fees.\textsuperscript{117}

Insurers in Ontario believe that the U.K.’s “single policy” approach to operator liability and claims resolution would be an effective means of ensuring liability is clearly determined without disadvantaging individual claimants (see case study on page 66 for further detail). The policy ensures that claims are processed expeditiously and injured persons are compensated without delay. All litigation and fault-determination will be handled by the auto insurer so that the injured person is not required to engage in legal action against large commercial stakeholders (such as AV auto-manufacturers).

The European Parliamentary Research Service predicts that four main categories of risk associated with liability will emerge as AVs become increasingly common (see the case study below that outlines the recommended EU approach to AV liability regulation):\textsuperscript{118}

1. Risks relating to the failure of operating software enabling an AV to function
2. Risks relating to network failures
3. Risks related to hacking and cybercrime
4. Risks/external factors relating to programming choices

\textsuperscript{115} Autonomous Vehicles: Revolutionizing Our World (2016). Borden Ladner Gervais
\textsuperscript{116} Quantifying and Uncertain Future: Insurance in the new mobility ecosystem (2016). Deloitte
\textsuperscript{117} Quantifying and Uncertain Future: Insurance in the new mobility ecosystem (2016). Deloitte
\textsuperscript{118} A Common EU approach to liability rules and insurance for connected and autonomous vehicles (Feb 2018). European Parliamentary Research Service (EPRS)
As a result of these four main risks (and many others), liability exposure is expected to increase for the following stakeholders:

- **Connected and autonomous vehicle / component manufacturers:** These stakeholders will likely place increased emphasis on the effective functionality of their CV/AV technologies / products because they may be liable for component failure in the event of a collision. At a recent Council of the State Governments meeting, Robert Peterson, law professor at Santa Clara University stated that while OEMs/auto-manufacturers are only responsible for 2% of crashes today, it is expected that they will be responsible for 80-100% of crashes in the future. According to the Ministry of Transportation, there were 68,156 vehicles involved in personal or fatal injury collisions in 2016 and approximately 25 personal injury or fatal collisions per 100 million kilometres travelled. If OEMs/manufacturers had been responsible for 80-100% of those collisions, they would have been liable for a minimum of 54,525 vehicles, or 20 personal injuries or fatalities per 100 million kilometres travelled (compared with 1,363 vehicles or 0.5 personal injuries or fatalities at 2%). To address the potential shift in liability, companies such as Volvo, Alphabet (Waymo) and Daimler (Mercedes) have publically stated that they will accept full liability for collisions that are caused by their vehicles in autonomous mode. This strong stance highlights the confidence that these manufacturers have in their autonomous technologies, provides some clarity around liability for insurers and members of the public, and encourages social acceptance of the development and operation of CVs and AVs.

- **Software developers:** These stakeholders will be responsible for the creation, maintenance and / or operation of connected and autonomous vehicle software and will be subject to increased liability for events such as software bugs and

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**Case Study:**

**Background**

In February 2018, the European Parliamentary Research Service (EPRS) released a report that outlines a recommended approach to AV regulation, specially as it relates to liability and insurance. Four policy options were analyzed to address gaps in the current EU liability framework:

1. The status quo
2. Reform of the Product Liability Directive
3. Reform of the Motor Insurance Directive
4. Introduction of new EU legislation and setting up of a no-fault insurance framework for damages resulting from AVs

Each of the options were evaluated against seven key criteria: legal certainty, potential litigation burden, impact on innovation, impact on level of consumer protection, political acceptance, degree of regulatory intervention needed and degree of dependence on soft law.

**Conclusion**

The EPRS determined that the introduction of new EU legislation and confirming a no-fault insurance framework for AVs would most effectively promote the development and adoption of AVs in the EU.

**Source:** A Common EU approach to liability rules and insurance for connected and autonomous vehicles (Feb 2018). European Parliamentary Research Service

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119 Autonomous Vehicles; Considerations for Personal and Commercial Lines Insurers (2016). Munich RE
122 Calculations: 68,156 collisions in 2016 * 80%, 25 injuries or fatalities per 100 million KM travelled * 80%
123 Note: The total number of vehicles involved in personal or fatal injury collisions may not be an accurate representation of total collisions in Ontario. The figure does not include collisions in which no parties were injured meaning that it may be understated.
cyber hacks. Liability exposure for these stakeholders will increase as the mobility ecosystem transitions towards future state 4 where shared AVs dominate our roads. These “shared fleets” will be supported by highly sophisticated software that will be the target of major cyber attacks that could lead to coordinated, mass collision events.

- **Operators / owners of fully autonomous vehicles (either private individuals or commercial entities):** These individuals and/or organizations will need to ensure that they are maintaining the quality of their assets (AVs) to avoid liability for loss events. These operators will also avoid tampering with the operating system that supports the AVs to avert assertions of liability against them.\(^\text{125}\) According to Canadian law firm Borden Ladner Gervais, “owner liability for autonomous vehicles will likely be governed by the pre-existing law (both common and statutory) governing this issue in addition to potential liability for failing to properly maintain an autonomous vehicle.” The law firm further explains that amendments to the current provincial legislation would be required when determining if an owner is vicariously liable and under what circumstances.\(^\text{126}\)

- **Mobility management providers of shared CV/AVs:** Mobility management providers such as Uber and Lyft may elect to own and operate a fleet of CV/AVs and will likely be subject to similar liability as the stakeholder group highlighted above. Mobility management providers will also likely be liable for loss events related to the negligent/faulty coordination of their CV/AV fleet.

- **Infrastructure Developers and Operators:** In order for connected vehicles to operate, they will need to receive data from surrounding intelligent infrastructure such as signs, lane markers, and beacons.\(^\text{127}\) The organizations that develop/operate this infrastructure may be liable for vehicle collisions if the infrastructure fails to effectively communicate to connected and autonomous vehicles (e.g., emits an incorrect signal or malfunctions). As a result, these stakeholders may require insurance products to protect against component failure and collision liability. See page 60 for more information on the infrastructure requirements for CV/AVs and page 79 for more information on the ethical considerations that relate to CV/AV infrastructure liability.

As a result of this shift in liability, demand for commercial and product liability insurance offerings will likely increase for all of the stakeholders outlined above. See Figure 14 below for a high level description of how liability is expected to shift as vehicles move towards level 5 automation. Figure 7 above outlines key stakeholders expected coverage as the transportation sector transitions through the 4 future states of mobility. Insurers will also need to carefully monitor the

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\(^\text{125}\) Autonomous Vehicles: Considerations for Personal and Commercial Lines Insurers (2016). Munich RE

\(^\text{126}\) Autonomous Vehicles: Revolutionizing Our World (2016). Borden Ladner Gervais

\(^\text{127}\) An Assessment of Autonomous Vehicles: Traffic Impacts and Infrastructure Needs (Mar. 2017). Center For Transportation Research, The University of Texas at Austin
progression of CV/AV regulations, specifically as they relate to stakeholder liability, and adjust strategies accordingly.

*Figure 14: Liability comparison as level of automation shifts*

**Implications for Ontario:** Current liability and fault determination regulations in Ontario are comprehensive but may need to be updated to better apply to CV/AVs. The Ontario government will benefit from collaborating with insurers, auto-manufacturers, and other mobility ecosystem stakeholders, as well as sharing learning and progress with government bodies and regulators in other jurisdictions (such as California) to determine how to regulate CV/AV liability and fault determination. Consideration for Ontario’s context as a common law jurisdiction and the application of existing and new case law to questions of liability will be an equally important input to new regulations or standards.

**Areas for further research**

7. The Ontario government could continue to engage with insurers, auto-manufacturers and government bodies in other jurisdictions (such as California) to understand relevant considerations and model options for CV/AV liability and fault determination.

8. Auto-manufacturers, mobility management firms and other key stakeholders could assess the advantages and drawbacks of various coverage options in an environment in which liability has shifted away from the driver and / or passenger towards commercial entities.

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128 Graphic was created based on insights derived from: Autonomous Vehicles: Considerations for Personal and Commercial Lines Insurers (2016). Munich RE
9. Government bodies, network providers, infrastructure operators and other key stakeholders could collaborate on the development of V2V, V2I and I2V communication standards and regulations that provide clarity on collision liability for connected vehicles.

A shift in the competitive landscape

As connected and autonomous vehicles become increasingly common, experts predict there will be major shifts in the competitive landscape for insurance. Non-traditional competitors are expected to enter and disrupt the market: key stakeholders such as auto-manufacturers, technology companies, ride sourcing and car sharing firms may perceive shifts in the mobility ecosystem as a valuable opportunity to gain market share and begin to offer their own insurance products. One key advantage that these stakeholders will have over insurance companies is their direct access to vehicle and passenger data. Morgan Stanley predicts that 20% of the auto insurance market may be appropriated by such “disruptors,” primarily due to their privileged access to valuable vehicle data. It is still uncertain as to how these stakeholders will be incentivized (or mandated) to share CV/AV data with insurance companies, public sector entities (including law enforcement agencies) and other bodies acting in the public interest. See Figure 15 below for an overview of potential disruptors to the CV/AV insurance market. Each key stakeholder group is explained in further detail below.

Figure 15: Sample potential disruptors to the auto insurance industry as AV’s become more common
Auto-manufacturers
As auto-manufacturers continue to develop their connected and autonomous vehicle capabilities, they may begin to offer their own personalized insurance offerings to customers. For instance, Tesla CEO Elon Musk recently stated “not to the exclusion of insurance providers but if we find that insurance providers are not matching the insurance proportionate to the risk of the car, then if we need to, we will in-source it. I think we will find that insurance providers do adjust the insurance cost proportionate to the risk of a Tesla.”131 Tesla has already partnered with a number of insurance companies around the globe to deliver a customized, all-inclusive insurance offering to their customers, branded as “InsureMyTesla.”132 These partnerships were established because Tesla believed that current insurance products were not accurately reflecting the safety of their auto-pilot features. Such claims were recently validated by the National U.S. Highway Traffic Safety Association who stated that collision rates for Tesla vehicles have dropped over 40% since the introduction of its autopilot features.133 Auto-manufacturers like Tesla are expected to self-insure and / or partner with insurance companies to develop customized, all-inclusive products to their customers that accurately reflect the advantages of connected and autonomous technologies.

What is Self-Insurance?
Definition: A system whereby a firm sets aside an amount of its monies to provide for any losses that occur—losses that could ordinarily be covered under an insurance program. The monies that would normally be used for premium payments are added to this special fund for payment of losses incurred.
CV/AV context: Auto manufacturers and ride / car sharing companies may elect to develop and provide their own insurance coverage for certain CV/AV related products / services.

Ride sourcing and car sharing companies
The increased adoption of ride sourcing and car sharing models has altered consumer need for traditional auto insurance offerings. Car sharing companies such as Zipcar, Car2Go, and Fair have introduced new insurance options that better align with consumer preferences. For instance, instead of a standard fixed-term coverage package, Zipcar offers a transparent “pay-per-use” option to customers where insurance is included in the price of each trip.134 This delivery model aligns with the needs of customers that do not own personal vehicles and aim to avoid fixed-term coverage products. As shared autonomous vehicles become increasingly common, car sharing and ride sourcing companies alike may continue to develop and offer insurance products that better align with consumer needs. For instance, experts predict that self-insurance may emerge as a dominant model for large, shared vehicle fleets, similar to large commercial

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131 Tesla expands on its new car insurance program as self-driving technology improves (Feb. 2017). Electrek
132 Tesla is already showing how the insurance industry will be disrupted by self-driving cars (Feb. 2017). Business Insider
133 Ibid.
transportation and logistics companies today. Regulators may require companies (including those who elect to self-insure) to purchase stop-loss and other forms of catastrophic coverage from third party insurers. Insurance companies will need to prepare for this shift and develop new products and delivery models that are tailored towards the ride sourcing and car sharing markets. This is expanded on further below as usage-based insurance becomes an increasingly popular product and delivery method, building on the car sharing model.

**Other insurance companies**

It is anticipated that there will be major shifts in the current insurance competitive landscape as CV/AVs become increasingly common. Experts predict that there will be widespread consolidation across the insurance industry. Smaller insurance firms who have historically offered traditional personal auto insurance will not have the capabilities or scale required to provide coverage to large commercial customers. Larger insurance companies will benefit from large cash reserves that should allow them to insure larger commercial customers as CV/AVs become increasingly common. To increase scale and build out capabilities, many insurance companies are expected to partner with and / or be acquired by larger insurance companies. Some experts also predict that some smaller insurance companies may be forced to cease operations if they fail to adjust strategies and keep pace in the new competitive landscape. Large economies of scale will be a key success factor when insuring large fleets of CV/AVs, auto-manufacturers and other commercial customers. Insurance companies that are preparing for this shift now will be best positioned for future success.

“Large global players may enter the Canadian market and gain market share by providing coverage to large commercial clients while leveraging their significant cash reserves”

- Canadian insurance company

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136 Ibid.
138 Ibid.
139 Ibid.
The need to build cross-sector relationships

To manage the uncertainty associated with the CV/AV market, insurers can partner and/or build relationships with relevant stakeholders in other sectors such as technology, OEM/auto manufacturing, and government to co-develop strategic, connected and autonomous vehicle related initiatives.\(^{140}\) Insurance companies can market themselves as valuable partners to these stakeholders due to their strong underwriting expertise and market experience.

Such partnerships are already starting to surface. In Canada, Tesla recently partnered with Aviva Insurance to offer tailored insurance offerings to their customers that can be conveniently accessed and paid for online (branded as “InsureMyTesla Powered by Aviva”).\(^{141}\) An increasing amount of insurers are expected to follow this trend and partner with auto-manufacturers and other stakeholders to achieve synergies and avoid disruption.\(^{142}\) In the U.S., Farmers Insurance recently engaged in partnership with Tesloop, a small shared car service that uses Tesla cars (equipped with autopilot features) to transport passengers around Southern California. Farmers created a new auto policy for the shared car service and decreased premiums by 25% to account for the reduced risk that Tesla’s autopilot features offer.\(^ {143}\) Although Tesloop is still a relatively small mobility service with only 6 cars in its fleet, the partnership grants Farmers the opportunity to test how different policies can be designed for autonomous technologies. Root Insurance in Ohio has also begun to develop policies for autonomous technologies. The insurance company is now offering Tesla drivers a tiered discount based on the number of miles the car is driven in auto-pilot mode.\(^{144}\) This discount was applied based on the fact that Tesla cars are safer to drive while autopilot features are engaged. Given the decreased risk of collision, it is likely that other insurers will begin to adjust premiums that reflect the reduced risk that autonomous technologies offer. Insurers can also work with auto-manufacturers and technology companies to develop common systems of data collection to alleviate cross-platform complications.

Insurance companies might look to other industries for examples of partnerships founded on mutual benefit. Apple and AT&T’s 5-year exclusive deal to distribute and service the first iPhone, signed in 2007, initiated a decade-long (albeit

\(^{140}\) Insuring the Future of Mobility (May 2016). Deloitte.


\(^{142}\) Insuring the Future of Mobility (May. 2016). Deloitte

\(^{143}\) Tesla is already showing how the insurance industry will be disrupted by self-driving cars (Feb. 2017). Business Insider

\(^{144}\) Tesla owners are already getting insurance discounts for using Autopilot (Mar. 2017). Business Insider
sometimes contentious) corporate partnership provides a good example. Apple was expected to achieve strong network coverage at a reduced price point and AT&T was expected to achieve increased average revenue per user (ARPU) and reduced churn rates.\textsuperscript{145} Insurance companies can analyze partnerships such as Apple and AT&T agreement when determining how to structure deals with auto-manufacturers and other stakeholders to best position themselves for future success.

**Implications for Ontario:** Insurers in Ontario face the same shifting landscape as other jurisdictions and could begin thinking about their value add for potential partners. Regulators will need to consider whether controls are required to maintain consumer choice as insurers increasingly develop exclusive partnerships with automakers and other providers or embed coverage in bundled products (e.g., customer transparency).

**Areas for further research**

10. Regulators could further research what may be required to maintain consumer choice as insurers increasingly develop exclusive partnerships with automakers and other providers or embed coverage in bundled products. This could include potential standards for consumer transparency (e.g., whether a customer is buying a bundled product versus having the choice to buy individual products), reporting requirements, etc.

11. Federal and provincial governments could continue to monitor the competitive landscape of the insurance industry to proactively identify and address monopolistic / oligopolistic patterns as cross-industry partnerships related to CV/AVs and overall consolidation emerge and consumer choice is potentially limited. Regulators will also be tasked with determining data privacy implications as industry consolidation occurs.

12. Insurers could conduct an assessment of the Ontario insurance landscape, including key strengths and competitive advantages, to help determine the success factors of those companies that will survive and thrive in an evolving competitive landscape, as well as options for success in a potentially consolidated market.

\textsuperscript{145} Project Vogue: Inside Apple’s iPhone Deal with ATT (Sep. 2013). Forbes
The rise of shared vehicle models
The increased popularity of ride sourcing and car sharing platforms such as Uber, Lyft and ZipCar is expected to result in a decline in vehicle production (see Figure 16)\(^\text{146}\) and a decrease in demand for personal vehicle ownership. A recent study conducted by Barclays bank predicts that the number of personally owned vehicles will decline by 50% over the next 25 years due to increased adoption of shared self-driving vehicles.\(^\text{147}\) The Ontario market is already transitioning to ride sourcing, with companies including Uber and Lyft gaining significant traction in large regions including the GTA, Kitchener-Waterloo and Ottawa.\(^\text{148}\) This trend is expected to continue as vehicles become more autonomous, enabling fleets of vehicles to operate at maximum efficiency.

In response to this significant shift in ownership patterns, auto-manufacturers will likely build out their own shared vehicle capabilities as part of transitioning towards the role of a mobility management provider. Some auto-manufacturers are already doing this - GM recently made a $500M investment into Lyft with a goal of developing a shared, self-driving vehicle model.\(^\text{149}\) Volvo has also recently reached an agreement with Uber to build out its AV fleet capabilities, in addition to expanding to other areas of the mobility marketplace (see case study). Mercedes (Daimler Co.) also currently has a strong foothold in the car sharing market with its ownership of Car2Go, the largest vehicle sharing company in the world.\(^\text{150}\)

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\(^{146}\) The Driverless, car-sharing road ahead (Jan 2016). The Economist
\(^{147}\) Disruptive Mobility: A scenario for 2040 (2015), Barclays Bank PLC
\(^{149}\) GM invests $500 million in Lyft, sets out self-driving car partnership (Jan. 2016). Reuters
\(^{150}\) Automated Vehicles; Implications for the Insurance Industry in Canada (2016). The Insurance Institute of Canada
increasing amount of auto-manufacturers are building out their own shared self-driving capabilities which will significantly impact the insurance sector.

The decline in demand for personally owned vehicles, however, is currently not consistent across all jurisdictions. For example, Seattle, Detroit, Washington, D.C., New York and San Francisco have all experienced a decline in vehicle ownership per household, while Philadelphia, Atlanta Denver and El Paso have experienced an increase in vehicle ownership per household.\textsuperscript{151} This is likely due to variety of region specific factors such as public transportation infrastructure, ride sourcing adoption (e.g., Uber and Lyft) and gas prices.\textsuperscript{152} According to Statistics Canada, new passenger car sales increased by 2\% in Ontario from 2016-2017, however, new passenger car sales decreased by -6\% and -5\% in 2014/15 and 2015/16 respectively.\textsuperscript{153,154} As stated above, experts project that demand for personal vehicle ownership will decline over the long term as shared vehicle models become increasingly common.\textsuperscript{155}

**Impact on insurance providers**

Insurance companies will be forced to adapt to the following shifts as ride sourcing and car sharing models become increasingly common:

a. A decrease in demand for personal auto insurance coupled with an increase in demand for commercial insurance

Demand for personal auto insurance is projected to decrease by 60\% by 2040 as result of declining demand for personal vehicle ownership.\textsuperscript{156} This trend would place downward pressure on auto insurance company revenues and force firms to adapt. As auto-manufacturers continue to transition towards shared autonomous vehicle service models (e.g., fleets run by ride sourcing or car sharing companies), demand for commercial auto insurance is expected to increase and account for 28\% of total losses by 2040 (up from 13\% in 2015).\textsuperscript{157} This presents an opportunity for insurance companies to create new products tailored towards the commercial market that address new needs associated with shared AV models. In the Ontario market, Aviva and Intact Insurance have successfully addressed the recent shift towards ride sourcing. Aviva currently insures Lyft and Intact insures Uber in Ontario.\textsuperscript{158} These, larger, more established firms were able to effectively navigate an uncertain regulatory environment and provide coverage to these large commercial customers. Relationships with large ride sourcing

\textsuperscript{151} Millennials Leading a Decline in Car Ownership in Some U.S. Cities (May. 2017). Planetizen
\textsuperscript{152} Car ownership may decrease in the U.S. – here’s why (Feb 2017). Curbed
\textsuperscript{153} Deloitte conducted quantitative analysis to determined YoY growth rates using statistics Canada data
\textsuperscript{154} New Motor Vehicle Sales by Province (Feb. 2018). Statistics Canada
\textsuperscript{155} Disruptive Mobility: A scenario for 2040 (2015). Barclays Bank PLC
\textsuperscript{157} Ibid.
\textsuperscript{158} Ridesharing and auto insurance in Ontario (Mar 2018). Financial Services Commission of Ontario
companies such as Uber and Lyft will be valuable to insurers as they continue to build out their CV/AV capabilities.

b. A shift in claims complexity and liability / fault-determination

Insurance companies will need to develop a revised approach to claims resolution and liability / fault-determination as shared autonomous vehicle service models become more common. Insurers will need to prepare for the following potential shifts within the mobility ecosystem. Note that these shifts are not likely to be sequential and there is potential for some of the shifts to “co-exist”: 159

**Shift 1: Shared semi-autonomous vehicles co-exist with standard vehicles.** During this time period, courts and insurers will be challenged to determine if collision responsibility should be placed on the driver of the Level 2 or 3 vehicle, on the hardware/software that supports the semi-AV or a combination of the two. 160 Claims resolution will be complex during this stage as insurers will have to deal with multiple stakeholders such as the driver, the auto-manufacturers (e.g., GM, Audi), companies that manage the ride sourcing platform (e.g., Lyft, Uber) and potentially the technology companies that developed and / or manage the autonomous software / hardware. As mentioned above, initial level 2 and 3 CV/AV models may collide with other vehicles due to factors such as technical glitches, over-reliance on CV/AV technologies by the driver, and driver underload (lack of stimulation). 161 These factors may contribute to the complexity of claims resolution during the transitionary period.

**Shift 2: Shared fully autonomous vehicles co-exist with standard / semi-autonomous vehicles.** This shift presents similar complexities to those outlined above, however, the “driver” in the fully autonomous vehicle will likely have severely reduced / no collision liability. Greater collision liability will likely be placed on the remaining stakeholders outlined above. 162

**Shift 3: Shared fully autonomous vehicles dominate our roads.** This shift will result in increased liability for auto-manufactures, ride sourcing companies, car sharing companies, other fleet operators and technology companies that developed / manage the underlying software / hardware. 163 See the Outlook on Claims and Liability sections above for further explanation on how claims and liability will likely be managed by insurance companies and courts.

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159 Ibid.
160 Autonomous Vehicles; Considerations for Personal and Commercial Lines Insurers (2016). Munich RE
162 Insuring the Future of Mobility (May. 2016). Deloitte.
163 Ibid.
Implications for Ontario: Ontario’s insurers will look to meet new market demands by shifting their product offering mix (e.g., commercial insurance for auto-manufacturers operating new AV or shared vehicle fleets, cyber security insurance, increased emphasis on product liability insurance) or by building or leveraging partnerships with mobility service providers to offer bundled products (e.g., shared vehicle subscriptions with insurance included). Insurers will need to work with regulators to enable responsible innovation in products and partnerships.

Areas for further research

13. Determining the contributing factors influencing acceptance and uptake of ride sourcing (e.g., geography, demographics, gas prices, alternate options), shared vehicle ownership our use, and new mobility models (including AVs) and their relative significance in Ontario will be an important input for insurers, governments, and all other members of the mobility ecosystem.

14. Insurers could further explore how the adoption of ride sourcing and car sharing (including different scenarios for ride sourcing as well as commercial vs. personal ownership) will influence the uptake of AVs (in terms of level of acceptance, timing, etc.) as well as how AVs will accelerate adoption of ride sourcing or car sharing models, allowing them to efficiently plan investments and assess risk over the short to medium term.

These shifts are illustrative scenarios and are not guaranteed or likely to happen sequentially.
Insurance products and channels
The new insurance product mix
Demand for traditional personal auto insurance coverage is projected to decrease as the transportation system continues to evolve. A list of traditional auto insurance coverage is outlined in the table below:

<table>
<thead>
<tr>
<th>Traditional Coverage Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Comprehensive</strong></td>
<td>Protection for the policyholder’s vehicle for damages that are not related to a collision (e.g., natural disasters, falling objects, vandalism, theft)</td>
</tr>
<tr>
<td><strong>Collision</strong></td>
<td>Protection for the policyholder’s vehicle for damages arising from a collision. Examples of covered incidents include hitting another car or hitting a stationary object</td>
</tr>
<tr>
<td><strong>Driver Liability</strong></td>
<td>Protection for the driver against the damages caused to another person’s body (bodily injury liability) or property (property damage liability) because of the negligent operation of the vehicle</td>
</tr>
<tr>
<td><strong>Product Liability</strong></td>
<td>Protection for OEMs and suppliers against component failure</td>
</tr>
<tr>
<td><strong>Other Coverages</strong></td>
<td>Other traditional automobile insurance coverages include medical payments, under-insured/un-insured, and personal injury protection, among others</td>
</tr>
</tbody>
</table>

Consumer demand for both driver liability and collision coverage is expected to decrease as autonomous vehicles become more common (see Figure 18). Declining demand for driver liability coverage is due to the fact that drivers will no longer be required to operate their AVs therefore limiting / removing their liability. Collision coverage demand is also expected to decrease due to increased vehicle safety and reduced occurrences of collisions.

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165 Insuring the Future of Mobility (May. 2016). Deloitte.
166 Ibid.
Insurance companies have the opportunity to introduce a range of product offerings to address this shift in consumer and commercial demands. The transition period in which fully autonomous, semi-autonomous and standard vehicles co-exist presents a complex demand dynamic for auto insurance products. During this period, demand for personal auto insurance will remain steady as drivers in control of standard and semi-autonomous vehicles still require coverage. Consumers that elect to use fully autonomous vehicles will likely not be required to purchase driver liability insurance as the operation of the vehicle will be fully managed by an auto-manufacturer or other vehicle service providers (shared or non-shared). As the transportation sector transitions towards level 5 automation, demand for new insurance product offerings will emerge to address the risks associated with autonomous technologies such as those outlined below:

a. **Autonomous product liability insurance**: Fully and semi-autonomous vehicle manufacturers and operators will exhibit increasing demand for product liability coverage. This is largely due to the fact that partial/full liability is expected to be transferred from the human driver to the manufacturers and operators of the autonomous technology. These companies will be looking to protect against component failure due to factors such as flawed algorithms and hardware/software malfunction. A recent Insurance Institute of Canada report states that auto product liability claims will likely grow from almost nothing today to become a market approaching the size of today’s commercial auto insurance market. Experts predict that the introduction of

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168 Autonomous Vehicles; Considerations for Personal and Commercial Lines Insurers (2016). Munich RE
170 Automated Vehicles; Implications for the Insurance Industry in Canada (2016). The Insurance Institute of Canada
autonomous product liability offerings will result in $2.5 billion in annual premiums.¹⁷¹,¹⁷²

**b. Cyber security insurance products:** Autonomous vehicle hardware / software developers and service providers will aim to protect against cyber risks such as hacking, cyber theft, ransomware and misuse of customer information.¹⁷³ These companies will have access to vast consumer data (e.g., travel patterns and passenger behavior) that will be a target of cyber hacks. Analysts anticipate significant risk of hackers seizing control of entire fleets of autonomous vehicles. Companies that manage large fleets of autonomous vehicles (shared or non-shared) are subject to significant cyber risk and will be demanding comprehensive cyber security coverage to mitigate this risk. A recent Harvard Business Review article states that experts anticipate that insurance companies have the potential to achieve $12 billion in annual cyber security premiums.¹⁷⁴,¹⁷⁵

**c. Infrastructure Insurance:** Fully and semi-autonomous vehicle manufacturers / operators will be looking to implement various safeguards such as cloud server systems and signals to protect riders / drivers.¹⁷⁶ This presents a large opportunity for property and casualty insurers to underwrite the value of the safeguard’s hardware and / or software. Experts predicts that infrastructure insurance have the potential to garner annual premium revenues of $500 million.¹⁷⁷,¹⁷⁸

**d. Fleet Operation Liability Insurance:** Fleet operators (such as Uber and Lyft) are expected to exhibit increased demand for specialized insurance offerings to protect against the risks associated with their business model.¹⁷⁹

¹⁷² Note: Represents the U.S. Market (USD)
¹⁷⁴ Ibid.
¹⁷⁵ Ibid.
¹⁷⁶ Ibid.
¹⁷⁷ Ibid.
¹⁷⁸ Ibid.
¹⁷⁹ Autonomous Vehicles: Plotting a Route to the Driverless Future (2017). Accenture
**Figure 19: Current versus potential insurance product offerings**

<table>
<thead>
<tr>
<th><strong>Current Auto Insurance Product Offerings</strong></th>
<th><strong>Potential Future Auto Insurance Product Offerings</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Comprehensive</strong>: Protection for the policyholder’s vehicle for damages that are not related to a collision</td>
<td><strong>Autonomous Product Liability</strong>: Protection for OEMs and suppliers against CV/AV component failure</td>
</tr>
<tr>
<td><strong>Collision</strong>: Protection for the policyholder’s vehicle for damages arising from a collision</td>
<td><strong>Cyber Security</strong>: Protection for CV/AV hardware / software developers against cyber risks such as hacking, cyber theft, ransomware and misuse of customer information</td>
</tr>
<tr>
<td><strong>Driver Liability</strong>: Protection for the driver against the damages caused to another person’s body or property because of the negligent operation of the vehicle</td>
<td><strong>Infrastructure</strong>: Protection for CV/AV vehicle manufactures / operators who are looking to implement various safeguards such as cloud server systems and signals to protect riders / drivers</td>
</tr>
<tr>
<td><strong>Product Liability</strong>: Protection for OEMs and suppliers against component failure</td>
<td><strong>Fleet Operation Liability</strong>: Protection for CV/AV fleet management firms against risks associated with fleet operation</td>
</tr>
<tr>
<td><strong>Other Coverages</strong>: Other coverages such as medical payments, under-insured/uninsured, and personal injury protection</td>
<td></td>
</tr>
</tbody>
</table>

**Channels**

Auto insurance can be delivered through different channels to align with evolving customer needs. In the short to medium term transition phase, as personal car ownership continues to dominate, insurance agents and direct channels will likely remain the primary outlets for traditional, vehicle-centric personal auto policies. A number of forces may cause the number and premiums of these traditional policies to decline, including a decrease in personal car ownership, an increase in bundling coverage with other products and services (such as vehicle subscription and maintenance), and a rise in self-insurance for large shared vehicle fleets. This will likely cause total agency commissions to fall as well.

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With new technologies, insurance companies can introduce advanced delivery methods, including subscription, usage based or pay-per-use models. These models might be delivered by insurance companies or by mobility management providers that can offer products as an added fee to their customers. Business to business relationships with mobility management providers, like that between Liberty Mutual and Care by Volvo in the U.S. or between Intact and Uber in Canada, will be increasingly important as insurers introduce fleet coverage or micro-insurance (e.g., subscription-based or usage-based) products (discussed below).

Subscription-based models are an emerging form of vehicle ownership, with Volvo, Ford, Cadillac, and Porsche offering monthly subscription car services to date. These bundles typically include the vehicle, maintenance, insurance, and concierge service for a monthly fee. Distinct from leases due to their short duration and extra services (including insurance), the delivery channel is also typically through mobile or digital channels versus a physical dealership. Care by Volvo, one example of a subscription-based service, is anticipated for launch in Canada in spring 2018. Car sharing services such as Car2Go and Fair already have similar models on the market in Canada and the US.

Figure 20 - UBI Models and Case Studies

<table>
<thead>
<tr>
<th>Pay-As-You-Drive/ Distance Based</th>
<th>Pay-How-You-Drive</th>
<th>Pay-As-You-Go</th>
</tr>
</thead>
<tbody>
<tr>
<td>National General Insurance</td>
<td>TD MyAdvantage(Canada)</td>
<td>Metromile (US)</td>
</tr>
</tbody>
</table>

Figure 20 - UBI Models and Case Studies

The first UBI programs were introduced a decade ago. As telematics technology have become more effective and less expensive, a number of UBI models have emerged.

- National General Insurance Low-Mileage Discount (US)
- TD Insurance
- Metromile

National General Insurance and GM OnStar were among the first to institute a telematics-driven pay-as-you-drive insurance discount program in the U.S. Active OnStar subscribers with OnStar Vehicle Diagnostics can opt-in to receive an insurance discount based on tiers corresponding to miles driven (less than 15,000 miles / year). Mileage is confirmed based on OnStar Vehicle Diagnostics reports.

Using telematics connected to an app on the driver’s mobile phone, the program collects and analyzes driving data for each trip including acceleration, braking, speeding and cornering and assigns a driving score. An average score is determined based on a 12-month rolling trip average and used to calculate a discount on premiums up to 25%, applied when the policy is next renewed.

Metromile sets a low base rate then charges an additional rate per mile (a few cents), up to a cap of 250 miles / day. Metromile Pulse, a wireless OBD-II port plug in, counts miles to determine a total monthly bill. Driving behaviour is not taken into account. Metromile Smart Driving App does provide the driver with information on trips taken, vehicle condition, and parking location.

Source: National General Insurance Low-Mileage Discount.

Source: TD MyAdvantage Overview.

Source: Metromile website.
https://www.metromile.com/

As discussed in the case study above, usage-based insurance (UBI) is an innovative insurance

"We would love to be able to introduce more flexible, usage-based offerings. However, current Ontario regulation prevents us from doing so"

- Major Ontario insurance provider
model that more closely aligns an individual’s driving behaviours with premium rates for auto insurance (rather than relying on aggregated risk profiles).\textsuperscript{183} Distance driven and driving behaviors are tracked, either by using odometer readings or telematics that are self-installed into a special vehicle port or already integrated in the vehicle. These telematics devices measure a number of elements of interest to underwriters: kilometers driven, time of day, where the vehicle is driven (GPS), rapid acceleration, and braking patterns. Telematics auto insurance allows driver and vehicle behaviour to be monitored in real-time, informing individualized premium pricing.\textsuperscript{184}

UBI programs offer many advantages to insurers, consumers and society. Linking insurance premiums more closely to actual individual vehicle or fleet performance allows insurers to more accurately price premiums. Risk can be more accurately assessed based on real-time driving behaviour, frequency, and location, potentially increasing affordability. This may also incent consumers to reduce kilometers driven and adopt safer driving habits by linking these decisions directly to premium costs. This level of consumer control is enhanced as the majority of UBI programs are delivered via an app, allowing customers to track usage, interact with their insurer, and make updates to their account or policy digitally. Fewer kilometres driven and safer driving also aid in reducing collisions, congestion, and vehicle emissions, reducing the likelihood of a loss event and contributing to the safety and environmental benefits of connected and autonomous vehicles. While these channels will reduce cost of coverage for customers and better align with their needs, there may be regulatory barriers to implementation in Ontario, as detailed in the discussion on Ontario’s regulatory framework below (see section on Regulatory framework and Role of Government).


\textsuperscript{184} Ibid.
**Implications for Ontario:** Insurers in Ontario have started to develop new products and channels to accommodate an increasingly digital market and shifting models of ownership (e.g., Intact and Aviva’s ride sourcing insurance policies). The current regulatory framework, however, may present barriers to further innovative product development and delivery (e.g., pay-per-mile insurance) that need to be addressed so the province can compete.

**Areas for further research**

15. Insurers could develop a better understanding of how new products and delivery models will impact auto-manufacturers, government bodies and other mobility ecosystem stakeholders. Strategic partnerships with key stakeholders will allow insurers to develop effective products and delivery models tailored to the CV/AV market.

16. The benefits and challenges of the current regulatory regime surrounding insurance (including regulations related to new insurance product approval, liability and fault determination, privacy, data management and protection, transportation-related, and others) could be reviewed by the federal and provincial government, as well as other key stakeholders (e.g., auto manufacturers) with due consideration for how to balance privacy concerns, competitiveness, and innovation with regard to new insurance products and delivery channels.

17. The government’s regulatory review (including insurance, privacy, data, passenger & commercial transportations regulations etc.) should in particular focus on implications for consumers and insurers in the Ontario context, given the large geographical range, kilometres driven, and mobility patterns given the mix of urban, suburban, and rural locations.
Role of insurers in smoothing the transition towards connected and autonomous mobility

The transition period in which fully and semi-autonomous vehicles may share the road with standard vehicles will place strain on the current transportation system, with the need to accommodate a range of vehicle capabilities, risk levels, and technological needs. Insurance companies have a key role in working with governments and auto-manufacturers to encourage the adoption of autonomous vehicles and accelerate / ease the transitionary period. Customer education and awareness will be integral in encouraging the adoption of autonomous vehicles.\(^{185}\) Expert research indicates that consumers were much more willing to use autonomous vehicles once they understood the benefits they provided (i.e., shorter commute times, safety, ability to multi task etc.).\(^{186}\) Today, approximately 51% of Ontarians trust autonomous vehicles and public acceptance of autonomous vehicles in Canada has increased over time.\(^{187}\) Figure 21 below demonstrates that the percentage of Canadian consumers who think self-driving vehicles will not be safe is decreasing with increased exposure and testing, in line with other global regions.

**Figure 21 - Percentage of consumers who think fully self-driving vehicles will not be safe (2017-2018)**

![Figure 21 - Percentage of consumers who think fully self-driving vehicles will not be safe (2017-2018)](image)

Auto-manufacturers will likely lead the promotion of autonomous vehicle benefits to encourage vehicle sales.\(^{188}\) During these promotions, auto-manufacturers may highlight a range of insurance coverage options that can be included in the vehicle purchase price. Insurance companies can work with auto-manufacturers

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\(^{186}\) Ibid.


\(^{188}\) Ibid.
to develop coverage products with easy online enrolment options to help encourage the adoption of autonomous vehicles.

Another barrier to accelerating the CV/AV transitionary period is infrastructure capabilities. Connected vehicles will need to communicate with intelligent infrastructure to effectively monitor and respond to the surrounding environment. Infrastructure developers and operators will be tasked with implementing technologies such as “smart” traffic signs, lane markers, guide walls and beacons to provide information to the connected vehicle and ensure a safe journey. Figure 22 below outlines the infrastructure needed to support select CV/AV technologies and the associated barriers to adoption.

Figure 22: Infrastructure Need and Barrier to Adoption Evaluation for Different Technologies

<table>
<thead>
<tr>
<th>Example CV/AV Technology</th>
<th>Infrastructure Need</th>
<th>Infrastructure Cost</th>
<th>Barriers to Adoption</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lane Departure Warning</td>
<td>Lane Marks</td>
<td>Low</td>
<td>Infrastructure</td>
</tr>
<tr>
<td>Left Turn Assist</td>
<td>Lane Marks</td>
<td>Low</td>
<td>Cost, Infrastructure</td>
</tr>
<tr>
<td>Adaptive Cruise Control</td>
<td>None, possible</td>
<td>Depends</td>
<td>Cyber security</td>
</tr>
<tr>
<td></td>
<td>dedicated lane</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Traffic Sign Recognition</td>
<td>Traffic Sign</td>
<td>Moderate</td>
<td>Cost, Technological Maturity</td>
</tr>
<tr>
<td>High Speed Automation</td>
<td>Traffic Sign, Lane</td>
<td>Moderate</td>
<td>Reliability</td>
</tr>
<tr>
<td></td>
<td>Marks</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Automated Assistance in</td>
<td>Lane Marks,</td>
<td>Relatively High</td>
<td>Infrastructure,</td>
</tr>
<tr>
<td>Roadwork and Congestion</td>
<td>Beacons, Guide</td>
<td></td>
<td>Reliability</td>
</tr>
<tr>
<td></td>
<td>Walls</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fully Driverless Cars</td>
<td>Lane marks, traffic</td>
<td>Relatively High</td>
<td>Regulation, Liability, Cost,</td>
</tr>
<tr>
<td></td>
<td>signs, lighting,</td>
<td></td>
<td>Cyber-Security,</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>infrastructure</td>
</tr>
</tbody>
</table>


Infrastructure developers and operators will look to insure against infrastructure component failure. Insurers will have a key role to play in developing offerings that align with the needs of these customers and reduce strain on the transportation system.

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189 An Assessment of Autonomous Vehicles: Traffic Impacts and Infrastructure Needs (Mar. 2017). Center For Transportation Research, The University of Texas at Austin
190 Ibid.
191 Ibid.
Insurance companies can also conduct research alongside other key stakeholders at autonomous vehicle testing centers. The insights gained from this research will allow insurers to remain informed on the latest advancements in technology and how they may impact future insurance offerings / models. For example, the Ontario government’s recent $80 million investment into the Autonomous Vehicle Innovation Network (AVIN) project in partnership with the Ontario Centres of Excellence (OCE) will help promote technological advancement, and create sites across the province to develop, test and validate new technology. In addition, the AVIN Central Hub will facilitate program delivery and act as a resource and focal point to share information, build connections and raise awareness between CV/AV stakeholders. Canadian insurance companies can collaborate with AVIN when developing effective new product offerings / delivery models to encourage AV adoption and minimize the transition period. In the U.S., test centers such as Mcity facilitate strong collaboration between key stakeholders and provide clear guidelines on data sharing (See case study). Automotive industry researchers believe that collaboration amongst key stakeholders in locations such as the AVIN Demonstration Zone, and Mcity will be key in accelerating the development of autonomous vehicle development, regulation and ultimately adoption. A recent study conducted by the European Parliament states that accelerating the adoption of AVs by five years will generate European added economic value of approximately €148 billion. It is therefore in the interest of federal and provincial regulators to determine the economic

Case Study:

What is Mcity?
The University of Michigan operates a state of the art autonomous vehicle testing facility in Ann Arbor, Michigan. Here, a range of both public and private stakeholders collaborate on the development autonomous technologies.

Data Sharing
All Mcity stakeholders have early access to testing data generated by other Mcity partners.

Benefit to Insurers and the Transportation Sector
Insurance companies have direct access to the latest testing data that will allow them to develop their AV capabilities (e.g., product development and underwriting methodology). Mcity also promotes collaboration amongst key public and private stakeholders to accelerate both the development and adoption of AVs.

Source: Mcity Website. (March 2018). University of Michigan

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192 Ontario launches $80 million new autonomous vehicle network in Stratford (Nov. 2017). IT World
194 European Added Value is the quantification of the socio-economic costs and benefits related to the earlier than anticipated baseline roll-out of AVs (see footnote below for source)
value of accelerated AV adoption in Ontario and to develop an effective regulatory framework that encourages safe and secure uptake.\textsuperscript{195}

\textbf{Implications for Ontario:} As discussed, autonomous vehicle testing sites (such the Autonomous Vehicles Innovation Network demonstration zone in Stratford, Ontario) will act as collaboration “hubs” for insurers, government bodies, auto-manufacturers and other key stakeholders to collaborate on strategic CV/AV initiatives that enable a smooth transition for the transportation sector in Ontario. Strategies may differ by region depending on vehicle ownership patterns, access to other modes of transportation, and consumer preferences.

\textbf{Areas for further research}

18. Key stakeholders could establish collaborative partnerships to collectively identify consumer concerns and barriers to AV adoption and develop strategies to address them.

19. All industry players, including insurers and government researchers, could apply demographic information (e.g., population, vehicle ownership patterns, access to other transportation) to understand how strategies to accommodate, manage risk, and encourage adoption of autonomous vehicles might differ by region, as well as how connected and autonomous vehicles might complement other transportation or city-building initiatives.

\textbf{Regulatory framework and role of government}

Governments play three key functions as relates to connected and autonomous vehicles:

- Policymaker / regulator: ensuring public safety, security, and accessibility while encouraging innovation and providing for data access where appropriate; developing policy and programs, planning infrastructure
- Researcher and developer: fostering innovation through funding, convening relevant stakeholders, and collaboration across sectors, balancing the interest of the citizen with technological advancement
- End user: operating vehicle fleets, investing in infrastructure, and procuring products and services\textsuperscript{196}

All three order of government have a role in regulating or enabling an innovative, competitive, and transparent insurance industry, with different functions depending on the context.

\textsuperscript{195} A Common EU approach to liability rules and insurance for connected and autonomous vehicles. (Feb 2018). European Parliamentary Research Service (EPRS)

There is ongoing debate as to how the existing insurance framework could adapt to the control, operation and insurance of autonomous vehicles. Some insurers, industry associations, and insurance experts felt that updates were needed to reflect the particular context of connected and autonomous vehicles. Updates could result in new or amended regulation / legislation while others felt voluntary standards speaking to best practice guidelines would be adequate. One insurer suggested that regulations could be used to drive standards adoption, introducing consistency, rigour, and enforceability while allowing flexibility as standards are easier to amend in response to industry, social, and technological shifts.

**Federal responsibilities and national frameworks**

The role of the Federal Government and arms-length agencies with national jurisdiction is primarily as policymaker / regulator. A range of national frameworks (regulatory, policy, or guidance-based) impact auto insurers (though, as outlined below, auto insurance itself is determined at the provincial level), including:

- **Transport Canada** governs vehicle safety and related standards under the *Motor Vehicle Safety Act* and related regulations, standards, technical standards documents, and test methods, as well as the *Motor Vehicle Transport Act*.\(^{197}\) All regulation governing driver licensing, vehicle registration and the safe operation of vehicles on public roads is provincial jurisdiction, and falls under the *Highway Traffic Act* in Ontario.

- **The *Insurance Companies Act* (ICA)** governs all federally incorporated or registered insurance companies in Canada, with the Financial Consumer Agency of Canada responsible for all components related to consumer provisions.\(^{198}\) ICA regulations cover a range of areas including complaint information, electronic documents, and prepaid payment products.

- **The Office of the Superintendent of Financial Institutions (OSFI), an independent agency of the Government of Canada, regulates and supervises Federally Regulated Financial Institutions (FRFIs), including all property and casualty insurance companies incorporated under the *Insurance Companies Act*, to determine their financial soundness and regulatory compliance.**\(^{199}\) The OSFI is not responsible for regulating licensing and products (described below under “Current Provincial Responsibilities”). The OSFI sets guidelines and expectations for its membership with respect to key topics such as cyber security risk.\(^{200}\)

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• Canada’s *Personal Information and Electronic Documents Act* (PIPEDA) protects personally identifiable information held by private sector organizations. Organizations subject to PIPEDA, including insurance companies, may only collect personal information that is necessary for the identified purposes. This collection must be limited to what is reasonable in the circumstances and must consider the balancing of customer needs against privacy rights. Personal information must be protected by security safeguards appropriate to the sensitivity of the information.

• New amendments to PIPEDA also mandate privacy breach notification clauses and logging of security incidents, some of a number of new regulations and amendments brought into force under the recently enacted *Digital Privacy Act* (DPA).²⁰¹ Once enacted, the breach notification provisions of the DPA will amend PIPEDA to require organizations to notify not only affected individuals but also the Office of the Privacy Commissioner of Canada (OPC) in the event of a breach, and other relevant stakeholders.

Beyond the financial soundness of insurers offering automotive insurance, policy and product frameworks are determined at the provincial level. Some stakeholders felt national guidance or a national framework could help drive consistency for insurers and consumers operating across borders while reducing regulatory burden. This would require alignment across provincial regulators as to mandated products, minimum coverage, and scope of application. Regulators might follow the model of the Canadian Council of Motor Transport Administrators’ National Safety Code for Motor Carriers, developed by member jurisdictions (including provincial and territorial governments and the federal government) and motor carrier industry stakeholders. The Code is a set of harmonized standards relating to driver licensing and the commercial regime to ensure road safety and regulatory harmonization across the country.²⁰²

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Provincial responsibilities and Ontario regulatory framework
Policymaking, regulation, research and development, and commitments as an end user are largely determined by each province’s unique auto insurance framework. Insurer licensing, marketing of insurance products, and other components of auto insurance are the responsibility of provincial and territorial governments.203 Ontario’s auto insurance framework is unique to Ontario, though contains some parallels to other provinces (e.g., “no-fault” insurance and mandatory third party liability coverage for all vehicle owners).

The Financial Services Commission of Ontario (FSCO) regulates a number of financial services sectors, including the insurance sector. The FSCO is responsible for administering legislation and related regulation relative to auto insurance, including approving auto insurance policies. Key legislation, regulation, and provisions related to auto insurance include:

- **Insurance Act and related regulations**: Comprehensively specify the development, content, and governance over insurance policies, including provisions related to formal policy requirements, minimum coverages, liability policies and minimum liabilities, property damage compensation, claims processes and dispute resolutions204
- **Compulsory Automobile Insurance Act**: Ensures and specifies the responsibility of vehicle owners and lessees to ensure all motor vehicles carry automobile insurance205
- **Registered Insurance Brokers Act**: Details the qualifications required to become a registered insurance broker206
- **Motor Vehicle Accident Claims Act**: Provides for compensation to people injured in automobile collision when no automobile insurance exists to respond to the claim207
- **Highway Traffic Act**: Details the rules for operation of vehicles on public roads, including provisions related to liability and reportable collisions.

“Really simply, how many times does the word “driver” appear in regulation? How many regulations need to be changed?”

– Insurance industry expert

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205 Ibid.
206 Ibid.
207 Ibid.
Insurers, industry associations, and industry experts contended that the current framework does not allow insurers to adequately respond to the shift towards greater levels of automation and greater shared ownership. Specifically, many recommended a review of the regulatory framework before Level 3 – 5 automated vehicles are deployed to give clarity for industry and the public, as well as a shift to less rigid models that allow regulators to adapt and proactively keep pace with technological change.\(^\text{208}\)

**Shifts in product types**

If ownership continues to shift from individual vehicle ownership to increased use of ride sourcing or shared vehicle ownership, regulation will have to either keep pace with new product developments or allow the flexibility for product innovation. To date, the FSCO Superintendent has approved auto insurance benefits for three insurers covering fleets from seven ride sourcing companies. All drivers and vehicle owners using insured ride sourcing companies are covered while the app is turned on. Passengers are covered from the moment they turn on the ride sourcing app to when they exit the vehicle. The driver or vehicle owner must rely their own personal auto insurance coverage when the app is turned off.\(^\text{209}\)

Insurers must obtain superintendent approval for all additional benefits in except of the *Statutory Collision Benefits Schedule*, a process that can take over six months.\(^\text{210}\) Given the pace of change to technology and ownership models in this space, industry experts warned this could stifle innovation and competitive advantage.\(^\text{211}\) Similarly, in order to support new policies such as the fleet coverage for ride sourcing companies, the Ontario Government approved changes to the definition of “fleet” in the *Insurance Act*, Regulation 664 to encompass a

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\(^{209}\) Ridesharing and auto insurance in Ontario. (2018). Financial Services Commission of Ontario; The first such product was Aviva Canada’s “Permission to Carry Paying Passengers for a Transportation Network” endorsement to the OAP 1 (standard personal automobile insurance). As of November, 2017, Aviva insures the Lyft ridesharing app. The second product was Intact’s blanket fleet coverage under OAP 1 for Uber Services (operated by Rasier Operations B.V.). See FSCO Superintendent’s Bulletin No. A-12/16 for further background.

\(^{210}\) Insurance Act, R.S.O. 1990, c. I.8, s. 224 and primary interviews.

\(^{211}\) Insurance Act, R.S.O. 1990, c. I.8, s. 224
group of automobiles available for hire “through a common online-enabled application or system for the pre-arrangement of transportation.”

The FSCO recognizes that automobile insurance will continue to evolve and “will require innovative solutions and responses by all stakeholders, including FSCO, that respond to technological advances.” A good example is the Superintendent’s approval of an Electronic Insurance Card for all ride share drivers covered under Intact’s Uber policy. This allows ride share drivers to provide electronic evidence of insurance through an online-enabled application in place of a physical card or certificate. The issue of whether electronic insurance cards might be approved more broadly is undergoing consultation at the national level. While developments like this are promising for industry stakeholders, some suggested that introducing legislative change for each new model is unrealistic and suggested a shift from the current rules-based system to a principles-based framework that would allow new policies to be introduced and iteratively define requirements for an evolving landscape.

Shifts in determining coverage

Telematics embedded in vehicles can provide highly detailed, real-time data on a vehicle’s usage, driver behaviour, and the conditions surrounding a collision. As discussed above, this allows insurers to set premium rates with great accuracy, based on the client’s actual mobility patterns and associated level of risk. Insurers in the US, Australia, EU, and UK have experimented with usage-based and behaviour-based policies over the past decade, with some companies offering discounts on premiums based on safe driving behaviours (e.g., Allstate’s Drivewise program and TD’s MyAdvantage as one of the first Canadian examples), mileage driven (e.g., National General Insurance Low-Mileage Discount) or both (e.g., Progressive Insurance’s Snapshot program or QBE’s Insurance Box). As telematics have increased the ability for driver and vehicle information to be transmitted and premiums adjusted in real time, start-ups including Metromile and By Miles are beginning to experiment with pay-per-distance models where clients pay a low base rate and an additional risk-adjusted per-mile / kilometer fee.
Existing provincial regulation can limit the ability of Canadian insurers to experiment with some of these more recent models. Insurers in Canada can use usage information to offer a discount on premiums but not to drive the entire price. Premiums must be priced based on traditional proxies then given a discount (within a given threshold) based on usage. The FSCO Superintendent’s Bulletin A16/16 states that usage-based policies are permissible under s. 127 of the Insurance Act, permitting mid-term adjustments to a premium based on a given method (e.g., a usage-based discount). Usage data may be used to set discounts in accordance with an approved risk classification system, review rating criteria currently used to assess premiums, and to detect and prevent fraud. The Superintendent specifies that the maximum premium must be the undiscounted premium rate.\(^\text{217}\)

Any regulatory change in this space must also consider associated legislation related to the use of consumer data. The FSCO Superintendent’s Bulletin A16/16 specifies that telematics data collected for the purposes of auto insurance rating qualifies as personal information under PIPEDA and should be treated as such.

Insurers must ensure that clients opt-in to the collection and use of telematics data for usage-based adjustments.

Access to data
Insurers and industry associations expressed the access to data and ability to leverage digital technologies would be increasingly critical enablers as their industry seeks to embrace new automotive technologies. Stakeholders emphasized that insurers should be involved from the beginning stages of research and development and should be granted equal access to testing data that may only be available to auto-manufacturers. One proposal was put forward by insurers and industry associations for the Ontario government to amend data reporting requirements for its AV Pilot Regulation to include mandatory elements to the data reporting under the pilot, including testing, collision, and disengagement data. The California Department of Motor Vehicles, for instance, requires manufacturers to submit Autonomous Vehicle Collision Reports as well as an Annual Report of Autonomous Vehicle Disengagement, all of which are made public. This information would allow insurers to understand the risk profile of emerging vehicles and proactively adjust their product mix and practices accordingly.

The Provincial Government might play a dual role with respect to data access:

1. Setting standards for ownership and use of data so that all stakeholders, including insurers, may develop products, services, and business models accordingly
2. As a steward, aggregating data for shared use among all interested stakeholders

These and other ideas related to data access, ownership, privacy and security are further explored in Connected and Autonomous Vehicles in Ontario: Implications for Data Access, Ownership, Privacy, and Security.

Municipal responsibilities
Municipalities are responsible for executing on the legislative and regulatory framework created by provinces and territories. Municipalities also set by-laws regulating signage, traffic management systems, and licensing and requirements for commercial vehicles, including insurance coverage. Municipalities including Ottawa, Toronto, London, Winnipeg, and Vancouver have recently introduced vehicle-for-hire by-laws covering taxicabs, limousines, and “private transportation companies” (e.g., Uber, Lyft) that will set requirements for insurance for new ride sourcing models.

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219 See by-laws for City of Ottawa, City of Toronto, City of London, City of Winnipeg, and City of Vancouver.
As end users, municipalities may also be fleet or transportation operators and may seek to shape how insurance policies evolve with new technologies and modes of mobility. Finally, municipalities may control infrastructure (e.g., cooperative intelligent transport systems) capturing data that could be shared with insurers for specific uses related to improving traffic and road safety.

**Implications for Ontario:** Ontario insurers report that the current regulatory framework could be adjusted to better apply to CV/AV technologies. The provincial government could look to other jurisdictions for models that have introduced flexible and responsive regulatory practices and have made data open and accessible in the initial development phases of this ecosystem. The provincial government could also participate and learn from CV/AV testing zone initiatives and results to inform policy and potential regulatory development based on near-real world scenarios.

**Areas for further research**

20. Provincial entities including the Information and Privacy Commissioner of Ontario, Consumer Protection Ontario, and the Ministry of Government and Consumer Services more broadly could work with federal counterparts (e.g., the Competition Bureau, the Office of the Privacy Commissioner of Ontario) to assess the need for standards with respect to personal data collection and use by insurers

**Jurisdictional approaches**

The section below outlines the approach to connected and autonomous vehicle insurance regulation across a number relevant jurisdictions including the U.S. (specifically Michigan, Arizona, and California) and Australia. Jurisdictions were selected based on a range of criteria including geographic proximity, comparable regulatory environment and similar demographic factors to Canada. Insurers, government bodies and other key stakeholders in Ontario can apply insights from the advancement of CV/AV technology, insurance and regulation in these jurisdictions and incorporate them into their own CV/AV’s approach / framework.

**United States**

Due to Canada’s close proximity to the United States and the likelihood that connected and autonomous vehicles will need to function cross-border within harmonized regulation and infrastructure, the analysis below focuses on American national and state governments. A recent European Parliament study states that, “insufficient coordination among (different) jurisdictions on the adoption of regulatory rules enabling the testing, licensing and operation of autonomous technologies could ultimately lead to unnecessary barriers to the development
and deployment of new solutions.” Similar to countries in the European Union, private companies, governments, and vehicle operators in North American nations (such as Canada the U.S.) may benefit from coordination and collaboration on the development of CV/AV regulations.

**U.S. National Government**

The National Highway Traffic Safety Administration (NHTSA) is responsible for the development and enforcement of national vehicle safety standards, including those that relate to CV/AVs, however, CV/AV insurance regulation is currently a state responsibility (see Figure 24 below for a comparison of NHTSA and State responsibilities). As mentioned above, the NHTSA recently released a document entitled “Automated Driving Systems 2.0” that provides guidance for automated driving systems to states and industry. In this document, the NHTSA encourages States and insurance companies to begin to consider how to allocate liability to vehicle owners, operators, passengers, manufacturers and other entities when a collision occurs. The regulatory body is also encouraging states to determine which key stakeholders must carry auto insurance by law. Other than these guidelines, the NHTSA has done little to shape the development of autonomous vehicle insurance regulations. During a recent meeting organized by the Counsel of State Governments (CSG), Robert Peterson, law professor at Santa Clara University stated that “while the federal government might have the authority to pre-empt states on autonomous vehicle policy as it regards insurance, (it is unlikely that it will) happen anytime soon because there is currently no burning issue that might prompt them to do so.” For the time being, the NHTSA is expected to continue to closely monitor the advancement of AV technology and see what auto insurance products emerge to determine what long-term, federal insurance regulations should be developed. Industry experts, insurers and other key stakeholders were generally very supportive of the NHTSA’s approach to federal AV regulation thus far. They believed that the voluntary guidelines provided a strong framework for future AV regulation, but does not stifle innovation or discourage AV development.

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220 A common EU approach to liability rules and insurance for connected and autonomous vehicles (Feb 2018). European Parliamentary Research Service (EPRS)


State governments
As outlined in Figure 24 above, state governments are responsible for the development of auto insurance and liability regulations. Auto insurance is typically harmonized across Canada and the U.S., allowing consumers to receive the same coverage on both sides of the border. Most experts believe that cross-border insurance regulation harmonization will help encourage the adoption of CV/AVs. According to the National Conference of State Legislature, 22 states have enacted autonomous vehicle legislation and 6 states have passed executive orders that relate to autonomous vehicles. This analysis highlights Michigan’s approach to AV insurance due to its close proximity to Ontario, high rates of cross-border trade and similar weather conditions. Arizona and California’s approach to AV insurance is also included due to the fact that these states are considered “hubs” for autonomous vehicle development and have more well-defined approach to AV-insurance. Each State’s current approach to Autonomous Vehicle insurance is highlighted below:

A. Michigan

In 2016, The State of Michigan introduced Senate Bill 995 which allows for the operation of autonomous vehicles on public roads (prior to this, they were limited to pre-approved testing zones). This will allow for more dynamic testing as autonomous technologies continue to develop. The Bill also highlights the creation of the Michigan Future Mobility Council whose goal is to ensure that the State continues to be a world leader in autonomous vehicle technology. An individual
who represents the interests of the insurance sector will be appointed to the council by the government. This representative will help guide the development of AV insurance regulations as autonomous technologies continue to evolve. The State of Michigan has also made significant investments towards the development of Autonomous Vehicle test centers. Advanced testing zones such as the American Centre for Mobility in Ypsilanti and Mcity in Ann Arbor (see case study above) are being created in an effort to accelerate technological advancement. The American Centre for Mobility will test autonomous vehicles during all four seasons to ensure the vehicles can function while subject to harsh weather conditions. Insights that emerge from this test center should be monitored by auto-manufacturers, government bodies and insurance companies as they continue to develop AV insurance strategies and regulations.

B. Arizona

Arizona’s Governor Doug Ducey signed an executive order in 2015 directing relevant AV stakeholders to “undertake any necessary steps to support the testing and operation of self-driving vehicles on public roads within Arizona.” The State’s lack of regulation towards autonomous vehicles has attracted significant investment from tech and auto giants such as Uber, Lyft and Waymo (Alphabet’s autonomous vehicle company). In late 2017, Waymo began testing autonomous minivans on public roads around Phoenix without any humans in the vehicles. This marks a significant step forward for Autonomous Vehicles as technologies continue to develop. Arizona’s Department of Insurance has yet to change its minimum insurance liability rules for self-driving vehicle trials (such as those being conducted by Waymo). Stephen Briggs, a spokesperson for Arizona’s Department of Insurance recently stated that “insurance companies need to figure out how they will insure (driverless vehicles) – the government does not have the resources to do this.” Insurance companies operating in Arizona have the opportunity to capitalize on the lack of autonomous vehicle regulation by developing / piloting new AV products as the technology continues to develop. Mobility advisors and fleet operators have been very supportive of Arizona’s approach to AV regulation because it fosters open collaboration with the government on the development of effective regulations. A lack of regulation also allows ride sourcing and car sharing companies, technology firms and auto-manufacturers to easily form formal / informal partnerships with insurance companies to test and develop new coverage options. That said, the ability to monitor safety outcomes and to collect to improve safety and performance is currently more limited than those jurisdictions with a more prescriptive regime.

228 American Center for Mobility Willow Run (2018). American Center for Mobility
230 Where Self Driving Cars go to learn (Nov. 2017). New York Times
231 WAYMO HAS TAKEN THE HUMAN OUT OF ITS SELF-DRIVING CARS (Nov. 2017). Wired
232 Where Self Driving Cars go to learn (Nov. 2017). New York Times
C. California

California has one of the most robust autonomous vehicle testing ecosystems among states paired with one of the most rigorous regulatory frameworks, with over 50 companies testing nearly 300 autonomous vehicles licensed with the state as of 2018. California Vehicle Code (CVC) Section 38750 requires the DMV adopt regulations to govern the testing and public use of autonomous vehicles on California roadways.

A manufacturer can apply for any of three permit options:

- a testing permit, which requires a driver (52 permit holders as March 2018)
- a driverless testing permit (permits available as of April 1, 2018)
- a deployment permit (permits available as of April 1, 2018)

Amendments to Article 3.7 of the Vehicle Code approved in February 2018 allow companies to apply for driverless testing permits in addition to testing with a safety driver and deployment. This change in regulation will likely further incentivize public and private investment into the development of autonomous vehicles in the region. The new regulations state that all manufacturers conducting AV testing will require insurance coverage against collisions caused by autonomous vehicles. In previous versions of the bill, the state proposed a number of regulations that address the question of liability between the driver and manufacturers of autonomous vehicles. Key proposed regulations were as follows:

- (For drivers of a Level 3 vehicle) In the event that the autonomous vehicle requires the driver to take control of the vehicle or when the vehicle is operating outside of its approved operational design domain, the driver shall be responsible for the safe operation of the vehicle, including compliance with all traffic laws.
- The manufacturer of the vehicles ... shall be responsible for the safe operation of the vehicle, including compliance with all traffic laws applicable to the performance of the dynamic driving task, when the autonomous vehicle is operating in autonomous mode within its approved operational design domain.

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236 Ibid.
238 Ibid.
These proposed regulations were ultimately removed due to public objection during the period of public consultation in late 2017. California is one of the first States to draft and propose such regulations related to liability.

Manufacturers that apply to be part of the Autonomous Vehicle Driverless Testing Program are required to submit a Report of Traffic Collision Involving an Autonomous Vehicle (form OL 316) within 10 business days of the incident and an annual report summarizing disengagements during testing (OL 311R). These reports are held by the Department of Motor Vehicles and made available to the public, with any sensitive or personal information redacted as necessary. Insurers in Ontario are in favour of this model, with the provincial government acting as neutral mediator, data analyst, and repository, as it allows insurers and other interested stakeholders access to key testing data to inform product and practice development.

Overall, each of these states have employed a regulatory approach that fosters the advancement of connected and autonomous vehicle technologies. The states have not made many changes to their current auto insurance frameworks as of yet due to the uncertainty surrounding the CV/AV market.

**Australia**

Many parallels can be drawn between the Australian and Canadian markets including a similar legislative system, relatively equal economic activity (GDP) and a comparable population distribution. Australia has been active in reviewing their legislative and regulatory framework to prepare for and enable connected and autonomous vehicles and related infrastructure, with potentially applicable analysis and lessons for Ontario.

In November 2015, Australia’s Transport and Infrastructure Council tasked the National Transport Commission (NTC) with identifying regulatory barriers associated with the introduction of more automated road and rail vehicles in Australia, one of the most comprehensive national regulatory reviews and consultations on the implications of autonomous vehicles.

Following extensive research and expert consultation to inform policy options, Australian transport ministers approved the NTC’s recommendations and agreed to a phased regulatory reform program so that Level 1 to Level 3 automated vehicles could operate safely and legally on Australian roads before 2020 and Level 4 and 5 beyond 2020. The NTC has done extensive work since then to

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239 The remarkable similarities between Australia and Canada (October 2014). Tim Mackay – Head of Strategy at Quantum Financial
implement the reform roadmap, with areas of focus including safety, driver
distraction, privacy, liability, and compliance and enforcement.

The following options related to liability were explored as part of a public and
expert consultation over the course of 2016: \(^{241}\)

- Current liability laws are well-established but assigning fault could be more
  complex
- Access to vehicle data is a critical issue for some insurers
- There may be limitations on road manager liability
- Access to compulsory third-party insurance schemes could be restricted

Having proposed policy options in response to these issues – broadly to rely on
the current framework, to provide industry guidance, or to create new legislation
– the NTC concluded the following: \(^{242}\)

- Assigning fault will be more complex when collisions involve automated
  vehicles, and “the efficient sharing of consistent and reliable data between
  relevant parties, including insurers, is likely to be critical”; that said, current
  laws and approaches were considered adequate for the time being to determine
  liability between drivers, manufacturers, technology providers and
  infrastructure managers; the industry is still evolving and new legislation would
  be premature
- Industry guidance would be helpful in clarifying liability with specific respect to
  connected and autonomous vehicles

Priority reform initiatives carried out from 2016 to 2017 focused primarily on
safety, with new initiatives now ongoing starting to address issues of privacy,
compliance and enforcement. The National Enforcement Guidelines for Automated
Vehicles, released in November 2017, is the first completed insurance-related
initiative. \(^{243}\)

The guidelines address Australian Road Rule 297, which specifies that a driver
must not drive a vehicle unless the driver has proper control. The guidelines
clarify how this requirement applies to vehicles with Level 1 to 3 automated
functions. \(^{244}\) Examples of “proper control” for each level of automation are
specified in detail, as well as how a driver might demonstrate “proper control” if
questioned by law enforcement. Australia’s approach confirms unequivocally that
the human driver is responsible for an automated vehicle’s compliance with road


\(^{244}\) The NTC chose not to include Level 4 and 5 automated vehicles in their scope as these vehicles would not be commercially released by
2020 or, in the case of Level 5, for the foreseeable future. Further, at these levels of automation, the driver has limited to no involvement in
the driving task, which may require legislative amendment.
traffic rules up to and including Level 3 automation, indicating that the current liability framework could still apply for the foreseeable future.

**Implications for Ontario:** As demonstrated above, Ontario is not alone in needing to further explore this space. Ontario researchers and academics working in the field of connected and autonomous vehicles have strong relationships with their American counterparts, mirrored by dialogue between provincial and state governments and information-sharing between municipalities. As global jurisdictions, including those with similar structures, similar environments, or shared borders with Ontario, continue to advance research in this space, the Ontario government and research community should continue to engage with the results and analyze how they might apply to the Ontario context (e.g., the benefits of harmonizing CV/AV regulation across borders).

**Areas for further research**

21. Identify key issues and lessons learned from the United States’ approach to AV regulation and Australia’s regulatory reform initiative to inform similar ongoing or to-be initiated projects in Ontario.

**Ethical considerations**

Insurers, OEMs, federal, provincial and municipal governments, and other mobility stakeholders, will be tasked with addressing an array of key ethical considerations as they continue to develop their connected and autonomous vehicle strategies. Key ethical considerations surrounding programmed AV decision making (specifically in collision events), data privacy and data reporting will need to be addressed by all CV/AV stakeholders. Each of these topics is explored in further detail below:

**Programmed AV decision making**

In today’s transportation system dominated by standard vehicles, human drivers make the final decision on how to react to situations that could result in collisions. Human drivers may be forgiven for making an instinctive, suboptimal decision but programs of autonomous vehicles will not be afforded this luxury. Programmers will have to develop a set of pre-determined actions for their vehicles to follow across a range of “lose-lose” situations. An ethical / moral question arises from this increase in responsibility: what is the correct action for an AV to take in certain lose-lose (collision) situations? Does the car prioritize the safety of the passengers or pedestrians? Ethical questions like these will be difficult for auto-manufacturers and software developers to answer. The Massachusetts Institute of Technology (M.I.T) recently conducted a study on the use of utilitarian AVs (that
is, AVs that sacrifice their passengers for the greater good). Participants from six different Amazon Mechanic Turk Studies approved of the use of utilitarian AVs and would like others to buy them, but they themselves prefer to ride in AVs that prioritize the protection of their passengers at all costs. The study concluded that participants disapprove of enforcing utilitarian regulations for AVs and would be less willing to buy such an AV. This study further highlights the complex ethical decisions that auto-manufacturers / programmers have to make as AVs become more common. The U.S. Department of Transportation (DoT) recently released a 15-point policy that requires manufacturers to explain how their AVs will handle “ethical considerations” but there has been no consensus or legislation around ethical decision-making as of yet. Insurance companies will need to monitor regulations regarding the ethical decision making of AVs as they emerge and adjust policies accordingly, especially as they relate to risk and liability.

Data access and privacy
In order for CV/AVs to be effective, auto-manufacturers will need to collect massive amounts of consumer data, raising questions of data ownership, access, privacy, and specific ethical concerns. Consumer data such as daily routine, passenger information and GPS location will be captured by these vehicles and shared with / sold to third parties. As outlined above, access to this data will benefit insurers in many ways such as more accurate risk assessment and premium calculations. Auto-manufacturers and insurance companies, however, will need to consider the following when electing to use this data:

- It is ethical to capture, share / sell and derive insights from this data?
- Does the use of this data breach the Personal Information Protection and Electronic Documents Act?
- How will regulators draft / alter data privacy legislation as autonomous vehicles continue to evolve?
- What data will be made available to the various mobility ecosystem stakeholders (including insurers, government, and other regulators)? For what use cases and under what model (e.g., data-sharing, mandated disclosure)

Questions such as those outlined above will need to be answered / considered by all relevant stakeholders as connected and autonomous vehicles become available to the public. Government regulations that emerge to address the questions outlined above will have major implications on CV/AV insurance policy and insurers should prepare to react accordingly.

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245 The Social Dilemma of Autonomous Vehicles (Jun. 2016) Massachusetts Institute of Technology M.I.T.
247 The Ethics of Autonomous Cars (Oct. 2013). The Atlantic
248 Autonomous Vehicles will change driving, insurance landscapes in Canada (Oct. 2017). The Lawyer's Daily
Data reporting for connected vehicles
A number of ethical concerns relating to data reporting will need to be addressed by government bodies, auto-manufacturers and other key stakeholders as connected and autonomous vehicles become more common. While driving, a CV/AV will be collecting data on itself, surrounding vehicles and the infrastructure it interacts with. In the event a collision does occur, CV/AVs will need to be programmed to determine how much data to report to regulators and other stakeholders. Key ethical questions may arise from this complex situation:

- Will the vehicle only be required to report the data it generated itself at the time of the collision?
- Will the vehicle be required disclose the decision making process it went through at the time of the collision?
- Will the vehicle be required to report data received from infrastructure to help determine collision liability (e.g., a traffic light, lane mark or sign emitted an incorrect signal that caused the collision)?
- Will infrastructure and surrounding vehicle operators willingly report data that makes them liable for collision?

Ethical concerns that relate to connected vehicle data reporting such as those outlined above will need to be addressed by all key stakeholders in the mobility ecosystem. For more information on the implications that CV/AVs have on data access, ownership, and privacy, please refer to the Connected and Autonomous Vehicles in Ontario: Implications for Data Access, Ownership, Privacy and Security.

Implications for Ontario: Ontario regulators should incorporate key ethical concerns such as autonomous vehicle decision making in any legislative, regulatory or policy framework and should consider whether existing data privacy frameworks need to be further customized to the CV/AV context.

Areas for further research
22. OEMs and other industry players along with federal, provincial and municipal governments, will need to consider a range of ethical considerations such as autonomous vehicle decision making and data privacy when developing CV/AV regulations. Insurers will need to ensure they are legally compliant and acting in their clients’ best interest with respect to data privacy and protection while also aligning with regulations on autonomous vehicle decision making when determining liability.
3.0 Conclusion

This report provides an overview of considerations related to insurance as connected vehicles become ubiquitous on Ontario roads and as the fleet of vehicles, both passenger and commercial, achieve new levels of automation. Across the literature as well as in speaking to experts, it is clear that this transition is in its nascent stages but very much accelerating. A number of opportunities exist for further research, as outlined: some should be pursued in the near-term to address pressing issues (e.g., safety, security) and to proactively prepare for and enable future success. Some should be explored while organizations monitor the evolution of the connected and autonomous landscape. Finally, some are long-term investments in a deeper understanding of connected and autonomous vehicle technology and its implications for Ontario.

**Areas to address now to enable future success**

**Positioning for long-term success (Recommendation 1):** Insurers could analyse how near-term opportunities such as the projected short-term increase in premium revenues might best be positioned (e.g., re-investment in R&D initiatives) for long-term success.

**Understanding the impact on premiums (Recommendation 2):** Through engagement with key stakeholders in the mobility ecosystem (such as auto-manufacturers and fleet operators), Ontario insurers could more precisely understand and model the impact of CV/AV development on premiums, specifically with respect to the pace of transition to greater levels of vehicle connectivity and automation.

**Reviewing the policy for claims resolution (Recommendation 4):** The federal and provincial government could include insurers in policy discussions on CV/AV data privacy regulations, specifically as they relate to the claims resolution process, so that any new or amended frameworks appropriately balance consumer privacy with innovation in insurance.

**Defining data needs and developing the required data infrastructure (Recommendation 5):** In order to obtain relevant data from OEMs / 3rd parties, insurers and their relevant delivery partners (e.g., police and investigators) will need to understand and define what data is important and develop the infrastructure required to analyse it for underwriting, claims processing and other business purposes.

**Understanding CV/AV liability and fault determination (Recommendation 7):** The Ontario government could continue to engage with insurers, auto-manufacturers
and government bodies in other jurisdictions (such as California) to understand relevant considerations and model options for CV/AV liability and fault determination.

**Developing CV communication standards (Recommendation 9):** Government bodies, network providers, infrastructure operators and other key stakeholders could collaborate on the development of V2V, V2I and I2V communication standards and regulations that provide clarity on collision liability for connected vehicles.

**Learning from the U.S. and Australia’s approaches (Recommendation 21):** Identify key issues and lessons learned from the United States’ approach to AV regulation and Australia’s regulatory reform initiative to inform similar ongoing or to-be initiated projects in Ontario.

**Areas to monitor over the near-term as the industry evolves**

**Skills gaps and talent strategy (Recommendation 3):** Insurers could identify data analysis capability needs and current internal skills gaps to inform talent development strategies and capitalize on the potential for business process improvements such as enhanced claims processing and risk assessment.

**Required training for the new insurance landscape (Recommendation 6):** Industry associations, the provincial government, academia and other stakeholders could coordinate to identify what educational / training programs are needed to train or re-train a robust talent pool for insurers and related industries.

**Analyzing coverage mix options (Recommendation 8):** Auto-manufacturers, mobility management firms and other key stakeholders could assess the advantages and drawbacks of various coverage options in an environment in which liability has shifted away from the driver and / or passenger towards commercial entities.

**Factors to succeed in the evolving industry (Recommendation 12):** Insurers could conduct an assessment of the Ontario insurance landscape, including key strengths and competitive advantages, to help determine the success factors of those companies that will survive and thrive in an evolving competitive landscape, as well as options for success in a potentially consolidated market.

**Adoption of new mobility models (Recommendation 13):** Determining the contributing factors influencing acceptance and uptake of ride sourcing (e.g., geography, demographics, gas prices, alternate options), shared vehicle ownership or use, and new mobility models (including AVs) and their relative significance in Ontario will be an important input for insurers, governments, and all other members of the mobility ecosystem.
The relationship between ride sourcing / car sharing and CV/AV uptake (Recommendation 14): Insurers could further explore how the adoption of ride sourcing and car sharing (including different scenarios for ride sourcing as well as commercial vs. personal ownership) will influence the uptake of AVs (in terms of level of acceptance, timing, etc.) as well as how AVs will accelerate adoption of ride sourcing or car sharing models, allowing them to efficiently plan investments and assess risk over the short to medium term.

Impact of new insurance products and channels (Recommendation 15): Insurers could develop a better understanding of how new products and delivery models will impact auto-manufacturers, government bodies and other mobility ecosystem stakeholders. Strategic partnerships with key stakeholders will allow insurers to develop effective products and delivery models tailored to the CV/AV market.

Regulatory framework review (Recommendation 16): The benefits and challenges of the current regulatory regime surrounding insurance (including regulations related to new insurance product approval, liability and fault determination, privacy, data management and protection, transportation-related, and others) could be reviewed by the federal and provincial government, as well as other key stakeholders (e.g., auto-manufacturers) with due consideration for how to balance privacy concerns, competitiveness, and innovation with regard to new insurance products and delivery channels.

Review in the Ontario context (Recommendation 17): The government’s regulatory review (including insurance, privacy, data, passenger & commercial transportations regulations etc.) should in particular focus on implications for consumers and insurers in the Ontario context, given the large geographical range, kilometres driven, and mobility patterns given the mix or urban, suburban, and rural locations.

Provincial and federal government collaboration on data regulation (Recommendation 20): Provincial entities including the Information and Privacy Commissioner of Ontario, Consumer Protection Ontario, and the Ministry of Government and Consumer Services more broadly could work with federal counterparts (e.g., the Competition Bureau, the Office of the Privacy Commissioner of Ontario) to assess the need for standards with respect to personal data collection and use by insurers.

Areas for long-term investment

Maintaining consumer choice (Recommendation 10): Regulators could further research what may be required to maintain consumer choice as insurers increasingly develop exclusive partnerships with automakers and other providers or embed coverage in bundled products. This could include potential standards for
consumer transparency (e.g., whether a customer is buying a bundled product versus having the choice to buy individual products), reporting requirements, etc.

Addressing competition and consolidation concerns (Recommendation 11): Federal and provincial governments could continue to monitor the competitive landscape of the insurance industry to proactively identify and address monopolistic / oligopolistic patterns as cross-industry partnerships (related to CV/AVs) and overall consolidation emerge and consumer choice is potentially limited. Regulators will also be tasked with determining data privacy implications as industry consolidation occurs.

Addressing barriers to AV adoption (Recommendation 18): Key stakeholders could establish collaborative partnerships to collectively identify consumer concerns and barriers to AV adoption and develop strategies to address them.

Understanding CV/AV adoption across varying regions / demographic populations (Recommendation 19): All industry players, including insurers and government researchers, could apply demographic information (e.g., population, vehicle ownership patterns, access to other transportation) to understand how strategies to accommodate, manage risk, and encourage adoption of autonomous vehicles might differ by region, as well as how connected and autonomous vehicles might complement other transportation or city-building initiatives.

Incorporating key ethical concerns (Recommendation 22): OEMs and other industry players along with the federal, provincial, and municipal governments, will need to consider a range of ethical considerations such as autonomous vehicle decision making and data privacy when developing CV/AV technology and regulations (respectively). Insurers will need to ensure they are legally compliant and acting in their clients’ best interest with respect to data privacy and protection while also aligning with regulations on autonomous vehicle decision making when determining liability.

In addition to the above, insurers might consider five foundational actions to plan for the transition to fully connected and autonomous vehicles while accounting for the decades and uneven progress in between:

1. Re-assess current strategy (including growth plan, product mix, and customer strategy) and adjust it accordingly to prepare for the rise of connected and autonomous vehicles
2. Identify key capability gaps and make the correct strategic investments (e.g., analytic capability and infrastructure gaps)
3. Define your organization’s data needs and the channels through which access might be gained
4. Develop relationships and collaborate with key stakeholders such as auto-manufacturers, technology companies and government bodies to share data, knowledge and capacity
5. Plan for the transition to fully autonomous vehicles while accounting for the decades in between

While Ontario may not regularly see vehicles performing all driving functions (Level 4 or 5) for another twenty five years, the transition has started and Ontario will need to build the foundations now to compete, ensure safety and promote the effective adoption of connected and autonomous vehicles.

4.0 Acknowledgments

This research has attempted to take a holistic, cross industry view of the future of mobility in Ontario. In order to achieve this level of breadth and depth, the authors engaged leaders from private companies, governments and academia in a variety of disciplines to understand the implications of connected and autonomous vehicles, identify gaps in our collective knowledge, and set paths for further research. This report is the product of extensive research and a range of interviews. Deloitte extends its sincerest gratitude to the many individuals who contributed through interviews, discussions, and review cycles. Given the breadth of areas impacted by connected and autonomous vehicles, this contribution was invaluable in developing a holistic and comprehensive perspective on the implications of connected and autonomous vehicles in Ontario.

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