About the Insurance Institute
The Insurance Institute is the premier source of professional education and career development for the country’s property and casualty insurance industry. Established in 1899, the Institute is a not-for-profit organization serving more than 39,000 members across Canada through 19 volunteer-driven provincial Institutes and chapters. For more information, please visit insuranceinstitute.ca.

About the CIP Society
Since 1998, the CIP Society has represented more than 17,000 graduates of the Insurance Institute’s Fellowship (FCIP) and Chartered Insurance Professional (CIP) programs. As the professionals’ division of the Insurance Institute of Canada, the Society’s mission is to advance the education, experience, ethics and excellence of our members. The Society provides a number of programs that promote the CIP and FCIP designations, continuous professional development, professional ethics, mentoring, national leaderships awards, and understanding of emerging issues in the industry. The CIP Society, on behalf of its membership and for the benefit of the industry, is proud to have contributed to the development of this research report. Please visit insuranceinstitute.ca/cipsociety.

About the Institute’s research
This research report represents the second in the Insurance Institute’s Emerging Issues Research Series – providing relevant and insightful research reports on the issues impacting the property & casualty insurance industry in Canada. The report joins the first report, “Cyber Risks: Implications for the Insurance Industry in Canada,” and the “Demographic Analysis of the P&C Insurance Industry in Canada,” that the Institute has been conducting since 2007. A French translation of this report is also available. For more information, please visit insuranceinstitute.ca/research.

About the author of this report
Paul Kovacs is widely known and respected in the industry as the founder and executive director of the Institute for Catastrophic Loss Reduction (ICLR), president and CEO of the Property and Casualty Insurance Compensation Corporation (PACICC), and is also an Adjunct Research Professor, Economics, at the University of Western Ontario. The Insurance Institute was pleased to contract with Paul Kovacs & Associates to research and write this report.

Acknowledgements
The Insurance Institute would like to thank the following people who reviewed, commented on and/or contributed to the report:
Tim Bzowey, Head, Home & Auto, RBC Insurance
Mark Francis, Manager, Driver & Vehicle Licensing, Insurance Corporation of BC (ICBC)
Bern Grush, Co-author of EndOfDriving.org
Barrie Kirk, Executive Director, Canadian Automated Vehicles Centre of Excellence (CAVCOE)
Robyn Robertson, President and CEO, Traffic Injury Research Foundation (TIRF)
Nikol Kovacs & Nancy Kovacs, Paul Kovacs & Associates

ISBN: 0-919244-27-0
Copyright © 2016
The Insurance Institute of Canada
All Rights Reserved

This research paper is published in the public domain. When citing excerpts or the report in its entirety, please use the following citation: Automated Vehicles, Implications for the Insurance Industry in Canada, The Insurance Institute of Canada, 2016.

Automated Vehicles: Implications for the Insurance Industry in Canada

www.insuranceinstitute.ca
Executive summary

"I have seen the future."
Promotional slogan,
General Motors’ Futurama exhibit,
1939 World’s Fair

This report is a celebration of the thousands of lives that will be saved and hundreds of thousands of injuries prevented as safer vehicles become available over the next 10 years and beyond. The report is also a call to action for Canada’s insurance industry to become engaged in discussions with automakers, regulators, and others who will influence the introduction of semi-automated and self-driving vehicles in Canada, and to become a champion for the expected reduction in traffic fatalities and serious injuries.

Over the next 10 years, conventional vehicles offered by most of the leading automakers will evolve into semi-automated vehicles with on-board sensors and computers to assist drivers. With these semi-automated vehicles, there will be fewer collisions and the potential to significantly reduce traffic fatalities and serious injuries, relative to current rates. In addition, many drivers will appreciate automated driving in stop-and-go traffic, intelligent cruise control on the highway, and parking assistance.

Starting in five to 10 years and possibly building over the next 40 to 50 years, some automakers and some technology companies see the potential to replace human drivers with self-driving vehicles. Fully automated vehicles have the potential to further reduce traffic fatalities and transform personal transportation relative to semi-automated vehicles.

Timing is critical in the story of vehicle automation. The focus of this report is on the changes in motor vehicles expected over the next five to 10 years, and the implications that these changes will have for the insurance industry. Semi-automated vehicles have begun to replace conventional cars and trucks, and this transition will accelerate and eventually dominate new vehicle sales. Also, the first self-driving cars will be introduced in Canada within the next five to 10 years, but there is considerable uncertainty about the ultimate role for fully automated cars over the next 40 or 50 years. Despite the uncertainty, this report seeks to identify opportunities over the next five to 10 years for the insurance industry to prepare for and influence developments in vehicle automation over the near and long term.

A challenge for the insurance industry over the next 10 years will involve determining who is responsible for collisions. Conventional vehicles will share the roads with semi-automated vehicles and the first self-driving vehicles. Personal liability for most collisions will begin to shift to include a mix of personal and product liability.
These developments raise many questions for the insurance industry:

- Will vehicles have on-board devices to identify whether or not the vehicle’s technology was engaged at the time of a collision?
- Will insurance companies be allowed to access this information?
- How will insurance companies recover costs when automakers are found to be at fault?
- How should costs be shared when driver errors and vehicle automation systems failure both contribute to a collision?

Clear determination of responsibility is essential to ensure effective insurance coverage; unfortunately the next 10 years may have less clarity about responsibility than the past 40 or 50 years.

Over the next five to 10 years, conventional, non-automated vehicles will continue to account for most of the cars and trucks in Canada. The frequency of collisions resulting in serious injuries and vehicle damage will decline for new, semi-automated vehicles, but this will be offset by the expected higher cost of repairs for vehicles that experience collisions. As a result, the impact of vehicle automation on insurance claims costs and industry revenues will only begin to emerge over the next 10 years, relative to the significant disruption expected over the next decades. It is important for the insurance industry to begin now to prepare for the extensive changes vehicle automation is expected to ultimately bring for the industry.

Another challenging issue for the insurance industry is determining where vehicle automation fits within a broad range of issues facing the industry and society. Canadian policy-makers, for example, have announced large, multi-decade investments in public transit, but have taken relatively little notice of vehicle automation as an issue. Many stakeholders continue to react to the disruptions coming from the emerging sharing society, such as Uber. Vehicle automation promises significant reductions in traffic fatalities and serious injuries, a benefit that is absent in discussions about public transit and a sharing economy.

There is the potential for the insurance industry to step up as a champion for the safety benefits that may flow from the appropriate use of vehicle automation, as the industry did with graduated licensing, the fight to eliminate drinking and driving, use of seat belts, and a number of other road safety measures.

A discussion about vehicle automation is a discussion about road safety. Over the past 30 years, 94,000 Canadians were killed in traffic collisions, and 6.7 million were injured. Driver error was the primary cause of most collisions. If drivers learn to appropriately use the new assistance technology, there will be a significant reduction in the risk of collisions over the next 10 years. Fewer collisions will mean a reduction in traffic fatalities and injuries. Indeed, it is the objective of some automakers to eliminate traffic fatalities and serious injuries in new vehicles.

Future vehicles promise to significantly reduce traffic fatalities and injuries through the greatest change in automotive technology since the introduction of motor vehicles.

This is a critical time for the insurance industry to become engaged in the discussion about vehicle automation, and to champion the remarkable potential to reduce traffic fatalities and serious injuries.
## Contents

Executive summary.............................................................................................................................................................................. i

Foreword.............................................................................................................................................................................................................. 1

Introduction.................................................................................................................................................................................................. 2

**Six critical questions**

- What is a semi-automated or self-driving vehicle? .......................................................................................................................... 4
- When will fully self-driving vehicles become available? ........................................................................................................................ 12
- Why are traffic collisions expected to fall significantly? ......................................................................................................................... 18
- Will higher repair costs limit insurance savings? .............................................................................................................................. 28
- Who will be held responsible for traffic collisions? .......................................................................................................................... 34
- Why does the big picture include public policy, sharing and transit? .................................................................................................. 42

Recommendations for the insurance industry........................................................................................................................................... 50

Appendix I – A case study – A day in the life of the family car................................................................................................................. 52

Appendix II – Bibliography.......................................................................................................................................................................... 54

Appendix III – An alternative view: Automation facilitating greater mobility and public transit .......................................................... 60
Foreword

The Insurance Institute is proud to publish this second of a series of reports on emerging issues impacting the property & casualty insurance industry in Canada.

Our intention is to provide research of value to our stakeholders. We are confident that this research report, and the series of reports, will provide information and insights to enable insurance organizations to broaden their understanding of how emerging risks will impact the delivery of insurance products and services in Canada.

This report provides a broad scope perspective to what is known about automated vehicles today, and the current and potential changes to auto insurance, fatalities and injuries due to traffic collisions, and liability issues that will impact the insurance industry in Canada in the near and distant future.

To provide additional insight into the industry’s perspective on automated vehicles at this point in time, we took the opportunity to survey Institute members, inviting them to share their views on the state of preparedness of the Canadian insurance industry for the introduction of automated vehicles. More than 3,000 members of the insurance community responded, which likely represents the largest survey ever conducted in Canada addressing the introduction of automated vehicles and the insurance implications.

- More than 73 percent of respondents believe that the introduction of self-driving vehicles will be difficult for the insurance industry.
- Almost half (46 percent) of respondents believe that the industry is not prepared for the expected change in the frequency and severity of collisions over the next 10 years.
- Almost 70 percent believe that the insurance industry is prepared to participate in discussions about the introduction of self-driving vehicles.

It is our hope that this research report is interesting and insightful, but also provides the foundation on which to bring the industry and stakeholders together and start the dialogue, with helpful resources and constructive recommendations to inform the transformative process.

Sincerely,

Peter Hohman, FCIP, MBA, ICD.d
President & CEO, Insurance Institute of Canada
Introduction

“It is difficult to make predictions, particularly about the future.”
Danish proverb

Today, driver error is responsible for most collisions. In 40 to 50 years, there may be only self-driving vehicles on Canadian roads with no scope for driver error. Presently, individuals own most vehicles in Canada, but in the future it is possible that a combination of sharing, short-term rental, and public transportation may substantially reduce individual ownership of vehicles. Over a period of a few decades, foundations for the personal automobile insurance industry in Canada — that driver errors contribute to most collisions and personal ownership of vehicles is the norm — may largely disappear and significantly disrupt the industry.

Or perhaps not. It is difficult to anticipate a few decades into the future.

The focus of this paper is on the important changes in motor vehicles that will take place over the next 10 years with the introduction of semi-automated vehicles and the implications for the Canadian insurance industry. The direction and extent of change over the next few years is better known relative to the uncertain disruption that may occur over a longer period of time.

Vehicle automation is good for society, with a significant reduction in traffic fatalities and serious injuries expected over the next 10 years as driver-assistance technology is introduced into new vehicles in Canada. The benefits from the reduction in collisions will increase over time as more vehicles include forward collision avoidance and other emerging safety technology, as the capability of the equipment improves, and if drivers learn to best utilize the new systems.

Perhaps the greatest unknown over the near term is the extent that drivers will be willing and able to use the new safety technology.

The impact of vehicle automation on the insurance industry has begun and will build over the next few decades. Some challenges for the insurance industry include determination of fault, appropriate pricing for new vehicles, and recovery of costs that are a result of product liability.

Responsibility for collisions will begin to shift from drivers to vehicles. Over the next 10 years, the roads will be shared by fully human-driven vehicles, semi-automated vehicles with driver assistance systems, and the first self-driving vehicles. As on-board computers begin to make driving decisions, responsibility for collisions will move beyond human drivers to include automakers, software developers, and maintenance professionals. There will be a shift from personal liability for collisions involving conventional vehicles, to shared liability for semi-automated vehicles, and predominantly product liability for self-driving vehicles.

The broader context of personal mobility continues to evolve, with an uncertain and perhaps diminished role expected for vehicles owned by individuals. Ride sharing and vehicle sharing have emerged over the past decade as an alternative to individual ownership of vehicles, particularly for younger Canadians.
The federal, provincial, and many local governments across Canada have recently announced large, long-term investments in public transportation, with an objective of partially displacing vehicle use. Policy decisions over the next five to 10 years will have a major impact on the driving environment over the next few decades. The insurance industry may seek to influence the nature of the investments that will be made in road infrastructure and public transit, and regulation of the sharing sector.

This research report is crafted around an assessment of six questions and the implications for the Canadian insurance industry:

• What is a semi-automated or self-driving vehicle?
• When will fully self-driving vehicles become available?
• Why are traffic collisions expected to fall significantly?
• Will higher repair costs limit insurance savings?
• Who will be held responsible for traffic collisions?
• Why does the big picture include public policy, sharing and transit?

The report concludes with a number of recommendations for the Canadian insurance industry.
What is a semi-automated or self-driving vehicle?

“Motor vehicles, and drivers’ relationships with them, are likely to change significantly in the next ten to twenty years, perhaps more than they have changed in the last one hundred years.”

National Highway Traffic Safety Administration, 2013

There were self-driving vehicles in Canada when the country was founded almost 150 years ago – the horse and wagon. When the horse understood the destination, the driver often did not need to become engaged in the driving process, but the driver had the option of assuming control at any time. Efforts to create self-driving cars and trucks began shortly after motor vehicles were introduced. These typically failed due to limitations in the technology available at the time and the cost of implementation.

Self-driving vehicles have returned. These remarkable machines are being tested on public roads. The first fully automated, self-driving cars, supported by sensor technology and on-board computing, could be available to consumers within the next five to 10 years. Over the long term, self-driving vehicles hold great promise to transform society, including dramatically reducing traffic fatalities and serious injuries.

Automakers have promised driver assistance systems over the next five to 10 years that automate aspects of driving – semi-automated vehicles. For example, cars with intelligent cruise control and lane-keeping mechanisms would allow drivers to travel on a highway without putting their hands on the steering wheel or using the brakes and throttle. Cars with a forward collision avoidance system could prevent drivers from turning in front of oncoming traffic if they fail to see an approaching vehicle. Vehicles with auto-park would park themselves even if the driver gets out to watch. Semi-automated vehicles with some of these features are available today, and hold great promise to reduce traffic collisions and enhance the driving experience.

This report focuses on three groups of vehicles:

• Conventional, non-automated vehicles
• Semi-automated vehicles with driver assistance
• Conditional automation, high automation, or fully automated self-driving vehicles

---

The Government of Ontario passed legislation in 2015 that includes a definition of an automated vehicle as a motor vehicle with an automated driving system that provides conditional, high, or full driving automation as set out by the Society of Automotive Engineers. The Ontario legislation defines automated driving as “a system that performs dynamic driving tasks to operate a vehicle with limited or no need for any driving tasks to be performed by a human driver.”

Most cars and trucks on Canadian roads today are conventional vehicles with no automation. Human drivers execute all critical driving tasks. This includes determining the destination, route, direction, vehicle speed, and steering. These vehicles may have conventional cruise control, ABS brakes, and warning systems, but they do not have automated systems with an on-board computer to help drivers.

Some semi-automated vehicles are now available. With partial automation, such vehicles provide driver assistance. The driver has overall responsibility for the operation of the vehicle, but computer systems may offer assistance such as emergency braking, intelligent cruise control, and blind spot warnings. Semi-automated vehicles have some capacity to drive themselves with active direction from human drivers, and provide assistance when humans are driving.

Self-driving vehicles with conditional or high automation are being tested, but are not yet available for purchase to be used on public roads. These vehicles have the capacity to fully drive themselves in a wide range of situations, but the driver may need to assume control, or may choose to assume control in some circumstances. Compared to semi-automated vehicles, the driver has little, if any, need to assume control of self-driving vehicles.

A number of terms are used to describe the changes taking place in the capacity of vehicles to drive themselves. These include automated vehicles, autonomous vehicles, self-driving cars, driverless cars, robot taxis, intelligent driving assistance systems, computer-controlled cars, autopilot, safe road trains, and connected cars. Each of these terms is distinct and describes specific changes taking place in the design and production of new vehicles.

In particular, the popular terms “automated” and “autonomous” are sometimes used interchangeably, as though they have the same meaning, which is not correct. The preferred focus of the automotive engineering community is on the degree of driving automation introduced in vehicles. The term “autonomous” incorrectly implies that the technology will allow vehicles to govern themselves and make driving decisions, rather than the reality that on-board computers use automation to determine and implement driving algorithms. This report deals with the automation of vehicles, with a focus on changes expected over the next 10 years.

---

4 S. W., “Why Autonomous and Self-Driving Cars Are Not the Same,” The Economist Explains (blog)
The vehicles presently on the road

The vast majority of cars and trucks presently on the road do not have sensors to monitor the area around the vehicle or on-board computers that use sensor information to assist drivers. Human drivers make all of the decisions that control the safe operation of conventional vehicles. These vehicles may have extensive safety features to reduce the severity of collisions, and mechanisms to enhance the driving experience, like GPS, but they do not have the capacity to make driving decisions. Canada’s roads, traffic regulations, and insurance coverage have been designed for conventional vehicles.

Some new vehicles are semi-automated. For example, when drivers engage the turn signal, some cars with driver assistance technology can change lanes without any further input from the driver: the car determines available space, controls the steering, and operates the gas pedal. A semi-automated vehicle with forward collision prevention will attempt to stop itself with emergency braking if a pedestrian unexpectedly steps in front of it. Vehicles with driver assistance automation are rare today, but within 10 years they may account for the majority of the new vehicles sold in Canada.

Imagine entering a vehicle, providing a destination, and then relaxing for the trip in a self-driving vehicle. These highly and fully automated vehicles would be able to make all of the decisions about which route to follow, when to accelerate or brake, and how to avoid collisions. A self-driving vehicle would have no need for a human driver, but drivers could choose to disengage the self-driving features if they wanted to or needed to assume control. Self-driving cars are currently being tested, but are not yet ready for sale.

Over the next 10 years, the roads in Canada will include a mix of conventional vehicles, semi-automated vehicles, and the first self-driving vehicles. These vehicles will have different, and at this time unknown, driving performance.

Six levels of vehicle automation

In 2014, the Society of Automotive Engineers (SAE) International issued a report identifying six levels of vehicle automation to support and clarify stakeholder discussion about automated vehicles. See page 7 for a fuller description of the six levels of vehicle automation. This scale is now widely used to describe and assess change underway in automobile design and production:

- **Level 0 – No automation**: The full-time performance by the human driver of all aspects of the dynamic driving task, even when enhanced by warning or intervention systems.

- **Level 1 – Driver assistance**: The driving mode-specific performance 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.

- **Level 2 – Partial automation**: The driving mode-specific performance 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.

- **Level 3 – Conditional automation**: 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.

- **Level 4 – High automation**: 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.

- **Level 5 – Full automation**: 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.

---

## Summary of SAE International’s Levels of Driving Automation for On-Road Vehicles

<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>

*Human driver monitors the driving environment*

*Automated driving system (“system”) monitors the driving environment*

Source: [http://www.sae.org/misc/pdfs/automated_driving.pdf](http://www.sae.org/misc/pdfs/automated_driving.pdf)
WHAT IS A SEMI-AUTOMATED OR SELF-DRIVING VEHICLE?

The National Highway Traffic Safety Administration in the United States published a five-step scale of vehicle automation that is also widely used. The elements are similar, but the Administration combines high automation and full automation into a single category. Both scales provide a sense of the continuum of automation that is emerging for new vehicles.

When compared with the terms used for this report, Level 0 vehicles are described as conventional vehicles. Level 1 and 2 vehicles are described as semi-automated vehicles. The driver is responsible for the safe operation of the vehicle at all times but has access to support in some situations. With supervision by the driver, these vehicles may have the capacity to drive themselves in some circumstances, like following a car in stop-and-go traffic or when parking. Level 3, 4, and 5 vehicles are described as self-driving cars and trucks. These vehicles have the capacity to fully drive themselves in most situations, but drivers may need to assume control in some circumstances.

Sensor-based systems

Semi-automated and self-driving vehicles are designed around a suite of sensors that provide information that can be used by on-board computers to advise drivers or directly assume control. These vehicles carry a combination of sensors that may include lidar, radar, cameras, ultrasonic sensors, and infrared sensors. Many sensors are used to provide redundancy if part of the system fails. Also, the various capacities of the sensors enhance the ability of vehicles to operate in a wide range of circumstances.

An on-board computer interprets the sensor data and can provide commands for the vehicle’s control system to act upon. These commands are generated in real time: the computer makes the decisions and transmits them to the control system as quickly as, or even faster than, a human driver could. These systems can be designed to assist drivers or, as self-driving vehicles become available, to replace human drivers.

There are important differences in the capabilities of the emerging driver assistance systems. The collision data collected by the insurance industry will likely become an important source of information about the relative strength of the automated driving systems. Organizations, like the Insurance Institute for Highway Safety, provide information about crash performance in test conditions. Collision and repair cost information from real-world circumstances are needed to further support insurance underwriting and vehicle design decisions.

---

7 Kumar, “Driverless Cars: Boon or Bane for Auto Insurers?” IBM Global Business Services, p. 2.
Connected vehicle systems

The first connected vehicles are being tested today. In 10 to 20 years, vehicles are expected to accept input from other vehicles and local infrastructure. This information would be combined with data collected by on-board sensors in converged systems to support decisions made by drivers and vehicles. Dedicated short-range wireless technology will be used to communicate from vehicle to vehicle and from vehicle to infrastructure. Commercial wireless technology, Bluetooth, and Wi-Fi could be used to create a network of connected cars.

Communication networks in the immediate vicinity would be used to prevent collisions. This includes avoiding vehicles, pedestrians, cyclists, and other obstacles. Connections over long distances could be used to manage congestion through the optimization of routes that would avoid crowded roads, construction areas, and collisions.

The benefits of connected vehicles are greatest when a large number of vehicles and infrastructure sources provide information. Regulators in the United States have announced their intent to mandate dedicated short-range communications equipment in all vehicles, perhaps by 2022. Some initial standards have been established, but these will need to evolve with changes in technology. Systems designed to share information raise questions about protection of privacy and concerns about security from cyber attacks.

It is possible that connected vehicles will be able to travel safely at high speeds with minimal space between vehicles. This may reduce congestion on the roads and improve fuel efficiency. In the distant future, vehicles that are connected with

---

9 Kumar, “Driverless Cars: Boon or Bane for Auto Insurers?” IBM Global Business Services, p. 5.
other vehicles and communicating with intelligent road infrastructure could eliminate the need for traffic lights and speed limits. Beyond development and testing, connected vehicles systems are not expected over the next 10 years. This may, however, be the best time for society to begin investing in the appropriate roadway infrastructure and vehicle equipment regulations in order to minimize the time needed to realize the long-term safety benefits of connected vehicle systems.

Implications for the insurance industry

The nature of driving has changed very little over the past 40 to 50 years. Profound change, however, is expected to emerge over the next 10 years and will build over a few decades. Important changes for the insurance industry will be most evident if self-driving cars become commonplace. Current insurance coverages and practices were not designed for a world where human drivers are replaced by vehicles that can drive themselves. Fortunately, this is not expected on a large scale over the next 10 years. A transition to self-driving vehicles may take several decades, although some experts warn that there is the potential for change to come quickly.

Conventional vehicles are expected to account for most of the vehicles on Canadian roads over the next 10 years. It is unclear how the introduction of semi-automated vehicles and the first self-driving vehicles will change the collision experience of conventional vehicles. It is also unclear how responsibility for collisions will be determined when conventional vehicles collide with semi-automated and self-driving vehicles.

The insurance industry will face a number of challenges over the next 10 years as it provides cover for the new vehicles with driver assistance technology. Automakers are promising a marked reduction in the risk of collisions in semi-automated vehicles, but insurers will have little initial evidence about the frequency and severity of claims. Questions about semi-automated vehicles are emerging for the industry:

• How can the insurance industry secure timely information about the collision experience and repair costs for semi-automated vehicles?
• Will automakers install a “black box” to record when driver assistance features are engaged?
• Will insurance companies be allowed access to this data?
• What safety technology will be required by regulation in new vehicles?
• Will there be a need to redesign the coverage offered?

Self-driving vehicles will also be introduced over the next five to 10 years. Questions are also emerging for the industry about self-driving vehicles:

• Will the insurance coverage for the first self-driving vehicles be modelled on the product liability coverage currently in place for aircraft, ships, and trains with substantial automation?
• What incremental coverage will be offered to drivers who will have the option to take control over self-driving vehicles?
• Will auto rate regulation apply to product liability coverage for the first self-driving vehicles?
• Will insurance cover a variety of vehicle ownership alternatives like personal ownership, car sharing, ride sharing, ride hailing, and pooled ride hailing?
• Is the current construction of insurance coverage appropriate for vehicles with automation?
• What decisions will manufacturers and regulators make over the next decade that could determine the nature of connected vehicles over the long term?

The issues emerging as a result of vehicle automation will present many challenges for the insurance industry, regulators, and other stakeholders, largely due to the expected speed of change. Much preparation needs to be completed in a short period of time.

When will fully self-driving vehicles become available?

“The problem isn’t technology, it’s legislation, and the whole question of responsibility that goes with these cars moving around… and especially who is responsible once there is no longer anyone inside.”

Carlos Ghosn, CEO, Nissan 2014

Self-driving vehicles are being tested in private facilities and on public roads around the world. The capacity of these vehicles is remarkable and advancing. Nevertheless, many issues need to be resolved before self-driving vehicles can be offered to the public.

Self-driving vehicles, for example, cannot drive themselves if the lane markings on the road are covered by snow, or if their sensors are obscured by intense rainfall or fog. Currently, the computers in self-driving vehicles have difficulty judging the behaviour of pedestrians and other drivers at a four-way stop, at times becoming frozen in place and unable to proceed. The vehicles cannot recognize signals provided by a crossing guard, directions from a police officer, or gestures from another driver. Automakers and technology companies are actively working to resolve these issues. Nevertheless, considerable work remains before vehicles can safely drive themselves on public roads.

Gil Pratt, CEO of the Toyota Research Institute, notes “most of what has been collectively accomplished has been relatively easy because most driving is easy. Where we need autonomy to help us is when the driving is difficult.” A major challenge involves programming decisions to be applied in extraordinary circumstances. For example, what should a vehicle do if it must decide between striking an animal on the road and colliding with a telephone pole? An important element of the testing involves anticipating the likely behaviour of other drivers and pedestrians in a wide range of circumstances, so computer programs learn how to drive as well as or better than human drivers. Fully-automated vehicles have considerable capacity to safely drive themselves in test conditions, but are still learning to drive safely in the real world.

A brief history of vehicle automation

Vehicles with automation have been operating for a long time. For example:

- Sailors have used self-steering mechanisms to guide sailboats for thousands of years. In 1896, Nikola Tesla demonstrated a radio-controlled boat with no pilot on board.
- In 1912, less than a decade after the first flight by the Wright brothers, Sperry Corporation developed an autopilot device for...
a aircraft. The Sperry autopilot held the aircraft on a particular compass bearing and elevation for an extended period of time without needing the pilot’s attention.

- In 1925, a driverless car, called the “Linrrican Wonder,” was demonstrated in New York City. The radio-controlled car was under the direction of an individual riding in the car following behind. The car successfully navigated a traffic jam in New York City, as the first of several demonstration events held in the United States.

- In 1939, General Motors sponsored the “Futurama” exhibit at the World’s Fair. The Fair was attended by 44 million people. The one-acre animated model showcased a world 20 years into the future, 1959, defined by self-driving cars, automated highways, and vast suburbs. Spectators sporting a button declaring “I have seen the future” “flew” for 18 minutes on a conveyor system over 50,000 model vehicles and half a million buildings.

- During the 1950s and 1960s, researchers explored the prospect of intelligent highways that would assume control over cars and trucks. Tracks and sensors in the highways would guide vehicles safely at high speed with little distance between the cars and trucks. General Motors developed a prototype self-driving vehicle – the Firebird III. It had an electronic brain that would follow a metal conductor in “the highway of the future” without any direction from the driver. The vehicle had an automated guidance system and “no hold” steering. The driver could assume control over steering by engaging a joystick located between the two seats.

- In the 1970s and 1980s, self-driving vehicles were portrayed in movies and television shows. Dudu was a yellow Volkswagen beetle showcased in four German movies. KITT was a Pontiac Trans Am on the American television show Knight Rider. They simulated extensive capacity to drive themselves.

- The first self-driving vehicles emerged in the late 1970s and early 1980s.15 There were several projects underway: the Navlab project at Carnegie Mellon University in the United States, the ARGO project in Italy, the EUREKA Prometheus project of Mercedes-Benz and Bundeswehr University in Germany, and vehicle testing in Japan. These test vehicles processed information from sensors on each vehicle rather than following direction from the highways.

The innovation process accelerated and became more focused when the United States Government conducted a series of Grand Challenges. The objective was to facilitate the development of robotically controlled vehicles that could be used by the military.

- In 2004, a prize of $1 million was offered to the team that developed a vehicle that could complete a 240-kilometre journey through the Mojave Desert in the least amount of time. A vehicle from Carnegie Mellon University travelled the greatest distance, but no prize was awarded because none of the vehicles completed 10 percent of the journey successfully.

- In 2005, 23 vehicles participated in the second challenge, competing for a $2 million prize. Five vehicles completed the course and all but one travelled further than the best vehicle the previous year. The desert course included three narrow tunnels and 100 sharp turns. The three leading vehicles came from two universities, Stanford and Carnegie Mellon.

- In 2007, $3.5 million in prizes were awarded to the three best vehicles in an urban challenge. A 96-kilometre course on a former air force base was used to simulate urban driving. Contestants were required to obey all traffic regulations while negotiating obstacles and merging into traffic. Six teams successfully completed the course in less than six hours, and the winning teams were from Carnegie Mellon, Stanford, and Virginia Tech.

Chris Urmson was part of the team from Carnegie Mellon University that had the best finish in the 2004 Grand Challenge, placed second and third in the 2005 contest, and won the 2007 event. He is currently leading the self-driving car team at Google.

WHEN WILL FULLY SELF-DRIVING VEHICLES BECOME AVAILABLE?

The current situation for vehicle automation

Aircraft are automated with autopilot technology. Ships have automated guidance systems. Automated forklifts are working in warehouses. Self-driving trucks are operating at mining sites on private property. Many commuter trains are highly automated and practically drive themselves.

Major automakers and some high-tech companies are working to develop fully automated vehicles, including Apple, BMW, Chrysler, Ford, General Motors, Google, Honda, Hyundai, Kia, Mercedes-Benz, Nissan, Tesla, Toyota, and Volvo. Equipment suppliers are also preparing for vehicle automation, including Bosch, Continental, Delphi Automotive, Mobileye, Nvidia, Valeo, Velodyne, and Canadian companies like Magna and Blackberry’s QNX software division.16

Automakers working to develop driver assistance technologies view self-driving vehicles as a natural extension of their current efforts. Automation of driving is seen to be a continuum, with the distinction between driver assistance and self-driving as an evolution in design and production.17

In contrast, some technology companies plan to offer self-driving vehicles as the first automotive product they will bring to market. Google, in particular, is actively working to position their self-driving cars as a revolution in mobility services, something quite distinct from conventional cars and trucks.18 In 2016, the National Highway Traffic Safety Administration in the United States agreed to the request from Google that the self-driving system (SDS) would be accepted as the driver from the perspective of the federal regulator. “If no human occupant of the vehicle can actually drive the vehicle, it is reasonable to identify the driver as whatever (as opposed to whoever) is doing the driving. In this instance, an item of motor vehicle equipment, the SDS, is actually driving the vehicle.”19 In contrast, the California Department of Motor Vehicles recently rejected the request by Google and developed regulations for self-driving cars that include “a requirement that the vehicles have a steering wheel and a human driver ready to take control if necessary.”20

Expectations for vehicle automation

In 2014, Nissan was the first automaker to set out a detailed timeline of the steps leading to the production of fully automated cars. Carlos Ghosn, CEO of Nissan and Renault, said, “By the end of 2016, Nissan will make available the next two technologies under its autonomous drive strategy. We are bringing to market traffic-jam pilot, a technology enabling cars to drive autonomously – and safely – on congested highways. In the same time frame, we will make fully automated parking systems available across a wide range of vehicles.” By 2018, new Nissan vehicles will be able to change lanes without driver input. According to Ghosn, the company expects to “introduce intersection-autonomy, enabling vehicles to negotiate city cross-roads without driver intervention” by the end of the decade. In 2013, Ghosn had said that 2020 would be the “absolute deadline” for Nissan to introduce self-driving vehicles to market.21

Some automakers and technology companies predict that the first self-driving cars will be ready for sale within the next five years. However, Elon Musk, CEO of Tesla Motors, and others believe that some additional time will be needed to secure regulatory approval. The history of the auto industry demonstrates that major changes in design often proceed over many years due to testing by manufacturers, regulators, and other stakeholders, including the insurance industry.

16 Mosquet, Dauner, Lang, Rußmann, Mei-Pochtler, Agrawall, and Schmieg, “Revolution in the Driver’s Seat: The Road to Autonomous Vehicles.”
17 Gordon-Bloomfield, “Nissan Changes Expectations, Timeline For Autonomous Drive Technology.”
18 Davies, “Google’s Plan to Eliminate Human Driving in 5 Years.”
19 Masunaga, “Who's the Driver of that Google Car? Feds Ready to Say it’s the Computer”
20 Masunaga, “Who's the Driver of that Google Car? Feds Ready to Say it’s the Computer”
21 As quoted in Gordon-Bloomfield, “Nissan Changes Expectations, Timeline for Autonomous Drive Technology.”
According to a report by PwC, “There is typically a fifteen-year span between the initial introduction of a new technology and 95 percent new vehicle models availability. It takes an additional 15 years (or 30 years in total) to reach 95 percent of all vehicle availability.”\(^{22}\) A recent report by the Victoria Transport Policy Institute, “Autonomous Vehicle Implementation Predictions,” notes that it takes two to five decades from initial commercial availability to market saturation. For example, it took 25 years until airbags were mandated and 50 years before automatic transmissions became affordable and effective.\(^{23}\)

Throughout the development period, adverse surprises, such as a fatality attributed to a self-driving car, may delay or even halt adoption.

Ian Robertson of BMW said, “We’ve reached the ‘feet off’ phase of autonomy, and now we’re in the ‘hands off’ and ‘eyes off’ phase, but only for brief periods. The next phase will be ‘brains off’ but while that technology could be there in, say, 10 years’ time, other factors probably mean it’s 15 years away… One of those factors is what you could call the moral dilemma.” It will take time to develop programs that anticipate and effectively manage difficult driving circumstances.\(^{24}\)

In early 2016, Kanetix, an online comparison website for insurance consumers, released the results of a poll they commissioned in which 1,095 Canadians indicated whether they would use a driverless car.\(^{25}\) One in four (23 percent) of the 1,095 Canadians responding to the survey did not want to ride in a self-driving vehicle. One in four (25 percent) looked forward to riding in a self-driving car, while the majority of respondents (52 percent) were uncertain at the time of the survey.\(^{26}\)

Fully Self-Driving Vehicle Implementation

(share of the market in percent)

<table>
<thead>
<tr>
<th></th>
<th>New Car Sales</th>
<th>All Vehicles</th>
</tr>
</thead>
<tbody>
<tr>
<td>2020s</td>
<td>2 - 5</td>
<td>1 - 4</td>
</tr>
<tr>
<td>2030s</td>
<td>20 - 40</td>
<td>10 - 30</td>
</tr>
<tr>
<td>2040s</td>
<td>40 - 60</td>
<td>30 - 50</td>
</tr>
<tr>
<td>2050s</td>
<td>80 - 100</td>
<td>50 - 80</td>
</tr>
<tr>
<td>2060s</td>
<td>80 - 100</td>
<td>80 - 100</td>
</tr>
</tbody>
</table>

Source: Victoria Transport Policy Institute

Surveys in other countries also show considerable ambiguity about the emerging technology. Some enthusiasts are excited about the prospect of self-driving vehicles, but many others are uncertain, and a number of people do not believe that self-driving vehicles should be allowed on public roads.\(^{27}\) Consumer acceptance is critical if automation is to be widely adopted. Public support is stronger for driver assistance technologies that demonstrate a reduction in the risk of collisions. Concern, however, has been expressed over fully self-driving vehicles.

---


\(^{24}\) As quoted in Boeriu, “BMW to Show Autonomous Concept in 2016.”


\(^{26}\) “Canadians Divided on Driverless Cars, Kanetix.ca Study Reveals,” Canadian Underwriter Online.

\(^{27}\) Kyriakidis, Happen, and De Winter, “Public Opinion on Automated Driving: Results of an International Questionnaire among 5000 Respondents,” pp. 127 – 140.
Implications for the insurance industry

Auto insurance accounts for half of the premium revenue generated by the insurance industry in Canada. Automation is expected to reduce the frequency of collisions for new vehicles and increase the complexity and cost of repairs. Automation of driving is expected to reduce the number of collisions due to driver error, but may increase the number of collisions due to defects by auto manufacturers, software designers, maintenance professionals, and roadways. As compared to the past 40 or 50 years, over the next 10 years rapid change in the frequency and nature of traffic collisions is expected.

The accelerated pace of change will present a number of challenges for the insurance industry. Brokers, agents, and policyholders may find it difficult to understand the underwriting outcomes for new vehicles. For example, with a sudden, unprecedented advance in safety performance, how will insurance companies determine the cost of coverage for vehicles?

Ratemaking will be a special challenge. There will be no history of losses to support rate determination for the first self-driving cars and trucks. The actuarial foundation for ratemaking relies on historical loss experience to anticipate future costs. Industry, public, and regulatory confidence in this critical relationship could erode when there is little information about the loss experience for self-driving vehicles. This would create greater uncertainty in corporate decision-making about rates. Uncertainty about expected losses and appropriate rates would extend beyond insurance companies and also present difficulties for regulators, particularly in jurisdictions that regulate the prices charged by auto insurers.

The introduction of automated driving is expected to alter other aspects of auto insurance, including claims resolution. Insurance companies and other stakeholders need to determine responsibility for collisions. For collisions involving two or more conventional vehicles, the claims process typically seeks to determine the share of responsibility for each of the drivers involved. With the introduction of automation, the claims process may also need it to determine the vehicle’s share of responsibility.

Insurance coverage is presently available for aircraft, trains, ships, and other vehicles with substantial automation. Insurance coverage for these automated vehicles could provide guidance for policies to cover self-driving cars. Such coverage would likely be based on product liability. Perhaps a greater challenge will be to secure regulatory approval. Primary coverage may focus on the vehicle manufacturer, but some residual coverage will be needed for drivers if the first self-driving vehicles have the capacity for drivers to assume control.

The insurance rates charged for other automated modes of transportation are not subject to rate approval. Will rates for self-driving cars and trucks be subject to rate approval? Moreover, current rate regulation was designed for coverage in which driver error is the cause for most collisions, and the criteria allowed for rate filings will need to change for self-driving cars. In addition, in order to resolve claims, insurance companies will need to know when the vehicle is in self-driving mode and when a driver assumes control. Insurance companies will want access to information captured by the vehicle that indicates who was in control at any given point in time.

Much work needs to be done within the insurance industry before there is high confidence in the insurance coverage offered for self-driving vehicles.
Why are traffic collisions expected to fall significantly?

“Safety was our absolute paramount goal. I felt like obviously my family will be in the car, my friends’ families, and if I didn’t do everything possible to maximize safety and something went wrong, I couldn’t live with myself.”

Elon Musk, CEO, Tesla Motors, 2015  

Between 1984 and 2013, there were 94,000 traffic fatalities and 6.7 million injuries in Canada. Collisions affect many others, including the family and friends of the victims, and result in tens of billions of dollars of medical treatment costs and vehicle damage. Collisions are the leading cause of preventable deaths for children and teenagers. Too many Canadians are killed each year or seriously injured on public roads. Will vehicle automation and driver assistance reduce collisions and improve road safety in Canada over the next 10 years? 

In brief, yes!

The discussion about automated technology for cars is a discussion about road safety. The widespread introduction of semi-automated vehicles will significantly reduce traffic fatalities and serious injuries. A large improvement will be evident within 10 years for new vehicles, with even greater improvements after that. Vehicles that combine human drivers with computer assistance are expected to result in safer travel than what is currently experienced with conventional vehicles.

Given that conventional vehicles dominate the current fleet of cars and trucks, the initial impact of vehicle automation on reducing collisions will be small. At this time driver assistance technology is only available on some models of cars and trucks. Over the next 10 years, the share of new vehicles with the new safety technology is expected to grow. Moreover, the capacity of these systems to avoid collisions and prevent fatalities is increasing as the systems learn and as the capacity of sensors and on-board computers improves. It may take 15 or 20 years before the majority of the vehicles on Canadian roads will have forward collision prevention and other driver assistance, but this will be accompanied by a marked reduction in traffic fatalities and injuries.

Consumers may find purchasing vehicles with driver assistance more attractive as the quality of assistance increases and the price decreases. Computers are learning to become more skilled at assisting drivers in an expanding range of dangerous circumstances and the cost of sensors and computer processing is decreasing rapidly.

28 Wieczner, “Elon Musk Explains What Happens When A Tesla Crashes.”
### Canadian Traffic Collisions, 1984-2013

<table>
<thead>
<tr>
<th>Year</th>
<th>Fatalities</th>
<th>Injuries</th>
<th>Drivers</th>
<th>Automobiles</th>
</tr>
</thead>
<tbody>
<tr>
<td>1984</td>
<td>4,120</td>
<td>237,455</td>
<td>15,540</td>
<td>10,781</td>
</tr>
<tr>
<td>1985</td>
<td>4,364</td>
<td>259,189</td>
<td>15,964</td>
<td>11,118</td>
</tr>
<tr>
<td>1986</td>
<td>4,068</td>
<td>264,481</td>
<td>16,226</td>
<td>11,586</td>
</tr>
<tr>
<td>1987</td>
<td>4,286</td>
<td>280,575</td>
<td>16,927</td>
<td>11,686</td>
</tr>
<tr>
<td>1988</td>
<td>4,154</td>
<td>278,618</td>
<td>17,155</td>
<td>12,086</td>
</tr>
<tr>
<td>1989</td>
<td>4,246</td>
<td>284,937</td>
<td>17,592</td>
<td>12,380</td>
</tr>
<tr>
<td>1990</td>
<td>3,963</td>
<td>262,680</td>
<td>17,718</td>
<td>12,622</td>
</tr>
<tr>
<td>1991</td>
<td>3,690</td>
<td>249,217</td>
<td>18,090</td>
<td>12,578</td>
</tr>
<tr>
<td>1992</td>
<td>3,501</td>
<td>249,821</td>
<td>18,465</td>
<td>12,781</td>
</tr>
<tr>
<td>1993</td>
<td>3,615</td>
<td>247,588</td>
<td>18,843</td>
<td>12,925</td>
</tr>
<tr>
<td>1994</td>
<td>3,230</td>
<td>241,899</td>
<td>19,243</td>
<td>13,131</td>
</tr>
<tr>
<td>1995</td>
<td>3,313</td>
<td>238,458</td>
<td>19,327</td>
<td>13,192</td>
</tr>
<tr>
<td>1996</td>
<td>3,129</td>
<td>227,283</td>
<td>19,964</td>
<td>13,251</td>
</tr>
<tr>
<td>1997</td>
<td>3,076</td>
<td>217,401</td>
<td>20,148</td>
<td>13,515</td>
</tr>
<tr>
<td>1998</td>
<td>2,919</td>
<td>213,319</td>
<td>20,744</td>
<td>13,887</td>
</tr>
<tr>
<td>1999</td>
<td>2,980</td>
<td>218,457</td>
<td>20,934</td>
<td>16,538</td>
</tr>
<tr>
<td>2000</td>
<td>2,904</td>
<td>222,848</td>
<td>20,593</td>
<td>16,832</td>
</tr>
<tr>
<td>2001</td>
<td>2,758</td>
<td>216,542</td>
<td>20,879</td>
<td>17,055</td>
</tr>
<tr>
<td>2002</td>
<td>2,921</td>
<td>222,665</td>
<td>21,163</td>
<td>17,543</td>
</tr>
<tr>
<td>2003</td>
<td>2,777</td>
<td>216,123</td>
<td>21,436</td>
<td>17,755</td>
</tr>
<tr>
<td>2004</td>
<td>2,735</td>
<td>206,104</td>
<td>21,673</td>
<td>17,920</td>
</tr>
<tr>
<td>2005</td>
<td>2,898</td>
<td>204,701</td>
<td>21,937</td>
<td>18,124</td>
</tr>
<tr>
<td>2006</td>
<td>2,871</td>
<td>199,976</td>
<td>22,278</td>
<td>18,739</td>
</tr>
<tr>
<td>2007</td>
<td>2,753</td>
<td>192,745</td>
<td>22,606</td>
<td>19,199</td>
</tr>
<tr>
<td>2008</td>
<td>2,431</td>
<td>176,394</td>
<td>22,972</td>
<td>19,613</td>
</tr>
<tr>
<td>2009</td>
<td>2,216</td>
<td>170,770</td>
<td>23,198</td>
<td>19,877</td>
</tr>
<tr>
<td>2010</td>
<td>2,238</td>
<td>172,081</td>
<td>23,541</td>
<td>20,268</td>
</tr>
<tr>
<td>2011</td>
<td>2,023</td>
<td>167,740</td>
<td>23,831</td>
<td>20,608</td>
</tr>
<tr>
<td>2012</td>
<td>2,076</td>
<td>166,872</td>
<td>24,147</td>
<td>20,652</td>
</tr>
<tr>
<td>2013</td>
<td>1,923</td>
<td>165,306</td>
<td>24,630</td>
<td>21,262</td>
</tr>
</tbody>
</table>

Source: Transport Canada

A number of automakers want to move beyond providing computer assistance to drivers. They are working to replace human drivers with self-driving vehicles. The first self-driving vehicles will be safer than conventional vehicles with no automation, but it is unclear if they will be safer than semi-automated vehicles with driving assistance. With the self-driving vehicles presently being tested, drivers need to manage a number of situations, such as extreme weather, intersections, construction, and poorly marked roads. Over time, this will change.
WHY ARE TRAFFIC COLLISIONS EXPECTED TO FALL SIGNIFICANTLY?


1971: Seat belts required in all new vehicles.\(^1\)

1976: Ontario is the first jurisdiction to pass the mandatory seat belt law.\(^1\)

1985: Amendments to the Criminal Code resulted in tougher penalties for impaired drivers.\(^3\)

1990: Canadian Motor Vehicle Safety Standard 108 (CMVSS 108) requires daytime running lights on all vehicles made or imported after January 1\(^{st}\), 1990.\(^4\)

1991: Seat belt legislation enacted in all jurisdictions.\(^5\)

1994-2005: Graduated licensing programs introduced in most Canadian jurisdictions.\(^6,\(^7\))

2008: New Criminal Code provisions on impaired driving give police better tools to detect and investigate alcohol- and drug-impaired driving. These changes increase the maximum sentences and toughen mandatory penalties.\(^8\)

2010: By 2010, hand-held cell phone use while driving banned in: British Columbia, Saskatchewan, Ontario, Quebec, Prince Edward Island, Nova Scotia, and Newfoundland and Labrador.\(^9\) Canada Motor Vehicle Safety Standard 126 requires Electronic Stability Control on all passenger cars, multi-purpose vehicles, trucks and buses with a Gross Vehicle Weight Rating of 4536 kg or less and manufactured on or after September 1\(^{st}\), 2011.\(^10\)

Source: Public Health Agency of Canada analysis of Statistics Canada mortality data.
Additional citations on page 59
Note: Rates are standardized to the 1991 Canadian population, and adjusted with a three-point central moving average.
Vehicle makers have been testing the new driver assistance technologies for several years. They have begun to offer elements of automated technology because they are confident that cars and trucks are safer with driver assistance. While the next generation of cars and trucks will have fewer collisions, fatalities, and injuries, an ongoing debate involves the timing and extent of the improvement.

The current situation for collisions

Worldwide, 1.25 million people die each year in collisions that involved motor vehicles. This includes approximately 2,000 fatalities a year in Canada. Many more people are injured. Collisions result in tens of billions of dollars of medical costs and property damage. Perhaps the most profound concern is the knowledge that much of this loss is preventable.

In 2013, Canada was ranked 13th safest in international studies of fatalities per kilometre driven. Traffic fatalities in Canada were 60 percent higher than those experienced in Sweden and the United Kingdom, the countries with the best road safety records. Canada’s safety performance was similar to France and Italy, and 20 percent better than the United States.

Traffic Fatality Rate, 2008 vs. 2013

---

Why are traffic collisions expected to fall significantly?

There are large variations across Canada in the risk of death from a collision. Since 2000, Ontario has ranked first or second best of any jurisdiction in North America in terms of the lowest fatality rate. The highest traffic fatality rates in Canada are in Saskatchewan and Prince Edward Island. Young drivers are much more likely to be involved in fatal collisions than more experienced drivers. More fatal collisions are on rural roads than urban. Alcohol use contributes to 38 per cent of fatal collisions in Canada.

Obviously several factors contribute to the risk of collisions. Semi-automated vehicles with driver assistance will have a bigger impact on some risks, like distracted driving and fatigue, but may have little impact on other risks, such as aggressive driving and severe weather.

The number of preventable traffic fatalities and injuries in Canada remains unacceptably high. Semi-automated and self-driving vehicles offer exciting new opportunities for reducing traffic fatalities and injuries in Canada.

Some critical trends in collisions

Road safety has increased since the automobile was introduced. The Province of Ontario, for example, publishes collision data from 1931 to the present. The number of traffic fatalities in the province increased over the first four decades from 571 deaths due to traffic collisions in 1931, to reach a peak of 1,959 deaths in 1973. While the number of traffic fatalities increased by 250 percent, during this time there was a 475 percent increase in the number of drivers and a 135 percent increase in the population, so the overall trend in road safety performance was ambiguous.

Traffic Fatality Rate, by province, 2013

Leading Cause of Death Among People 15 to 29 Years Old, 2012 (number of deaths, worldwide)

<table>
<thead>
<tr>
<th>Cause</th>
<th>Number of Deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traffic Collisions</td>
<td>325,000</td>
</tr>
<tr>
<td>Suicide</td>
<td>245,000</td>
</tr>
<tr>
<td>HIV/AIDS</td>
<td>240,000</td>
</tr>
<tr>
<td>Homicide</td>
<td>220,000</td>
</tr>
</tbody>
</table>

Source: World Health Organization


Over the past four decades, however, there has been a marked improvement in road safety. The number of traffic fatalities in Ontario fell from 1,959 in 1973 to 568 in 2012. Indeed, in each year since 2009, there have been fewer traffic fatalities in Ontario than there were in 1931, despite an increase of almost 9 million licensed drivers. The number of traffic fatalities in Ontario fell from 86 per 100,000 drivers in 1931, to 51 in 1973, and to six in 2012. Measured relative to the population, traffic fatalities increased from 17 per 100,000 people in 1931, to 24 in 1973, before falling to 4 in 2012. It is unacceptable that people continue to die in traffic collisions, but the recent progress to reduce the risk of fatalities and injuries has been significant.

While the other provinces do not have collision data covering as long a period of time, recent data show a similar pattern across the country.36 Over several decades, the population, the number of drivers, the number of vehicles, and the total kilometres driven has increased, and the number of fatalities and injuries has declined. Canada’s roads are safer. The improvements are significant and have been sustained.

Many factors have contributed to improvements in road safety. Vehicles are better designed to protect passengers. Most Canadians now wear seat belts. Roads are better designed and maintained. Drinking and driving has been reduced. Young drivers gradually earn the right to drive, and public awareness about safe driving has improved.

Since 1996, it has been Canada’s vision to have “the safest roads in the world.”37 Much work remains to be done toward achieving this vision, but there has been a significant, sustained improvement in road safety throughout Canada since the vision was established 20 years ago.

**Collisions over the next five to 10 years**

Vehicle manufacturers have made bold statements about improvements in safety that will be found in the vehicles they will offer over the next 10 years:

- Volvo has announced “Vision 2020.” The goal of this initiative is to eliminate vehicular deaths and serious injuries for drivers and passengers in new Volvo cars by 2020.38 To repeat, Volvo’s vision is to eliminate, not just reduce, fatalities and serious injuries in new Volvo vehicles within five years.
- Nissan has announced a “Double Zero” target of zero emissions and “virtually zero” fatalities and serious injuries from collisions involving new Nissan vehicles.39

The introduction of driver assistance technology is inevitable, but it will take time for these new vehicles to be designed, built, and sold. Approval by regulators, acceptance by consumers, and cost of production are some factors that will affect the pace of this change. Although semi-automated vehicles are expected to grow in popularity over the next 10 years, a clear timeline for becoming economically viable has not been projected. Over the next few years, this new safety technology will be included in many, but not all, new vehicles.

---

Over the next 10 years,

- Conventional vehicles will likely account for 70 to 90 percent of the kilometres driven on Canadian roads.
- Semi-automated cars and trucks will likely account for between 10 and 25 percent of the kilometres driven in Canada.
- Self-driving vehicles will likely account for less than five percent of the kilometres driven on public roads in Canada.

---

38 Petranly, “Why Volvo Thinks It Can Eliminate All Deaths in Its Cars by 2020” (blog).
WHY ARE TRAFFIC COLLISIONS EXPECTED TO FALL SIGNIFICANTLY?

In terms of numbers of vehicles, in 2016, almost 100 percent of the vehicles are conventional vehicles, while in 10 years it is likely that between 40 and 70 percent will be conventional. The percentage of conventional vehicles sold in Canada may be reduced further if new safety regulations are introduced to require, for example, forward collision avoidance on all new vehicles. Conventional vehicles are expected to improve their overall safety performance over the next 10 years, but not to match the gains expected in semi-automated vehicles with driver assistance.

The longer-term trends in collisions

Experiences in Sweden and the United Kingdom demonstrate that there are opportunities to improve the road safety performance of Canadians. The large differences in traffic fatalities and injuries within Canada also suggest scope for gains. The number of preventable traffic fatalities and injuries in Canada can be reduced.

Volvo and Nissan have challenged the auto industry and other stakeholders to go beyond reducing collisions and to focus on eliminating traffic fatalities and serious injuries involving new vehicles. Over the long term, there is scope to introduce communications between vehicles (V2V) and between vehicles and road infrastructure (V2I), which will provide vehicles with more information to eliminate collision risks. Investments to improve roads, bridges, and other transportation infrastructure will enhance safety.

The Traffic Injury Research Foundation and others have identified great potential for long-term gains in road safety, predominantly from improving driver performance. This may appear to contradict the idea of self-driving vehicles, but it is central to an assessment of the impact of vehicle automation over the next five to 10 years and beyond. The introduction of semi-automated vehicles will reduce some risks but introduce others, and the overall impact is unknown. As vehicles become safer some drivers may take more risks. Moreover, there will be no safety gains if drivers choose to turn off the new safety features.

There are three critical findings from a national survey conducted by the Traffic Injury Research Foundation:

- Less than one-third of drivers are familiar with modern safety features. Most do not know the features on the vehicle they are driving, nor how they should best be used.
- Many drivers believe that they can react faster and drive better than the features offered by new safety technology, despite considerable evidence that the assistance would make them better drivers.
- Perhaps of greatest concern, a number of drivers disclosed that with vehicle automation they will take more risks, such as driving when fatigued, distracted, or impaired. They also disclosed they may increase aggressive behaviour such as tailgating.

A new challenge involves the safe transfer of control between vehicles and drivers. This will occur frequently in semi-automated vehicles, and be less common in self-driving vehicles, but in either case this is a new concept for drivers. Moreover, transfer of responsibility back to human drivers is most likely when the risk of collision increases. What systems in the vehicle will best achieve an appropriate transfer of control? Specifically, how can the new vehicle automation systems reduce the risk of collisions involving aggressive, distracted, immature, and impaired drivers – drivers who are currently responsible for most preventable collisions? While the specific issues may evolve, driver behaviour will remain central to road safety for conventional vehicles and semi-automated vehicles.

---

An example of automation – forward collision avoidance

Front crash warnings and emergency braking are examples of innovations in vehicle automation being developed by several automakers, major parts suppliers, and technology companies to reduce the risk of collisions. The issue involves collisions where a vehicle rear-ends another vehicle, strikes a pedestrian, or collides with an object. The National Transportation Safety Board in the United States assessed the data from 2012 and identified that 1.7 million rear-end collisions that resulted in 1,705 fatalities and 500,000 injured people. Research by the Board found that forward collision avoidance had the potential to prevent or mitigate 82 percent of the fatal collisions. In some collisions the driver never engaged the brakes, while in other collisions the brakes were engaged too late and/or without sufficient force. The reasons for the failure of drivers to prevent a collision varied and included inattentiveness, excessive speed, fatigue, and reduced visibility.

Collision warning systems combined with emergency braking hold great promise to reduce the frequency and severity of forward collisions. Sensors involving cameras, radar, and lidar can be used to monitor the area in front of a vehicle to determine if the vehicle is too close to another vehicle, a pedestrian, or an object. This information is processed on-board to assess the risk of a collision. The system provides a warning, typically an audible warning, if the risk exceeds a threshold. Some new vehicles combine warning systems with emergency braking, so they have the capacity to engage the brakes if the driver does not respond to the warning. If the driver does apply the brakes, the vehicle will automatically increase the strength of the response if it believes that more force is required. The objective is to prevent a collision or to reduce the severity of the crash.

Emergency Brake Testing (speed reduction in IIHS testing)

<table>
<thead>
<tr>
<th></th>
<th>20 kms/hr</th>
<th>40 kms/hr</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subaru Outback</td>
<td>20*</td>
<td>40*</td>
</tr>
<tr>
<td>Subaru Forester</td>
<td>20*</td>
<td>40*</td>
</tr>
<tr>
<td>Cadillac SRX</td>
<td>20*</td>
<td>31</td>
</tr>
<tr>
<td>Cadillac ATS</td>
<td>20*</td>
<td>24</td>
</tr>
<tr>
<td>Volvo S60</td>
<td>20*</td>
<td>23</td>
</tr>
<tr>
<td>Volvo XC60</td>
<td>20*</td>
<td>18</td>
</tr>
<tr>
<td>Mazda 6</td>
<td>20*</td>
<td>did not activate</td>
</tr>
<tr>
<td>Audi A4</td>
<td>18</td>
<td>did not activate</td>
</tr>
<tr>
<td>Audi Q5</td>
<td>18</td>
<td>did not activate</td>
</tr>
<tr>
<td>Acura MDX</td>
<td>11</td>
<td>10</td>
</tr>
<tr>
<td>Lexus ES</td>
<td>10</td>
<td>6</td>
</tr>
<tr>
<td>Jeep Grand Cherokee</td>
<td>6</td>
<td>11</td>
</tr>
</tbody>
</table>

Source: U.S. National Traffic Safety Board
* vehicle stopped before striking the target

WHY ARE TRAFFIC COLLISIONS EXPECTED TO FALL SIGNIFICANTLY?

Front collision warnings combined with emergency braking have been available for several years as an option that can be added to some new vehicle models. Since 2013, the Insurance Institute for Highway Safety has been providing independent testing of vehicle crash avoidance systems. Test vehicles are driven towards a barrier at 12 or 25 miles per hour (20 or 40 kilometres per hour. Early test results found that some vehicles stopped themselves without striking the barrier; some reduced speed but still experienced a collision; and some emergency braking systems failed to engage under test conditions.44 This testing does not seek to address issues such as drivers disengaging the warning system and severe weather affecting sensors.

There are significant differences in the collision avoidance systems presently available in terms of their operations and objectives. The effectiveness of these vehicle automation systems relies heavily on the acceptance and understanding of drivers.

In 2015, 10 major automakers made a joint commitment to install automatic braking systems in all new vehicles sold in the United States.45 The companies are Audi, BMW, Ford, General Motors, Mazda, Mercedes Benz, Tesla, Toyota, Volkswagen, and Volvo. The announcement did not include a specific time frame for implementation, but did emphasize the shift in road safety focus from protecting occupants to preventing collisions. Over the next five to 10 years, there is high confidence that front collision avoidance systems will become commonplace in most new vehicles sold in Canada, resulting in a significant reduction in the risk of traffic fatalities and severe injuries.

Implications for the insurance industry

For many decades, the insurance industry has been a champion for road safety, fire prevention, and loss reduction. The introduction of semi-automated vehicles over the next 10 years has the potential to reduce traffic fatalities and injuries significantly relative to conventional vehicles. It is natural for the insurance industry to be an ally supporting drivers, vehicle manufacturers, regulators, and other stakeholders involved in the process to ensure the responsible introduction of vehicle automation.

Reduced risk of collisions also brings challenges for the insurance industry. Warren Buffett, CEO of Berkshire Hathaway, observed that, “If you could come up with anything involved with driving that would cut accidents by 30 percent, 40 percent or 50 percent, that would be wonderful. But we would not be holding a party at our insurance company.”46

Insurance companies need to secure data to ensure that pricing for new vehicles is valid and appropriate. In 2013, the Casualty Actuarial Society invited members to join an Automated Vehicles Task Force to explore these issues. In 2014, the task force published a report assessing the findings of the motor vehicle crash causation study for automated vehicles.47 In 2015, the Canadian Institute of Actuaries and the Casualty Actuarial Society hosted a joint member training session to explore the impact of automated vehicles on the insurance industry. These are early examples of industry actions taken to ensure that rates reflect the actual risk of loss for specific policyholders.

The strategic plan of the General Insurance Statistical Agency does not specifically mention vehicle automation, but does identify the need to “develop a proactive approach to review data requirements, including the identification of new data elements

---

45 Lowy, “Automakers Commit to Put Automatic Brakes in All Cars.”
46 Buhayar and Robison, “Can the Insurance Industry Survive Driverless Cars?”
and reporting improvements." The plan also mentions "providing information regarding emerging trends" and needing to "ensure clarity about emerging trends and their impact on data collection and reporting." There is considerable scope for the agency to provide leadership in support of the appropriate introduction of semi-automated and self-driving vehicles.

Since 1959, the Insurance Institute for Highway Safety has operated a testing program to assess the crashworthiness of vehicles. In 2013, the Institute introduced a new program to test technologies that seek to avoid or prevent collisions, with a focus on frontal crash prevention. This is a proactive effort by the insurance industry to measure the safety performance of new semi-automated vehicles.

For more than 20 years, many companies in the Canadian insurance industry have chosen to use the Canadian Loss Experience Automobile Rating (CLEAR) system to help determine the price for auto insurance coverage. The system tracks the actual collision experience of each vehicle model. The system provides insurance companies with detailed information about each vehicle model, with a lag in time to permit processing of the information. The strength of tools like CLEAR increases when the observed performance accumulates over time. The effectiveness of this tool is compromised somewhat when only a small number of vehicles are operating in Canada, so little information is available, and when major changes are first introduced.

There have been dozens of articles about automated vehicles published in the insurance industry journals. In 2013, the National Insurance Conference of Canada hosted a discussion on “The end of auto insurance?” In 2015, the Insurance Institute of Canada’s Chartered Insurance Professionals Society hosted a webinar on “The future of auto insurance: From semi-autonomous to driverless.” The Institute also prepared this research report on automated vehicles. In 2016, PACICC’s Risk Officer’s Forum hosted a webinar on self-driving vehicles.

The insurance industry has begun to assess the impact of vehicle automation, but much work remains to prepare for the disruption automation will likely bring.

Preventable Rear Collision Losses
(share of U.S. collisions in percent)

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Preventable Fatalities</td>
<td>82.2</td>
</tr>
<tr>
<td>Preventable Injuries</td>
<td>93.5</td>
</tr>
</tbody>
</table>

Source: U.S. National Traffic Safety Board

Will higher repair costs limit insurance savings?

The days when a car aficionado could repair his or her own car are long past, due primarily to the high software content.

Marc Andreessen, co-founder, Netscape, 2011

Some analysts cite research that driver error is responsible for more than 90 percent of vehicle collisions, and suggest that cars and trucks without drivers may experience a similar, large reduction in collisions, fatalities, injuries, repair costs, and insurance rates. These reports often include comments implying that self-driving vehicles may be available soon, building public expectations of great improvements in safety and much lower insurance costs in the near future.

Assessments by the insurance industry and others, however, caution that the introduction of semi-automated vehicles will slow the growth in collision damage claims, but the auto insurance industry will continue to pay billions of dollars of damage claims for many years. Major disruption in the insurance industry is not expected over the next five to 10 years.

How can these divergent views be reconciled? Why is it important for the insurance industry in Canada to discuss the costs associated with the increased uncertainty about liability and higher expected repair costs, and to actively manage expectations about the cost of insurance over the near and long term? The insurance industry will likely need to explain to vehicle owners, regulators, and other stakeholders that vehicles promising a large reduction in fatalities and serious injuries may cost much more to repair. The industry will also need to explain that it is reasonable that the cost of insurance does not fall at the same rate as the decline in the risk of fatalities.

Manufacturers of semi-automated vehicles with driver assistance are working to ensure that where the risk of collision is concerned, new vehicles can perform better than human drivers in conventional vehicles. Since driver error is responsible for most collisions, and semi-automated vehicles could potentially reduce the risk of collisions by 30 to 40 percent over the next 10 years, the implications are exciting. Over the next 40 to 50 years, fully automated vehicles may bring

49 Andreessen, “Why Software Is Eating the World”
further improvement in road safety. Nevertheless, over the next few decades, there will still be collisions due to driver error and/or the failure of vehicles, and, consequently, a continuing need for auto insurance.

**Repairs for conventional vehicles**

The vast majority of the vehicles on the road today in Canada are conventional cars and trucks with no automation. The majority of the new vehicles sold in Canada over the next three to five years will likely be conventional vehicles. Most automakers presently offer driver assistance on only select vehicle models. These safety features are often bundled with high-cost optional packages, limiting the number of new car buyers who have the means and inclination to purchase these vehicles.

It is unclear how the frequency and nature of collisions will change for conventional vehicles as more vehicles with automated capacity come on to the roads over the next five to 10 years. For example, emergency braking on semi-automated vehicles will stop a car without input from the driver if certain circumstances arise. Emergency braking should reduce the risk that conventional vehicles experience a rear-end collision. Emergency braking may, however, increase the risk that conventional vehicles crash into the rear of semi-automated vehicles that stop suddenly.

Whether the transition to automated vehicles over the next 10 years will increase or reduce the risk of collisions for conventional cars and trucks is uncertain. Driver behaviour will ultimately be a critical factor to determine the collision experience, as drivers of conventional vehicles learn to share the roads with semi-automated and self-driving vehicles.

Assuming no change in the frequency and cost of collisions for the large number of conventional vehicles, combined with fewer collisions for the small number of semi-automated vehicles, the overall trend in the collision experience in Canada is unlikely to change much over the next five years. A larger impact will likely become evident 10 years from now when more semi-automated vehicles are in use. In total, the number of collisions, fatalities, and injuries is likely to fall as a larger share of the cars and trucks on public roads are semi-automated vehicles. The collision experience will likely be lower for the semi-automated vehicles, but will change little for society as a whole, given the continuing dominance of conventional vehicles.

**Repairs for semi-automated vehicles**

The primary objectives of the manufacturers of new vehicles with driver assistance are to reduce traffic fatalities and injuries and to enhance the driving experience. Manufacturers expect that in all driving circumstances, semi-automated vehicles will perform at least as well as human drivers in conventional vehicles, and better than human drivers in certain high-risk situations. Nevertheless, semi-automated vehicles are still expected to be involved in collisions.

When a collision occurs, the cost of repair is expected to be higher than for conventional vehicles. Semi-automated vehicles carry sensors, cameras, and an on-board computer. Some sensors are only effective when they are located in areas, like the side mirrors, that may be prone to damage, even from minor collisions. It will be more expensive to repair a vehicle with sensors and a computer than it will be to repair a vehicle without these driver assistance features. Moreover, the insurance industry is presently learning whether the same professionals who have demonstrated their capacity to repair conventional vehicles can also repair vehicles with sensors and a computer, or if special training and skills are required.

In 2015, KPMG published the report “Marketplace of Change: Automobile Insurance in an Era of Autonomous Vehicles.” The report assesses the period from 2013 through 2040, and projects that the average cost for auto insurance companies of a traffic collision involving semi-automated and self-driving vehicles will increase by 40 percent in that time frame.\(^\text{53}\)

Over the next 10 years, KPMG projects a 25 to 30 percent increase in the cost of repairs and a 35 to 40 percent reduction in the frequency of collisions. Overall, the net impact of fewer collisions but higher repair costs may be a 10 percent reduction in the average cost per vehicle of providing auto insurance in 10 years, or a 1 percent a year change in insurance costs. This

---

WILL HIGHER REPAIR COSTS LIMIT INSURANCE SAVINGS?

Expected Collisions Frequency

Source: KPMG

Expected Collisions Severity

Source: KPMG

Expected Collisions Severity vs. Frequency

Source: KPMG
Automated Vehicles Implications for the Insurance Industry in Canada

Analysis implies that, over the next 10 years, traffic fatalities and serious injuries in semi-automated vehicles will be 35 to 40 percent less than conventional vehicles today, but the overall cost of insuring these vehicles may only fall by 10 percent due to the higher cost of repairs.

A 2015 study by Swiss Re found that auto insurance claims and revenues in advanced countries, like Canada, are expected to be largely unchanged over the next decade or two. Reductions in the frequency of collisions for new vehicles are expected to be offset by increases in claims costs and the number of vehicles. A 2015 study by PwC predicts an 8 percent reduction in total insurance payments for auto collision claims by 2025 in the United States, from US$83 to US$76 billion, due to the introduction of vehicle automation.

These three independent studies all lead to a similar finding – that overall auto insurance claims will likely be relatively stable over the next 10 years, with a significant reduction in the frequency of collisions largely offset by the higher cost of claims. Stable, or a moderately lower, claims cost implies that the price of auto insurance will be relatively stable, or may decline moderately. Much larger changes, in contrast, are projected over the next 20 to 30 years. For example, KPMG expects an 80 percent reduction in the frequency of auto insurance claims over the next 25 years, offset by a 40 percent increase in the average claims cost. Overall, this would result in a 40 percent reduction in total value of claims payments by the insurance industry.

Moreover, the KPMG report anticipates that auto product liability claims will grow from almost nothing today to become a market approaching the size of today’s commercial auto insurance market. The commercial auto insurance market is expected to grow by 30 percent due to more vehicle fleets and increased auto sharing. But the personal auto insurance market is projected to shrink over the next 25 years by 60 percent. KPMG and others anticipate relatively small changes over the next 10 years, followed by a significant shift in the auto insurance market through 2040 and beyond.

PwC’s study predicts an even greater shift in car sales over the next 20 to 30 years with the introduction of self-driving vehicles. In particular, PwC identifies the disruptive potential of car sharing with fully self-driving vehicles. There are important differences in the analysis by PwC, KPMG, Swiss Re, and others regarding the impact of automated vehicles on the insurance industry over the long term, particularly in terms of the extent of disruption to the personal auto insurance market. There is, however, widespread agreement about the outlook over the next 10 years.

### Expected Auto Loss Claims, United States
(billions of U.S. dollars, adjusted for inflation)

<table>
<thead>
<tr>
<th>Category</th>
<th>2013</th>
<th>2040</th>
</tr>
</thead>
<tbody>
<tr>
<td>Personal Auto</td>
<td>126.15</td>
<td>49.88</td>
</tr>
<tr>
<td>Commercial Auto</td>
<td>18.85</td>
<td>24.08</td>
</tr>
<tr>
<td>Product Liability</td>
<td>0</td>
<td>12.04</td>
</tr>
</tbody>
</table>

Source: KPMG

Projections of a modest reduction or no change in overall claims costs over the next 10 years would represent a marked change from the growth in auto insurance claims cost in Canada over the past few decades. For example, adjusted for inflation, auto insurance claims in Canada doubled over the past 30 years. The actual loss experience data will be the most important factor driving change in the cost of insurance for new vehicles over the near term.

McKinsey anticipates that original equipment manufacturers (OEMs) will use the introduction of semi-automated and self-driving vehicles to challenge the business model of independent service shops. Automakers may use the safety-

---

54 Bongers, Sebastiaan. “Re/Insurance Risk Landscape: The Swiss Re Perspective.”
58 Driverlessuser, “PwC Predicts Collapse of Car Sales Because of Self-Driving Cars.”
60 Bertoncello and Were, “Ten Ways Autonomous Driving Could Redefine the Automotive World.”
critical nature of automated features to press consumers for strict adherence to using service processes and original service equipment for maintaining and repairing new vehicles. Automakers may seek this market to secure after-market revenues and to better manage risks associated with collisions resulting from technical failures. A shift over time to increased use of original equipment for repairs may further contribute to the rising cost of repairs for insurance companies.

Repairs for self-driving vehicles

Little information is available about the collision damage experienced in the testing of self-driving vehicles. By November 2015, Google reported that its test vehicles were driven more than two million kilometres on public roads and were involved in 17 collisions. Measured per kilometre driven, one study found that the collision rate for Google test vehicles is nine times higher than that of conventional vehicles.\(^{61}\) In part, this is due to more accurate reporting of minor collisions. Google claims that each collision through November 2015 was due to error by the driver of a conventional vehicle that collided with a test car. Each report indicates no cost of repair for the test vehicles, because Google employees repaired the cars themselves.

Disengagement reports to the Government of California provide information about near collisions when drivers assumed control of test vehicles on public roads. The report from Google covers the 15-month period from September 2014 to November 2015. Google vehicles drove for 683,000 kilometres and the drivers assumed control in 341 situations, including 13 incidents where post-event analysis shows there would likely have been a collision.\(^{62}\) In two cases, the vehicle would have struck a traffic cone. In one case, another vehicle was travelling the wrong way down the road in the path of Google’s test vehicle. Circumstances where the driver is required to assume control to prevent a collision are rare, but the analysis by Google indicates that “In 3 of the 13 occasions, a driver in another vehicle that would have, in simulation, caused contact with our car, […] in these cases, we believe that a human driver could have taken reasonable action to avoid the contact but the simulation indicated that the [self-driving test car] would not have taken that action.”\(^{63}\)

Tests of self-driving vehicles on public roads show that some drivers of conventional vehicles express anger when the test vehicles travel at a slower speed than the rest of traffic. Also, some test vehicles are programmed to pause before they turn at a stop sign. The State of California requires that test vehicles be labeled so that other drivers will be made aware that the movements of these vehicles may be different than those of conventional vehicles.

Ultimately, the cost of repairs for self-driving vehicles will likely only become evident after these cars and trucks transition from testing to regular operation on public roads.

Implications for the insurance industry

Driver assistance systems are available today, and self-driving vehicles are being tested around the world. But the insurance industry needs evidence to determine the real-world benefits. Much can change over long periods of time, but over the next 10 years, it is very likely that the insurance industry will continue to pay billions of dollars each year to help Canadians recover from traffic injuries and to repair damaged vehicles.

---

\(^{61}\) Smith, “Driverless Cars in 2016: 7 Numbers Everyone Should Know.”


Many factors influence the cost of resolving collisions, and managing the risk of traffic collisions is complex. The insurance industry has long been a champion of safer vehicles. The industry should champion regulation of vehicle design that accelerates the introduction of technologies that reduce traffic fatalities and serious injuries. Canadians must invest in better road infrastructure. And Canadians must learn to become better drivers, including learning about the emerging driver assistance technologies.

Semi-automated and self-driving vehicles are exciting developments that will reduce traffic fatalities and injuries, but the insurance industry needs to be proactive to ensure that discussions about the prospect of lower insurance costs are realistic. Projections that traffic fatalities and serious injuries will decrease are welcome news to be celebrated. However, unwarranted expectations by the public, media, and policy officials may result in inappropriate regulatory intervention in the auto insurance industry.

The insurance industry must continue to remind stakeholders that insurance is needed to protect drivers when collisions occur, and the price of insurance reflects the cost of claims. Canadians will need to understand that the risk of increased litigation, uncertainty over responsibility for collisions, higher repair costs, and other factors will limit the change in insurance costs as vehicle automation advances.
Who will be held responsible for traffic collisions?

When you drive manually, the driver is responsible. When it’s automatic, we as the manufacturer are liable. If you’re not ready to make such a statement, you’re not ready to develop autonomous solutions.

Hakan Samuelsson, CEO, Volvo, 2015

Over the past several decades, drivers have been found responsible for the vast majority of traffic collisions experienced in Canada and elsewhere. However, 40 or 50 years from now, it is possible that all of the vehicles on the road will be self-driving vehicles, with no capacity for human control, so drivers will no longer be responsible for collisions. The transition from human drivers to self-driving vehicles will involve many years with a mix of conventional vehicles, semi-automated vehicles, and self-driving vehicles sharing the same public roads. Who will be held responsible for collisions during a period when driving decisions will increasingly include support from on-board computers?

In the future, when vehicles collide, insurers and the courts need to determine the shared responsibility of the drivers, vehicle owners, automakers, vendors, software engineers, and vehicle maintenance professionals. In 10 or 20 years, if not sooner, it will be important also to consider the responsibility of failure in systems that connect vehicles to other vehicles and infrastructure, as well as cyber attackers and others. Starting now, long-standing experience that drivers were responsible for most collisions must give way to a more complex reality of shared responsibility.

Automated driving systems will require policymakers to revisit issues that include speeding, drinking and driving, underage driving, vehicle theft, distracted driving, graduated licensing, and parking infractions. Other issues include driving without a licence, operating a vehicle without proof of insurance, and licensing of seniors. Trial and error will be involved as regulations evolve to cover the changes as vehicles transition from conventional to semi-automated, and then to self-driving.

An important opportunity over the next 10 years will involve the education and re-education of drivers to learn how to best use the emerging driver assistance systems. Since 1964, the Traffic Injury Research Foundation has been the leading road safety research institute in Canada. For more than 50 years, the Foundation has been a leader in the development of actions to address aggressive, distracted, and impaired drivers. The Foundation’s “Brain on Board” program describes the driver as “your vehicle’s most important safety feature” and provides tools to increase drivers’ knowledge about how the features work. Many of the benefits of vehicle automation require public understanding, trust, and use of the new technology.

Responsibility for collisions will shift

- Driver error was responsible in the past
- Shared responsibility for semi-automated vehicles
- Manufacturers will be responsible for self-driving cars
- Implications for the insurance industry

---

64 Delp, “Volvo’s Liability Stance Is Positive for the Industry – But May Not Be All It Seems.”
65 Traffic Injury Research Foundation, “Traffic Injury Research Foundation Signs Memorandum of Understanding with AROSO to Bring Award-Winning Brain on Board to Arab Countries.”
Who is Liable for Accidents?

How will drivers learn to use the new technology? Indeed, some new risks may emerge as drivers switch between vehicles with different capacities, or some drivers may take risks to test the limits of the new safety systems. Aggressive drivers may decide to turn off some features, so the safety benefits of the technology are lost. Semi-automated vehicles require the transfer of control between the driver and the vehicle, a skill that drivers must learn.

Driver error was responsible for collisions in the past

In 2008, the United States Department of Transportation issued a report to Congress conducted by the National Highway Traffic Safety Administration – the “National Motor Vehicle Crash Causation Survey.”\(^6\) The survey provides a detailed assessment of more than 5,000 collisions over a 30-month period between 2005 and 2007. Data on more than 600 elements were collected on site immediately following each collision to determine the cause. The report concluded that human error was responsible for 93 percent of the collisions. The other 7 percent was due to vehicle breakdown, severe weather, road conditions, or unknown factors.

Determination of legal responsibility is critical for the insurance industry. Insurance coverage is designed around responsibility and the capacity for managing risk. Auto insurance coverage presently in place was built on the experience that driver error has been the cause of most collisions. Claims resolution typically focuses on the determination of the relative contribution of each of the drivers involved. Collisions that are the result of failure by automakers or some other factor not involving the driver are rare, and are typically addressed as extraordinary circumstances outside the norm for claims resolution.

Shared responsibility for collisions involving semi-automated vehicles

The immediate challenge for the insurance industry and the courts involves determining when drivers are responsible for collisions, or when collisions are due to a failure in technology. This includes collisions of semi-automated vehicles, and also the first self-driving vehicles where the driver has the option of assuming control by disengaging self-driving features. The insurance industry, courts, drivers, vehicle owners, public officials, and automakers will all be seeking information to determine what caused the collision and who is responsible.

The design of insurance coverage will need to evolve. The focus of insurance coverage will remain on the driver, for at least the next 10 years, because drivers will remain responsible for the overall safe operation of conventional and semi-automated vehicles. There is, however, an expectation that failure of the new driver assistance technologies will be found responsible, at least in part, for some future collisions. This may be most evident over the next five to 10 years when the new systems are being introduced, when systems have had relatively little testing and drivers have had limited explanation about use.

Volvo announced in 2015 that the company would accept responsibility for everything its cars do while operating in autonomous mode. The manufacturer’s willingness to accept responsibility appears to include the actions of its semi-automated vehicles. All new Volvos, for example, include auto-brake collision avoidance for pedestrians and cyclists. Some models offer automatic braking that will stop drivers from turning in front of oncoming vehicles. Some models also offer automatic control of steering, brakes, and throttle to enable a vehicle to follow the vehicle ahead in stop-and-go traffic.

Statements by Elon Musk of Tesla focus on the importance of driver responsibility to manage semi-automated vehicles. “I’m quite confident within three years [that] the car will be able to take you from point to point… without you touching anything. You could be asleep the whole time and do so completely safely… [but for now] we are advising drivers to keep their hands on the wheel. It’s very important that drivers exercise caution because the new [autopilot] software is very new.”

Carlos Ghosn, CEO of Nissan and Renault, identified the importance of legislation to clarify “the whole question of responsibility that goes with these cars moving around…and especially who is responsible once there is no longer anyone inside.”

Ultimately, the courts will have the final determination, but there is a sense that uncertainty about liability will increase over the next 10 years, relative to the clarity that has been evident over the past few decades. Leadership from the insurance industry will be needed to re-establish clarity about responsibility.

The tone and emphasis of the message from automakers to drivers differs from company to company. When a dispute arises about driver error or equipment failure, it is not clear how determination of responsibility will be established in practice over the next five to 10 years. Some vehicles with

---

68 Delp, “Volvo’s Liability Stance is Positive for the Industry – But May Not Be All It Seems.”
semi-automated features are operating in Canada today, so this is not an issue of the distant future but one that insurance companies must deal with immediately. Several challenges emerge: One is to determine if the safety features in a semi-automated vehicle were engaged or disengaged when a collision occurred. A second involves determining the responsibility of the vehicle owners, automakers, and/or repair professionals for the appropriate maintenance of vehicles. These issues are not new for insurance companies and other stakeholders, but they are expected to grow in importance when human drivers share responsibility with computers to control vehicles.

The insurance industry needs to develop a consensus among Canadian stakeholders around the issue of legal responsibility of various parties for traffic collisions when driver assistance or self-driving systems are engaged. Moreover, it is important to establish procedures that can be applied to determine responsibility.

Recent interest in vehicle automation suggested that replacing human drivers with self-driving vehicles may significantly reduce collisions, traffic fatalities, and insurance premiums. Some suggest that the number of collisions and insurance premiums may fall by more than 90 percent. This speculation appears to be directly linked to the 2008 Causation Survey assessing conventional vehicles.

In 2014, the Casualty Actuarial Society established an Automated Vehicles Task Force to reassess the data collected in the Causation Survey.\(^\text{70}\) The task force identified limitations in the initial findings when applied to automated vehicles. First, data was only collected for serious collisions in which emergency medical services were called to the site. The survey does not include information about minor collisions. Second, the research team was only deployed to visit collisions that occurred between 6:00 a.m. and midnight. Other evidence indicates that issues like drinking and driving would be significantly under-represented due to the absence of overnight deployment. Third, the team would be sent to the collision site only if it could arrive in time to speak directly with the drivers involved and the police. As a result, the survey likely represents the experiences of more urban collisions than rural collisions.

The task force believes that 78.7 percent of the collisions were due to human error. Many collisions (21.3 percent) were the result of issues with the vehicle or severe weather where semi-automated or self-driving technology would not have prevented the collisions.\(^\text{71}\) Automated vehicles would not be expected to perform better than human drivers in these situations. While most of the collisions were due to driver error, for 32.4 percent of the circumstances it is unclear to what extent automated systems would reduce the risk of collision.\(^\text{72}\) Circumstances included evidence of driving while distracted, driving impaired, sleeping, and having a heart attack. Fully self-driving vehicles may be able to cope with these situations, but semi-automated vehicles require a driver able to take control.

The task force concluded that automated driving technology would reduce some risks, increase some risks, and introduce new risks. Driver assistance systems that are currently being introduced in semi-automated vehicles have the potential to address the causes of about half (48.9 percent) of serious collisions.\(^\text{73}\) Driver behaviour remains a vital part of collision-reduction. Fully self-driving vehicles may ultimately have the potential to address 78.7 percent of the risk of collisions. The task force members disagree with the speculation that, in the near future, automated vehicles could reduce collisions, traffic fatalities, and insurance costs by 90 percent.\(^\text{74}\)

\(71\) Casualty Actuarial Society Automated Vehicles Task Force, p. 9.
\(73\) Casualty Actuarial Society Automated Vehicles Task Force, p. 15.
\(74\) Casualty Actuarial Society Automated Vehicles Task Force, p. 1 and p. 16.
Drivers, auto manufacturers, regulators, and insurance companies have been operating for decades in an environment with clarity about responsibility for most collisions – driver error. Driver errors include driving while distracted or speeding. Other driver errors occur when drivers monitor the conditions inadequately or exercise poor control of the vehicle. Experience shows that recognition errors, decision errors, or performance errors by drivers accounted for the vast majority of collisions. Some collisions, however, were due to factors that will not be reduced with vehicle automation: the failure of brakes, tires, or some other vehicle component, problems with the roadway, or conditions with extreme weather.

Evidence that driver error accounts for the vast majority of collisions has become the basis for auto insurance coverage. Insurance companies have little experience pursuing auto manufacturers, software designers, vehicle maintenance professionals, and other parties that may be found responsible for future collisions. This will soon change. Manufacturers will be responsible for fully automated vehicles

Someday, there may be no scope for driving control by humans beyond providing a destination. Drivers will not be responsible for collisions. If collisions in the future are the result of failure in the design, manufacture, and maintenance of vehicles, then the insurance industry will look to product liability, not driver error, as the primary means to manage the risk of collisions. Residual risks to the owner for theft and damage may eventually be included in homeowners’ or tenants’ coverage. There will also be the risk of circumstances where collisions result, at least in part, from public infrastructure failures or cyber attacks.

The application of manufacturer liability will be easiest to put into practice for vehicles that are fully self-driving, with no capacity for human drivers to take control. The expectation that self-driving vehicles will be required to include a switch so that drivers will be able to assume control will, however, cause some ambiguity about responsibility for collisions.

For many decades, human drivers have made decisions about operating a vehicle safely. Some decisions have been difficult to make. For example, when a pedestrian unexpectedly steps onto the road in front of a vehicle, the driver may have to choose between applying the brakes yet striking the individual, or turning into oncoming traffic and colliding with an innocent party. Some drivers’ choices are challenged in the courts, but humans make decisions based on the information available at the time and a lifetime of experience with decision-making. It is assumed that most drivers do their best when confronted by a difficult situation.

Some driving decisions made by vehicles will likely be challenged, further adding to the uncertainty about responsibility for collisions. In particular, public opinion surveys show that many people are skeptical that vehicles are as capable as humans of making safe driving decisions. Over time, this view may change as these vehicles demonstrate their skill to drive safely in a wide range of circumstances. Automated driving involves anticipating the broadest possible range of scenarios and deciding upon the appropriate response in advance. Decision algorithms are designed so that computers learn and constantly work to improve their performance. Moreover, connected vehicle systems will have the potential to automatically share the learning between vehicles, something impossible for human drivers.

The engineering and regulatory communities will need to clarify expectations about the responsibility that human drivers will bear as automation is introduced into vehicles. These efforts will need to set out the circumstances where humans would be expected to retain ultimate responsibility, despite the availability of driver assistance, and the circumstances where manufacturers should assume responsibility.

If a driver engages automated self-parking, and the car collides with a stationary vehicle, this would appear to be the responsibility of the vehicle manufacturer. If a driver decides to park the car without engaging the automated self-parking, the collision would likely be due to driver error. Questions emerge:

• Will the vehicle record when the self-parking feature or other driver assistance technology is engaged?
• Who will own the driving data?
• Which stakeholders should be allowed to access this data?
AUTOMATED VEHICLES IMPLICATIONS FOR THE INSURANCE INDUSTRY IN CANADA

• How might the courts react if this data is withheld when resolving a dispute?
• Could data recorders potentially eliminate fraud and disputes about responsibility?

It is possible that tort law could stop or significantly delay the deployment of fully automated, self-driving vehicles. Software developed to guide self-driving vehicles is designed to improve its responses, learning how to cope with a broad range of traffic situations. Automakers may find it difficult to defend in court the decisions self-driving vehicles made when involved in collisions, particularly the first fully automated vehicles. The early automated vehicles will likely experience collisions where they are at fault or are unable to defend the appearance that they are at fault.

While 1.25 million people die worldwide each year as a result of driver error, the first self-driving vehicle collisions that result in fatalities will challenge public acceptance of the new technology.

Implications for the insurance industry

Lengthy consideration will go into reworking laws, regulatory systems, and infrastructure to accommodate semi-automated and self-driving vehicles. Insurance companies, regulators, automakers, and other stakeholders should not underestimate the extent of the effort required. The number of policy choices and range of options is extensive.75 Since vehicles were introduced 130 years ago, human error has been the predominant cause of collisions. The current legal system and insurance process has been built around an expectation of driver error.

In 40 to 50 years, most vehicles may be fully self-driving. Most collisions may be the result of failure by manufacturers, software, or maintenance. The industry has already developed coverage for aircraft, trains, and other vehicles with extensive automation. The distant future may be very different for the Canadian auto insurance industry and regulators, but there is time and precedent to develop these new systems.

The greatest challenge about liability will likely be over the next 10 years. Conventional, semi-automated, and the first self-driving vehicles will share the roads. Drivers and manufacturers will share responsibility for collisions. Current systems have not anticipated a shift in liability from drivers to manufacturers. There are no clear rules for determining responsibility, nor approved techniques for securing evidence about liability in this new situation. Moreover, historical information used for ratings and case law used for identifying precedents may have little value as new systems to cope with these changes emerge. More information will be needed about the relative performance of vehicles, and there will be less need for detailed information about drivers.

There will be inevitable lawsuits and court rulings needed to establish new norms. These issues will be resolved with time, but over the next 10 years, the insurance industry is entering a period where uncertainty will increase. The insurance industry will need to invest in research and collaborate with regulators and other stakeholders to re-establish clarity of responsibility for traffic collisions.

Willingness to Share Driving Data
(international survey, scale from 1 to 5, 2015)

<table>
<thead>
<tr>
<th>Category</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surrounding Vehicles</td>
<td>3.8</td>
</tr>
<tr>
<td>Roadway Organizations</td>
<td>3.6</td>
</tr>
<tr>
<td>Vehicle Developers</td>
<td>3.6</td>
</tr>
<tr>
<td>Insurance Companies</td>
<td>3.2</td>
</tr>
<tr>
<td>Tax Authorities</td>
<td>2.9</td>
</tr>
</tbody>
</table>

Source: Kryakidid et al

WHO WILL BE HELD RESPONSIBLE FOR TRAFFIC COLLISIONS?

An important issue will involve the capture of and access to data about collisions. Authorities in the United States are considering mandating data collection by all new vehicles. International polling data shows that most vehicle owners are willing to share driving information with other drivers, roadway organizations, and vehicle developers. An international survey of 5,000 drivers found that many vehicle owners, however, are reluctant to share this information with insurance companies. Automated vehicles require and generate a large volume of driving data. A report by KPMG questions the capacity of insurance companies to process this information.

Some technology companies and vehicle manufacturers familiar with these data may consider providing insurance coverage. Auto manufacturers may include insurance coverage in the price of the vehicle, perhaps developed through access to data about collision frequency and repair costs.

Connected vehicles will be designed to share information with other vehicles to increase the information available to ensure the safe operation of cars and trucks. This capacity to share information will, unfortunately, increase the risk of data theft, fake driver information, denial of service, personal tracking, and transportation system attacks.

Reported cyber hacks have stopped a Jeep on the highway; hijacked Tesla’s onboard systems to cut power to the car, disengage the powertrain, and manipulate the windows; and unlocked a BMW from afar through the connected drive system. Doors can be locked, brakes disabled, or the throttle engaged by troublesome hackers. Cyber criminals could steal cars remotely by disabling the immobilizer and ordering the vehicle to drive away. Terrorists could use automated driving systems to cause accidents targeting groups of people.

Consumers will be reluctant to purchase and use semi-automated and self-driving vehicles if they believe that connected vehicles could put their personal information and safety at risk. Automakers are working on data security, but this is an unresolved and evolving issue associated with the introduction of semi-automated and self-driving vehicles.

Cyber insurance coverage for vehicle owners and producers will be important for the advancement of vehicle automation.

---

76 Kyriakidis, Happee, and De Winter, “Public Opinion on Automated Driving: Results of an International Questionnaire among 5000 Respondents,” p. 133.
Why does the big picture include public policy, sharing and transit?

“What we maybe should’ve realized sooner was that we are running a political campaign and the candidate is Uber... And this political race is happening in every major city around the world. And because this isn’t about a democracy, this is about a product, you can’t win 51 to 49. You have to win 98 to 2.”

Travis Kalanick, Co-founder, Uber, 2015

Remarkable change is under way around the world due to the automation of vehicles. Travel is expected to become much safer, and the very nature of transportation will evolve significantly. Governments at all levels should assess the potential impacts that the automation of vehicles could have on road safety, traffic fatalities and injuries, transportation, urbanization, and densification, as well as economic and environmental considerations. Much foresight, leadership, and planning is needed.

For example, the Prime Minister of Japan, Shinzo Abe, opened the 2015 Science and Technology in Society Forum meeting in Kyoto with an enthusiastic discussion about self-driving vehicles. Prime Minister Abe spoke with pride, indicating that two years earlier he was the first person in Japan to test a self-driving vehicle on a public road. He looks forward to a time when he will be able to eliminate the requirement in Japan that all vehicles must have a driver, and expects that self-driving vehicles will be widely present in Tokyo during the 2020 Olympics.

The Prime Minister was speaking about this issue in Japan, but there is little policy discussion about semi-automated and self-driving vehicles in Canada and most other countries. Where does vehicle automation fit within a broader review of major public policy opportunities and challenges over the near and long term?

Canada’s Road Safety Strategy

There is a long and successful history of collaboration and partnership in Canada to champion road safety. Organizations like the Canadian Council of Motor Transport Administrators (CCMTA) bring together the federal and provincial governments, members of the engineering and policy communities, automakers, researchers, insurance companies, and other stakeholders. An objective of the CCMTA is to make Canada’s roads “the safest in the world.”

The big picture includes:

- Canada’s Road Safety Strategy
- The economic impact of automated vehicles
- Planning priorities of urbanization, densification and climate change
- The sharing economy
- Implications for the insurance industry

---

80 Swisher, “Man and Uber Man.”
81 Kyoto International Conference Centre, trans., “Remarks by Prime Minister Shinzo Abe at the Annual Meeting of the Science and Technology in Society (STS) Forum.”
Canada’s 2025 Road Safety Strategy, published by the CCMTA in 2016, is a multi-disciplinary strategy built around six objectives:

- Raise public awareness and commitment to road safety
- Improve communication, co-operation, and collaboration
- Enhance legislation and enforcement
- Improve road safety information
- Improve the safety of vehicles and road infrastructure
- Leverage technology and innovation

Self-driving vehicles are not mentioned in the strategy, but the CCMTA indicates that “Road safety advances for vehicle safety may be realized through innovative measures adopted by the vehicle manufacturers as well as the passing of Canada Motor Vehicle Safety Standards.”

Transport Canada has lead responsibility for regulating vehicle design and engineering in Canada through the Motor Vehicle Safety Act. The federal department actively assesses emerging vehicle technologies, with a particular focus on the safety implications. Vehicle engineering is one of 13 road safety topics explored in the Government of Canada’s report “Road Safety in Canada.” Transport Canada’s public information about the cars and trucks of the future does not mention self-driving vehicles but does explore 15 advanced vehicle technologies. These include forward collision warnings and braking, lane keeping assistance, pedestrian detection, adaptive cruise control, brake assist, and others. The federal government is actively assessing vehicle automation technologies.

An overall objective of the Government of Canada has been to align Canadian and American vehicle safety legislation to maximize the safety benefits for consumers and support the competitiveness of domestic automakers. Vehicles that comply with the federal regulations are permitted on Canadian roads. Semi-automated vehicles and the expected self-driving vehicles must comply with federal safety regulations.

The provincial and territorial governments are responsible for the testing and licensing of drivers. In late 2015, Ontario became the first jurisdiction in Canada to establish specific regulations for testing self-driving vehicles on public roads. Ontario also provided $3 million in research funding for the Connected Vehicle/Automated Vehicle Program. In particular, the Canadian Automated Vehicles Centre of Excellence is the leading research institute in Canada involved in the study of connected and automated vehicles. Over the next five years, the research will focus on increasing road safety, analyzing collision information, monitoring road conditions, and reducing driver distraction.

The Ontario Good Roads Association proposed establishing a steering organization to guide the introduction of automated vehicles. The proposal identifies almost 20 tasks for the steering organization.

Provincial and territorial legislation does not anticipate nor prohibit the prospect of semi-automated and self-driving vehicles, with the exception of the special regulations to permit testing in Ontario. It is likely that the status of semi-automated and self-driving cars will be clarified in provincial and territorial legislation over the next five to 10 years.

Patrick Lin has speculated about the ethics of a future where regulators may test vehicles to determine their ability to safely drive on public roads. Lin asks, “Is it enough for a robot car to pass a human driving test?” Should manufacturers be held to a higher standard than human drivers?

---

87 Ontario Centres of Excellence, “Connected Vehicle/Automated Vehicle (CVAV) Program.”
89 Lin, “The Ethics of Autonomous Cars.”
WHY DOES THE BIG PICTURE INCLUDE PUBLIC POLICY, SHARING AND TRANSIT?

The United Nations Convention on Road Traffic provides international guidance for road safety legislation. Canada and the United States were among 93 countries that ratified the 1949 Convention. Article 8 requires that, “Every moving vehicle or combination of vehicles shall have a driver,” and “Every driver shall at all times be able to control his vehicle.” Only 73 countries have ratified the revised Convention, and this does not include Canada or the United States. Article 8 was recently modified to add, “Vehicle systems which influence the way vehicles are driven shall be deemed in conformity […] when such systems can be overridden or switched off by the driver.” A number of countries have indicated that this is the language that they will use in legislation to allow semi-automated and self-driving vehicles on public roads. In particular, there is an expectation that automated vehicles will be required to include a switch so that drivers have the option to assume control on public roads.

The road safety authorities in Canada are monitoring issues related to vehicle automation, and have expressed support for automakers pursuing innovation expected to reduce collisions. However, regulators in the United States (the National Highway Traffic Safety Administration, the National Transportation Safety Board, and several state agencies), Europe, and Japan have been much more active in promoting connected and automated vehicles than their counterparts in Canada.

The economic impact of automated vehicles

“Automated Vehicles: The Coming of the Next Disruptive Technology” was published by the Conference Board of Canada in 2015. The study reports that replacing conventional vehicles with self-driving vehicles would result in more than $65 billion in economic benefits for Canadians each year.

The greatest gains come from fewer collisions. The report assumes that traffic collisions will decline in Canada by 80 percent, resulting in an 80 percent reduction in traffic fatalities and an 80 percent reduction in the cost of treating traffic injuries. As a result, fewer collisions are expected to eventually generate more than $37 billion a year in savings, including $25 billion in the value of lives saved and $12 billion in reduced medical costs due to prevented injuries. The report also estimates more than $20 billion a year in savings from a reduction of time wasted in traffic. Canadians presently spend more than 5 billion hours a year commuting. The study assumes that more than two-thirds of this time could be directed to work and leisure activities in self-driving vehicles. In addition, the report identifies more than $8 billion a year in savings from congestion avoidance and fuel savings.

Public opinion polling data from a University of Michigan survey of 1,500 drivers in the United States, United Kingdom, and Australia indicates that people are uncertain about what they would do in a self-driving car. Two thirds said they would “watch the road” (41 percent) or they would “not ride in a self-driving vehicle” (22.4 percent). The other third indicated that they would read (8.3 percent), text (7.7 percent), sleep (7 percent), watch movies (5.3 percent), work (4.9 percent), or play games (2 percent).

Despite the potential benefits of automated vehicles, recent Canadian policy statements about transportation and the economy have focused extensively on public transit. The federal, many provincial, and several local governments across the country are planning to invest billions of dollars in public transit over the next 10 years. An explicit goal of many plans is to

Benefits to Canada from Self-Driving Vehicles (billions of dollars a year, 2015)

<table>
<thead>
<tr>
<th>Benefits</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collision Avoidance</td>
<td>37.4</td>
</tr>
<tr>
<td>Less Wasted Time</td>
<td>20.0</td>
</tr>
<tr>
<td>Congestion Avoidance</td>
<td>5.0</td>
</tr>
<tr>
<td>Fuel Savings</td>
<td>2.6</td>
</tr>
</tbody>
</table>

Source: Conference Board of Canada
establish a meaningful and sustainable public transit alternative to cars and trucks. Some plans seek to reduce the number of vehicles in Canada or, at a minimum, to slow the rate of growth. The potential for automated and connected buses, streetcars, and subways has been largely absent in the planning and is not anticipated over the next 10 years.

*There has been little research into the suitability of these emerging systems for the Canadian weather and driving culture.*

Aggressive investments in public transit have the potential to delay investments in semi-automated and self-driving vehicles. Little public funding, for example, has been directed to support the development of automated technologies in Canada. There has been little research into the suitability of these emerging systems for the Canadian weather and driving culture. There are no multi-stakeholder programs seeking to educate the public about how to best benefit from automated vehicles. The modest actions seeking to support vehicle automation and the potential to reduce traffic fatalities contrast with many stakeholders pushing to accelerate plans to invest in public transit.

### Planning priorities of urbanization, densification, and climate change

In 2013, Ontario published a transportation plan, “The Big Move,” for the greater Toronto and Hamilton area. The 25-year plan includes 92 priority actions and supporting policies. It seeks to reduce the percentage of people travelling by car from 70 percent to 50 percent, reduce the average distance each person travels by car each day by 27 percent, and eliminate legal and liability barriers to ride sharing. The plan, however, does not mention vehicle automation and self-driving cars.

Other provinces and cities have established long-term plans often based on the assumption of increasing urbanization and densification. Seeking to protect lands on the urban fringe, many provinces and local planners support a policy of densification, where multi-story construction and infill is favoured over low-rise urban sprawl. Planners may view the development of self-driving vehicles as a direct challenge to efforts to promote urbanization and densification. In particular, the emerging self-driving technology may break the link in consumer perception between longer commute time and wasted time.

---

Discussion about self-driving vehicles has begun to enter into the broader discussions about urban planning. Some urban planners view self-driving vehicles as technology offering both threats and benefits. For example, commuters may become more accepting of long-distance commutes and urban parking space may become available for increased development. McKenzie estimates that a transition to self-driving vehicles would significantly alter the shape of urban centres, “potentially reducing the need for parking spaces in the United States by 5.7 billion square metres.” See Appendix III on page 60 for an alternative view of how automation can facilitate greater urban mobility.

Over the years, there has been an active discussion across Canada about the actions needed to confront climate change. Commitments to reduce greenhouse gas emissions have been often linked to investments in public transit, construction of energy efficient buildings, and promotion of fuel-efficient vehicles. Also with reference to climate change, some governments have indicated that they will seek to reduce the number of vehicles on the road in the future.

The impact of automation and self-driving vehicles on climate change is unclear at this time. Self-driving vehicles have the potential for more efficient use of fuel than human drivers. Connected vehicle systems may enable cars and trucks travelling together to drive safely with reduced fuel. However, there is also the potential that self-driving vehicles may encourage greater urban sprawl, with longer commute times and increased fuel use. Self-driving vehicles may be sent away to find a remote parking space, or they may be programmed to idle in traffic as they wait for their next passenger.

### The sharing economy

Individual ownership of vehicles remains the dominant choice in Canada, but many mobility service alternatives are now available. Carpooling, short-term vehicle rentals, and taxis have long been seen as alternatives to conventional vehicle ownership or temporary transportation needs. Leasing of cars and pooling of rides emerged as viable options for many. In recent years, companies like Zipcar, Car2Go, and Uber have established the idea of consuming “mobility as a service.”

A report by PwC projects that vehicle sharing would account for only 1 percent of the vehicles in the United States within the next 30 years if automakers were to produce only conventional vehicles. They project, however, that vehicle sharing may account for 25 to 30 percent of vehicles within the next 30 years if self-driving vehicles are available as expected. Focusing specifically on the next five to 10 years, PwC believes that sharing will be a very small part of the vehicle market.

The investment bank Barclays projects that the number of owned vehicles will decline by 50 percent over the next 25 years due to increased sharing of self-driving vehicles. Barclays anticipates a combination of on-demand shared self-driving cars and pooled shared self-driving cars that service multiple riders simultaneously. Barclays believes that one shared vehicle may replace the need for seven conventional vehicles.

A report sponsored by McKinsey also anticipates that self-driving vehicles have the potential to transform transportation, but the next 10 to 15 years will largely involve setting the foundation for the major changes that follow. In “Ten Ways Autonomous Driving Could Redefine the Automotive World,” McKinsey reported on interviews with 30 subject matter experts and found that self-driving vehicles could become the primary means of transportation over the next 25 to 35 years.

---

97 Townsend, Re-Programming Mobility: The Digital Transformation of Transportation in the United States, pp. 1 – 60.
98 Bertencello and Wee, “Ten Ways Autonomous Driving Could Redefine the Automotive World”
100 Barclays Bank PLC, “Disruptive Mobility: A Scenario for 2040 …”
101 Bertencello and Wee, “Ten Ways Autonomous Driving Could Redefine the Automotive World”
Presently, for typical individual vehicle owners, their cars are inactive for more than 23 hours a day. Car sharing could significantly increase the productive time for vehicles. While personal ownership is expected to continue to dominate over the next decade, a major shift towards sharing is possible in the next 20 to 30 years.

The president of Uber has indicated that the company is actively working to develop self-driving vehicles as an alternative to human drivers. In 2013, Google became a major investor in Uber. In 2016, General Motors invested US$500 million in Lyft, the ride-sharing company, toward development of a sharing model for promoting the use of self-driving vehicles. Mercedes-Benz is also a leader in the development of self-driving cars, and they own Car2Go, the largest vehicle-sharing company in the world. Companies developing self-driving vehicles are working directly with the leading companies that are creating a market for “mobility as a service” as an alternative to private vehicle ownership.

Some auto industry experts, however, are skeptical about the pace and extent of change in vehicle ownership. Dennis DesRosiers of DesRosiers Automotive Consultants, for example, predicts it could take another century before even half of the vehicles on the road are replaced by self-driving vehicles. He notes that 70 percent of Canadians owned a vehicle in 2000, and this increased to 85 percent in 2015. New vehicle sales in Canada were the highest on record in 2015, breaking the previous record set in 2014. There is no evidence that meaningful change in vehicle ownership has begun in Canada. Private vehicle ownership continues to enjoy strong support, and predictions of a shift to a sharing economy remain speculation at this time.

Todd Litman of the Victoria Transportation Institute also believes that the pace of change to self-driving vehicles will be slower than predicted by many. He identifies more than half a dozen concerns and problems with the emerging technology and argues that the costs will exceed the benefits. He writes, “When the vehicle technology is mature, self-driving capability will probably add several thousand dollars to the vehicle purchase price, plus a few hundred dollars in annual service costs, adding $1,000 to $3,000 to the annual vehicle costs… If autonomous vehicles reduce fuel consumption by 10% and insurance costs by 30%, the annual savings will total about $500, which will not fully offset predicted incremental annual costs.”

Several analysts have focused on the potential for automation of freight vehicles. McKinsey, for example, believes that commercial vehicles may become automated faster than personal vehicles. Mercedes-Benz is testing self-driving freight trucks in Nevada. Morgan Stanley has identified the potential for broad adoption of semi-automated trucks over the next
15 years.¹⁰⁶ Truck operators could “tether” vehicles together and move in a convoy with a human driver in the lead vehicle followed closely by a number of self-driven vehicles. These systems are being tested in Europe. They are effective for long-haul highway driving, but likely will require human drivers for urban driving or congested highway travel.

Truck operators could “tether” vehicles together and move in a convoy with a human driver in the lead vehicle followed closely by a number of self-driven vehicles.

One fundamental question involves the impact of self-driving vehicles on travel behaviour. Some anticipate that the technology may further increase individual car ownership and private vehicle use, encouraging urban sprawl. Others argue that it will be easier and more efficient to share cars, discourage individual ownership, and perhaps reduce total usage of vehicles. Development of self-driving vehicles will change the economics of alternative forms of transportation. Some predict that a major rebalancing of vehicle ownership may emerge. Little change is expected over the next 10 years, but these sharing models may be among the first commercial users of self-driving vehicles.

Implications for the insurance industry

Semi-automated and self-driving vehicles hold great promise to improve road safety in Canada. These vehicles have the potential to transform the way people travel and businesses transport goods. Discussion about this remarkable change in technology, however, has largely been absent in most policy debates about urban development, public transit, and economic prosperity. Even within the insurance industry, the discussion about semi-automated and self-driving cars is just emerging.

The lack of prominence for fully automated and connected vehicles as a major issue may be due to timing. Over the next 10 years, conventional vehicles will give way to semi-automated cars and trucks with driver assistance. Most Canadians do not yet have first-hand experience with semi-automated vehicles. Although self-driving vehicles are a technology that is being tested, many Canadians may think such vehicles form part of a distant future, not yet ready for serious discussion.

However, funding commitments and some key regulatory decisions about public transit, road infrastructure, and sharing are being made now. The Government of Canada was elected in 2015 with a promise to “almost double federal infrastructure investment to nearly $125 billion – from $65 billion – over ten years, which will be the largest new investment in Canadian history.”¹⁰⁷ Provincial and city governments are struggling with the regulatory implications of the presence of Uber in major cities across Canada and the world. The insurance industry needs to be active over the next five years if it seeks to influence these investments and policy decisions.

The current policy focus on public transit builds on a specific vision of the future. Most of the anticipated growth in the Canadian population over the next few decades will be in urban centres that will be increasingly dense. Historically, discussions about urban planning did not focus on the risk of natural disasters and did not involve the insurance industry.

The industry, for example, knows that a consequence of urbanization and densification has been increasing loss and damage from natural hazards. It will be interesting if the recent international focus on disaster risk reduction results in reduced local pressure to promote densification.

Conventional cars and trucks are the primary means of transportation for Canadians today. A long-term vision for the transportation policy in Canada, built around semi-automated and self-driving vehicles, could invest in supports for connected infrastructure and vehicles. The benefits of connected vehicle systems, in terms of reducing traffic fatalities, are

greatest when a large number of cars and trucks work together to share information. Canada could be one of the first jurisdictions to require that manufacturers of all new vehicles must install the capacity to accept information from other vehicles (V2V) and local infrastructure (V2I) about the driving situation. Canadians could also plan to invest in road infrastructure that signals information about road conditions and provides other supports, like clear marking of lanes, for self-driving vehicles. Most importantly, there could be a national, multi-stakeholder effort to educate Canada’s drivers about the proper use of the emerging auto technology in order to ensure the greatest improvement in road safety.

Policy decisions expected over the next five to 10 years may have a major impact on the business environment for the insurance industry over the next few decades.
Vehicle automation will shift focus from protecting occupants to avoiding or preventing collisions, and shift responsibility for collisions from driver error to vehicle failure.

The shift has the potential to change dramatically the auto insurance business.

Over the long term, the personal auto insurance industry may be significantly disrupted by a reduction in claims, increased sharing of vehicles, growing use of public transit, reduced personal ownership of vehicles, and other factors. The extent of these changes is unknown at this time, but will likely be relatively small over the next five to 10 years.

It will take 15 to 25 years to replace the existing fleet of conventional vehicles with semi-automated vehicles with collision prevention technology. Also the first self-driving vehicles will become available soon, but it will take time to determine the ultimate role for these vehicles. There is time to prepare for the prospect of major change if the insurance industry starts now.

Most importantly, vehicle automation has the potential to reduce significantly the risk of traffic fatalities and serious injuries. The insurance industry should champion the safety benefits of semi-automated vehicles and self-driving vehicles.

The issues emerging as a result of vehicle automation will present many challenges for the insurance industry, regulators, and other stakeholders, largely due to the expected speed of change. Much preparation needs to be completed in a short period of time.

This report includes the following recommendations for the insurance industry in Canada.

\[\text{Smith, The Wealth of Nations, pp. 349 – 350.}\]
Seven recommendations for the Canadian insurance industry to prepare for semi-automated and self-driving vehicles:

- Create an opportunity (potentially a national forum) for the private insurance industry, governments, regulators, and other champions for road safety to work together to secure reductions in traffic fatalities and injuries through the introduction of automated vehicles and connected vehicle systems. In particular, there could be a national, multi-stakeholder effort to educate Canada’s drivers about the proper use of the emerging driver aids in order to improve driver behaviour and prevent collisions.

- Undertake a research program, including a comprehensive assessment of policy issues and regulations, to ensure that they accommodate the deployment of semi-automated and self-driving vehicles. (For example, should all new vehicles be required to record when vehicle technologies are engaged? Should this information be available to insurance companies when resolving a claim to ensure that responsibility is fully documented and fraud is eliminated?)

- Monitor developments in selected other jurisdictions concerning the regulation of semi-automated and self-driving vehicles, and requirements for licensing, vehicle production, and insurance.

- Work with regulators to clarify liability and develop policy wordings. This would focus on shared personal and vehicle responsibility for collisions involving semi-automated vehicles, predominantly product liability for collisions involving self-driving vehicles, and clear wordings about damage resulting from cyber attacks or road infrastructure failure.

- Establish a joint working group with the Canadian Council of Insurance Regulators to clarify the expected regulation of insurance for semi-automated and self-driving vehicles.

- Form a group to work with the General Insurance Statistical Agency. This group could identify the specific changes in the statistical plan that would best support measuring the impact of the new vehicle technologies. The group could also seek access to loss data from select other jurisdictions around the world to secure data required for sound underwriting.

- Undertake communications initiatives to inform drivers and other stakeholders about the importance of insurance protection for all vehicles, including vehicles with automation, and the correlation between the price of insurance coverage and the cost of claims paid.

For its part, as the industry’s educator, The Insurance Institute will continue to educate and provide information to its members concerning automated vehicles. Services include sharing news stories about developments, presenting seminars and webinars where members learn from subject-matter experts, updating educational materials, and conducting member surveys and timely research on emerging issues, like this report, as appropriate.

This is a critical time for the insurance industry to become engaged in the discussion about vehicle automation, and to champion the remarkable potential to reduce traffic fatalities and serious injuries.
Appendix I - A case study - A day in the life of the family car

Three brief stories speculate about the changes that vehicle automation may bring in a typical day for a young family in Canada. The focus of this report is on the important changes expected over the next decade, but more profound change is possible over the long term in terms of the capacity of automated vehicles and the impact on society.

The year is 2016

The alarm wakes you to the new day. After a shower, you dress for work and have breakfast with the family. Like many other people in the community, you ride to work in your conventional vehicle. You choose a route. While driving, you have time to check the morning news on the radio and hear that almost 2,000 Canadians were killed and 165,000 were injured in traffic collisions last year.

You are responsible for controlling the car throughout the trip. Last week, you were involved in a collision when the other driver turned left in front of you when the driver did not see you coming through the intersection. When you find a parking space, you back your car into the space. Then you walk up to the office to check your notes for the first meeting of the day and review your recent email messages.

Your spouse will take the children to school in your other car and then drive to work. The cars are due for servicing, but that needs to wait until the weekend. At the end of the day, the family returns home for supper. There is time for an evening shopping trip to the mall to pick up groceries and to refuel the car with gas for the drive tomorrow.

The year is 2025

The alarm wakes you to the new day. After a shower, you dress for work and have breakfast with the family. Like many other people in the community, you ride to work in your semi-automated vehicle. You choose the route. While driving, you have time to check the morning news on the radio and learn that traffic fatalities and injuries in new, semi-automated vehicles are almost 40 percent lower than for the average vehicle on the road 10 years earlier.

You are responsible for controlling the car throughout the trip. Last week, you were almost involved in a collision, when the other driver, not seeing you coming through the intersection, turned left in front of you. Fortunately the collision avoidance system in your car was able to stop your vehicle and prevent a collision. When you find a parking space, you press the auto-park button and the vehicle drives itself into the space. Then you walk up to the office to check your notes for the first meeting of the day and review your recent email messages.

Your spouse will take the children to school in your other car and then drive to work. The cars are due for servicing but that needs to wait until the weekend.
At the end of the day, the family returns home for supper. There is time for an evening shopping trip to the mall and to pick up groceries. And then, the vehicles end the day by recharging their batteries to be ready for tomorrow.

**The year is 2050**

The alarm wakes you to the new day. After a shower, you dress for work and have breakfast with the family. You slip inside your self-driving car and tell the vehicle to take you to work. You own your family vehicle, but many of your friends pay for a similar service from a vehicle sharing company. While travelling to work, you check the morning news and learn that traffic fatalities and injuries have declined by almost 80 percent over the past 35 years in self-driving vehicles. There is also time during the trip to review your notes for the first meeting of the day, check your email messages, and read the joke of the day.

The car drives itself. It determines the best route to ensure a smooth and quick trip by checking the traffic reports. Sensors in the car and connections with other vehicles and the road infrastructure manage the risk of collisions with other vehicles, pedestrians, and objects. The vehicle stops in front of your office to let you out. You did not participate in any of the driving other than providing a destination.

The vehicle is programmed to return home and pick up your children. It is a school day. When the children are on board, your spouse must confirm that the vehicle can depart and travel without an adult on board. When the car arrives at school, an approved adult has the code to open the vehicle and safely take your children inside.

Your spouse uses a car sharing service to travel to work. There is no longer any need for a second family vehicle. Next, the vehicle knows that it needs to be serviced today. It travels to the dealership and awaits its regular check-up. When the servicing is complete, the vehicle returns home to wait for its next task. Through the remainder of the day, the vehicle first brings your children home and then retrieves you from your office. After dinner, there is a short family trip to the mall to shop and to pick up groceries. And then, the vehicle ends the day by recharging its batteries so it will be ready for tomorrow.
Appendix II – Bibliography

http://www.rand.org/content/dam/rand/pubs/research_reports/RR400/RR443-1/RAND_RR443-1.pdf

http://www.wsj.com/articles/SB1000142405311903480904576512250915629460


http://www.mckinsey.com/insights/automotive_andAssembly/ten_ways_autonomous_driving_could_redefine_the_automotive_world


http://www.bloomberg.com/news/articles/2015-07-30/can-the-insurance-industry-survive-driverless-cars-


https://www.casact.org/pubs/forum/14fforum/CAS%20AVTF_Restated_NMVCCS.pdf

http://www.wired.com/2015/05/google-wants-eliminate-human-driving-5-years/


http://www.thestar.com/business/2016/01/08/is-this-your-new-car.html
AUTOMATED VEHICLES IMPLICATIONS FOR THE INSURANCE INDUSTRY IN CANADA


Kumar, Y. Shyam. "Driverless Cars: Boon or Bane for Auto Insurers?" IBM Global Business Services, 2013.


http://www.celent.com/reports/scenario-end-auto-insurance


http://www.vtpi.org/avip.pdf

http://bigstory.ap.org/article/9076f3b0736644739b9878dbd9de782/automakers-commit-putting-automatic-brakes-all-cars


https://www.bcgperspectives.com/content/articles/automotive-consumer-insight-revolution-drivers-seat-road-autonomous-vehicles/


http://www.fool.com/investing/general/2016/01/02/driverless-cars-in-2016-7-numbers-everyone-should.aspx

Statistics Canada, Quarterly Survey of Financial Statements


https://www.teslamotors.com/en_CA/blog/your-autopilot-has-arrived


http://www.tirf.ca/media/news_show.php?nid_id=170&lid=1


V Transport Canada. Personal communication, 2010

* Nunavut does not have a graduated driver licensing program.
Appendix III – An alternative view: Automation facilitating greater mobility and public transit

SAE International’s Level of Driving Automation for On-Road Vehicles proposes that achieving Level 5 Full Automation will come about by the continuous addition and augmentation of driver assistance features (“Feature Creep”) and automated driving systems. According to Bern Grush of Grush Niles Strategic, there may be an alternative perspective that proposes that if the focus is more on how autonomous vehicles can enable greater people mobility, through transit and sharing (“Transit Leap”), society may achieve Level 5 value sooner.⁴

With “Feature Creep” the focus is on automated user-features and conversion of our household fleet to full-automation one owner at a time. The risk is in simply converting – and expanding – the current population of household / individual ownership of cars. Essentially, the outcome would maintain high ownership, low-use per vehicle, congestion, sprawl and parking.

With “Transit Leap” the focus is on automated, public-use, shared-mobility applications that evolve to Transit as a Service (TaaS). If municipalities can begin using autonomous vehicles in constrained, short, repetitive, fixed routes, it becomes possible to move through opportunistic stages of growth in route length, coverage area, schedule flexibility and app-based service levels. Transit Leap changes, over a span of two or three decades, from a small, slow, local service of a handful of vehicles to on-demand (and some scheduled) vehicles and routes routes that span to megaregions. This approach adds clusters of autonomous vehicles one constrained area at a time, growing market adoption (and its social value) spatially rather than consumer-by-consumer.

As Transit Leap vehicles are added, they are fully autonomous (level 5) from the outset, beginning with first-and-last mile applications that fill an immediate, unaddressed need. In this vision, Transit Leap progresses through larger and more capable roll-outs and ends with massive shared fleets that span megaregions after mid-century. This view promotes transit and sharing, encourages low individual / household ownership of vehicles and advocates for high density and necessary urban planning.

<table>
<thead>
<tr>
<th>Leaps (parallel levels to SAE)</th>
<th>Name</th>
<th>Narrative</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>None</td>
<td>Classic bus routes</td>
</tr>
<tr>
<td>1</td>
<td>Fixed Loop: Shuttle, parking, shopping, tourist [2km²]</td>
<td>Driverless, short trips, fixed routes, repetitive</td>
</tr>
<tr>
<td>2</td>
<td>Small Area: Campus, first/last mile [5km²]</td>
<td>Self-optimizing, flexible, contained areas</td>
</tr>
<tr>
<td>3</td>
<td>Large Area: Central business district, borough, island [50km²]</td>
<td>Rich interconnect with rail, strong tailoring, stop at most addresses</td>
</tr>
<tr>
<td>4</td>
<td>City: [500km²]</td>
<td>Any address, any trip in one vehicle, high tailoring, high transport equity</td>
</tr>
<tr>
<td>5</td>
<td>Megaregion: [5,000km²]</td>
<td>Any time Any where Any distance</td>
</tr>
</tbody>
</table>

Source: © Grush Niles Strategic
Who will be responsible for traffic collisions?

The transition from human drivers to self-driving vehicles will involve many years with a mix of conventional vehicles, semi-automated vehicles, and self-driving vehicles sharing the same public roads. Who will be responsible for collisions during a period when driving decisions will increasingly include support from on-board computers?

It is important for the insurance industry to begin now to prepare for the extensive changes vehicle automation is expected to ultimately bring for the industry.

For more information about this Emerging Issues Research Series, please visit: www.insuranceinstitute.ca/research
PROFESSIONAL DESIGNATIONS
Chartered Insurance Professional (CIP)
Fellow Chartered Insurance Professional (FCIP)

INSURANCE EDUCATION & CERTIFICATES
Advanced CIP Program (CIP (Adv))
Adjusters’ Training & Education Series
General Insurance Essentials (GIE)
Insurance Licensing & CE Credits
Professional Development
Risk Management Certificate

NETWORKING & CAREER DEVELOPMENT
Seminars, Symposium, Special Events connecting the industry
Career Connections promoting careers in insurance

INDUSTRY INSIGHT & RESEARCH
Demographic Analysis of the p&c Insurance Industry in Canada
Emerging Issues Research Series: Implications for the Insurance Industry in Canada

Learning for the real world. Rewarding.