TORONTO

REPORT FOR ACTION

Preparing the City of Toronto for Automated Vehicles

Date: January 5, 2018
To: Public Works and Infrastructure Committee
From: General Manager, Transportation Services
Wards: All

SUMMARY

Automated vehicles are now on Toronto's streets, in various forms and for a variety of purposes. Partially automated vehicles are providing assistance to drivers in the form of cruise control, automated braking, and other safety features included in newer vehicles. Highly automated vehicles - often referred to as driverless or autonomous cars - are being tested on public roads in Ontario, including Toronto, through a permit from the Ministry of Transportation. These more advanced vehicles have the potential to reshape our transportation system, impacting road safety, traffic congestion, mobility equity, and environmental health.

This report responds to a request from the Public Works and Infrastructure Committee to provide an overview of the steps taken to date, and actions proposed, to prepare the City of Toronto for the introduction of automated vehicles. This includes the following:
- A brief technical overview of automated vehicles;
- Information on early public opinion regarding automation;
- An overview of how Transportation Services has been preparing for change; and
- An overview of the potential implications for City divisions and agencies.

The report further outlines next steps proposed, including the following:
- The development of a cross-divisional policy position to ensure preparedness amongst all City services; and
- The deepening of partnerships, including formal membership in the Municipal Alliance for Connected and Autonomous Vehicles in Ontario (MACAVO) and support for the University of Toronto's proposed iCity Centre for Automated and Transformative Transportation Systems.

RECOMMENDATIONS

The General Manager, Transportation Services recommends that:

1. The Public Works and Infrastructure Committee receive this report for information.

FINANCIAL IMPACT

Initiatives regarding the City's preparation for Automated Vehicles are currently being funded from within existing budgets.

The Acting Chief Financial Officer has reviewed this report and agrees with the financial impact information.

EQUITY IMPACT STATEMENT

Automated vehicles have the potential to improve mobility for segments of the population that cannot, or can no longer, drive or do not have access to a private automobile. Automation has the potential to support residents who would otherwise face barriers in accessing the transportation system. At this time, many automakers are charging a premium for automated features, increasing the overall cost of purchasing a private vehicle.

If deployed in a public or shared-use model, vehicle automation could reduce the marginal cost of travel and improve access in areas where transit is infrequent and other cost-effective forms of transportation are not feasible for most trips, especially access to employment.

DECISION HISTORY

Public Works and Infrastructure Committee, at its meeting of May 16, 2016, requested the General Manager, Transportation Services, to report on how the City of Toronto might prepare for the introduction of automated and autonomous vehicles, including the following:

a. Specific actions planned by Transportation Services to prepare for automated and autonomous vehicles over the next two years;
b. An overview of potential implications that could be experienced by other divisions as a result of vehicle automation, and where possible, options for mitigating impacts; and
c. An overview of the public's potential acceptance of automated and autonomous vehicles, and how it compares to other jurisdictions.

The Committee decision can be viewed at:
http://app.toronto.ca/tmmis/viewAgendaItemHistory.do?item=2016.PW13.14

The Executive Committee, at its meeting on September 22, 2016, referred a request to Transportation Services to enter into dialogue with the Government of Canada, the

Government of Ontario, other municipalities, academic institutions and private sector groups within the City of Toronto to work towards the establishment of a multi-jurisdictional task force with a mandate to prepare for the introduction and extensive use of automated vehicles by private users, the public and private sector entities. The Committee decision can be viewed at:
http://app.toronto.ca/tmmis/viewAgendaItemHistory.do?item=2016.EX17.29

COMMENTS

Technical Background

Automated vehicles are those in which at least some aspects of a safety-critical control function (e.g., steering, throttle, or braking) occur without direct driver input[1]. This may lead to a reduction in collisions and/or a reduction of collision severity. Automated functions can include, but are not limited to the following: throttle/braking, steering, navigation, vehicle detection, object avoidance and pedestrian detection/avoidance.

The Society of Automated Engineers (SAE) has divided the level of automation in vehicles according to a scale from zero to five (see Attachment 1). Levels one and two generally provide assistance to the driver and are thought to improve road safety. Levels four and five have the potential to change how vehicles are used, challenging current limitations and understanding around mobility, transportation demand, and traffic management, and subsequently having a broader impact on economic, social, and environmental issues.

Automated vehicles, including personal vehicles, taxis, small buses, and delivery robots are currently being tested in a number of locations within the United States, Australia, New Zealand, Europe, and Asia by both industry and government agencies. Nearly all automobile manufacturers have vehicles available commercially that include automation capabilities at levels one to two. Most manufacturers have also developed prototypes or have partnered with suppliers and technology companies to test level three to level five automated vehicles.

Motor Vehicle Jurisdiction in Canada

Vehicle standards are regulated by the federal government through the *Motor Vehicle Safety Act*, which includes the *Canada Motor Vehicle Safety Standards*. No new guidelines, regulations, or policy statements have been released regarding highly automated vehicles at this time; however, potential harmonization with the United States and other G7 nations is being explored. Domestic discussions are also taking place with provincial counterparts through the Canadian Council of Motor Transport Administrators.

In "Transportation 2030: A Strategic Plan for the Future of Transportation in Canada" the federal government has indicated support for the use of connected and automated vehicles to achieve broader goals in road safety, mobility, congestion reduction, emissions reductions, and economic development. Resources to develop a regulatory

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1 NHTSA Preliminary Statement of Policy Concerning Automated Vehicles, 2013

framework for automated vehicles has been included in both the 2016 and 2017 federal budgets, and programs that provide funding to spur innovation in industry, NGOs, and other orders of government have recently been announced.

The use of public roads by all vehicles is governed by the Province of Ontario through the *Highway Traffic Act.* In January 2016, the Ministry of Transportation released a testing framework for automated vehicles at level three automation and above. The first successful applicant to this program was announced on November 28, 2016, and the Ministry recently stated that seven companies have been approved for testing - Blackberry QNX, Continental, Erwin Hymer Group, Magna, Uber, University of Waterloo, and Toronto-based X-Matik. Automated vehicles at level three or above may only be operated in Ontario with a permit approved under this testing framework, and may test on any public highway governed by the Highway Traffic Act, including within the City of Toronto.

The provincial government is also interested in the economic development potential of automated vehicles. The Automated Vehicles Innovation Network was recently formed through the Ontario Centres of Excellence, and is supported by the Ministries of Research, Innovation and Science; Economic Development and Growth; and Transportation. The Network will receive $80 million over five years to support an AV demonstration zone (located in Stratford), research and development, talent development, and a central hub for coordination and information sharing.

Widespread adoption of vehicles still requires yet-to-be resolved issues in human factors and ethics, as well as legal frameworks in and across local, regional, and national jurisdictions. The City of Toronto has limitations on its ability to regulate vehicle standards and the operation and use of automated vehicles, but may be able to influence the areas where activities related to automation are more likely to occur through policies such as curbside management.

Automated Vehicles and Transportation Services

Staff in Transportation Services have been monitoring the technological developments, regulations, policy developments, and urban applications of automated vehicles since 2014.

- In 2015, an internal working group was formed, and a research workshop was conducted by the Canadian Automated Vehicles Centre of Excellence (CAVCOE) in March of 2015. Staff in Transportation Services, other City divisions, and City agencies attended the workshop, which included a presentation by staff from the Ministry of Transportation of Ontario.

- Later in 2015, Transportation Services partnered with the University of Toronto to research and produce a discussion paper authored by David Ticoll and called "Driving Changes: Automated Vehicles in Toronto". The paper was the basis for a subsequent series of research workshops with City and agency staff, focusing on the themes of vehicle automation and economic development and impact; information technology and data; the built environment; and mobility, safety, and equity. The full

report is available at: http://uttri.utoronto.ca/news/driving-changes-automated-vehicles-toronto/

- Following these discussions, an on-going Interdivisional Working Group on Automated Vehicles was formed to jointly monitor technological and policy development, share information, and collaborate on cross-divisional initiatives. Membership in this Group is listed in Attachment 2.

  - The Working Group has become a model for municipalities to follow in preparing for automated vehicles across functions. Transportation Services staff have presented the Working Group format and activities to the ten cities participating in the Bloomberg Aspen Initiative on Cities and Autonomous Vehicles, which includes Buenos Aires, Helsinki, London, Los Angeles, and Tel Aviv.

  - A draft Tactical Plan 2019-2021 (Attachment 3) has been developed by the Working Group to ensure all divisions and agencies are following a consistent direction with respect to automated vehicles and the City's policies, plans, and strategies. Public and stakeholder consultation on the draft Tactical Plan will take place in early 2018, and a final report to Public Works and Infrastructure Committee is planned for 2019.

Concurrently, Transportation Services staff developed and are implementing a three-year work plan, from 2016-2018, to focus internal efforts to prepare for automated and autonomous vehicles (Attachment 4). A temporary position was created and filled in late 2016 to move forward implementation of the work plan. This was the first staff position focused exclusively on preparing for automated vehicles at any government body in Canada. The work plan has three main goals:

- to provide leadership and engagement both within the City of Toronto and externally;
- to begin to prepare for automation no matter when, nor how, it is introduced; and
- to begin to integrate vehicle automation considerations into operational planning, where appropriate.

Highlights from the implementation of the workplan to date include:

- the development of a communications strategy around vehicle automation;
- a review of the Municipal Code and the potential challenges in enforcement and prosecution relating from automated vehicles;
- an exploration of service vehicles, sidewalk delivery robots, and other automated vehicles that are not passenger-oriented; and
- A series of research activities, undertaken in partnership with local universities, which are discussed in the next section.

Potential Implications for other City Divisions and Agencies

Automated vehicles have the potential to impact a wide array of City policies, programs, and services, as well as how the City conducts business; however, this is dependent on the development of the technology, the extent to which the economics of urban transportation are reshaped, public acceptance of the use of the technology, and other factors.

As automation is introduced and vehicles become increasingly connected, there will be a significant increase in data collection about drivers, passengers, and vehicles, including trip information and identifiers. Data must continue to be collected and maintained in accordance with existing privacy legislation and guidelines, while passenger safety is maintained. Federal and Provincial governments may also need to update various statutes and regulations, including the authorities provided to municipalities to regulate this new paradigm.

Partially automated vehicles are now in use, and are expected to become more widely used over the next few years as older private vehicles are replaced with newer technology. This evolutionary process is likely to create a low level of disruption, and is not anticipated to alter vehicle ownership patterns from the current trend in the next few years. Over the long-term and with higher levels of disruption, there may be larger implications beyond the road network that City divisions and agencies are now beginning to consider. This includes the following:

- **City Clerk's Office and Information & Technology** - Automated vehicles have the potential to introduce greater privacy concerns than the City has faced in the past, requiring new data management policies and guidelines to help such technology be used in a manner that respects the rights and concerns of individuals for the protection of their information.

- **City Planning** - Automated and autonomous vehicles and other technological innovations will introduce opportunities and challenges for sustainable travel behaviour, land use, built form, and use of public space, and their evolution in a direction consistent with the City's Official Plan vision and goals. Changes to zoning and other regulations may be required to ensure consistency with the vision and goals in response to evolving travel behaviour.

- **Economic Development & Culture** - Automation could result in increased economic opportunity through new and changing business models in logistics, passenger services, after-market services and auto parts, as well as software development and support. It also has the potential to create new, advanced employment opportunities as well as displace traditional jobs.

- **Environment & Energy** - Automated vehicle technology may develop in tandem with low or zero-carbon energy sources, such as electric vehicles, thereby decreasing mobile emissions. Demand for transportation is largely expected to increase, placing more pressure on roads. The ability of connected vehicles to increase traffic throughput may offset some, or all, of those increases. Without these technological co-developments, automated cars could lead to increased congestion and emissions.

- **Equity, Diversity and Human Rights** - Automated technology has the potential to improve access to transportation and mobility for the non-driving public and individuals with low socio-economic status. Seniors and people with disabilities could experience increased mobility and lower transportation costs while other users experience increased affordability and flexible access to transportation options.

- **Fire Services** - Automation must consider the legislated requirement for emergency vehicles to have the right-of-way when responding to emergency incidents and for the requirement to pull to the right and stop when an emergency vehicle approaches. AVs must be able to adapt and respond to unplanned routes and emergency lane closures related to emergency incidents and must be able to respond appropriately to an emergency vehicle approaching against the flow of traffic on a one-way street or other direction-controlled lane. Automatic notification to 9-1-1 in the event of an AV-related accident/incident should also be considered to provide earliest possible notification to emergency responders. The introduction of AVs will have implications on training provided to frontline staff including how to identify AVs, how to respond appropriately to incidents involving AVs including fires, accidents or medical emergencies involving on-board passengers.

- **Fleet Services** - Automated vehicle technology has a great potential to impact the City's fleets by enabling the increase in efficiency, safety and service delivery amongst the various functions of the City. Vehicle automation is currently being investigated by Fleet Services to determine how it can benefit the way we purchase new fleet vehicles and deploy our service.

- **Legal Services** - Automated vehicle technology may result in a change in driver responsibility and new City and Provincial legal tools and regulations may be required to adapt to the new driving environment. Changes in enforcement methods maybe required and the current rates for various infractions maybe impacted.

- **Municipal Licensing and Standards** - Automated vehicles may require regulation by the City depending on how they are used. Public safety and consumer protection issues that could arise include ensuring adequate insurance requirements, vehicle safety standards and data-sharing agreements.

- **Solid Waste Management Services -** Automated and autonomous vehicles have the potential to create a significant shift in the way the City collects its solid waste. Solid Waste Management Services is monitoring the development of autonomous vehicles, and is interested in exploring a pilot on autonomous vehicles for waste collection comparable to pilots currently being conducted in Sweden. Autonomous vehicles have the potential to create operational efficiencies, such as improved fuel economy and maintenance schedules, while improving working conditions, employee and public safety, and customer service levels.

- **Toronto Employment and Social Services** - Automated technology may result in increased job access if the lower cost of these vehicles results in residents being able to seek better employment at greater distances. A potential challenge is the disruption in employment to people currently employed in the transportation field as vehicle operators who could see their jobs replaced or reimagined as full automation is available.

- **Toronto Parking Authority** - Automated and autonomous vehicles could pose a potential long-term challenge as the technology may lower parking demand by allowing vehicles to drop off passengers and then return back home or to free parking locations. Such technology may also result in the provision of new services as vehicles gain the ability of self-parking.

- **Toronto Police Services** - Toronto Police Service is aware that several provincial and municipal agencies are in the initial stages of investigating the implications that automated vehicles may have on road safety and how the public and business will use and interact with this evolving technology. Part of the conversation that is not yet clear is how automated vehicles can impact police enforcement and role of the driver during the operation of an automated vehicle. The Toronto Police Service benefits from the many road safety partners and will be looking to direction from the Ministry of Transportation towards vehicle enforcement, service delivery and legal guidance as this technology becomes available.

- **Toronto Public Health** - Automated and autonomous vehicles offer a number of potential health benefits over the long term, including reducing injuries for all road users and decreasing health impacts from vehicle-related air pollution and noise. Additional benefits may arise from repurposing the current parking infrastructure to other uses that offer physical, mental and social health benefits such as cycling, walking, green space and community gathering. Pursuing opportunities that promote equity of access to transportation, and support the health of people who are most vulnerable as a result of factors such as physical disability, frailty or low income, should be a priority.

- **Toronto Revenue Services -** Automated and autonomous vehicles could pose a potential parking challenge as it relates to parking tickets and traffic. Vehicles may not have the technology to identify legal parking spaces and/or other restrictions and may result in parking tickets issued to these vehicles and/or may be towed if they are parked in heavily regulated areas (such as rush-hour

routes). Revenue Services is actively monitoring automated and autonomous vehicle developments with Transportation Services to minimize impact or mitigate issues.

- **Toronto Transit Commission** - TTC staff conducted research on the use of AVs in the transit industry and reported to the TTC Board in March 2017. AVs have the potential to improve safety, reliability and efficiency when it comes to delivering transit service. The adoption of this technology would require the TTC to develop new policies and procedures and would completely transform the way service is delivered. For additional details on the implications to transit see the TTC's report.

Automated Vehicle Preparation Partnerships

Transportation Services has engaged in various partnerships with academia, industry, peer cities, and other levels of government to jointly explore issues around vehicle automation, and to build capacity for future preparations.

Academia
Most notable are the relationships established with the University of Toronto and Ryerson University to facilitate both faculty- and student-led initiatives.

Completed projects include:
- the aforementioned "Driving Changes" discussion paper (University of Toronto) and public opinion survey (Ryerson University);
- the development of four alternate futures regarding the transportation system (by Ryerson graduate students in the School of Urban and Regional Planning), which helped to paint a picture of the various ways in which the market and government action may influence the adoption and use of automated vehicles; and
- research on how the introduction of the internal combustion engine-powered automobile impacted cities (by an undergraduate intern from the University of Toronto's Urban Studies Program). This historical review illustrated the stages of implementation of new transportation technology, as well as the context in which decisions were made decades ago that have since created unintended consequences that cities are dealing with today - demonstrating the importance of considering both the positive and potential negative outcomes of early policy decisions.

Moving forward, Transportation Services has pledged support for the University of Toronto's proposed establishment of the "iCity Centre for Automated and Transformative Transportation Systems" and for the initial research project entitled, "Phase I – Building the Analytical Foundation". This research will increase the ability to understand the outcomes of policy decisions by modelling and predicting the impacts of new transportation technologies on the transportation system, as well as measuring them against social, economic, and environmental goals. The intention of the Centre is to bring together researchers working in both transportation and technology, with practitioners in government and product developers in the private sector, to develop tools for cities to plan for and harness the commercial deployment of automated vehicles.

Professional Associations

Transportation Services has also been actively developing relationships with professional associations such as the Transportation Association of Canada (TAC), Intelligent Transportation Systems (ITS) Canada, and the Transportation Research Board (TRB). Staff have also been involved with efforts spearheaded by the National Association of City Transportation Officials (NACTO), such as the recent development and release of the Blueprint for Autonomous Urbanism.

In late 2016, the Ontario Good Roads Association (OGRA) established the Municipal Alliance for Connected and Autonomous Vehicles in Ontario (MACAVO). The purpose of the Alliance is to provide a forum for municipal staff to collaborate on researching, facilitate vehicle testing with industry and academics, and to share resources and knowledge for integrating connected, automated and autonomous vehicles into municipal operations. Other cities such as Barrie, Brampton, Hamilton, and Stratford, as well as the Regions of Durham and York are participating in MACAVO.

Governmental Partnerships

Communications have been established with staff at both the Governments of Ontario and Canada. The Government of Canada has recently announced a strategy for the future of transportation (Transportation 2030) and identified "support [for] the safe and rapid deployment of connected and automated vehicles" as a key initiative to advance green and innovative transportation. The City of Toronto responded to a call for applications from Transport Canada for its newly launched Program to Advance Connectivity and Automation in the Transportation System (ACATS).

In addition, networking with lead staff at other Canadian municipalities has taken place through a group facilitated by the City of Calgary, and with staff at international municipalities through direct outreach.

Awareness of, and Attitudes Toward, Automated and Autonomous Vehicles

Ryerson University conducted a public opinion survey of 3,201 residents aged 18 to 75 across the Greater Toronto and Hamilton Area in November 2016, which was co-funded by Metrolinx and the City of Toronto. The survey was conducted to gain an understanding of how likely individuals were to adopt driverless cars, how likely they were to change their transportation behaviour, the role they see for governments, and how demographic groups might differ in their responses. Key findings of the survey were as follows:

- The research found that 85% of respondents had previously heard of a "driverless car", and just over half (51%) were aware of the "Google car" prototype (now known as "Waymo") being tested in a number of cities in the United States.

- Amongst those who are attracted to the potential benefits of autonomous vehicles, they preferred the following benefits:

Table 1 - Summary of attractiveness of autonomous vehicle benefits with age cohorts most attracted and least attracted to each benefit.

Benefit	Percent of Respondents Attracted to Benefit	Age Cohort Most Attracted to Benefit	Age Cohort Least Attracted to Benefit
Safety improvements	49%	Under 35 (51.4%)	35-55 (48.5%)
Better traffic flow	45%	35-55 (46.2%)	Over 55 (43.2%)
Supporting travel for adults with disabilities	44%	Over 55 (48.6%)	Under 35 (39.1%)
Not needing to park	44%	Under 35 (47.1%)	Over 55 (39.2%)
Doing other things in the vehicle instead of actively driving	36%	Under 35 (41.6%)	Over 55 (27.3%)
Fewer vehicle emissions	34%	35-55 (35.3%)	Under 35 (31.3%)
More reliable travel	29%	Under 35 (30.5%)	Over 55 (27.7%)
Being connected to data services while in the vehicle	20%	Under 35 (23.1%)	Over 55 (15.7%)

- Overall, nearly one quarter (24%) of respondents were indifferent to any perceived benefits of a driverless car. Respondents over 55 years of age were most likely (30.1%) to be unattracted to the concept.

- When asked about travel time being freed for other purposes, almost half of respondents to the Ryerson survey indicated they were likely to travel further to work. Across the GTHA, this was strongest for Toronto and Hamilton residents (50.1% and 47.4% respectively) and weakest for Durham residents (39.7%).

- Almost half (48.7%) of respondents to the Ryerson survey felt that government response to vehicle automation should be to monitor the development of the technology.

- Of those who felt that government should take an active approach, roughly one quarter (23.5%) answered that automated and autonomous vehicles should be encouraged, and one in 20 (5.4%) answered that government should actively discourage the vehicles.

- Asked separately, three quarters (74.2%) of respondents expected governments to regulate how automated and autonomous vehicles are used.

- Support for public investment to encourage or regulate automated vehicles was split, with almost half (46.3%) in favour of investment, just over one fifth (21.9%) opposed to investment, and nearly a third (31.8%) unsure.

- Younger respondents were most likely to support government leadership and investment, while older respondents were most like to oppose it.

The full results of this study are being finalized, and will be available in early 2018.

Next Steps

Research conducted over the last few years leads to the conclusion that driverless cars or autonomous vehicles have the potential to impact the existing legislative environment and a wide array of City policies, programs, and services, as well as how the City conducts business. Early implications are thought to be most-focused on the transportation system itself, including driver behaviour. Over the long-term and with higher levels of automation, there may be larger implications beyond the road network that City divisions and agencies are now considering.

In 2018, Transportation Services will implement the final year of the "Preparing for Autonomous Vehicles" workplan, focusing on the relationships between infrastructure and automation. It is anticipated that a subsequent workplan will be necessary for 2019 to 2021, to explore on-the-ground pilot projects and the continued evolution of transportation infrastructure and automation, and following the direction of the finalized Tactical Plan 2019-2021. It is anticipated that Transportation Services will continue to play a leadership role in educating staff and assessing potential implementation approaches to vehicle automation. Accordingly, assistance will also be provided by divisional staff to help all potentially impacted City agencies and divisions begin to prepare for, and respond to, automated vehicles.

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ATTACHMENTS

Attachment 1 - Society of Automotive Engineers (SAE) Levels of Vehicle Automation
Attachment 2 - City of Toronto Interdivisional Working Group on Automated Vehicles
Attachment 3 - Draft Automated Vehicle Tactical Plan 2019-2021
Attachment 4 - Preparing for Autonomous Vehicles: Transportation Services Workplan 2016-2018

Attachment 1: Society of Automotive Engineers (SAE) Levels of Vehicle Automation

SAE level	Name	Narrative Definition	Execution of Steering and Acceleration/ Deceleration	Monitoring of Driving Environment	Fallback Performance of Dynamic Driving Task	System Capability (Driving Modes)
Human driver monitors the driving environment						
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	Human driver	Human driver	Human driver	n/a
1	Driver Assistance	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*	Human driver and system	Human driver	Human driver	Some driving modes
2	Partial Automation	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*	**System**	Human driver	Human driver	Some driving modes
Automated driving system ("system") monitors the driving environment						
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*	System	**System**	Human driver	Some driving modes
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*	System	System	**System**	Some driving modes
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*	System	System	System	**All driving modes**

Source: SAE International, 2014

Attachment 2: City of Toronto Interdivisional Working Group on Automated Vehicles

Transportation Services (Chair)
City Clerk's Office
City Manager's Office (Equity, Diversity & Human Rights; Strategic & Corporate Policy)
City Planning
Corporate Finance (Insurance & Risk Management)
Economic Development & Culture
Environment & Energy
Fire Services
Fleet Services
Information & Technology
Legal Services
Municipal Licensing & Standards
Revenue Services
Solid Waste Management
Toronto Building
Toronto Employment & Social Services
Toronto Office of Partnerships
Toronto Parking Authority
Toronto Police Services
Toronto Public Health
Toronto Transit Commission

Attachment 3: Draft Automated Vehicle Tactical Plan 2019-2021

The City of Toronto is committed to its established vision and goals as articulated in approved strategies, plans, and policies. The potential development, introduction, and use of automated vehicles should contribute to achieving this vision and these goals. The City of Toronto acknowledges the division of roles and responsibilities with other orders of government, industry, academia and the community. The City of Toronto further acknowledges the need for effective relationships with these groups in comprehensively addressing and preparing for vehicle automation.

1. Equity: The City of Toronto will encourage the adoption of advanced driver assistance systems in a manner that improves social equity.

2. Environmental Impacts: The City of Toronto will encourage the adoption of advanced driver assistance systems in a manner that reduces the net environmental impacts from transportation and increases the proportion of low or zero-emission vehicles operating on streets and highways.

3. Road Safety: The City of Toronto will encourage the adoption of advanced driver assistance systems that automate driving tasks without reducing the need for the human driver to monitor the driving environment [SAE levels 1 and 2] that are proven to create a net benefit to road safety.

4. Modal Shift: The City of Toronto will encourage the adoption of advanced driver assistance systems that reduce car dependency and increase average auto occupancy, facilitate transportation demand management, and enhance the safety and attractiveness of walking, cycling, and transit.

5. Transit-centric: The City of Toronto will take a transit-centric approach to vehicle automation. The City will encourage the adoption of advanced driver assistance systems for public and mass transit vehicles, with the purpose of improving reliability, efficiency, safety, and seamlessness of transit. The City will also encourage the development of advanced driver assistance systems that facilitate increased transit priority.

6. Traffic Management: The City of Toronto will enhance its ability to manage traffic in real-time through advanced driver assistance systems. The technology will be used for the purpose of measuring traffic congestion, providing improved traveller information, implementing active traffic management, as well as facilitating transit and emergency vehicle priority.

7. Public Service Vehicles: The City of Toronto will encourage the development and adoption of advanced driver assistance systems for municipal and other public service vehicles for the purpose of improving safety and public service delivery.

8. Economic Development: The City of Toronto will support and enhance the automotive and technology development sectors to develop talent and attract industries, investment, and employment with a focus on exporting products and services that support this tactical plan.

9. Privacy and Security: The City of Toronto will support and enhance user data protection and transportation network security in relation to this tactical plan.

10. Business Intelligence: The City of Toronto will enhance its ability to collect and analyze aggregated and anonymized data generated by advanced driver assistance systems. The data will be used to inform the implementation and evaluation of this tactical plan.

The City of Toronto Automated Vehicle Tactical Plan will be reviewed in three years. In the interim, the City will monitor the development, implementation, and impacts of advanced driver assistance systems technology. Further, the City will focus on researching and analyzing the impacts from the adoption of advanced driver assistance systems to the point where the human driver is not required to monitor the driving environment (SAE levels 3-5) as they relate to travel demand, land use and built form, road safety, workforce transition, traffic and vehicle enforcement, and municipal revenues.