BEST PRACTICES FOR AUTOMATED VEHICLE TRIALS IN NORTH AMERICAN MUNICIPALITIES

A Research Report for the City of Toronto

by

CAVCOE
(Formerly the Canadian Automated Vehicles Centre of Excellence)

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Executive Summary

CAVCOE (formerly the Canadian Automated Vehicles Centre of Excellence) is pleased to submit to the City of Toronto this draft final report on research into *Best Practices For Automated Vehicle Trials In North American Municipalities.*

Three objectives of this research study are:

1. To identify the AV trials and demonstrations in the US and Canada in which a municipality is involved as a stakeholder, for example as a funder, proponent or co-proponent, host, or external stakeholder.

2. To gather information on each, as described below, using publicly available information, questionnaires and interviews.

3. To prepare this report summarizing best practices that emerge from the case studies.

The research combined with CAVCOE's background knowledge in this area has identified many aspects of the best practices in designing and deploying an AV trial. These are the key ones:

Planning

- Set specific project goals, such as
    - Deploy a trial to learn the deployment issues and see how the vehicle operates.
    - Increase public awareness.
    - Increase AV awareness among employees.

- Conduct testing before launch.

- Train the safety conductors thoroughly.

Insurance

- Obtain appropriate insurance. Some equipment providers already carry insurance on their fleet on a worldwide basis. Obviously, other stakeholders will need their own insurance.

Data Gathering Strategy and Privacy

- Establish the data needs early.
- Comply with all relevant data and privacy laws.
- Develop a transparent data strategy and policy.
- Determine who owns the data and/or has rights to the data. The background is that there may be competing interests for data ownership. Is it the vehicle owner? Or the operator? Some passengers may feel that they own data about them.

Partners

- Expect and plan for a wide range of partners for the project.
- Engage stakeholders early.
- Organizations involved in trials need a clear understanding of the operational capabilities and limitations of the equipment.

Communications – Internal and External

- Develop and implement a communications plan. There are three categories of audience:
    - All members of the City of Toronto team so that everyone knows about the project and understands it.
    - All stakeholder organizations as defined in Section 2.3, so that everyone understands the big picture and their role.
    - The public, including seniors, people with disabilities and school children. A pilot automated shuttle project by Aurrigo in the UK is focused on the transit needs of blind people.

Operation

- Realize that most automated shuttle trials require operators for the foreseeable future, although some trials may evolve over time and be proven safe without operators.

- Ensure that the regulatory aspects are fully addressed, for example:
    - Importation needs of Transport Canada.
    - Compliance with all provincial/territorial highway traffic Acts or equivalent, and eligibility for AV trial programs as applicable.
    - Coordination with the municipality and conformity with any additional requirements and/or regulations.

Technical

- Prepare for weather- and environment-related impacts on the vehicle, including the sensors. In winter, snow and ice buildup on some sensors can degrade their performance. On windy summer days, dust and sand can sometimes get into the sensors and also degrade the performance.

- Consider that in some areas, the landscape can change almost daily, for example in areas that are undergoing rapid development. This can confuse positioning systems that rely on comparing a video image of the surroundings with a geo-indexed library.

- Be aware that while the technology is getting better year-by-year, it will never be perfect. There will be times when the hardware and/or software will not work.

Safety

The topic of safety is clearly very important to stakeholders involved in CAV pilots and is covered in some detail in this report.

Stakeholders who have been involved in trials emphasize the importance of safety. A worst-case scenario is a collision during a trial that leads to death or injuries. The report provides examples of past safety-related incidents with automated shuttle trials with public organizations that were identified during the research.

Best practices include developing a safety plan that includes the following, at a minimum:

- Conduct an Avoid, Control, Accept, Transfer (ACAT) evaluation and analysis; the project lead organization should ensure that this is done by a suitably qualified person or people.

- Train the on-board safety person thoroughly.

- Develop and implement a plan with first responders and other stakeholders involved in the operation of the trial.

Paratransit Vehicles

- There is significant interest in using shuttles as paratransit vehicles, and it is always beneficial to include this use-case where possible. However, there is little in the way of best practices in this area.

Other Best Practices

- Explore the legal, regulatory and insurance questions.
- Learn from other similar trials.
- Trials can help develop and showcase local talent.
- At the moment, all identified AV trials carry the public for free.
- Carefully design and test the survey instruments that are used to measure the public's perception. Surveys for past pilots have varied in depth.
- Take advantage of the fact that AVs are a subject in which the public has a substantial interest.
- Prepare for the fact that the vehicles are evolving relatively quickly.
- Consider the new technical considerations associated with driverless vehicle operations. These include both hardware and software issues related to the vehicles and the deployment environment, as well as broader concerns about maintaining interoperability with existing infrastructure and systems.
- Remember the nine key areas that could pose early obstacles to deployment:
    - Vehicle capabilities.
    - Operating environment.
    - Product availability.
    - Planning and implementation.
    - Financial considerations.
    - Labour considerations.
    - Data and evaluation.
    - Public acceptance.
    - Federal, Provincial and local regulations.

BEST PRACTICES FOR AUTOMATED VEHICLE TRIALS IN NORTH AMERICAN MUNICIPALITIES

1. Introduction

1.1 General

CAVCOE (formerly the Canadian Automated Vehicles Centre of Excellence) is pleased to submit to the City of Toronto this draft final report on research into *Best Practices For Automated Vehicle Trials In North American Municipalities.*

1.2 Background

The City of Toronto is actively engaged in studying Automated Vehicles (AVs) for passenger transportation and non-passenger use cases. Staff keep abreast of developments in this sector and are knowledgeable on the background of the technologies and their implications. CAVCOE is up to speed with developments in this sector and develops original thought development to help better understand possible future scenarios. In this section, we present the background and motivation for this research project.

First, the City of Toronto has developed a plan to trial an automated transit shuttle service. A submission to Transport Canada's Program to *Advance Connectivity and Automation in the Transportation System* (ACATS) was successful. The shuttle is intended to test the technology's ability to meet an existing unmet need in public transit, such as filling the lower-demand "last mile" gap. While the location of the trial has not yet been selected, the shuttle will not be tested on an existing transit route.[1]

A second part of the background is that there is a substantial level of activities in AV trials and demonstrations in Canada and the US. The following table shows the many Canadian CAV tests and trials, past, present and future. This table includes many pilots that are outside the scope of the research study, such as testing of automated farm equipment and an automated airport security vehicle. A later table is focused on the projects in the scope of this study.

[1] This paragraph is from City of Toronto documentation with light editing.

Table 1: List of Canadian AV Trials

	Secure Sites	Public Roads
Scope	• This table provides a comprehensive view of Canadian AV trials, demonstrations and pilots, including those that are out of scope for this research study.	
	• No public access	• Sometimes with barriers and sometimes in mixed traffic
Past	• **Montreal QC**: Shuttle trial at Olympic Park **Montreal QC**: UITP conference • **Ottawa ON**: Shuttle trial on Parliament Hill • **Calgary AB**: automated shuttle trial (Zoo - Telus Spark Science Centre)	• **Windsor-Essex ON**: pilot of car travelling cross-border
Present	• **Kapuskasing ON**: GM's in-house test-track for various cars • **Blainville QC**: Transport Canada's test track • **Stratford ON:** AVIN/APMA Demonstration Zone in Stratford ON; various cars • Near **Regina SK**: DOT Technology: automated farm equipment • **Edmonton AB:** fence at Edmonton International Airport patrolled by robotic security AVs • **Ottawa ON:** L5 CAV test site; cars, shuttles and military vehicles • **Edmonton AB:** truck testing at Edmonton International Airport • **Edmonton**: automated shuttle	• **Kanata ON**: car with link to city infrastructure • **Edmonton AB**: ACTIVE project; connected vehicle testing in Edmonton AB • **Vancouver BC**: AURORA project; connected vehicle testing at UBC • **Candiac QC:** automated shuttle • **Montreal QC**: Shuttle between metro and market
Future	• **Toronto ON:** automated shuttle trial by the City of Toronto	• **Quebec**: 2-3 more shuttle projects planned, including at least one in Montreal • Up to **12 municipalities** across the country: CUTRIC shuttle pilots

1.3 Study Objective and Scope

Three objectives of this research study are:

1. To identify the AV pilots and demonstrations in the US and Canada in which a municipality is involved as a stakeholder, for example as a funder, proponent or co-proponent, host, or external stakeholder.

2. To gather information on each, as described below, using publicly available information, questionnaires and interviews.

3. To prepare this report summarizing best practices that emerge from the case studies.

Other aspects of the scope of the research were:

1. The data gathering use publicly available information.

2. Questionnaires will be sent to all stakeholders, with the option to complete and return a written form and/or participate in a telephone interview.

3. The information will include trials and demonstrations in Canada and the US that have concluded – at least for now. One example is the Windsor-Essex demonstration of an AV crossing the Canada-US border. This appears to have been a one-off demonstration.

4. Some of the questions will not apply to all the identified trials and demonstrations. For example, some industry-supported trials involve in-kind contributions instead of monetary fees. These details will be identified and included in the report.

Many of the pilots in Canada and the US have involved low-speed shuttles. The exceptions have been:

- In Canada, there have been technology trials and demonstrations involving, for example, communications between AVs and infrastructure such as traffic signals and technical tests of the new 5G cell-phone systems. The Mayor of Ottawa rode in a QNX prototype AV in a well-publicized public demonstration in 2017.

- In the US, there have been pilots of driverless taxis, such as those conducted by Waymo and others. There have been no similar pilots in Canada.

Finally, equipment providers and service operators have conducted pilots with multiple municipal stakeholders. In the body of this report, we have presented the overall conclusions and best practices without linking them to specific projects.

Appendix A lists the detailed research questions; they expand on the scope.

1.4 Methodology

The research identified a target list of AV pilots in Canada and the US. This was reviewed with the City of Toronto and the information gathering phase commenced.

The information was gathered via several approaches:

- Publicly-available articles and reports.
- Exchanges of emails with individuals in the target municipalities.
- Telephone calls with key individuals.
- Participation in Transport Canada's Forum on Low-Speed Automated Shuttles held on June 13, 2019. The speakers included vehicle manufacturers, service providers, Transport Canada officials, and other experts, as well as the City of Toronto and CAVCOE.
- Background information and expertise from the CAVCOE team members, for example on the important topic of safety.

The resulting information was processed and formatted for this report. The detailed information on each pilot is contained in the Appendices. The higher-level analysis, conclusions and recommendations are based on both Canadian and US pilots.

Additional sources of information for US pilots include:

- National League of Cities
  https://www.nlc.org/sites/default/files/2018-10/AV%20MAG%20Web.pdf

- Pittsburgh
  http://apps.pittsburghpa.gov/redtail/images/5056_AV_Testing_EO.pdf

- "Autonomous Los Angeles"
  http://www.thelacoalition.com/site/wp-content/uploads/2018/04/Autonomous-Los-Angelespdf.pdf

- Volpe National Transportation Systems Center – which published *Low-Speed Automated Shuttles: State of the Practice Final Report.* Although a US report with US examples, the state of the practice information is very relevant and applicable to Canada.
  https://rosap.ntl.bts.gov/view/dot/37060

Additional sources of information regarding national guidelines for trials of automated vehicles include:

- Transport Canada: Safety Assessment for Automated Driving Systems in Canada
  https://www.tc.gc.ca/en/services/road/documents/tc_safety_assessment_for_ads-s.pdf

- Canada: 'Testing Highly Automated Vehicles in Canada – Guidelines for Trial Organizations', Transport Canada and CCMTA
  https://www.nlc.org/sites/default/files/2018-10/AV%20MAG%20Web.pdf

- UK: 'Code of Practice: Automated Vehicle Trialling', Centre for Connected and Autonomous Vehicles and Department for Transport.
  https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/776511/code-of-practice-automated-vehicle-trialling.pdf
  We note that the national guidance from the UK includes the development of a detailed safety case before conducting trials.

- US Department of Transportation: Comprehensive Management Plan for Automated Vehicle Initiatives.
  https://www.transportation.gov/sites/dot.gov/files/docs/policy-initiatives/automated-vehicles/317351/usdot-comprehensive-management-plan-automated-vehicle-initiatives.pdf

1.5 Report Layout

The body of the report provides high-level information on the background, methodology, results and best practices.

The Appendices contain detailed questions used in the survey and the detailed answers from the research. Most of the text in these Appendices is taken verbatim from the survey responses and published information.

2. Research Results

2.1 Target Trial Projects

The following is the list of pilot locations identified together with the number of pilots in a city if there have been more than one. Responses were received for the pilots shown in bold.

Table 2: Trials Researched

Canada	US
• **Candiac** • **Edmonton (4)** • **Montréal (6)** • **Ottawa (2)** • **Ontario (various locations)** • **Québec rural locations** • **Stratford** • **Surrey** • **Vancouver** • **Various national locations (for CUTRIC pilots)** • **Wetaskiwin** • **Windsor (2)**	• **Mcity, Ann Arbor** • Arlington • Austin • Babcock Ranch • Boston • Columbus • Concord • Denver • Detroit • Gainesville • Greenville County • Grand Rapids • Houston • Kirkland • Knoxville • Las Vegas • **Los Angeles** • Miami • New York City • Phoenix • Pittsburgh • **Portland** • Reno • **San Antonio** • San Francisco • San Jose • **Bishop Ranch, San Ramon** • Stamford • Tampa • Union Point • Washington DC

All the pilots were shuttles except:

- Ottawa trials and pilots involving QNX were cars.
- The Windsor-Detroit cross-border pilots were cars.
- The planned CUTRIC pilots will use both buses and shuttles.

2.2 Preamble to the Results

It is useful to mention at this time some general observations that apply to many of the findings. Subsequent sections provide the details of the research and our overall conclusions and recommendations.

First, it was not possible to obtain all the answers to all the questions. Some stakeholders in AV pilots in both Canada and the US were reluctant to share information that was not already in the public domain. We hypothesize that there could be several reasons for this:

- The progress of a project affects the willingness of people to discuss the details. People are often more willing to share information on past projects and less willing to share their views of the future.

- Linked to the above, there is likely a reluctance among participating companies to share too much information because it can give their competitors an edge.

- Given the temporary and short nature of many pilots, there may not have been sufficient documentation and/or data collection to address the questions posed.

- Another possibility is that the stakeholders did not see a benefit in spending time answering our questions.

Finally, it is useful to note that there are two broad categories of pilots – although some pilots have elements of each:

- Trials with objectives that include demonstrating existing AVs. This includes allowing municipalities and other stakeholders to become more familiar with the operational and service-delivery issues, as well as helping to inform the public, provide demonstration rides and gather their reactions. These pilots, by their very nature, tend to be higher profile and are more public-facing. The automated shuttle demonstrations and pilots conducted by third party providers are in this category.

- Trials that are designed to test technical issues, including communications, vehicle design, AV hardware and software, and related issues. These pilots are generally not promoted to the public to the same extent, apart from – sometimes

– an initial news release. One example in this category is some of the testing being conducted at the L5 test track in Ottawa. L5 is managed by Invest Ottawa, an agency of the City of Ottawa, so it falls into the scope of this research report. The Federal and Provincial governments are also very involved. One focus of the testing at L5 is 5G, the new cell-phone technology that will be very important to the operation of AVs. L5 is a secure, fenced and gated site, so the public is generally unaware of the scope of the work happening at that site.

2.3 Stakeholders

In most -- probably all -- pilots, there are distinct categories of stakeholders:

- Vehicle supplier.
- Vehicle technology developer where the OEM incorporates hardware and/or software from a Tier 1 or Tier 2 supplier.
- The service provider / operator.
- The municipality.
- A provider of hardware other than the vehicle itself.
- A local university or college.
- A landowner (owner or organization responsible for private lands hosting the test/pilot/trial).
- The operator of the AV test track if one is being used.
- A government agency that provides funding.
- A government agency that is involved in the regulations related to a pilot.

The pilot leader can be any of these, but is typically one of the first four in the above list.

The above stakeholders may sometimes provide funding, or they may provide contributions in lieu of funding. We are also seeing a trend towards vehicle suppliers and service providers seeking funding for their involvement in a pilot. Additional information is provided in the next section.

2.4 Trial Objectives

The automated shuttle market is maturing rapidly and the majority of the pilots researched used this type of vehicle. This was especially true for the higher profile pilots involving the public. The pilots involving cars generally had more technical objectives, such as testing 5G and connectivity to city infrastructure. Municipalities are involved in pilots with technical objectives, but generally from the perspective of the transportation infrastructure.

There are separate but overlapping types of testing. There are two main factors influencing all this: the status of the technology and the regulations:

Table 3: Types of Pilots

	Low Speed Shuttles	Cars
Technology testing and verification.	Mainly complete, except for testing new models and improvements and enhancements.	Ongoing in Canada and the US, on both private test facilities and public roads.
Service demonstrations and trials, ranging from a few days to up to 12 months.	Ongoing in Canada and the US, on both private test facilities and public roads, with a trend to public roads.	Driverless taxi services have been demonstrated in the US but not yet in Canada.
Commercial operations.	In various countries, but not yet in Canada.	No driverless taxi services are currently in full commercial operation. Various OEMs have announced driverless taxi services starting in the early 2020s. Ford, for example, has announced theirs will be launched in 2021.

Today, there have been many shuttle pilot projects around the world. It is difficult to be precise on exactly how many. One article published in December 2018[2] contains a table showing 74 self-driving car tests around the world. Given that this report identifies 53 in Canada and the US, a total of 74 around the world seems low. It is reasonable to assume that Europe and Asia each have at least as many as in North America – and probably more. The estimated number world-wide would therefore be somewhere around 200.

In addition, there are ongoing commercial services in various countries, some of them carrying the public and others for private applications. The significance is that, for basic and highly constrained deployments, suppliers have less need to test the technology than was the case 2-3 years ago. This is not to say that all technology development is finished, because that is far from the reality. As noted below, the Bishop Ranch deployment in San Ramon required lengthy development by the AV technology provider in order to facilitate deployment in a mixed traffic, low-speed environment. But suppliers are increasingly weighing the benefits of being involved in a pilot and committing

[2] https://qz.com/1488576/self-driving-car-tests-around-the-world/

resources, versus the significant cost to participating in pilots, especially as there are many organizations seeking to conduct pilots.

This means that suppliers will examine a proposed pilot and be more focused on the business case than they used to be when they examine the expected benefits:

- Can the trial be linked in some way to AV technology software or hardware development that will benefit the technology developer in other locations and markets?

- Is there a novel aspect to the pilot that will result in new knowledge that would be useful? One example would be a pilot that focuses on the needs of disabled people.

- Or is there a particularly challenging environment? For example, Saudi Arabia has been promoting its harsh climate as a feature of testing AVs in that country.

- Is there a roadmap from a proposed pilot leading to a significant sale? If there is, the supplier(s) will of course be more willing to treat this as a part of its marketing program. A Transportation Master Plan or a Transit Master Plan leading to a requirement for AVs would, of course, provide support for this position.

- Absent any of the above tangible benefits, a supplier may request payment for its costs associated with a pilot. This is not a firm rule, but any municipality planning a pilot should be aware of this possibility.

The conclusion is that it would be beneficial if the project leader develops supporting documentation to show what is in it for the suppliers and other stakeholders.

2.5 Summary of Trials

General
The terminology used is as follows:

- “Automated vehicles” or AVs is a generic term that refers to any kind of AV, including cars, buses and automated shuttles.

- Automated shuttle is a specific kind of AV, typically low-speed and with no specific driver’s position. An operator generally has a control box that can be used to manually control the shuttle if needed. One version of this control box is similar to an Xbox controller.

- Hence, all automated shuttles are AVs, but not all AVs are automated shuttles.

A statistical analysis of the data would not provide meaningful data because of the variations in the way responders answered the questions. Some responders grouped a significant number of pilots into one response, whereas others had multiple versions of a relatively standard reply with minor changes for each geographic location.

Canadian Trials

Despite the rapid progress mentioned above, automated vehicle technology is very recent and pilots on public roads in Canada are just starting. Most of the deployments reported in this report were conducted on controlled facilities.

In order to meet the objectives for the first pilots and to ensure that the deployment is safe, the demonstrations have used test track facilities, private roads, and/or dedicated lanes on public roads. Using a geographically-constrained environment allows data to be collected on the pilot projects and the vehicles themselves, whilst also informing, educating and reassuring the general public.

The latest testing also included testing of vehicle to infrastructure technology (V2X) connectivity. Adding the ITS technology will provide a wider and better understanding to get municipalities and other stakeholders ready for the arrival of that new capability.

Testing on a private road and/or in a dedicated lane has also been a way to involve cities and other levels of government. This has allowed them to see the technology in action and create working groups to prepare for the development of new mobility options in their jurisdictions.

The projects currently in operation at the time of writing are:

Ottawa/Stratford – Ottawa L5 Test Track and the AVIN/APMA Demonstration Zone in Stratford

Blackberry QNX and its partners have been conducting technology testing. This project has been ongoing for almost two years and the Blackberry QNX role is evolving. Limited information on the projects are available. Based on the conversation with the stakeholders, they see the benefit of a long-term project in order to address and correct the technology challenges that they are encountering. The collaboration between all stakeholders is designed to maximize the benefits over the longer-term.

City of Candiac Project

The Candiac project was the first pilot on public road in mixed traffic in Canada. V2X technology was deployed for the first time in the context of a year-long deployment of autonomous vehicle.

Montreal Shuttle Project

The recently launched Montreal autonomous vehicle pilot is also on public roads and includes ITS technology for the road infrastructure. This short project will

also include an element of research for public acceptance and the riders' reactions.

Ottawa L5
The Ottawa L5 test facility is managed by Invest Ottawa, an agency of the City of Ottawa, so it falls into the scope of this research report. The Federal and Provincial governments are also very involved. One focus of the testing at L5 is 5G, the new cell-phone technology that will be very important to the operation of AVs. L5 is a secure, fenced and gated site, so the public is generally unaware of the scope of the work happening at that site.

We also note that Canadians are very interested in AV deployment, both professionally and personally. There is a great level of interest in the subject. There is clearly a need for information that can be shared and communicated to provide a view of the current situation, the future and the best practices.

US Trials
The majority of stakeholders in US pilots that were contacted were non-responsive. Of those that responded, all the pilots used automated shuttles.

The two pilots for which we received the most information were Mcity and Bishop Ranch, San Ramon.

Mcity, University of Michigan, Ann Arbour MI
The primary goal of this research project is to understand human acceptance, trust, and behavior when riding in a driverless shuttle or interacting with one on the road.

Bishop Ranch, San Ramon CA; Contra Costa Transportation Authority (CCTA)
The objective is to explore the potential of AVs to improve public-transit outcomes. The trials use public roads on Bishop Ranch development in mixed traffic.

3. Best Practices

This section on best practices combines two main sources of information:

- The results of the research conducted for this project.
- CAVCOE's background knowledge in transportation safety engineering.

Most of the best practices found during this research have arisen from automated shuttle projects where the driving system is not fully automated. For AV developers that are creating more advanced technology targeted for use on virtually all public roads (high capability SAE Level 4 systems and above), the best practices are mostly similar, although there will be differences, particularly with regard to infrastructure requirements and the Operating Design Domain (ODD).

The best practices are listed below, organized by category.

3.1 Planning

- Set specific project goals, such as
    - Deploy a pilot to learn the deployment issues and see how the vehicle operates.
    - Increase public awareness.
    - Increase AV awareness among employees.

- Develop and implement a plan for site setup, including signage, additional parts if required, washrooms if required, etc.

- Conduct testing before launch.

- Train the safety conductors thoroughly.

- Anticipate that the current generation of vehicles may have issues with dust (which can obscure the sensors), rain, uneven road services, birds and other animals.

- Consider incorporating one or more related experiments from a local post-secondary institution; they have a wide breadth of research capability.

- Consider a relevant science display for the public addressing both the current and possible future AV technologies.

- Carefully conduct route selection in partnership with other stakeholders. This is a big component of the overall safety plan. Other considerations include pedestrian

and road traffic, road surface, and the risk of changes in the view as seen by the AV.

- Require that the vehicle supplier train the team who will actually be involved in the pilot.

- Ensure that there is a business case for the vehicle supplier be involved in the pilot.

- Consider a dedicated lane for shuttles with no barricades. The reason for this is safety; the ability for shuttles to operate safely in mixed traffic is a work in progress. A dedicated lane improves safety.

- Inform, engage and coordinate with the transit unions and consider using transit drivers as onboard ambassadors.

- Prepare plans for how the data will be stored and used – and address the related privacy issues.

3.2 Liability and Insurance

- Obtain appropriate insurance. Some equipment providers already carry insurance on their fleet on a worldwide basis. Obviously, other stakeholders will need their own insurance.

3.3 Data Gathering Strategy and Privacy

- Establish the data needs early.

- Comply with all relevant data and privacy laws.

- Develop a transparent data strategy and policy.

- Determine who owns the data and/or has rights to the data. The background is that there may be competing interests for data ownership. Is it the vehicle owner? Or the operator? Some passengers may feel that they own data about them.

- Agree on any data anonymization procedures and standards.

- Agree what the data is to be used for.

- Agree what the data is NOT to be used for.

- Agree where and how the data is to be stored.
- Set limits on the commercial use of data, if relevant.
- Collect data in agreed formats in order to maximize future value.

3.4 Partners

- Expect and plan for a wide range of partners for the project.
- Engage stakeholders early.
- Organizations involved in pilots need a clear understanding of the operational capabilities and limitations of the equipment.

3.5 Communications – Internal and External

- Develop and implement a communications plan. There are three layers to the audiences: the municipality, project partners, and the public.
    - All members of the municipal team to ensure that everyone knows about the project and understands it.
    - All stakeholder organizations as defined in Section 2.3, so everyone understands the big picture and their role.
    - The public, including seniors, people with disabilities and school children. A pilot automated shuttle project by Aurrigo in the UK is focused on the transit needs of blind people.
- Where feasible, develop unique branding for the vehicle(s). One example is the panda on the City of Calgary's ELA pilot.

3.6 Operation

- Realize that most automated shuttle pilots require an operator for the foreseeable future, although some pilots may evolve over time and be proven safe without an operators.

- Determine any special challenges that exist, such as the Candiac pilot that involves mixed traffic and the Calgary project that involved a railroad crossing. Sometimes, for safety reasons, a shuttle is driven in a manual mode over a railroad track.

- Ensure that the regulatory aspects are fully addressed, for example:
    - Importation needs of Transport Canada.
    - Compliance with all provincial/territorial highway traffic Acts or equivalent, and eligibility for AV pilot programs as applicable.
    - Coordination with the municipality and conformance with any additional requirements and/or regulations.

3.7 Technical

- Prepare for weather- and environment-related impacts on sensors and the vehicle. In winter, snow and ice buildup on some sensors can degrade their performance. On windy summer days, dust and sand can sometimes get into the sensors also degrade the performance.

- Consider that in some areas, the landscape can change almost daily, for example in areas that are undergoing rapid development. This can confuse positioning systems that rely on comparing a video image of the surroundings with a geo-indexed library.

- Be aware that while the technology is getting better year-by-year, it will never be perfect. There will be times when the hardware and/or software will not work.

- Include in the RFP one or more questions about the vulnerability of their shuttles to hacking. The background is not hypothetical: this actually happened with a Jeep Cherokee in 2015[3] and the shuttle was forced off the road.

3.8 Safety

In this section of the report, we cover best practices and lessons learned. The topic of safety is clearly very important to stakeholders involved in CAV pilots and is covered in some detail in this section.

Stakeholders who have been involved in pilots emphasize the importance of safety. A worst-case scenario is a collision during a pilot that leads to death or injuries. To address safety, this section amalgamates the results of our research for this project with additional information on managing a pilot as safely as possible.

[3] https://www.kaspersky.com/blog/blackhat-jeep-cherokee-hack-explained/9493/

The following is a list of safety related incidents or actions regarding automated shuttle pilots with public organizations that were identified during the research:

Las Vegas, NV (Keolis, Navya) November 2017
On launch day, the automated shuttle had a low-speed collision with a large delivery truck[4]. An NTSB investigation determined two main probable causes for the accident: the truck driver's assumption that the shuttle would move to avoid him, and that the safety operator inside the shuttle did not have direct access to the manual override controls. (The X-box style controller was locked in a storage compartment)[5].

Babcock Ranch, FL (Transdev, Easymile) October 2018
NHTSA, a US Government agency, called the self-driving school bus project 'unlawful' and closed it down as permission was only granted for "testing and demonstration purposes"[6] and that use as a school bus was in violation of the importation authorization[7].

Vienna, Austria (Navya) July 2019
An article on a collision between a driverless shuttle and a pedestrian in Vienna said: "…the rough outlines seem clear enough. A 30 year-old woman was walking across a street when she collided with the side of an autonomous shuttle bus made by the French company Navya, which was traveling at about 7.5 miles per hour [12 km/h], resulting in an injury to her knee."[8] "A statement by NAVYA… received by The Verge[9] revealed that the pedestrian was allegedly wearing headphones and looking at her phone. The woman only suffered "minor scratches," according to the statement."

Salt Lake City, UT (EasyMile) July 2019
"A 76-year-old Utah Tax Commission employee was injured and required medical attention when the autonomous shuttle he was riding in made an unexpected emergency stop on Tuesday."[10] Following the incident, the Utah Department of Transportation has lowered the speed limit from 12 mph to 9 mph (19 km/h to 14 km/h).

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[4] https://www.theverge.com/2017/11/8/16626224/las-vegas-self-driving-shuttle-crash-accident-first-day
[5] https://www.ntsb.gov/investigations/AccidentReports/Reports/HAB1906.pdf
[6] https://jalopnik.com/feds-order-company-to-stop-shuttling-florida-kids-to-sc-1829906624?rev=1540215965818&utm_source=jalopnik_twitter&utm_campaign=socialflow_jalopnik_twitter&utm_medium=socialflow&/setsession
[7] https://www.nhtsa.gov/press-releases/nhtsa-directs-driverless-shuttle-stop-transporting-school-children-florida
[8] https://www.thedrive.com/tech/29079/navya-shuttle-incidents-show-risks-of-even-a-low-speed-rush-to-autonomy
[9] https://futurism.com/the-byte/driverless-bus-collides-pedestrian-vienna
[10] https://www.deseretnews.com/article/900080444/utah-driverless-shuttle-accident-state-employee.html

Concord & San Ramon CA, USA (GoMentum)
Even with the best planning and safety plan, collisions can happen. One example is GoMentum which stated that safety was a key concern of theirs. Their team tested the shuttles at their dedicated GoMentum facility (private, dedicated test facility) prior to being used in the public domain. The Las Vegas shuttle grabbed national headlines for being the first shuttle deployment in the US by a few days. However, the Las Vegas pilot is now infamous for having an incident where a truck on the route reversed into a shuttle.

Building on the idea for a safety case development as noted in the UK code of practice cited in Section 1.4 and our own extensive background in traffic safety, CAVCOE has developed guidelines for the development of a safety culture for a private sector client, that included the development of a safety plan. Based on the lessons that can be learned from the real-life safety incidents noted above, the development of a safety culture and a safety plan would be a best practice that would seek to directly address potential safety issues before they arise.

- Review the relevant Federal and Provincial / Territorial safety regulations and guidelines that have been published. One example is *Testing Highly Automated Vehicles in Canada,* prepared and published by Transport Canada[11].

- Develop a safety plan which includes the following, at a minimum.

- Conduct an Avoid, Control, Accept, Transfer (ACAT) evaluation and analysis; the project lead organization should ensure that this is done by a suitably qualified person or people,

- Train the on-board safety person thoroughly.

- Develop and implement a plan with first responders and other stakeholders involved in the operation of the pilot.

- Develop a response plan – including communications – in case there is an incident.

Notes on Safety Culture Development, adapted from CAVCOE's previous work, are included as Appendix D.

[11] https://www.tc.gc.ca/en/services/road/safety-standards-vehicles-tires-child-car-seats/testing-highly-automated-vehicles-canada.html

3.9 Accessibility

There is significant interest in using shuttles as paratransit vehicles and it is always beneficial to include this use-case where possible. There is little in the way guidelines for shuttle- or AV-specific best practices. However, many jurisdictions have existing accessibility legislation or guidelines that should be followed as a starting point? E.g AODA in Ontario.

Activities in this area include:

- ITS America has conducted research, two workshops, and developed and published a report on *Driverless Cars and Accessibility*[12].

- Transport Canada and Innovation Science and Economic Development (ISED) have formed an *Advisory Group on the Vehicle of the Future*, including an *Expert Working Group on Enhanced Accessibility and Mobility*. The report from this group is now in its final stages at the time of writing.

- Canadian Standards Association, operating as CSA Group with support from Transport Canada's program to Advance Connectivity and Automation in the Transportation System (ACATS), is engaging stakeholders to develop standards and guidelines, contribute to international standards development, and develop a forward-looking standardization roadmap. As part of this, CSA is developing a roadmap leading to accessibility standards in AVs.

These initiatives demonstrate a lot of interest and potential, but these are all works-in-progress at this.

3.10 Other Best Practices

- Learn from other similar pilots.

- Seek opportunities to use pilots to help develop and showcase local talent.

- At the moment, all identified AV pilots carry the public for free.

- Carefully design and test the survey instruments that are used to measure the public's perception. Surveys for past pilots have varied in depth.

[12] https://static1.squarespace.com/static/596fb16003596e0fa70a232f/t/5c9bab319b747a61663ac9bc/1553705778370/ITSAmerica_Driverless+Cars+Accessiblity+Mobility_April2019.pdf

- Take advantage of the fact that AVs are a subject in which the public has a substantial interest.

- Also remember that the vehicles are evolving relatively quickly.

- Consider the new technical considerations associated with driverless vehicle operations. These include both hardware and software issues related to the vehicles and the deployment environment, as well as broader concerns about maintaining interoperability with existing infrastructure and systems.[13]

- Ensure that stakeholders have adequate resources and permissions for identifying, procuring, and operating these systems.

- Remember the nine key areas that could pose early obstacles to deployment:
    - Vehicle capabilities.
    - Operating environment.
    - Product availability.
    - Planning and implementation.
    - Financial considerations.
    - Labour considerations.
    - Data and evaluation.
    - Public acceptance.
    - Federal, state (provincial in Canada) and local regulations.

3.11 Context for Best Practices

The following provides some background information for the best practices listed above.

- The Traffic Injury Research Foundation (TIRF), with funding from the Toyota Canada Foundation, conducted a national survey to examine driver knowledge, attitudes, perceptions, and practices related to emerging automated vehicles. The survey was augmented with four focus groups that involved drivers and non-drivers representing several age groups. The report[14] showed that people are initially not comfortable in a vehicle in mixed traffic without a driver. Just one-fifth (20%) of respondents reported they would prefer to use a limited self-driving vehicle; just 14% preferred fully self-driving vehicles. However, experience by Google and others shows that the public adapts very quickly.

[13] This and the subsequent bullets are from a report from Volpe: https://rosap.ntl.bts.gov/view/dot/37060

[14] http://tirf.ca/wp-content/uploads/2017/01/Automated-Vehicles-Driver-Knowledge-Attitudes-and-Practices-10.pdf

- The background is that legal liability and insurance for AV pilots and operations in Canada is very much a work in progress. In the short term, for a pilot, it is important that the stakeholders' lawyers and insurance experts be involved and that they explore the legal, regulatory and insurance questions.

- The AV trial regulations published by the Ontario Ministry of Transportation has a section on insurance requirements and collision reporting[15].

- In the longer-term, the Canadian insurance industry is developing an approach. The Insurance Bureau of Canada has an industry working group examining this and a preliminary report was published in 2018.

- The safety technology on vehicles is getting better and the role of the on-board safety operator is evolving to be more of an ambassador. However, he/she is essential as one level of safety. However, despite the above focus on a safety operator, there is at least one project that has been using a shuttle for the last six months without a safety operator.

4. Conclusions

Designing and deploying an AV trial, demonstration or pilot is non-trivial. Best practices include addressing a wide range of planning, liability and insurance, communications between stakeholders and with the public, operations, and safety.

At the same time, there have been many examples of successful AV pilots in Canada and the US.

This report provides a long list of best practices for organizations planning an AV pilot.

[15] http://www.mto.gov.on.ca/english/vehicles/automated-vehicles.shtml

Appendices

Appendix A: Research Questions

The questions developed by the City of Toronto for the research are:

1. Which municipalities are considering or are involved in establishing dedicated testing facilities or on-road locations?
    a. E.g. Stratford's testing grounds, LA was also considering a corridor.
    b. We will include those pilots in which a municipal government is a stakeholder and exclude those that do not involve a municipality.

2. What is the purpose of their testing facility/location?
    a. E.g. To attract investment? To test technology and vehicles? Linked to a grant program/funding? To measure awareness / public acceptance?

3. What is the technological scope (e.g. CV, AV, other)?

4. What types of vehicles are being tested?

5. Are the interactions with other road users being tested?
    a. Is there any impact on facilities and infrastructure?

6. Where in the City are these facilities / locations generally sited? Core, suburbs, exurbs, industrial parks, etc.?

7. Are the on-road facilities typically loops or corridors?

8. What are the technical specifications of the facility/location? How was it determined what was needed?
    a. This could include communications systems, security, charging infrastructure, type of CV, indoor/outdoor storage, track length, turn-arounds, interaction with curbs, pick-up and drop-off arrangements etc.

9. Are on-road testing grounds in mixed traffic?

10. Are there any restrictions (e.g. time-of-day, partial closure, duration of pilot)?

11. Who are the partners in the testing facility? What is their role?

12. What is the role of the municipality?

13. Who are the champions that have taken the lead in proposing and then implementing the pilot?

    a. Who could the City of Toronto approach?

14. How is the facility or corridor upgrades funded?
    a. Start-up funding and on-going operational support?
    b. How much is the municipality funding?
    c. If there have been in-kind contributions, what form did these take?

15. Who has access to use the testing grounds, and how did they get it?
    a. Is access limited to certain groups?
    b. Are any agreements required?
    c. Are any fees charged?
    d. Are there data-sharing or reporting requirements?

16. Was there public consultation in selecting on-road locations? What criteria were used to select the on-road location?

17. Is the public notified when testing occurs?
    a. Who performs the notification: the municipality or the testing agency?

18. What has the public reaction been?

19. What benefits are anticipated/have been realized from the testing facility and municipal investment?

20. Are there any standard technologies being tested (particularly in connected infrastructure)? Are there any gaps?

21. What regulations, standards, codes of practice or guidelines where used in setting up the pilot?
    a. Are there any testing safety standards (or any other standards/regulations/guidelines) that the test beds are converging to?
    b. Was a project specific safety plan or safety case put in place?

22. What is the operating structure and the insurance structure?

23. How has liability been assigned/addressed?

Appendix B: Table Showing Results for Canadian Trials

Past Projects

Location / Item	Calgary TELUS Spark/Zoo
Project Scope	
Operational date	9/7/2018 - 9/30/2018
Stakeholders	PWT City of Calgary
Objective / Goal	City Labs Program
Road Conditions	Dedicated lane
Site Location	Core of the Telus Spark - Zoo
AV Operating Mode	Corridor
Site Technical Specification	As per Site Assessment Review (SAR)
Operating Restrictions	Trial Length Operating Days Operating Hours
Project Partners - Role	PWT - Operating Partner City of Calgary - Project Partner ATCO - Major Sponsor Telus - Major Sponsor
Municipality's Role	Approval Body
Project Lead Contact	Dan Finley
Project Funding	Private and public funding, combination of In-Kind and financial investment
Municipality's Funding	The municipality was involved in the funding with in-kind and financial support. Details were not available.
Anticipated benefits	Awareness of the autonomous shuttle and testing of the technology for short distance transportation
Connected technology tested	None
Alternative Locations - shortlisted	None
Project Set up guidelines	As per the site plan, formally known as the “Site Assessment Review” (SAR)
Project's Safety Plan	There was a safety plan put in place by the project team and the vehicle constructor that has previous experiences in deployment
Insurance Structure & Liability	Stakeholders, including PWT, were responsible for the insurance and the liability of the project.
Vehicle	
Technological Scope	Automated shuttle
Vehicle Type	EZ10

Vehicle Manufacturer	EasyMile - Ligier
Vehicle Operator	PWT
Operator Training	The operator was trained by the manufacturer as per training program and requirement on vehicle safety
Vehicle Maintenance	PWT + EasyMile
Communication / PR	
Public Consultation for site selection?	No consultation was done prior to the launch of the project
Public Notification at project Start?	Yes
Who performed notification?	City of Calgary & PWT
Communication objective	Awareness
Public Reaction	Positive

Location / Item	Edmonton Blatchford
Project Scope	
Operational date	10/5/2018 - 10/16/2018
Stakeholders	PWT City of Edmonton
Objective / Goal	Testing - Demo
Road Conditions	Dedicated - Public
Site Location	Core
AV Operating Mode	Corridor
Site Technical Specification	As per Site Assessment Review (SAR)
Operating Restrictions	Trial Length Operating Days Operating Hours
Project Partners - Role	PWT - Operating Partner City of Edmonton - Project Partner ATCO - Major Sponsor Telus - Major Sponsor
Municipality's Role	Approval Body
Project Lead Contact	John Stepovy
Project Funding	Private and Public funding, combination of In-Kind and financial investment
Municipality's Funding	The municipality was involved in the funding with in-kind and financial support. Details were not available.
Anticipated benefits	Awareness of the autonomous shuttle and testing of the technology for short distance transportation
Connected technology tested	None
Alternative Locations - shortlisted	Several
Project Set up guidelines	As per Site Assessment Review (SAR)
Project's Safety Plan	There was a safety plan put in place by the project team and the vehicle constructor that has previous experiences in deployment
Insurance Structure & Liability	Stakeholders were responsible for the insurance and the liability of the project
Vehicle	
Technological Scope	Autonomous Vehicle
Vehicle Type	EZ10
Vehicle Manufacturer	EasyMile - Ligier
Vehicle Operator	PWT

Operator Training	The operator was trained by the manufacturer as per training program and requirement on vehicle safety
Vehicle Maintenance	PWT + EasyMile
Communication / PR	
Public Consultation for site selection?	None
Public Notification at project Start?	Yes
Who performed notification?	City of Edmonton & PWT
Communication objective	Awareness
Public Reaction	Positive

Location / Item	Edmonton Chappelle Gardens
Project Scope	
Operational date	10/17/2018 - 10/21/2018
Stakeholders	PWT Brookfield Developments
Objective / Goal	Demo
Road Conditions	Dedicated route
Site Location	Suburbs
AV Operating Mode	Corridor
Site Technical Specification	As per Site Assessment Review (SAR)
Operating Restrictions	Trial Length Operating Days Operating Hours
Project Partners - Role	PWT - Operating Partner Brookfield Developments - Project Partner ATCO - Major Sponsor Telus - Major Sponsor
Municipality's Role	Approval Body
Project Lead Contact	John Stepovy
Project Funding	Private and Public funding, combination of In-Kind and financial investment
Municipality's Funding	The municipality was involved in the funding with in-kind and financial support. Details were not available
Anticipated benefits	Awareness of the autonomous shuttle and testing of the technology for short distance transportation
Connected technology tested	None
Alternative Locations - shortlisted	None
Project Set up guidelines	As per Site Assessment Review (SAR)
Project's Safety Plan	There was a safety plan put in place by the project team and the vehicle constructor that has previous experiences in deployment.
Insurance Structure & Liability	Stakeholders were responsible for the insurance and the liability of the project
Vehicle	
Technological Scope	Autonomous Vehicle
Vehicle Type	EZ10
Vehicle Manufacturer	EasyMile - Ligier
Vehicle Operator	PWT
Operator Training	The operator was trained by the manufacturer as per training program and requirement on vehicle safety.
Vehicle Maintenance	PWT + EasyMile
Communication / PR	

Public Consultation for site selection?	None
Public Notification at project Start?	Yes
Who performed notification?	Brookfield & PWT
Communication objective	Awareness
Public Reaction	Positive

Location / Item	Edmonton Strathcona
Project Scope	
Operational date	10/22/2018 - 11/4/2018
Stakeholders	PWT City of Edmonton
Objective / Goal	Testing - Demo
Road Conditions	Dedicated - Public
Site Location	Core
AV Operating Mode	Corridor
Site Technical Specification	As per Site Assessment Review (SAR)
Operating Restrictions	Trial Length Operating Days Operating Hours
Project Partners - Role	PWT - Operating Partner City of Edmonton - Project Partner ATCO - Major Sponsor Telus - Major Sponsor
Municipality's Role	Approval Body
Project Lead Contact	John Stepovy
Project Funding	Private and Public funding, combination of In-Kind and financial investment
Municipality's Funding	The municipality was involved in the funding with in-kind and financial support. Details were not available
Anticipated benefits	Awareness of the autonomous shuttle and testing of the technology for short distance transportation
Connected technology tested	None
Alternative Locations - shortlisted	Several
Project Set up guidelines	As per Site Assessment Review (SAR)
Project's Safety Plan	There was a safety plan put in place by the project team and the vehicle constructor that has previous experiences in deployment.
Insurance Structure & Liability	Stakeholders were responsible for the insurance and the liability of the project
Vehicle	
Technological Scope	Autonomous Vehicle
Vehicle Type	EZ10
Vehicle Manufacturer	EasyMile - Ligier
Vehicle Operator	PWT
Operator Training	The operator was trained by the manufacturer as per training program and requirement on vehicle safety.
Vehicle Maintenance	PWT + EasyMile

Communication / PR	
Public Consultation for site selection?	None
Public Notification at project Start?	Yes
Who performed notification?	City of Edmonton & PWT
Communication objective	Awareness
Public Reaction	Positive

Location / Item	Edmonton University of Alberta
Project Scope	
Operational date	11/5/2018 - 11/16/2018
Stakeholders	PWT City of Edmonton University of Alberta
Objective / Goal	Research
Road Conditions	Mixed - Private
Site Location	Core
AV Operating Mode	Corridor
Site Technical Specification	As per Site Assessment Review (SAR)
Operating Restrictions	Trial Length Operating Days Operating Hours
Project Partners - Role	PWT - Operating Partner City of Edmonton - Project Partner University of Alberta - Research Partner ATCO - Major Sponsor Telus - Major Sponsor
Municipality's Role	Approval Body
Project Lead Contact	John Stepovy
Project Funding	Private and Public funding, combination of In-Kind and financial investment
Municipality's Funding	The municipality was involved in the funding with in-kind and financial support. Details were not available.
Anticipated benefits	Research and development on the autonomous vehicle. Details on the R&D was not available.
Connected technology tested	Yes, no information on the technology tested
Alternative Locations - shortlisted	None
Project Set up guidelines	As per Site Assessment Review (SAR)
Project's Safety Plan	There was a safety plan put in place by the project team and the vehicle constructor that has previous experiences in deployment
Insurance Structure & Liability	Stakeholders were responsible for the insurance and the liability of the project
Vehicle	
Technological Scope	Autonomous Vehicle
Vehicle Type	EZ10
Vehicle Manufacturer	EasyMile - Ligier
Vehicle Operator	PWT

Operator Training	The operator was trained by the manufacturer as per training program and requirement on vehicle safety.
Vehicle Maintenance	PWT + EasyMile
Communication / PR	
Public Consultation for site selection?	None
Public Notification at project Start?	N/A
Who performed notification?	N/A
Communication objective	N/A
Public Reaction	N/A

Location / Item	Montreal At the “ITS World Congress”. (ITS = Intelligent Transportation Systems)
Project Scope	
Operational date	10/30/2017 – 11/02/2017
Stakeholders	Keolis Canada, the City of Montreal, ITS World Congress organization
Objective / Goal	Technology testing and demonstration to delegates and the public
Road Conditions	Public road closed to the traffic (exception for residents) during the demonstration hours, with the authorization of the City of Montreal
Site Location	Downtown Montreal
AV Operating Mode	Loop around the Palais des Congrès of Montreal 
Site Technical Specification	Urban road in a dense neighbourhood. The location needed to be found near the Palais des Congrès of Montreal and was determined in coordination with the City of Montreal, Keolis and NAVYA.
Operating Restrictions	3 days, from 10/30/2017 to 11/2/2017 from 10 a.m. TO 4 p.m.
Project Partners - Role	• Keolis Canada: plans, finances and operates the demonstration. • City of Montreal: plans and supports the application of Keolis Canada to obtain authorization to use the city’s roads for an AV demonstration. • Palais des Congrès: allows the demonstration at the proximity of its exhibitors. Rents a parking space to store and charge the shuttle to Keolis Canada. • ITS World Congress: coordinates all demonstrations during the congress.
Municipality's Role	• City of Montreal: plans and supports the application of Keolis Canada to obtain authorization to use the city’s roads for an AV demonstration
Project Lead Contact	Keolis, Marie-Hélène Cloutier, Vice-présidente expérience passager, marketing et commercialisation
Project Funding	Keolis Canada supported the whole costs of the demonstration
Municipality's Funding	No money, the City of Montreal supported Keolis Canada with authorization to use the public space and roads

Anticipated benefits	Demonstration of a new technology
Connected technology tested	None
Alternative Locations - shortlisted	Locations in downtown Montreal near the Palais des Congrès.
Project Set up guidelines	Keolis Group's and NAVYA's operational guidelines for AV projects
Project's Safety Plan	Standard Keolis Canada's operating process to guarantee passengers' and other users' safety in all circumstances
Insurance Structure & Liability	Keolis Canada operated an AV vehicle owned by the Keolis Group and provided insurance
Vehicle	
Technological Scope	Electric Autonomous Vehicle
Vehicle Type	NAVYA
Vehicle Manufacturer	NAVYA
Vehicle Operator	Keolis Canada
Operator Training	Keolis Canada based on guideline provided by the constructor and previous AV worldwide experiences
Vehicle Maintenance	According to the level/type of maintenance Keolis Canada or NAVYA. Keolis aims at acquiring more technical maintenance skills on AV vehicles.
Communication / PR	
Public Consultation for site selection?	No. Proximity to the Palais des Congrès and technical feasibility of the route, according to the technology's specificities.
Public Notification at project Start?	Yes
Who performed notification?	Keolis Canada
Communication objective	Keolis Canada met the local business owners directly impacted by the demonstration to inform them about the closure of the roads, as well as to find with them solutions according to their delivery needs and access to parking spots. This discussion was led by Keolis Canada and supported by the City of Montreal, to have to most minimal impact on local businesses and residents of the area.
Public Reaction	Really enthusiastic delegates as well as the general public, also invited to test the technology.

Location / Item	Montreal Land of the Olympic Park, between PIE IX and Viau Metro stations
Project Scope	
Operational date	06/06/2017 - 06/09/2017
Stakeholders	Transdev, EasyMile and the Olympic Park
Objective / Goal	The Olympic Park was looking for a first mile/last mile solution to connect the PIE-IX and Viau Metro stations with various attractions/buildings on the site of the Olympic Stadium. The project had to be ecofriendly and the vehicles had to be safe, accessible to all and interact with pedestrians.
Road Conditions	Mix - Private
Site Location	The Olympic Stadium is in the periphery of downtown with various cultural, sport and entertainment venues on site
AV Operating Mode	Corridor with 3 stops programmed
Site Technical Specification	As an operator of public transport services, Transdev provided recommendations based on its knowledge of the site and best practices. The Olympic Park was also involved and provided information regarding transport demand on-site (tourists and visitors) and safety (intersections, interactions with pedestrians and cyclists).
Operating Restrictions	The service operated Tuesday to Friday, from 10:00 am to 4:00 pm.
Project Partners - Role	Transdev: Operator, communication support, project leader Easymile: vehicle provider, constructor Olympic Park: location provider, communication team,
Municipality's Role	None
Project Lead Contact	Cedric Essiminy from the Olympic Park
Project Funding	The project was jointly funded by Transdev and the Olympic Stadium. OP provided in-kind: The Olympic Park provided the garage and the necessary equipment to charge the vehicles overnight. Transdev provided resources at no cost during the project, for maintenance related activities and project management.
Municipality's Funding	None
Anticipated benefits	Transdev wanted to present the autonomous mobility solution and make it accessible to everyone. This project allowed local Transdev teams in Québec to learn the different skills necessary to operate and maintain this new kind of vehicle.
Connected technology tested	None
Alternative Locations - shortlisted	None
Project Set up guidelines	As per site assessment
Project's Safety Plan	None
Insurance Structure & Liability	Operations were covered by Transdev's private liability insurance
Vehicle	

Technological Scope	Electric Autonomous Vehicle
Vehicle Type	EZ10
Vehicle Manufacturer	EasyMile - Ligier
Vehicle Operator	Transdev
Operator Training	Transdev trained the operators based on guidelines provided by the manufacturer
Vehicle Maintenance	Operator (Transdev)
Communication / PR	
Public Consultation for site selection?	None
Public Notification at project Start?	Yes
Who performed notification?	Collaboration between the Operator (Transdev) and the Olympic Park
Communication objective	General information on the project, the location and invitation to ride
Public Reaction	At first, people were a bit nervous to get in. Quickly they were getting comfortable and very curious about the technology, asking a lot of questions about the vehicle and how it works.

Location / Item	Montreal On the Grounds of the Olympic Park, between PIE IX and Viau Metro stations with stops at Desjardins and the planetarium
Project Scope	
Operational date	09/10/2018 – 12/07/2018 (Fall 2018)
Stakeholders	Transdev, EasyMile and the Olympic Park
Objective / Goal	The Olympic Park was looking for a first mile/last mile solution to connect the PIE-IX and Viau Metro stations with various attractions/buildings on the site of the Olympic Stadium. The project had to be ecofriendly and the vehicles had to be safe, accessible to all and interact with pedestrians. One the main objectives of the project was to provide the employees of Desjardins, who recently moved in the Montreal Tower, with an innovative transport solution to connect their office to the metro.
Road Conditions	Mix- Private
Site Location	The Olympic Stadium is in the periphery of downtown with various cultural, sport and entertainment venues on site
AV Operating Mode	Corridor with 4 stops programmed 
Site Technical Specification	As an operator of public transport services, Transdev provided recommendations based on its knowledge of the site and best practices. The Olympic Park was also involved and provided information regarding transport demand on-site (Employees of Desjardins, tourists and visitors) and safety (intersections, interactions with pedestrians and cyclists).
Operating Restrictions	The service operated Monday through Friday, from 6:00 am to 10:00 am in the morning and 3:00 pm to 6:00 pm in the evening for the duration of the pilot project. The service was operated with only one shuttle for a time following various technical difficulties necessitating replacement parts.
Project Partners - Role	Transdev: Operator, communication support, project leader Easymile: vehicle provider, constructor Olympic Park: location provider, communication team,
Municipality's Role	The city didn't have an active role in the project but was involved regarding the phase 2 of the project which should take place in 2019
Project Lead Contact	Cedric Essiminy from the Olympic Park

Project Funding	The project was jointly funded by Transdev and the Olympic Stadium. OP provided in-kind: The Olympic Park provided the garage and the necessary equipment to charge the vehicles overnight. Transdev provided resources at no cost during the project, for maintenance related activities and project management.
Municipality's Funding	None
Anticipated benefits	Experimenting is a necessary step before moving on to permanent solutions. This project allowed local Transdev teams in Québec to learn the different skills necessary to operate and maintain this new kind of vehicle. The project also allowed to test the vehicle in specific weather conditions in Quebec and test the acceptability of autonomous vehicles by the population.
Connected technology tested	No connected technology, but there were 2 vehicles on the road
Alternative Locations - shortlisted	None
Project Set up guidelines	As per site assessment review plus best practices learned from the 2017 project
Project's Safety Plan	The fire station responsible for the neighborhood was involved in the project
Insurance Structure & Liability	Operations were covered by Transdev's private liability insurance
Vehicle	
Technological Scope	Electric Autonomous Vehicle
Vehicle Type	EZ10
Vehicle Manufacturer	EasyMile - Ligier
Vehicle Operator	Transdev
Operator Training	Transdev trained the operators based on guidelines provided by the manufacturer
Vehicle Maintenance	Operator (Transdev)
Communication / PR	
Public Consultation for site selection?	None
Public Notification at project Start?	Yes
Who performed notification?	Collaboration between the Operator (Transdev) and the Olympic Park
Communication objective	General information on the project, the location and invitation to ride

Public Reaction	The reaction was overwhelmingly good. Passengers were excited about boarding an autonomous shuttle. Employees of Desjardins enjoyed the service, especially in the fall when the weather deteriorated. People felt very safe around the vehicles, and the low operating speed allowed for smooth interactions between the shuttles and pedestrians and cyclists alike.

Location / Item	**Montreal** **UITP World Congress in Montreal** **Although generally known as UITP, the initials stand for Union Internationale des Transports Publics, or in English, the International Association of Public Transport**
Project Scope	
Operational date	05/15/2017 – 05/17/2017
Stakeholders	Keolis Canada, the City of Montreal, UITP
Objective / Goal	Technology testing and demonstration to delegates and the general public
Road Conditions	Public road closed to the traffic
Site Location	Downtown Montreal
AV Operating Mode	Loop around the park in front of the Palais des Congrès
Site Technical Specification	Urban road in a dense neighbourhood. The location needed to be found near the Palais des Congrès of Montreal and was determined in coordination with the City of Montreal, Keolis and NAVYA.
Operating Restrictions	3 days rotation with EasyMile/Transdev who were sharing the same path. Requested to be open to the public by the City of Montreal.
Project Partners - Role	• Keolis Canada: plans, finances and operates the demonstration. • City of Montreal: plans and supports the application of Keolis Canada to obtain authorization to use the city's roads for an AV demonstration. • Palais des Congrès: allows the demonstration at the proximity of its exhibitors. Rents a parking space to store and charge the shuttle to Keolis Canada. • UITP: coordinates all demonstrations during the congress.
Municipality's Role	• City of Montreal: plans and supports the application of Keolis Canada to obtain authorization to use the city's roads and to close it to traffic for an AV demonstration.
Project Lead Contact	Keolis, Marie-Hélène Cloutier, Vice-présidente expérience passager, marketing et commercialisation
Project Funding	Keolis Canada supported the whole costs of the demonstration
Municipality's Funding	No money, the City of Montreal supported Keolis Canada with authorization to use the public space and roads
Anticipated benefits	Demonstration of a new technology.
Connected technology tested	None
Alternative Locations - shortlisted	Other locations in downtown Montreal near the Palais des Congrès

Project Set up guidelines	Keolis Group's and NAVYA's operational guidelines for AV projects
Project's Safety Plan	Standard Keolis Canada's operating process to guarantee passengers' and other users' safety in all circumstances
Insurance Structure & Liability	Keolis Canada operated an AV vehicle owned by the Keolis Group and provided insurance
Vehicle	
Technological Scope	Electric Autonomous Vehicle
Vehicle Type	NAVYA
Vehicle Manufacturer	NAVYA
Vehicle Operator	Keolis Canada
Operator Training	Keolis Canada based on guideline provided by the constructor and previous AV worldwide experiences
Vehicle Maintenance	According to the level/type of maintenance Keolis Canada or NAVYA. Keolis aims at acquiring more technical maintenance skills on AV vehicles.
Communication / PR	
Public Consultation for site selection?	No. Proximity to the Palais des Congrès and technical feasibility of the route, according to the technology's specificities.
Public Notification at project Start?	Yes
Who performed notification?	Keolis Canada
Communication objective	Demonstrate new technology to delegate, the city and the general public
Public Reaction	Really enthusiastic delegates as well as the general public, also invited to test the technology

Location / Item	Montreal UITP Montreal
Project Scope	
Operational date	05/15/2017 – 05/17/2017
Stakeholders	Transdev Canada, Transdev head office, the City of Montreal, UITP
Objective / Goal	Technology testing and demonstration to delegates and the general public
Road Conditions	A lane of a public road closed to traffic.
Site Location	Downtown Montreal
AV Operating Mode	Loop around the park in front of the Palais des Congrès
Site Technical Specification	Urban road in a dense neighbourhood. The location needed to be found near the Palais des Congrès of Montreal and was determined in coordination with the City of Montreal and Transdev.
Operating Restrictions	3 days rotation with Navya/Keolis who were sharing the same route. Requested to be open to the public by the City of Montreal.
Project Partners - Role	• Transdev: plans, finances and operates the demonstration. • City of Montreal: plans and supports the application of Transdev to obtain authorization to use the city's roads for an AV demonstration. • Palais des Congrès: allows the demonstration at the proximity of its exhibitors. Rents a parking space to store and charge the shuttle to Transdev. • UITP: coordinates all demonstrations during the congress.
Municipality's Role	• City of Montreal plans and supports the application of Transdev to obtain authorization to use the city's roads and to close it to traffic for an AV demonstration.
Project Lead Contact	Transdev Canada
Project Funding	Transdev supported the whole costs of the demonstration
Municipality's Funding	No funding from the City of Montreal; it supported Transdev with authorization to use the public space and roads.
Anticipated benefits	Demonstration of a new technology
Connected technology tested	None
Alternative Locations - shortlisted	Other locations in downtown Montreal near the Palais des Congrès
Project Set up guidelines	As per site assessment review plus best practices learned from the 2017 project and operational guidelines for AV projects
Project's Safety Plan	Transdev process, keeping safety as the first element

Insurance Structure & Liability	Operations were covered by Transdev's private liability insurance
Vehicle	
Technological Scope	Electric Autonomous Vehicle
Vehicle Type	EasyMile
Vehicle Manufacturer	EZ10
Vehicle Operator	Transdev North America
Operator Training	Transdev trained the operators based on guidelines provided by the manufacturer
Vehicle Maintenance	Operator (Transdev)
Communication / PR	
Public Consultation for site selection?	No. Proximity to the Palais des Congrès and technical feasibility of the route, according to the technology's specifications.
Public Notification at project Start?	Yes
Who performed notification?	Transdev
Communication objective	Demonstrate new technology to delegates, the city and the general public
Public Reaction	Really enthusiastic delegates as well as the general public, also invited to test the technology

Location / Item	Windsor, Ontario Continental and Magna Cross-Border demonstration
Project Scope	
Operational date	07/31/2017
Stakeholders	MTO, State of Michigan, Magna and Continental
Objective / Goal	The main objective was to fill the gap between the need of the industry and see the impact on the road safety
Road Conditions	Mix Traffic and public road
Site Location	Between Michigan and Ontario
AV Operating Mode	Loop on open road
Site Technical Specification	The MTO allowed the team to test those AV vehicles on the public road as a part of the MTO testing policy and the Michigan state allowed the vehicle for the US side
Operating Restrictions	No details available at this time
Project Partners - Role	Continental and Magna were the main team on the project. MTO and Michigan state supported the project by allowing the team to test on their roads
Municipality's Role	No details available
Project Lead Contact	Erik Thomsen, Team Leader, Special Projects, Road Safety Policy Office, Ministry of Transportation Ontario
Project Funding	Even if the ministry reported that Ontario is investing $80 million over five years for the Autonomous Vehicle Innovation Network to “help maximize the economic potential of automated and connected vehicle technologies, for that project the funding came from Continental and Magna, the project team according to MTO.
Municipality's Funding	The funding came from Continental and Magna, the project team according to MTO
Anticipated benefits	MTO recognized the benefit of AV and CV technology, addressed the amount of the collision on the road and the impact it can have, benefit for marginalize population, environmental technology, wants to support the technology, showcase Ontario leadership for AV demonstration to do business, investment and insuring that we are not impacting our citizen safety on the road.
Connected technology tested	No details available
Alternative Locations - shortlisted	No details available
Project Set up guidelines	The set up and the guideline of the project were done by the Continental and Magna team and approved by both government (Michigan and Ontario)

Project's Safety Plan	No details available
Insurance Structure & Liability	No details available
Vehicle	
Technological Scope	Autonomous vehicle, level 3 and 4, testing the adaptive cruise control and the assisted breaking
Vehicle Type	2015 Cadillac ATS and Continental's test drive vehicle is a Chrysler 300.
Vehicle Manufacturer	2015 Cadillac ATS and Continental's test drive vehicle is a Chrysler 300
Vehicle Operator	Continental and Magna
Operator Training	No details available
Vehicle Maintenance	No details available
Communication / PR	
Public Consultation for site selection?	No details available
Public Notification at project Start?	No details available
Who performed notification?	All Stakeholder were involved in the communications + the government of Canada with the involvement of the Federal Minister of Innovation, Science and Economic Development, Navdeep Bains
Communication objective	Supporting connected and automated vehicle development to promote economic growth and innovation is part of the plan to create jobs, grow the economy and help people in their everyday lives
Public Reaction	No details available

Location / Item	Windsor, Ontario Tardec Cross-Border demonstration
Project Scope	
Operational date	08/2017
Stakeholders	Tardec, State of Michigan and the Province of Ontario, along with automotive tech competitors Continental and Magna International
Objective / Goal	To test autonomous platooning technology
Road Conditions	Public road in mix traffic EXCEPT in the Windsor-Detroit tunnel
Site Location	Between Michigan and Ontario
AV Operating Mode	Loop on open road
Site Technical Specification	The MTO allowed the team to test those AV vehicles on the public road as a part of the MTO testing policy and the Michigan state allowed the vehicle for the US side
Operating Restrictions	No details available
Project Partners - Role	Tardec, State of Michigan and the Province of Ontario, along with automotive tech competitors Continental and Magna International
Municipality's Role	No details available
Project Lead Contact	Erik Thomsen, Team Leader, Special Projects, Road Safety Policy Office, Ministry of Transportation Ontario
Project Funding	Even if the ministry reported that Ontario is investing $80 million over five years for the Autonomous Vehicle Innovation Network to “help maximize the economic potential of automated and connected vehicle technologies, for that project the funding came from Continental and Magna, the project team according to MTO
Municipality's Funding	No details available
Anticipated benefits	MTO recognized the benefit of AV and CV technology, addressed the amount of the collision on the road and the impact it can have, benefit for marginalize population, environmental technology, wants to support the technology, showcase Ontario leadership for AV demonstration to do business, investment and insuring that we are not impacting our citizen safety on the road.
Connected technology tested	Platooning was tested, but no details other than that are available as this include military vehicle and intelligence
Alternative Locations - shortlisted	No details available
Project Set up guidelines	The set up and the guideline of the project were done by the Continental and Magna team and approved by both government (Michigan and Ontario)

Project's Safety Plan	No details available
Insurance Structure & Liability	No details available
Vehicle	
Technological Scope	U.S. Army Tank Automotive Research, Development and Engineering Center (TARDEC) wanted to test the platooning for their vehicles.[16]
Vehicle Type	
Vehicle Manufacturer	
Vehicle Operator	
Operator Training	Military operator
Vehicle Maintenance	No details available
Communication / PR	
Public Consultation for site selection?	No details available
Public Notification at project Start?	No details available
Who performed notification?	No details available
Communication objective	No details available
Public Reaction	No details available

[16] https://tardec.army.mil/

Location / Item	Ottawa, Ontario Parliament Hill
Project Scope	
Operational date	09/20/2017
Stakeholders	Transdev, EasyMile, Parliament Hill Authorities, CUTA
Objective / Goal	Demonstration of an autonomous shuttle to the Senate Standing committee on Transportation and the Minister of Transportation, the Hon. Marc Garneau
Road Conditions	Mix - Private
Site Location	Parliament Hill
AV Operating Mode	Loop with 3 stops
Site Technical Specification	The vehicle was verified in advance by the security staff on Parliament Hill. Multiple information and data documents had to be shared prior to the demonstration
Operating Restrictions	2 hours accessible only to Parliamentary Senators and Ministers
Project Partners - Role	Transdev: Operator, communication support, project leader CUTA: communication Standing Senators committee: communication, security, support to the project, coordination on the parliament deferent partners
Municipality's Role	None
Project Lead Contact	Transdev North America, Neal Hemenover, CIO
Project Funding	Transdev covered the entire cost of the project
Municipality's Funding	None
Anticipated benefits	Demonstrate that AV are not just only for vehicle but can also be use as a part of public transit, for a first mile last mile solution
Connected technology tested	None
Alternative Locations - shortlisted	None
Project Set up guidelines	As per site assessment
Project's Safety Plan	Heavy implication from the Parliament Hill security team and the RCMP
Insurance Structure & Liability	Operations were covered by Transdev's private liability insurance
Vehicle	
Technological Scope	Electric Autonomous Vehicle

Vehicle Type	Electric Autonomous Vehicle
Vehicle Manufacturer	EasyMile - Ligier
Vehicle Operator	EZ10
Operator Training	Transdev trained the operators based on guidelines provided by the manufacturer
Vehicle Maintenance	Operator (Transdev)
Communication / PR	
Public Consultation for site selection?	None
Public Notification at project Start?	Media were invited to be present for the demonstration
Who performed notification?	Communications were coordinated by the Senators communication team, the Parliament Hill communication team, Transdev's team and CUTA's team
Communication objective	Present the autonomous shuttle as a part of the AV ecosystem and demonstrate the added value by including it in a public transit service
Public Reaction	Very good and media coverage was excellent.

Location / Item	Wetaskiwin Reynolds Alberta Museum
Project Scope	
Operational date	12/05/2018 - 12/10/2018
Stakeholders	PWT Alberta-Reynolds Museum Alberta Government
Objective / Goal	Testing - Demo
Road Conditions	Mix - Private - Indoor
Site Location	Suburb
AV Operating Mode	Corridor
Site Technical Specification	As per Site Assessment Review (SAR)
Operating Restrictions	Trial Length Operating Days Operating Hours
Project Partners - Role	PWT - Operating Partner Province of Alberta- Project Partner ATCO - Major Sponsor Telus - Major Sponsor
Municipality's Role	Approval Body
Project Lead Contact	John Stepovy
Project Funding	Private and Public funding, combination of In-Kind and financial investment
Municipality's Funding	The municipality was involved in the funding with in-kind and financial support. Details were not available.
Anticipated benefits	Awareness of the autonomous shuttle and testing of the technology for short distance transportation
Connected technology tested	None
Alternative Locations - shortlisted	None
Project Set up guidelines	As per Site Assessment Review (SAR)
Project's Safety Plan	There was a safety plan put in place by the project team and the vehicle constructor that has previous experiences in deployment
Insurance Structure & Liability	Stakeholders were responsible for the insurance and the liability of the project
Vehicle	
Technological Scope	Autonomous Vehicle
Vehicle Type	EZ10
Vehicle Manufacturer	EasyMile - Ligier

Vehicle Operator	PWT
Operator Training	The operator was trained by the manufacturer as per training program and requirement on vehicle safety
Vehicle Maintenance	PWT + EasyMile
Communication / PR	
Public Consultation for site selection?	None
Public Notification at project Start?	Yes
Who performed notification?	Museum & PWT
Communication objective	Awareness
Public Reaction	Positive

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Current Projects

Location / Item	Candiac, Quebec Montcalm Boulevard
Project Scope	
Operational date	Launched on October 4th, 2018 to 2019 – 12 months project
Stakeholders	Keolis Canada, City of Candiac, Government of Québec, NAVYA, Technopole IVÉO, Propulsion Québec
Objective / Goal	First time to test an AV vehicle on open road in Québec for public transit during a long-term experimentation. Raise awareness about this new mobility and innovative mode of transportation. The project was made possible through the financial support of the Québec Government through a 350,000$ grant for innovative projects and has been duly analyzed by the Société de l'assurance automobile du Québec (SAAQ) and the Ministry of Transport, Sustainable Mobility and Transport Electrification.
Road Conditions	Mix Traffic - Public road
Site Location	Montcalm boulevard, Candiac
AV Operating Mode	About 2 km loop on open road.[17] 

[17] https://keoliscandiac.ca/en/

Site Technical Specification	As per site assessment, the path includes road crossing, left turn at a stop and rail crossing. Open road – must be wide enough to enable a shuttle to run and let other road users to overtake it. The location must be safe for other road users and pedestrians: the shuttle is operated at 25/h on average, this must be considered when choosing a location. The Montcalm Boulevard has a speed limit of 50 km/h and does not have an extremely dense traffic. Therefore, the shuttle does not constitute a major obstacle for other users. There must be a dense enough location in the city so the shuttle can easily locate itself. Since the autonomous shuttle has an objective of micro transit to serve the first and last mile of a trip, the location must be connected to other public transit modes.
Operating Restrictions	12-month pilot project. The autonomous electric shuttle cannot be operated during wintertime due to technical limitations (autonomous technology and electric battery).
Project Partners - Role	City of Candiac: main project partner for managing the urban planning and the design of the route, the equipment of infrastructures for the project and mobilizing the citizens around it. Keolis Canada: main project partner for managing the AV project, lobbying the government of Québec to allow such demonstration, obtaining authorization for the project, acquiring and providing a shuttle and operators and operating and maintaining the vehicle during the whole duration of the project, in collaboration with NAVYA. NAVYA: Keolis' partner. AV manufacturer and service provider for supervision, maintenance and advice regarding the technical implementation of the project. Propulsion Québec: Québec cluster to develop electric and smart transportation. Lobbied for enabling AV projects in Québec. Technopole IVÉO: supported the City of Candiac in implementing this first AV project on open road. Fostered partnerships with Québec player to develop the innovation around the project. CAA-Quebec Foundation: Keolis Canada's partner to implement research around road safety and social acceptance
Municipality's Role	Main project partner for managing the urban planning and the design of the route, the equipment of infrastructures for the project and mobilizing the citizens around it.
Project Lead Contact	Keolis, Marie-Hélène Cloutier, Vice-présidente expérience passager, marketing et commercialisation

Project Funding	Keolis Canada is the main project partner for managing the AV project, lobbying the government of Québec to allow such demonstration, obtaining authorization for the project, acquiring and providing a shuttle and operators and operating and maintaining the vehicle during the whole duration of the project, in collaboration with NAVYA. Keolis Canada absorbs most project costs and has received funding of 350,000$ from the Ministry of Economy, Science and Innovation of Québec.
Municipality's Funding	About 25,000$ in equipment costs (approximative information from the city). Resources donation from the City of Candiac as well as Propulsion Québec and Technopole IVEO
Anticipated benefits	Introduction of an innovative and sustainable new mode of transportation for the citizens in connection with the exo bus terminal and park & ride, the city hall, a retirement home and the city's main public park.
Connected technology tested	Connected smart traffic lights at the intersection of Montcalm North and Marie-Victorin Boulevards, with a Quebec company, Orange Traffic, partnering with the City of Candiac.
Alternative Locations - shortlisted	Keolis Canada was looking at implementing a similar project in the old city center of Terrebonne (QC).
Project Set up guidelines	Keolis Group's and NAVYA's operational guidelines for AV projects. Keolis Group's experience as an AV operator was used to guide the government in the writing of the bill n°165, An Act to amend the Highway Safety Code, enabling AV pilot projects by Minister's decree.
Project's Safety Plan	Standard Keolis Canada's operating process to guarantee passengers' and other users' safety in all circumstances.
Insurance Structure & Liability	Keolis Canada owns the autonomous shuttle in demonstration in Candiac. It has been able to provide material insurance for the vehicle. However, no insurance for bodily injury and civil liability is available on the Quebec market for AV project. Keolis Canada supports the whole financial risk in case of an accident. Please the memo that was sent to the government of Québec on the issue regarding insurance for AV projects. The Minister's decree 2018-16 allowing Keolis Canada to conduct the pilot project in Candiac defines insurance needs. Keolis Canada's insurance company for the shuttle. The City of Candiac's insurance company for the garage where the shuttle is stored and loaded.
Vehicle	
Technological Scope	Autonomous Shuttle, equipped with V2I technology to enable the shuttle to autonomously cross a crossroad with smart traffic lights.
Vehicle Type	NAVYA
Vehicle Manufacturer	NAVYA

Vehicle Operator	Keolis Canada
Operator Training	Keolis Canada based on guideline provided by the constructor and previous AV worldwide experiences
Vehicle Maintenance	According to the level/type of maintenance Keolis Canada or NAVYA. Keolis aims at acquiring more technical maintenance skills on AV vehicles.
Communication / PR	
Public Consultation for site selection?	No. The City of Candiac suggested the location according to Keolis Canada's and NAVYA's technical requirements. SAAQ and MTQ were involve in the location choice.
Public Notification at project Start?	Yes with 2 press conferences: to announce the project with the government (August 10th, 2018) and for the operational launch (October 4th, 2018).
Who performed notification?	Keolis Canada and the City of Candiac
Communication objective	• Announce the project with the government (August 10th, 2018) • Operational launch (October 4th, 2018): invite the press and the public to ride the shuttle.
Public Reaction	Excellent press coverage (almost 600 quotations on social media, online TV, radio and written press) and enthusiasm from the public and citizens of Candiac

Location / Item	**MTO - Ontario's Automated Vehicle Trial** **Various locations across Ontario, including Toronto, Ottawa, and Waterloo**
Project Scope	
Operational date	January 1, 2016 – December 31, 2026
Stakeholders	As of March 25, 2019, there are currently ten participants in the pilot: the University of Waterloo, QNX, Erwin-Hymer Group, Magna, Continental, X-Matik Inc., Uber, Aptiv, Logics Academy, and the University of Toronto.
Objective / Goal	In January 2016, Ontario became the first Canadian jurisdiction to permit automated vehicle testing on provincial roads. This pilot allows Ontario to establish rules, monitor industry developments, and evaluate the operation on Ontario's roads of automated vehicles (AVs) included in the pilot. Ontario has the opportunity to harness industry's momentum and continue leading Connected and Automated Vehicle development and deployment. The pilot is authorized under Section 228 of the Highway Traffic Act. The pilot includes passenger and commercial vehicles and streetcars. Motorized bicycles and motorcycles are not allowed.
Road Conditions	AV Trial participants are able to test their vehicle(s) on any public road in Ontario. For driverless testing there are additional conditions, including notifying local authorities of testing plans and for testing on a provincial highway, prior approval from the Ministry of Transportation Ontario (MTO) is needed. For the Cooperative Truck Platooning Trial, the ministry has chosen limited sections of its 400-series highway network to permit cooperative platoon testing (the network map can be found here). These sections were selected based on a review of existing infrastructure, while considering operational impacts. These sections are not prone to congestion; do not have complicated operations in terms of weaving or interchange spacing; entrance and exit ramps are to standard which will provide the best conditions for merging; and the presence of paved shoulders generally makes them more forgiving. As pilot operations progress, based on many considerations including road safety, the ministry will consider opening up more sections of the highway network for testing.

Site Location	AV testing can occur on any road in the province. In Stratford, there is a demonstration zone in the city's core as well as a private test track elsewhere in the city. In Ottawa, there is a designated test route on public roads in the Kanata region as well as a separate private test track. For more information on the Stratford Demonstration Zone or Regional Technology Development Sites that are part of the Autonomous Vehicle Innovation Network (AVIN) initiative, you may contact Raed Kadri at the Ontario Centres of Excellence (OCE). For more information on test facilities in Ottawa, you may contact Kelly Daize at Invest Ottawa.
AV Operating Mode	Some AV pilot participants have tested on test track loops, such as QNX in the City of Ottawa. On July 31, 2017, Magna and Continental completed North America's first cross-border automated vehicle drive between Ontario and Michigan. The route details and map have been shared previously. For more details on specific testing locations and routes, you may contact the pilot participants directly. For the Cooperative Truck Platooning Trial, the ministry has chosen limited sections of its 400-series highway network to permit cooperative platoon testing (the network map can be found here).
Site Technical Specification	For details please contact the AV Trial participants directly, or the OCE or Invest Ottawa.
Operating Restrictions	The AV Trial is a ten-year pilot authorized under Section 228 of the Highway Traffic Act. It is set to end in 2026. However, the ministry may extend the pilot for an additional one or two years if it feels that more data and/or time is required to evaluate the safety of automated vehicles included in the pilot prior to them becoming widely available to the public. The Cooperative Truck Platooning Trial is authorized under the same regulation as the AV pilot and is also set to end in 2026. There are no time-of-day restrictions for the AV or Platooning pilots. Certain conditions may prevent driverless or platoon testing in bad weather. For more information on the program requirements, please see MTO's website: Automated Vehicle Trial Program and Cooperative Truck Platooning Program Conditions

Project Partners - Role	A key partner for the AV Trial is the OCE. The OCE supports the pilot directly through its AVIN initiative, which supports small-to-medium-sized enterprises in developing, testing, demonstrating, and commercializing CV/AV technology in a variety of transportation applications. The AVIN Project includes a Central Hub function that facilitates collaboration between industry, academia and government to provide insights that will help Ontario prepare for adoption and deployment of CV/AVs. Since 2017, AVIN has successfully launched: • One of Canada's first CV/AV demonstration zones, that allows companies to test technologies on-road in Stratford, Ontario; • Six regional technology development sites across southern Ontario that enables small businesses to scale up their CV/AV technologies for commercialization, with support from regional experts; and • Two funding programs that facilitate partnerships between small-businesses, technology companies, industry, and academia to invest in research and development, and support training opportunities for new graduates. For more information on AVIN, please visit their website: https://www.avinhub.ca/ Other partners for the pilot include Invest Ottawa, industry stakeholders, road safety stakeholders, trucking associations, the federal government and municipalities. All of these partners play a role in supporting and promoting the pilot.

Municipality's Role	Municipalities' role in CV/AV testing and deployment includes the following: • Enacting and enforcing bylaws; • Managing public transportation; • Advocating for and accommodating testing; • Enforcing traffic laws and regulations; • Adapting infrastructure to support AV deployment; and • Public education on motor vehicle safety issues. In addition, for driverless testing in Ontario, pilot participants are required to notify municipalities of their testing plans in advance by contacting the city clerk's office. Municipalities can then inform trial organizations of any concerns with the proposed route such as due to events or construction projects, and can inform law enforcement personnel and first responders if deemed necessary. Municipalities can also inform trial organizations of their preferred routes for CV/AV testing, if applicable. Through the Municipal Alliance for Connected and Autonomous Vehicles in Ontario (MACAVO) project, organized by the Ontario Good Roads Association (OGRA), a preferred municipal network for CV/AV testing in Ontario has been developed and is available on OGRA's website.
Project Lead Contact	Industry stakeholders requested that MTO create a regulatory framework for on-road testing of CV/AVs. Any questions on the AV Pilot can be directed to Erik Thomsen.
Project Funding	There is some funding available for the AV trial through the AVIN initiative. Ontario is investing $80 million over five years to create the AVIN, in partnership with the OCE. Ontario's investment will support industry-led CV/AV R&D projects; create sites across the province to develop, test and validate new technology, including a Demonstration Zone in Stratford; and attract and grow talent in the CV/AV sector. There is also some funding available through the federal Program to Advance Connectivity and Automation in the Transportation System (ACATS). The Toronto Transit Commission (TTC) in partnership with Metrolinx is one of the recipients of funding for this program for a proposed driverless shuttle project. The organizations involved are not yet participants in Ontario's AV Pilot.
Municipality's Funding	
Anticipated benefits	The AV Pilot allows Ontario to establish rules, monitor industry developments, and evaluate the operation on Ontario's roads of AVs included in the trial. Ontario has the opportunity to harness industry's momentum and continue leading CV/AV development and deployment.

Connected technology tested	No, not that we are aware of. The Stratford Demonstration Zone has city-wide Wi-Fi. The Ottawa public AV test track is equipped with nine traffic lights with dedicated short-range communication (DSRC) and has crosswalk and communications technology including: communications technology including: DSRC, and GPS 4G communications technology including: DSRC, and GPS and 4G-LTE and 5G technologies for V2I, V2V, V2P and V2N.
Alternative Locations - shortlisted	
Project Set up guidelines	Ontario's AV Pilot was initiated under O. Reg. 306/15: Pilot Project – Automated Vehicles. The pilot is authorized under Section 228 of the Highway Traffic Act. The pilot includes passenger and commercial vehicles and streetcars. Motorized bicycles and motorcycles are not allowed. The province recognizes the importance of new vehicle technology, especially if it expands mobility options for Ontarians – but safety is our top priority. With the introduction of driverless and platoon testing, the ministry has taken a number of steps in ensuring the testing only be conducted in safe and controlled environments. For example, for driverless testing, some conditions include: having either a passenger on-board or a remote operator monitoring the vehicle's operations; submitting a law enforcement interaction plan to the ministry; vehicle signage; and, alerting local authorities of testing. For platoon testing, some conditions include: having a driver present in each vehicle with minimum experience and technology training requirements; trucking carriers involved must maintain a minimum carrier safety rating; a minimum safe gap must be kept between vehicles; and, vehicle signage.
Project's Safety Plan	
Insurance Structure & Liability	Pilot participants are required to hold $5 million in liability insurance in order to test vehicles that have a seating capacity of up to 7 passengers, or $8 million in liability insurance to test vehicles with a seating capacity of 8 or more passengers. For driverless testing, pilot participants will accept liability where there is an at-fault collision caused by their vehicle's technology.
Vehicle	
Technological Scope	Ontario's pilot framework includes both automated vehicles and cooperative truck platooning. Driverless testing and cooperative truck platooning are permitted under stringent conditions.

Vehicle Type	Currently passenger vehicles are being tested under the AV Pilot. See the above list of AV Pilot participants – those entities are directly responsible for the AV technology. Driverless vehicles and truck platoons are not yet being tested in Ontario, although the province has received much interest in testing these vehicles.
Vehicle Manufacturer	
Vehicle Operator	Currently, all entities that are directly responsible for the AV technology are also operating these vehicles under the AV Pilot. Partnerships are permitted under the AV pilot. For example, if a transit company sought to test a driverless shuttle, they could partner with the manufacturer to operate the vehicle. AV Pilot participants determine the training requirements for their operators. For the Platooning Pilot, the technology provider and Original Equipment Manufacturer (OEM) must provide appropriate practical training to the carrier and its drivers. Drivers must have a minimum of 5 years provable tractor semitrailer or truck driving experience to operate a tractor semitrailer or truck within the pilot.
Operator Training	
Vehicle Maintenance	Pilot participants are responsible for the maintenance of their vehicles.
Communication / PR	
Public Consultation for site selection?	Consultations were held with key stakeholders prior to the initiation of the AV Pilot and prior to the recent enhancements to allow driverless and cooperative truck platoon testing. The proposals were also posted to the regulatory registry. Public consultations were not held. As mentioned earlier, MACAVO/OGRA has developed a preferred road network for CV/AV testing in municipalities. Please contact Fahad Shuja for more information
Public Notification at project Start?	
Who performed notification?	MTO issued a news released upon launching the AV pilot and upon making enhancements to allow driverless and cooperative truck platoon testing. MTO also issued a news release on the day of the Ontario-Michigan cross-border drive on July 31, 2017. On October 12, 2017, the City of Ottawa issued a news release on the demo by QNX to showcase their vehicle's ability to communicate with infrastructure. The objective of the communication has been to inform the public of the testing taking place and to promote Ontario as facilitating innovation in the CV/AV sector.

Communication objective	
Public Reaction	There was not much public reaction until the fatal Uber and Tesla collisions in 2018. Since then, the public has been more reluctant about CV/AV testing in the province.

Location / Item	Ottawa, Ontario
Project Scope	
Operational date	11/2016 to present
Stakeholders	Blackberry, QNX
Objective / Goal	Awareness of Canadian CV/AV technology and innovation and this included using multiple BlackBerry QNX sensor-equipped vehicles along with technology from BlackBerry QNX and numerous Canadian and international partners. This also involved technology from the city of Ottawa (traffic light connectivity in 2017).
Road Conditions	The testing and demonstrations occur on public roads and on a private test track in Ottawa that we have been helping Invest Ottawa setup. The demonstrations serve to attract more technology providers, interest and investment in Canada.
Site Location	Tests were done in the suburbs (Kanata) and on private test track (Invest Ottawa test track in Ottawa). Our testing occurs multiple times per week on a regular basis.
AV Operating Mode	See https://www.investottawa.ca/ottawal5/ for more information on L5.
Site Technical Specification	All efforts and technical requirements were driven by BlackBerry QNX. They worked closely with the city of Ottawa for the Ottawa test requirements (2017-present)
Operating Restrictions	No, none. Test were done in all conditions to maximize the benefit of the efforts.

Project Partners - Role	Collaboration with many partners over the last 2-3 years. These include but are not limited to the following: Canadian Federal Government • Transport Canada • Parliamentary Subcommittees • Canadian Senate • National Research Canada • Global Affairs Canada • Foreign Affairs, Trade and Development Canada • ISED Canada • Various Senators Provincial Governments • Government of Ontario\ • MTO • MEDG • OCE Municipal Governments • City of Ottawa • City of London • City of Windsor • City of Stratford Educational Institutions • University of Ottawa • Carleton University • Waterloo Universit • University of Toront • Université de Sherbrooke Other: • Conference Board of Canada • Invest Ottawa • L-Spark • Waterloo EDC • Unmanned Systems Canada • Canadian Urban Transit Research (CUTRIC) • Alberta Center for Advanced MNT Products (ACAMP) • Ottawa Employment Hub • Mitacs Canada • Freight Management Association of Canada • Automotive Industries Association of Canada • Automotive Parts Manufacturing Association (APMA)

	• Dozens of Small-Medium Enterprises (WorldReach, Crank Software, Lixar, Neutron Controls, Martello, Soltare, Acerta, Bluink, Kybersecurity, EVE and many others)
Municipality's Role	The City of Ottawa has setup traffic infrastructure to communicate with the CV/AVs and has also setup a state-of-the-art test track.
Project Lead Contact	Grant Courville, VP Product Management and Strategy at Blackberry QNX
Project Funding	All efforts have been self-funded and self-initiated
Municipality's Funding	The CV/AV vehicles, sensors and software were defined and self-funded by BlackBerry QNX. The city is funding the private test track and the public test track infrastructure (i.e. DSRC).
Anticipated benefits	This is how QNX learned and improved their technology and help others learn about innovation in this area. This is also how they have been working to “put Canada on the CV/AV world map” since 2016”.
Connected technology tested	They have made use of DSRC as well as 4G LTE, Wi-Fi, Lidar, Radar, GPS and other technologies.
Alternative Locations - shortlisted	None
Project Set up guidelines	As part of Ontario AV Pilot Program, they followed the program insurance guidelines and have self-insured.
Project's Safety Plan	They are an ISO 9001 certified company and take safety and security very seriously. Their automotive safety software is also certified to the ISO 26226 Functional Safety standard.
Insurance Structure & Liability	Self-insured
Vehicle	
Technological Scope	Connected vehicle Autonomous Vehicle Sensor equipped vehicles
Vehicle Type	Purchased of 2 vehicles and then retrofitted these for our needs: Lincoln MKZ Jeep
Vehicle Manufacturer	Lincoln, Jeep retrofitted
Vehicle Operator	BlackBerry QNX is the operator
Operator Training	Self trained
Vehicle Maintenance	BlackBerry QNX
Communication / PR	
Public Consultation for site selection?	No. The Ontario government’s AV Pilot Program determined the guidelines and governance for AV testing on Ontario roads.

Public Notification at project Start?	They operate and test their CV/AV constantly on multiple roadways in all road conditions. They also performed MANY public awareness events to ensure the public understands the extensive focus on safety and the benefits that will be realized when CV/AVs become more commonplace.
Who performed notification?	Blackberry and Stakeholders
Communication objective	The demonstrations serve to attract more technology providers, interest and investment in Canada
Public Reaction	Very positive. Their publicized V2X on-road test in October 2017 attracted over 4000 people who lined the streets of Ottawa to see the vehicle operate. They are continually performing public outreach independently and with governments to keep the public informed. They continue to communicate using all forms of media – television, radio, online and print media, blogs, press announcements, launch events including one featuring PM Justin Trudeau in December 2016.

Location / Item	Stratford, Ontario
Project Scope	
Operational date	11/2016 to present
Stakeholders	Blackberry, QNX
Objective / Goal	Awareness of Canadian CV/AV technology and innovation and this included using multiple BlackBerry QNX sensor-equipped vehicles along with technology from BlackBerry QNX and numerous Canadian and international partners.
Road Conditions	The testing and demonstrations occur on public roads. The demonstrations serve to attract more technology providers, interest and investment in Canada.
Site Location	City of Stratford in late 2016. Our testing occurs multiple times per week on a regular basis.
AV Operating Mode	
Site Technical Specification	All efforts and technical requirements were driven by BlackBerry QNX, in collaboration with the city of Stratford (2016) for the track requirements
Operating Restrictions	No, none. Tests were done in all conditions to maximize the benefit of the efforts.

Project Partners - Role	Collaboration with many partners over the last 2-3 years. These include but are not limited to: Canadian Federal Government • Transport Canada • Parliamentary Subcommittees • Canadian Senate • National Research Canada • Global Affairs Canada • Foreign Affairs, Trade and Development Canada • ISED Canada • Various Senators Provincial Governments • Government of Ontario\ • MTO • MEDG • OCE Municipal Governments • City of Ottawa • City of London • City of Windsor • City of Stratford Educational Institutions • University of Ottawa • Carleton University • University of Waterloo • University of Toronto • Université de Sherbrooke Other: • Conference Board of Canada • Invest Ottawa • L-Spark • Waterloo EDC • Unmanned Systems Canada • Canadian Urban Transit Research (CUTRIC) • Alberta Center for Advanced MNT Products (ACAMP) • Ottawa Employment Hub • Mitacs Canada • Freight Management Association of Canada • Automotive Industries Association of Canada • Automotive Parts Manufacturing Association (APMA)

	• Dozens of Small-Medium Enterprises (WorldReach, Crank Software, Lixar, Neutron Controls, Martello, Soltare, Acerta, Bluink, Kybersecurity, EVE and many others)
Municipality's Role	City of Stratford participated in the set up of the project
Project Lead Contact	Grant Courville, VP Product Management and Strategy at Blackberry QNX
Project Funding	All efforts have been self-funded and self-initiated
Municipality's Funding	The CV/AV vehicles, sensors and software were defined and self-funded by BlackBerry QNX. The city is funding the public test track infrastructure (i.e. DSRC)
Anticipated benefits	This is how QNX learned and improved their technology and help others learn about innovation in this area. This is also how they have been working to “put Canada on the CV/AV world map” since 2016”
Connected technology tested	They have made use of DSRC as well as 4G LTE, Wi-Fi, Lidar, Radar, GPS and other technologies
Alternative Locations - shortlisted	None
Project Set up guidelines	As part of Ontario AV Pilot Program, they followed the program insurance guidelines and have self-insured
Project's Safety Plan	They are an ISO 9001 certified company and take safety and security very seriously. Their automotive safety software is also certified to the ISO 26226 Functional Safety standard
Insurance Structure & Liability	Self-insured
Vehicle	
Technological Scope	Connected vehicle Autonomous Vehicle Sensor equipped vehicles
Vehicle Type	Purchased of 2 vehicles and then retrofitted these for our needs: Lincoln MKZ Jeep
Vehicle Manufacturer	Lincoln, Jeep retrofitted
Vehicle Operator	BlackBerry QNX is the operator
Operator Training	Self-trained
Vehicle Maintenance	BlackBerry QNX
Communication / PR	
Public Consultation for site selection?	No. The Ontario government’s AV Pilot Program determined the guidelines and governance for AV testing on Ontario roads

Public Notification at project Start?	They operate and test their CV/AV constantly on multiple roadways in all road conditions. They also performed MANY public awareness events to ensure the public understands the extensive focus on safety and the benefits that will be realized when CV/AVs become more commonplace.
Who performed notification?	Blackberry and Stakeholders
Communication objective	The demonstrations serve to attract more technology providers, interest and investment in Canada
Public Reaction	Very positive. They are continually performing public outreach independently and with governments to keep the public informed. They continue to communicate using all forms of media – television, radio, online and print media, blogs, press announcements, launch events including one featuring PM Justin Trudeau in December 2016.

Future Projects

AVIN

A number of AVIN's announced projects involve municipalities, including the Ottawa L5 test track, and the Technology Demonstration Zone, located in Stratford, Ontario,

Other AV projects will be announced in the coming months.

Location / Item	British-Columbia Vancouver/Surrey Smart city Challenge
Project Scope	
Operational date	Surrey: Dates: February 1st to 4th, 9th to 10th, and 13th to 17th Time: 10am to 4pm Vancouver: Dates: February 23rd to March 3rd Times: 12 to 6pm weekdays and 10am to 5pm weekends
Stakeholders	City of Surrey and Vancouver, Smart Together project for the Canadian Smart City Challenge, EasyMile
Objective / Goal	Surrey and Vancouver will implement Canada's first two collision-free multi-modal transportation corridors, leveraging autonomous vehicles and smart technologies to demonstrate the path to safer, healthier, and more socially connected communities while reducing emissions, improving transportation efficiency, and enhancing livability in the face of rapid growth and traffic congestion.[18]
Road Conditions	Private location – separated from traffic
Site Location	Surrey: Surrey Civic Plaza Vancouver: Olympic Village SkyTrain station (parking lot) and Manitoba and W 1st Ave (northwest corner)
AV Operating Mode	No detailed available
Site Technical Specification	As per Site Assessment Review
Operating Restrictions	Specific Dates and time: Surrey: Dates: February 1st to 4th, 9th to 10th, and 13th to 17th Time: 10am to 4pm Vancouver: Dates: February 23rd to March 3rd Times: 12 to 6pm weekdays and 10am to 5pm weekends
Project Partners - Role	No detail on the role of all partner was available
Municipality's Role	Municipalities of Surrey and Vancouver are working closely together to prepare that demonstration as the AV will be integrated in the Smart City Challenge plan that they presented to the Federal government
Project Lead Contact	Director, Access to Information at 453 West 12th Avenue, Vancouver, British Columbia V5Y 1V4, or via telephone at 604-873-7999
Project Funding	No details available at this time
Municipality's Funding	No details available at this time

[18] https://www.smartertogether.ca/

Anticipated benefits	Autonomous shuttles are one of the main components of the City of Surrey and the City of Vancouver's Smart Cities Challenge bid to create Canada's first two collision-free multimodal corridors using smart mobility technologies.[19]
Connected technology tested	Autonomous electric vehicle
Alternative Locations - shortlisted	No information available at this time
Project Set up guidelines	As per site assessment
Project's Safety Plan	No information available at this time
Insurance Structure & Liability	No information available at this time
Vehicle	
Technological Scope	Autonomous electric Shuttle
Vehicle Type	EZ10
Vehicle Manufacturer	Easymile
Vehicle Operator	No information available at this time
Operator Training	No information available at this time
Vehicle Maintenance	No information available at this time
Communication / PR	
Public Consultation for site selection?	No information available at this time
Public Notification at project Start?	Communication was done through the Smart together website
Who performed notification?	No information available at this time
Communication objective	No information available at this time
Public Reaction	No information available at this time

[19] https://www.smartertogether.ca/events/experience-ela-the-ez10-driverless-shuttle/

Location / Item	Montreal Exact location TBC
Project Scope	
Operational date	Spring/Summer 2019
Stakeholders	City of Montreal, Jalon Mtl, Transdev, Stantec, Électroméga
Objective / Goal	First deployment of an autonomous vehicle in the public street of Montreal. Location and route are not confirmed yet, but the objective is to use the AV as a first mile/last mile solution.
Road Conditions	Public road – Mix traffic (if the project gets a derogation from the Minister of Transportation of Quebec)
Site Location	In Montreal, Hochelaga neighborhood
AV Operating Mode	No details available at this time
Site Technical Specification	No details available at this time
Operating Restrictions	No details available at this time
Project Partners - Role	Transdev: Operator, City of Montreal and Jalon: project leader, Stantec: planning for the city, Electromega: Infrastructure technology
Municipality's Role	The city of Montreal is involved in the project and as funding that was allowed to help to set it up.
Project Lead Contact	Mickael Bard, Jalon Mtl
Project Funding	In Spring 2018, the Quebec government $5 million was announced to support the city of Montreal in pilot project on autonomous vehicle. Exact funding for this project is not available. [20]
Municipality's Funding	In Spring 2018, the Quebec government $5 million was announced to support the city of Montreal in pilot project on autonomous vehicle. Exact funding for this project is not available. [21]
Anticipated benefits	The city of Montreal is working on a guideline to support sustainable deployment in the future. The objective is not only to demonstrate AV, but to make sure that there is an added value for the population and that it can be integrated in the actual transport proposition.
Connected technology tested	Autonomous vehicle, V2V and V2I technologies provided by Électroméga
Alternative Locations - shortlisted	No information available at this time
Project Set up guidelines	No information available at this time

20 http://ville.montreal.qc.ca/portal/page?_pageid=5798,42657625&_dad=portal&_schema=PORTAL&id=30450

21 http://ville.montreal.qc.ca/portal/page?_pageid=5798,42657625&_dad=portal&_schema=PORTAL&id=30450

Project's Safety Plan	No information available at this time
Insurance Structure & Liability	No information available at this time
Vehicle	
Technological Scope	Autonomous Shuttle, equipped with V2I and V2V
Vehicle Type	EX10
Vehicle Manufacturer	EasyMile
Vehicle Operator	Transdev
Operator Training	Transdev trained the operators based on guidelines provided by the manufacturer
Vehicle Maintenance	Operator (Transdev)
Communication / PR	
Public Consultation for site selection?	No information available at this time
Public Notification at project Start?	No information available at this time
Who performed notification?	No information available at this time
Communication objective	No information available at this time
Public Reaction	No information available at this time

Location / Item	Province of Quebec Rural deployment
Project Scope	
Operational date	Q3-Q4 2019
Stakeholders	IVÉO, Propulsion Québec, others TBC
Objective / Goal	Add a service in a rural community where Public transport is currently not available and where the population is aging
Road Conditions	Public road – Mix traffic (if the project gets a derogation from the Minister of Transportation of Quebec)
Site Location	Rural community - TBC
AV Operating Mode	No details available at this time
Site Technical Specification	No details available at this time
Operating Restrictions	No details available at this time
Project Partners - Role	No details available at this time
Municipality's Role	The municipality as showed a lot of interest in the project and is currently working with IVEO and Propulsion Quebec to list different financing option available. The municipality is also opened to offer in-kind element such as parking for the vehicle, marking for the road, etc.
Project Lead Contact	Marie-France Laurin, IVEO
Project Funding	Currently seeking for all available financing
Municipality's Funding	Currently seeking for all available financing
Anticipated benefits	Add a service in a rural community where public transport is currently not available and where the population is aging.
Connected technology tested	Autonomous vehicle, V2V and V2I
Alternative Locations - shortlisted	No information available at this time
Project Set up guidelines	No information available at this time
Project's Safety Plan	No information available at this time
Insurance Structure & Liability	No information available at this time
Vehicle	
Technological Scope	Autonomous Shuttle, equipped with V2I and V2V
Vehicle Type	No information available at this time

Vehicle Manufacturer	No information available at this time
Vehicle Operator	No information available at this time
Operator Training	No information available at this time
Vehicle Maintenance	No information available at this time
Communication / PR	
Public Consultation for site selection?	No information available at this time
Public Notification at project Start?	No information available at this time
Who performed notification?	No information available at this time
Communication objective	No information available at this time
Public Reaction	No information available at this time

Location / Item	National Smart Vehicle Demonstration and Integration Trial, Canadian Urban Transit Research and Innovation Consortium (CUTRIC-CRITUC)
Project Scope	
Operational date	To be determined, expected on-road launch in 2020 with the timeline of the project aligned with the full lifecycle of the vehicle (~5-18 years depending on the manufacturer).
Stakeholders	The National Smart Vehicle Demonstration and Integration Trial aims to deploy standardized and interoperable low-speed electric autonomous shuttles (e-LSAs) as first-mile/last-mile transit solutions in up to 12 municipal jurisdictions across Canada
Objective / Goal	The primary project objectives are to determine and/or develop standards for: vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) connected vehicle systems; cybersecurity of e-LSAs and infrastructure; e-LSA charging systems; and fleet operating systems.[22]
Road Conditions	
Site Location	Up to 12 municipal jurisdictions in Canada
AV Operating Mode	For public or private road: "This is to be determined and will depend on regulations within each provincial jurisdiction. Deployments will take place on both public and private roads in different jurisdictions."[23] For mix traffic vs dedicated path: "The Project will focus on deployments of e-LSAs in dedicated laneways."[24]
Site Technical Specification	There will be a need for some roadside V2I infrastructure utilizing DSRC. Exact systems will be determined by the municipalities based on the requirements of each route.
Operating Restrictions	Speeds of the shuttle are to be kept under 25 km/hr. Addition restrictions are to be determined by the municipalities based on the determined route.
Project Partners - Role	2getthere, EasyMile and Navya are the e-LSAs manufacturers involved in the project. There are multiple operators and infrastructure providers currently interested in deploying their products or systems in one or more of the municipalities.
Municipality's Role	Municipalities and/or transit systems are the project leads in each jurisdiction as e-LSAs will be purchased or long-term leased by the municipality or transit system.
Project Lead Contact	CUTRIC contacts : Kristina Mlakar or Catherine Gosselin (Quebec)
Project Funding	To be confirmed. Expected co-funding from municipal, provincial, and federal government. Potential to explore a public-private partnership.
Municipality's Funding	Expected from existing transit budget.

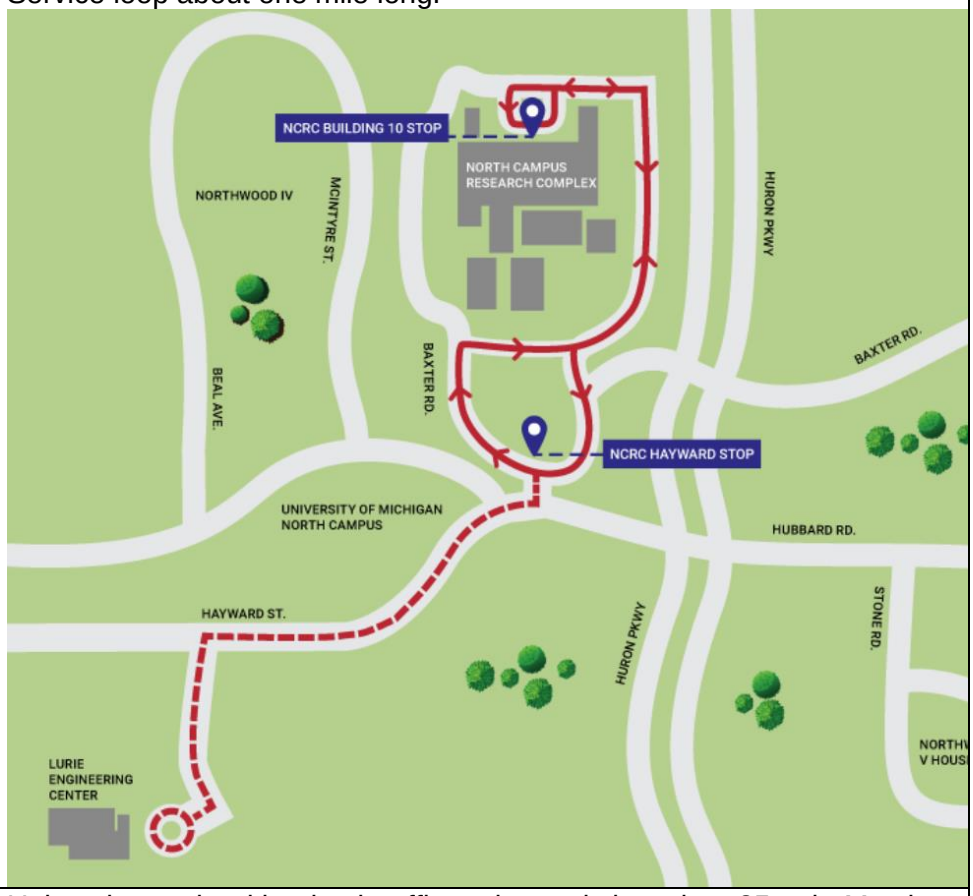
[22] http://cutric-crituc.org/home#/projects/
[23] Kristina Mlakar, CUTRIC, on December 27th, 2018
[24] Idem

Anticipated benefits	The project will provide the framework for technical standards which should be written into future RFP's for automated shuttles and infrastructure system buildout to ensure interoperability across OEMs.[25]
Connected technology tested	V2V and V2I DSRC technologies
Alternative Locations - shortlisted	Not applicable
Project Set up guidelines	No information available at this time
Project's Safety Plan	No information available at this time
Insurance Structure & Liability	No information available at this time
Vehicle	
Technological Scope	Autonomous Shuttle, equipped with V2I and V2V
Vehicle Type	Low-speed electric autonomous shuttles. Details are to be confirmed, but the vehicle manufacturer will be expected to contribute significant in-kind support in the form of maintenance support to ensure that the technologies within each vehicle are up to date with the latest update.
Vehicle Manufacturer	2getthere, Navya, EasyMile
Vehicle Operator	The interested operators in the Project are Bombardier, Thales, and Pacific Western Transportation.
Operator Training	No information available at this time
Vehicle Maintenance	No information available at this time
Communication / PR	
Public Consultation for site selection?	No information available at this time
Public Notification at project Start?	No information available at this time
Who performed notification?	No information available at this time
Communication objective	We expect that the public will react positively. Proactive risk management steps will be taken to ensure that the public is well educated about the technology prior to the launch and during the first phase of the launch (i.e. the first year).
Public Reaction	No information available at this time

[25] http://cutric-crituc.org/home#/projects/

Appendix C: Table Showing Results for US Pilots

Past Projects

Location / Item	Mcity/University of Michigan, Ann Arbor, Michigan
Project Scope	
Operational date	06/01/2018 to ???. Temporarily suspended to accommodate U-M construction
Stakeholders	Mcity (U-M)
Objective / Goal	"The primary goal of this research project is to understand human acceptance, trust, and behavior when riding in a driverless shuttle or interacting with one on the road."
Road Conditions	University roads with low-speed mixed traffic.
Site Location	U-M Campus
AV Operating Mode	Service loop about one mile long. 
Site Technical Specification	University roads with mixed traffic and speeds less than 25mph. Mostly flat.

Operating Restrictions	Monday to Friday, 9am to 3pm. Max AV speed 12mph. Stop completely at every stop sign. Only operate where max speed of other vehicles is <25mph. No grade more than 10%.Limit average passenger wait time for shuttle to <5minutes. Project finance limited to only two shuttles. Shuttle does not operate in snow or heavy rain (when windshield wipers run continuously). Battery constraints: Shuttle operations are suspended when vehicle battery charge declines below manufacturer specification – hot weather (AC) and cold weather (heater) can affect completion of 6hr shifts. Mcity shuttle operations manager pays close attention to changes along the route; the shuttle conductor interacts with the shuttle operations team and manually maneuvers the vehicles around obstructions in the road.
Project Partners - Role	Numerous partners within U-M, and partners outside U-M: • Mcity Leadership Circle and Affiliate members, • NAVYA • JD Power • Office of Michigan Secretary of State • Michigan Department of Transportation • Michigan Council on Future Mobility • City of Ann Arbor • Ann Arbor Area Transportation Authority • Ann Arbor Police Department • Ann Arbor Public Schools
Municipality's Role	The City of Ann Arbor is an Mcity Partner. The City may be responsible for the public operation of the university-owned roadways.
Project Lead Contact	Huei Peng, Director, Roger L. McCarthy Professor of Mechanical Engineering
Project Funding	Shuttle purchase with support from Mcity corporate members. Shuttle research operations supported by U-M funds.
Municipality's Funding	It is not known if Ann Arbor provided any direct financial support.
Anticipated benefits	“To maximize the research potential of the Mcity Driverless Shuttle project, we collect data in three areas: shuttle interactions with other road users, behavior of passengers riding the shuttle, and basic vehicle data.” “We estimate that this one-year project will produce data from about 7,500 vehicle miles, provide mobility to 10,000 riders, interact with 10,000 road users, and generate 1,500 effective user surveys.
Connected technology tested	Dynamic shuttle tracking via on-board units updates (via cell?) mobile and web applications to provide up to date app-based information for riders. Precise positioning obtained via global navigation satellite systems (GNSS); correction data delivered via cellular and radio links. Mcity runs a real-time kinematic (RTK) base station, which roughly covers the Ann Arbor area and provides these corrections. This system is used for research purposes as well as shuttle operations. In-shuttle wi-fi for research purposes.

Alternative Locations - shortlisted	Route design was influenced by many factors, but was always limited to being within the U-M boundary.
Project Set up guidelines	First Navya shuttle received 12/2016 & operated at Mcity test facility since 2017. Close coordination with stakeholders both within U-M and with partner organizations outside the university was critical in taking the Mcity Driverless Shuttle project from idea to reality. Understand vehicle limitations, budget, route suitability and desirability, shuttle stops and traffic interaction when carrying out route selection.

Project's Safety Plan	500 hrs testing before launch: close collaboration on requirements specific to research environment, including seat belts and a bespoke data acquisition system. Rigorous training and operating procedure for the onboard safety conductors, who play several important roles. All riders must be properly seated and wear seat belts. Safety conductor wears Mcity cap and t-shirt so as to be recognized. Safety consultation with internal stakeholders including Institutional Autonomous Systems Committee and Institutional Review Board (IASC and IRB), Department of Public Safety & Security (DPSS), Environmental Health & Safety (EHS) and external stakeholders including Ann Arbor Public Schools & First Responders, National Highway Traffic Safety Administration (NHTSA). Key comment from shuttle case study report: “Efficient, effective interaction with the targeted rider community and other road users is critical for user adoption and safety.” Vehicle Conductors are provided with a radio in case of breakdown or emergency, a checklist to ensure proper vehicle operation and a details of specific emergency procedures. From case study: “FIELD NOTE - We found it important to have a careful progression of training. Beginning in a closed testing site – the Mcity Test Facility – allowed conductors to build confidence safely, only moving into real traffic conditions once they had demonstrated their proficiency.” To avoid tiredness and boredom the Conductors work approx. 4hr shifts. The shuttle website and the signage at the shuttle safety stops explains the ridership rules, with special emphasis on safety rules. “Mcity carefully analyzed how to manage possible emergency situations. Safety conductors received extensive training, and Mcity staff developed emergency plans. U-M and federal, state and local stakeholders were briefed on incident response procedures and participated in mock crash scenarios.” “Mcity briefed the Ann Arbor Police Department and the Ann Arbor Public Schools on shuttle operations that may interact with school bus routes and explained the safety instruction. They provided to university bus drivers who frequently encounter the shuttles.” “FIELD NOTE: Exhaustive emergency preparation is essential when deploying driverless shuttles. Any emergency will require an immediate, well-executed response appropriate to the severity of the incident. All stakeholders must understand their role in an emergency through training and practice.”

Insurance Structure & Liability	The specific insurance details for the project are not known. “The State of Michigan (in addition to other U.S. jurisdictions) has established rules, regulations, and guidelines for compulsory insurance coverage. Generally, two auto liability regimes exist, either: (1) an injured party may seek redress for torts through the court system; or (2) insurers are required to make the injured party whole without a need to determine fault. Michigan, with its no-fault insurance laws, falls into the latter category.”
Vehicle	
Technological Scope	Electric Autonomous Vehicle
Vehicle Type	3No. NAVYA shuttles
Vehicle Manufacturer	NAVYA
Vehicle Operator	Mcity
Operator Training	See Mcity Driverless Shuttle Case Study document Chapter 6 for full details of Conductor training. Conductor role: On-board safety conductors monitor vehicle operation, interact with passengers, and intervene to minimize unsafe situations. Main safety training includes: Orientation session; Use of shuttle in manual mode; driverless vehicle use; on-the-route training; ongoing training.
Vehicle Maintenance	Overnight storage and charging stations located along the shuttle route to minimize operation outside of the Operating Design Domain (ODD). Installed high-voltage charging system, plus lock-box for shuttle keys and storage cabinet for cleaning supplies. Vehicles require 240VAC 40A circuit for fast recharging. Initial measurements show energy costs around 30–40kWh ($3.90–$5.20) per day per shuttle, for six hours of daily Michigan summertime operation.
Communication / PR	
Public Consultation for site selection?	No public consultation as the route was all on private land. “Since the selected shuttle route is completely on U-M property, Mcity was fortunate to have significant freedom in selecting the route, designating the stops, installing signs and posts, installing WiFi access points, and improving the operating environment in general.”
Public Notification at project Start?	Not necessary.
Who performed notification?	N/A
Communication objective	N/A
Public Reaction	N/A

https://mcity.umich.edu/how-to-launch-a-driverless-shuttle-u-michigan-shares-insights-in-new-case-study/

https://mcity.umich.edu/shuttle/

https://mcity.umich.edu/wp-content/uploads/2018/09/mcity-driverless-shuttle-case-study.pdf

Location / Item	Bishop Ranch, San Ramon (CCTA, GoMentum)
Project Scope	
Operational date	Since November 2017 in testing. 06/03/2018 Shuttle debuted, invited riders/tours only. (27/04/2018 was scheduled date for commuter access, but this has not happened yet) …to 06/2019 ongoing
Stakeholders	Bishop Ranch, San Ramon, Contra Costa Transportation Authority (CCTA)
Objective / Goal	Explore the potential of AVs to improve public-transit access.
Road Conditions	Public roads on Bishop Ranch development. Mixed traffic.
Site Location	Bishop Ranch, San Ramon, California: 
AV Operating Mode	Initially low speed and no signalized intersections. Later use has involved signal intersections. For routes with un-protected left turn, the vehicle only proceeds with attendant approval.
Site Technical Specification	Public roads, low speed, mostly flat, mixed traffic.
Operating Restrictions	Monday to Friday, daytime only, outside of rush hour, approximately 4 hours/day. Medium to light traffic only. One route makes an un-protected left turn and the safety driver is always responsible for this maneuver.
Project Partners - Role	City of San Ramon GoMentum (non-profit, owned by AAA Northern California since Jan 2019) Contra Costa Transportation Authority Bishop Ranch – site owner (Sunset Development) First Transit EasyMile

Municipality's Role	Partner; facilitated communications between stakeholders; assisted with route development.
Project Lead Contact	Randy Iwasaki (CCTA, GoMentum) riwasaki@ccta.net Jack Hall (CCTA, GoMentum) jhall@ccta.net
Project Funding	Bishop Ranch secured use of the vehicles (AV shuttles cannot currently be purchased in the US under the current NHTSA process). Vehicle operations were paid for by California Air Resources Board and State of California – some grants and also some private sector funding. First Transit (the company Board flew from the UK to visit the project)
Municipality's Funding	Unknown.
Anticipated benefits	Prove the benefits of AV shuttles so as to deploy up to 100 vehicles by 2020. Also: "If the pilot is successful, the county intends to deploy a fleet of several hundred driverless shuttles that would make connections within three miles of bus and rail transit stops" CCTA has changed the way that they gained information from the public: Rather than a traditional Open House (normally approximately 40 members of the public attend), CCTA created an interactive website. Users register and on login are allocated 'Contra Costa coins' which they could spend on the biggest issues that concern them. Also, CCTA did a series of telephone Town Halls which garnered thousands of listeners. Combined, CCTA got more comments in this one planning cycle than the previous 25 cycles combined. People wanted potholes fixing, adaptive signals that reduce waiting at red lights, a better subway, and a first-mile last-mile solution. Hence the AV shuttle project.
Connected technology tested	Signal Phase and Timing (SPaT) – (can be a DSRC technology) that allows the infrastructure to speak to the vehicle and will allow the vehicle to tell the signal to hold the green aspect to improve shuttle system efficiency. With multiple technology suppliers of systems interacting with the SPaT system it needed the GoMentum Signals Laboratory to figure out how to get the systems talking to each other. Every city has a different signals provider, so each city may need to develop it's own solution.
Alternative Locations - shortlisted	Not known.

Project Set up guidelines	Vehicle importation was a critical part of the process that determined project deployment timelines. The project started in a secure environment at GoMentum Station. The vehicles were tested there for a year to ensure safety and to develop operational effectiveness. This time allowed the AV provider to develop their system from private land to constrained use on public roads in low-speed mixed traffic. If vehicle was to be operated on public streets then California Public Utility Commission regulations pertaining to jitney service were applicable – just one more hurdle the Contra Costa Transportation Authority had to overcome. The San Ramon Police Chief wrote a letter of support and his office reviewed and approved emergency policy procedures with operational constraints. The CA DMV licensing process was important – as was qualification under FMVSS provisions. By engaging the Fire and Police Departments this paid dividends as the City Manager then got involved, which then brought in the City Mayor. This political support was important in prioritizing the project as some staff (e.g. traffic engineers) tend to be very busy doing their regular work. Route selection was very important. Route options were checked for potential conflicts e.g. nearby school. For nuances such as interactions with vulnerable road users (VRUs) a safety audit can be invaluable. Route planning is not just about infrastructure, but also encompasses technology, VRU's etc. With CV technology ensure that the infrastructure can speak to the vehicle – various SpaT issues had to be overcome for it to be used on this project. Every two weeks the project team held SCRUM (agile project management) meetings to maintain the project momentum. Once the route has been publicly announced it will attract considerable comment and criticism – the City have to be prepared to 'own the route'. Try not to over-promise on any aspect of the project to the partners, stakeholders, the public or government. Set a realistic schedule, particularly with start-up tech companies that are still developing their product and their market and gaining experience with every project. Do not underestimate how much staff and organizational effort is involved in a project like this – it is easy to feel under-staffed given the

	complexities and novelties of what is involved. Getting the right staff is very important. Be aware that a project like this can be sensitive and that information can be accessed by freedom of information requests.
Project's Safety Plan	One year of testing at GoMentum Station facilitated the development of a detailed safety plan. Liaison with City Fire and Police Depts facilitated the development of an Emergency Response Plan.
Insurance Structure & Liability	Insurance for $5 million was put in place.
Vehicle	
Technological Scope	Electric shared autonomous vehicle.
Vehicle Type	EasyMile 10
Vehicle Manufacturer	EasyMile
Vehicle Operator	First Transit
Operator Training	EasyMile and First Transit – with input from partner organizations and stakeholders.
Vehicle Maintenance	EasyMile and First Transit.
Communication / PR	
Public Consultation for site selection?	No – but public consultation determined that a first-mile, last-mile solution was a priority – hence the AV shuttle project.
Public Notification at project Start?	Media event held at Bishop Ranch to announce official launch.
Who performed notification?	Co-Operation between partners.
Communication objective	Maximize PR value for the benefit of Bishop Ranch, Partner organizations and stakeholders.
Public Reaction	The public are not yet allowed on the shuttles.

https://gomentumstation.net/ccta-testing-begins-for-1st-autonomous-shuttle-on-public-roads-in-ca-east-county-today/

http://eastcountytoday.net/ccta-testing-begins-for-1st-autonomous-shuttle-on-public-roads-in-ca/

https://gomentumstation.net

https://www.bishopranch.com/californias-first-driverless-bus-hits-the-road-in-san-ramon/

SPaT:
https://transportationops.org/sites/transops/files/SPaT%20challenge%20Folio%20imposed.pdf

https://www.greencaltrain.com/2017/07/touring-bishop-ranch-autonomous-shuttle-pilot-what-will-it-take-to-go-mainstream/

Location / Item	Los Angeles, California
Project Scope	
Operational date	
Objective / Goal	
Road Conditions	
Site Location	
AV Operating Mode	
Site Technical Specification	
Operating Restrictions	
Project Partners - Role	
Municipality's Role	
Project Lead Contact	Marcel Porras Michael Lim (author of 'Autonomous LA')
Project Funding	
Municipality's Funding	
Anticipated benefits	
Connected technology tested	
Alternative Locations - shortlisted	
Project Set up guidelines	
Project's Safety Plan	
Insurance Structure & Liability	
Vehicle	
Technological Scope	
Vehicle Type	
Vehicle Manufacturer	
Vehicle Operator	

Operator Training	
Vehicle Maintenance	
Communication / PR	
Public Consultation for site selection?	
Public Notification at project Start?	
Who performed notification?	
Communication objective	
Public Reaction	

Office of Extraordinary Innovation: https://www.metro.net/projects/oei/

http://www.thelacoalition.com/site/wp-content/uploads/2018/04/Autonomous-Los-Angelespdf.pdf

Didn't happen? Baidu teams with LA Paratransit agency automated shuttle pilot: https://techcrunch.com/2018/01/08/baidu-teams-with-us-paratransit-agency-on-la-self-driving-pilot/

Autonomous LA: Autonomous Vehicle Business Plan for Los Angeles (beta):
http://www.thelacoalition.com/site/wp-content/uploads/2018/04/Autonomous-Los-Angelespdf.pdf

Location / Item	Portland, Oregon
Project Scope	
Operational date	
Stakeholders	
Objective / Goal	
Road Conditions	
Site Location	
AV Operating Mode	
Site Technical Specification	
Operating Restrictions	
Project Partners - Role	
Municipality's Role	
Project Lead Contact	
Project Funding	
Municipality's Funding	
Anticipated benefits	
Connected technology tested	
Alternative Locations - shortlisted	
Project Set up guidelines	
Project's Safety Plan	
Insurance Structure & Liability	
Vehicle	
Technological Scope	
Vehicle Type	
Vehicle Manufacturer	
Vehicle Operator	

Operator Training	
Vehicle Maintenance	
Communication / PR	
Public Consultation for site selection?	
Public Notification at project Start?	
Who performed notification?	
Communication objective	
Public Reaction	

Portland – short feature in NLC document p.24:
https://www.nlc.org/sites/default/files/2018-10/AV%20MAG%20Web.pdf

https://www.portlandoregon.gov/transportation/73493

Location / Item	San Antonio, Texas
Project Scope	
Operational date	
Stakeholders	
Objective / Goal	
Road Conditions	
Site Location	
AV Operating Mode	
Site Technical Specification	
Operating Restrictions	
Project Partners - Role	
Municipality's Role	
Project Lead Contact	
Project Funding	
Municipality's Funding	
Anticipated benefits	
Connected technology tested	
Alternative Locations - shortlisted	
Project Set up guidelines	
Project's Safety Plan	
Insurance Structure & Liability	
Vehicle	
Technological Scope	
Vehicle Type	
Vehicle Manufacturer	
Vehicle Operator	

Operator Training	
Vehicle Maintenance	
Communication / PR	
Public Consultation for site selection?	
Public Notification at project Start?	
Who performed notification?	
Communication objective	
Public Reaction	

City RFI 20/7/2018 (submission by Aug 20):
https://webapp1.sanantonio.gov/RFPFiles/RFI_3598_201807200359261.pdf

RFP early 2019? San Antonio Office of Innovation
https://www.spartnerships.com/ready-ride-driverless-vehicle-2019/

Unable to find evidence of an RFP being issued.

Appendix D: Safety Culture Development

D.1 Safety Culture Development

For safety to become an intrinsic part of an AV pilot structure, all groups, organizations and partners involved should recognize their role in creating a safe environment, safe operations and a safe pilot.

All employees from Senior Management to the administration staff, engineers and junior staff should ascribe to the understanding that safety is always the top priority.

Safety should not be allowed to become an exercise in ticking boxes on a checklist, but rather become a way of thinking and operating that crosses over between personal and working life. Good safety culture at work will result in safer employees in their home and play environments – as employees will naturally start to think ‘safety’ and literally take safety home with them to their families and loved ones. Safe employees can reasonably be expected to have fewer injuries, have less time off work and be involved in fewer near misses.

It is recommended that every AV pilot meeting begin with a ‘Safety Moment’ where for between 20-60 seconds the meeting leader, or nominated attendee, describe a recent safety related incidence in their life. A safety lesson can be learned from what that persons describes as doing or not doing, and whether the outcome was good or bad in terms of safety.

All new tasks, whether they are based in the office, workshop or field should first be discussed by the team members and any concerns of note be recorded as part of a high level analysis (see Section D.2), along with an ACAT analysis (see Section D.3) if considered necessary. It may then be appropriate to develop a simple safety plan that all staff involved are required to read and initial to show that they have understood the risks involved and how they have been addressed.

Where a complex task or project is being developed, a safety case may need to be developed that is similar to the high-level safety review, ACAT analysis and safety plan, but is more detailed. A safety case is always a live document that is regularly reviewed and updated.

It is worth noting that the most serious safety related incidents involve a cascade of minor issues that combine together into something much more serious. By developing a strong safety culture, many of these minor issues can be identified and addressed in a way that seems second nature to staff.

One way to identify minor issues is to set up a simple reporting tool that allows employees to register any safety concern that they come across in the office, or whilst

doing their work. This could be an on-line app accessible from their phones or computers, or a stack of safety report cards kept around the places of work. To incentivize staff to report, they must know that they will not be punished for drawing attention to safety related issues, and all named submissions might have their names put into a weekly/monthly draw to win a gift-card or similar.

It would be helpful if a Safety Champion is identified within the organization, and this could be the Safety Officer if there is one in the lead organization for a pilot – which may be a vehicle provider, service operator or a government organization. The Safety Champion will be a focal point for developing the safety culture and for encouraging everyone in all stakeholders to play their part.

D.2 High Level Safety Review of Project

A high-level safety review should ideally capture all of the major risks and concerns associated with a project at an early stage. This has essentially already been carried out with the City of Toronto automated vehicle development as outlined in the Technology Description.

D.3 Avoid, Control, Accept, Transfer Evaluation

Risk management is an established and formalized set of principles. When developing an AV project with municipal involvement, it is recommended that there be some form of Safety System in place to help mitigate risks and hazards. If an appropriate safety system is not already in use by AV pilot stakeholders, CAVCOE recommends using an (ACAT) Evaluation process.

ACAT is a standard process that is carried out on each of the risk items identified in the safety review to better understand the residual risks, by asking questions like:

- Can any risks be Avoided? How?
- Can the risks be Controlled? How?
- What risks have to be Accepted? Why?
- Can the risks be Transferred? How much?

One of the values of an ACAT record (in addition to a written record of a project safety review) is an audit trail demonstrating safe work practices. In the event of an insurance claim or civil litigation, such documents are evidence of a safety culture in operation and demonstrate that safety is an integral part of normal operations.

D.4 Safety Plan for Deployment of an AV

More detailed risks and hazards can be captured in a safety plan. Sometimes the safety plan is referred to as a safety case, but the term ‘safety case’ is identified as a document with legal standing in some jurisdictions, and so ‘safety plan’ is the preferred term here.

A safety plan goes further than the safety review and ACAT evaluation, both in breadth and depth. A safety plan will ideally commence at the start of the project and is a live document that should be continually referenced, reviewed and updated throughout the life of the project. A safety plan covers all risks from high level project feasibility risks down to fully detailed task/item specific risks.

At the core of the safety plan is the hazard log. This is a record of as many conceivable and credible hazards facing the project as reasonably possible, and then for each one a risk score of the event occurring is estimated, along with an estimate of the severity score of the possible outcome. The chances of an outcome can simplistically be recorded as low, medium and high, and similarly the severity of the outcome can be recorded as low medium or high (in practice some risks scores and severities can be estimated with greater accuracy). By combining these two estimates/scores the greatest hazards to the project are quickly identified as being those with a high chance of occurring and with a high severity. In the early stages of a project these are often the highest priority hazards to address as they are most likely to undermine the project if left un-resolved.

The hazards and risks identified in any relevant ISO documents will be relatively comprehensive for general safety case development, but we recommend that site/task/deployment scenario specific risks and hazards are considered prior to any new use during the development stage.

As the project progresses and the ACAT principles are applied to each hazard, then the initially lower-rated hazards move up the priority hazard list and need to be addressed so as to mitigate the overall project risk as much as possible.

As the project progresses, as more information becomes available, as more knowledge is generated and as more ACAT principles are applied, then the risk or severity scores of particular hazards can be reduced so that those hazards are no longer a priority.