AV DEPLOYMENT PLAYBOOK:
THE ROADMAP FOR SUCCESSFUL AV IMPLEMENTATION

STANTEC
GENERATIONAV™
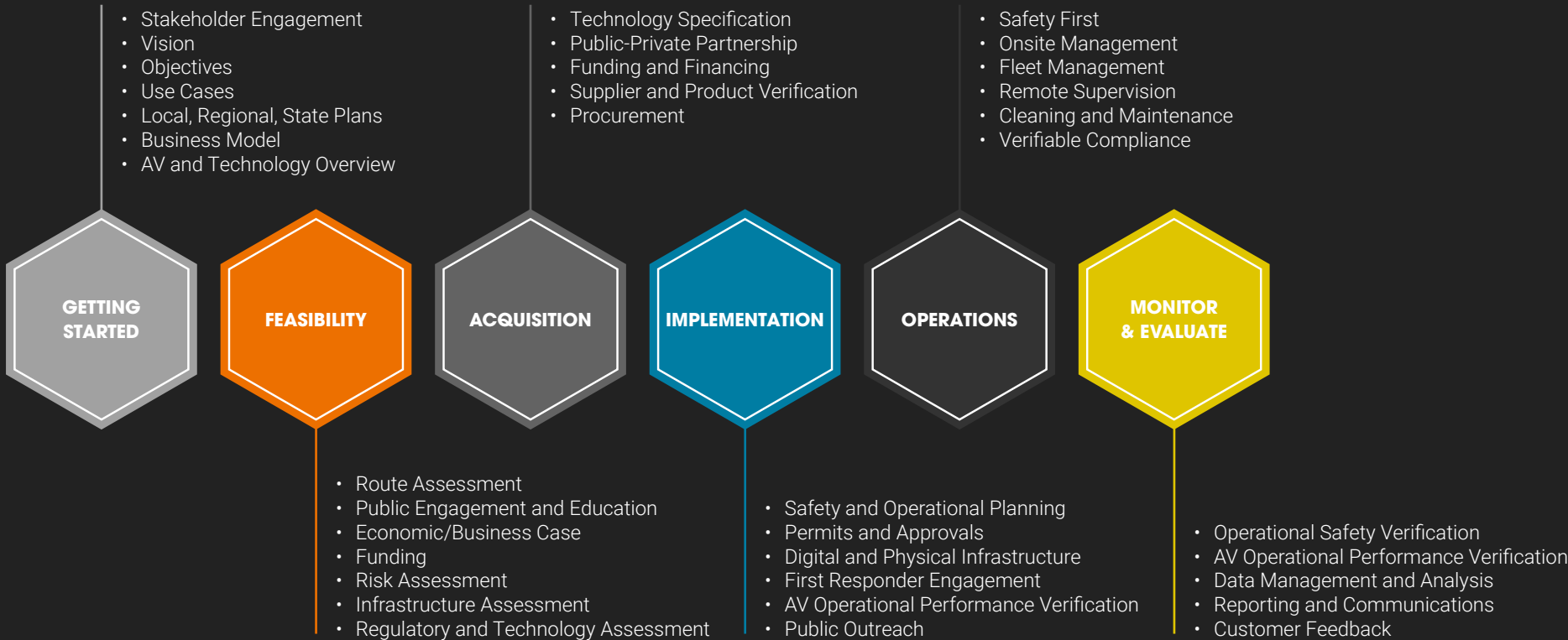
AV Deployment Playbook:
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Autonomous vehicles (AVs) are a smart technology solution that are helping cities, campuses, airports, warehouses, mines, and more increase mobility for their citizens, visitors, and goods by offering a safe, equitable, productive, and environmentally friendly mode of transportation. The intent of this playbook is to help you launch, operate, and evaluate this emerging technology in your community or environment.

It's not a difficult process—but when dealing with new technology, careful consideration must be paid to safety, public engagement and education, and risk and hazard mitigation. Keep in mind that most people have never been for a ride in an AV or seen them around a work site! Deploying AVs at any scale asks the public to put their trust in something new—extensive planning, outreach, and a thorough understanding of the process, from concept to deployment, are critical.

Establishing a clear path forward with defined objectives and the right people involved will set you on the path to a successful deployment before you can say "where's the driver?"

STEPS TO A SUCCESSFUL DEPLOYMENT

GETTING STARTED
- Stakeholder Engagement
- Vision
- Objectives
- Use Cases
- Local, Regional, State Plans
- Business Model
- AV and Technology Overview

FEASIBILITY
- Route Assessment
- Public Engagement and Education
- Economic/Business Case
- Funding
- Risk Assessment
- Infrastructure Assessment
- Regulatory and Technology Assessment

ACQUISITION
- Technology Specification
- Public-Private Partnership
- Funding and Financing
- Supplier and Product Verification
- Procurement

IMPLEMENTATION
- Safety and Operational Planning
- Permits and Approvals
- Digital and Physical Infrastructure
- First Responder Engagement
- AV Operational Performance Verification
- Public Outreach

OPERATIONS
- Safety First
- Onsite Management
- Fleet Management
- Remote Supervision
- Cleaning and Maintenance
- Verifiable Compliance

MONITOR & EVALUATE
- Operational Safety Verification
- AV Operational Performance Verification
- Data Management and Analysis
- Reporting and Communications
- Customer Feedback

Start with a vision

To kick-off the AV planning and deployment process, it is crucial to define a cohesive vision and program objectives. Establishing these allow you to set expectations and work toward a common goal. You'll build your vision and objectives around the need or challenge you're facing. Clearly define your problems and needs with stakeholders before seeking solutions. This way you'll find the best solution for your problem—not the other way around.

Once you've determined AV deployment is the answer you're looking for, you need to understand federal, state, and local plans and regulations pertaining to mobility and AV testing and deployment. It may also be necessary to map out a preliminary business model for the technologies under consideration.

From there, the next step is engaging with stakeholders—from public users to decision makers—at a workshop to discuss the opportunities AV technology could bring to the project. These discussions will aid in setting a vision and tailoring the plan for implementation. The goal of the workshop is to align objectives and chart a path toward deployment.

GETTING STARTED PHASE TASKS:
- Define the challenge, need, or opportunity
- Assess AV readiness
- Set a vision and objectives
- Define use cases and review AV tech
- Review local, regional, and state regulations and plans
- Develop preliminary budgets and a business model
- Educate and raise AV awareness among stakeholders

Key questions to reflect upon when considering an AV project:

1. What transportation problems are we experiencing that can potentially be mitigated or solved by AV technology?
2. What does our community or project hope to gain by introducing an AV system?
3. What are the use cases?
4. How can AV technology integrate with our existing transportation system?
5. How many people/goods need to be transported?
6. What are the posted speed limits on potential routes?
7. Where can we find funding?
8. Do our goals for AV deployment align with local, regional, and state plans?
9. What are the local, regional, and state regulations for AV operation?

Top 5 reasons to start with a vision

The community needs a voice.
The most successful projects are those that have buy in from the end users. Give your community a chance to weigh in on the challenges they're facing and the solutions that might help. You'll end up with something everyone can get behind.

A strong vision makes a strong business case.
For an AV project or program to be successful, a tangible, viable, and trackable business case should be developed. A vision provides the foundation upon which to build this case, as well as to demonstrate economic feasibility and sustainability.

AV capability is constantly evolving.
Current AV options present numerous possibilities—each with the potential to solve more and more challenges as they evolve. Understanding your challenges, goals, and objectives allows you to look for the best match between your needs and the capabilities each solution offers—and could offer in the future.

It allows you to develop a roadmap for the long-term.
The AV ecosystem is continuously evolving, creating uncertainty and making it difficult to create definitive plans. However, by knowing your destination, you'll be able to take whichever path is available and is the best fit for your project.

So many options!
In the last five years, the number of commercial AV companies has dramatically increased, with more coming to market every month. By knowing your end point, you'll be able to evaluate and sort the ever increasing options much more easily.

Much to consider

Conducting a feasibility study establishes the framework and pertinent details for the AV deployment project and for decision makers to confirm (or deny) the feasibility of the project. In many cases, key stakeholders are empowered and have an opportunity to learn about the technology and how it may address the identified problem statement. Using a systems approach, we ensure the preferred solution works as an integrated piece of the network, whether that's transit, delivery, security, or operations.

FEASIBILITY STUDY TASKS:
- Engage and educate stakeholders
- Conduct a site and route assessment
- Identify potential AVs and suppliers
- Develop program budgets, including insurance costs, and seek funding
- Conduct an initial risk assessment and plans for mitigation
- Develop a concept of operations and define the role you'll play during the operations phase
- Conduct economic feasibility analysis
- Conduct policy and regulatory analysis

Key questions to consider during a feasibility study:

1. Who owns the roads and how are they regulated?
2. What are the speed limits and traffic volumes on prospective routes?
3. What is the primary mission and who are the end users?
4. What are the risks and hazards of the program? Of the routes?
5. What road and digital infrastructure is needed to support deployment?
6. What funding opportunities exist?
7. What resources are required to support system operation?
8. How does the cost and efficiency compare to traditional operations?
9. How does AV service complement and support the broader mobility network?

EFFICIENT GOODS MOVEMENT
Integrating AVs into your existing infrastructure requires careful thought and planning. From operational goals and end-user needs, to secure locations for charging, maintenance, and storage, there's a lot to think about.

Assess necessary infrastructure improvements like signage, lane striping, etc. for safe AV operation.

Provide awareness to other roadway users, including pedestrians.

Create SOPs for handling and processing of goods deliveries.

Understand roadway conditions and mitigate risk through physical design, policy, and technology.

Define and designate pick-up/drop-off locations.

So many options

It's now time to evaluate the potential technology solutions that could meet the needs of the project and start the procurement process. This stage typically includes liaising between various entities—whether negotiating with developers and manufacturers, scheduling and operating demonstrations, creating the bid documents to go to market, and/or conducting supplier interviews. Each of these tasks are an important part of finding the right solution for your project.

ACQUISITION PHASE TASKS:
- Establish funding sources and agreements
- Get partnerships together
- Develop solicitation documents, including scope of work
- Define the acquisition process
- Determine internal roles and third-party support
- Interview technology partners
- Perform technical and operational assessments
- Finalize insurance requirements and supplier options

Key questions to consider when evaluating AV technology:

1. What is our procurement process that enables AV acquisition?
2. Do we have to make infrastructure modifications?
3. If there are necessary infrastructure modifications, how much will they cost?
4. Are infrastructure modifications procured through separate sources and budgets?
5. What are the current capabilities of AV technology? What capabilities are anticipated in the next 24 months?
6. What are insurance requirements and associated costs?
7. Is there an opportunity for a public-private-partnership?
8. Is there an outreach plan for elected decision-makers to highlight funding opportunities?

ACQUISITION MADE EASY
Here are some common areas of uncertainty

ACQUISITION MODEL:
The two main acquisition models available are own/operate or subscribe. Owners/operators have, or will develop, the infrastructure to maintain the vehicle fleet. Subscribers act more as program managers and vendors handle many daily needs.

COST:
Current costs to manage an AV program are relatively high. But as technology scales, costs will come down. And planning for the long-term can help. Find the right balance between capital and operating expenses.

INSURANCE:
Insurance companies guard against unpredictable occurrences. Take them through the outcome of a safety verification assessment. This will demonstrate mitigation efforts and reflect positively on the policy and premium.

RISK:
Creating a culture of safety is important for any organization. But risk extends beyond safety into finances, timing, and policy. Identify and mitigate risks to build confidence in an AV program.

Let's make it happen

With the technology and site selected, the implementation plan is ready to be created and executed. This typically includes finalizing stakeholder roles and responsibilities, defining deliverables, completing all necessary plans (e.g. emergency management, communications, data, training, etc.), obtaining permits and approvals, and making infrastructure modifications. This critical step considers the characteristics of the operational environment and the capabilities of the technology while ensuring the system will meet users' needs.

Critical components to the implementation phase also include standard and emergency operating procedure creation (SOPs and EOPs) and calibrating the AV system to its environment through operational safety and performance verification. Building on existing SOPs and EOPs will improve buy-in, streamline training, and prepare personnel for a variety of incidents. Operational and performance verification ensures the AV system will perform as intended within its ODD, when it comes time to operate.
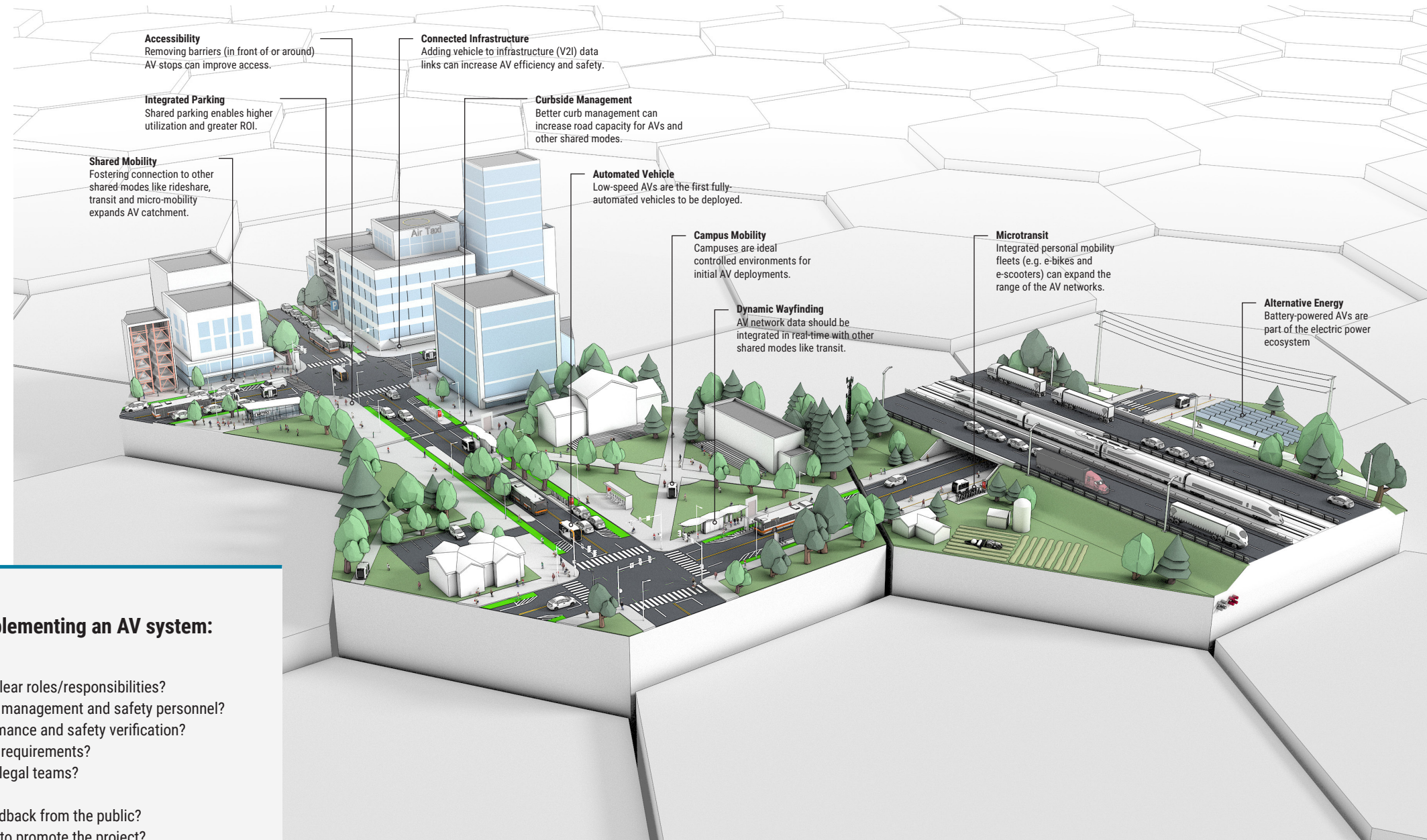
IMPLEMENTATION PHASE TASKS:
- Create all program plans
- Obtain all required permits and approvals
- Design and install infrastructure improvements
- Create and implement marketing plans and collateral
- Conduct operations and emergency response training
- Verify operational safety and AV performance
- Detail system launch

Key questions to consider when implementing an AV system:

1. What are the project phases and timelines?
2. Do we have stakeholder commitments and clear roles/responsibilities?
3. Have we engaged and trained all emergency management and safety personnel?
4. What are the processes and tools for performance and safety verification?
5. What are the reporting and communications requirements?
6. Have we engaged the risk management and legal teams?
7. Are there any statutory exemptions needed?
8. How will we engage, educate, and solicit feedback from the public?
9. Do we have a communications plan in place to promote the project?

Accessibility
Removing barriers (in front of or around) AV stops can improve access.

Connected Infrastructure
Adding vehicle to infrastructure (V2I) data links can increase AV efficiency and safety.

Integrated Parking
Shared parking enables higher utilization and greater ROI.

Curbside Management
Better curb management can increase road capacity for AVs and other shared modes.

Shared Mobility
Fostering connection to other shared modes like rideshare, transit and micro-mobility expands AV catchment.

Automated Vehicle
Low-speed AVs are the first fully-automated vehicles to be deployed.

Campus Mobility
Campuses are ideal controlled environments for initial AV deployments.

Microtransit
Integrated personal mobility fleets (e.g. e-bikes and e-scooters) can expand the range of the AV networks.

Dynamic Wayfinding
AV network data should be integrated in real-time with other shared modes like transit.

Alternative Energy
Battery-powered AVs are part of the electric power ecosystem

Time to deploy

All of the previous planning and design culminates with the launch of an AV system. But the work is not over. Operations and maintenance are an ongoing function of any system, and AV technology is no different. It is important to have the proper staff and assets in place to sustain a successful operation. Data collection and analysis, as well as verification of safety and performance are also critical tasks for this phase. Executing on the data plan ensures meaningful insights are gained and continuous improvement takes place. Lastly, continued marketing and communications is important for further educating stakeholders, citizens, and visitors. While these efforts start during vision development, they carry throughout deployment as information sharing and gathering is critical to keeping engagement high and supporting a positive user experience.

OPERATIONS PHASE TASKS:

- Execute the safety plan
- Manage and schedule operations and maintenance
- Train staff and support services
- Collect, analyze, and manage data
- Report on project status and progress

Key questions to consider when launching an AV system:

1. How is training for operations personnel and emergency management services structured and implemented?
2. What hazards need to be mitigated?
3. How can we ensure our data management plan delivers insights that support decision making?
4. Where are the vehicles stored and what is the charging plan?
5. How often are the vehicles cleaned?
6. Which party oversees the vehicle operations remotely?
7. Are there budget and resources in place to ensure analysis of data and feedback for future phases of the project?

CASE STUDY

For six weeks in the summer of 2019, the City of Montreal ran a self-driving shuttle pilot project along a 2.6 km (1.62 miles) route between the Maisonneuve Market and the Olympic Stadium. The EasyMile EZ10 shuttles, which accommodated up to 12 people, stopped at all intersections, and were able to detect obstacles using GPS, cameras, and LiDAR. A lot of work went into getting the pilot project up and running, starting with the development of a needs statement and a vision, and the formation of a stakeholder working group.

As part of the Quebec government's sustainable mobility policy, the province established a goal to provide 70% of the population with access to at least four types of sustainable mobility. This pilot project will go a long way in helping the City to determine the potential for AVs as sustainable public transit.

Transdev operated the service, with operators welcoming and informing passengers, and guaranteeing the safety of all aspects of the vehicle's performance throughout the journey. Stantec performed all engineering work required to make the shuttle service safe and standard-compliant, including route analysis and optimization, design validation for vehicle-infrastructure communications and installation of temporary traffic lights.

By the numbers

12
passenger maximum per vehicle

1
system of temporary traffic lights with special phase for the shuttle

2
traffic lights on the path where the controller was changed to allow the transmission of SPAT to DSRC
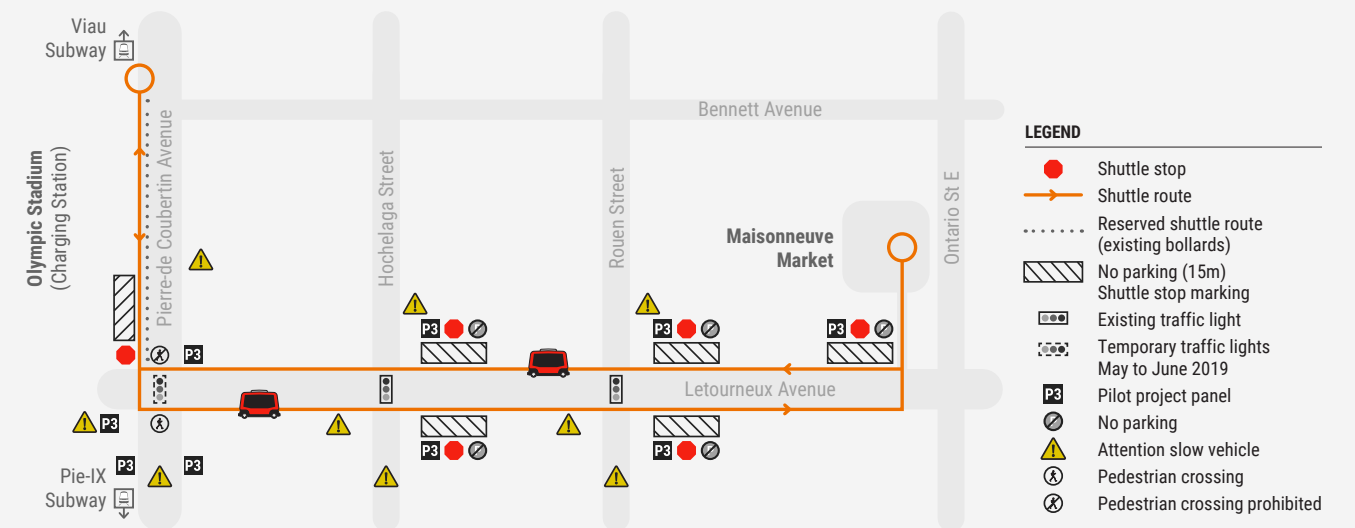
3
intersections with stops

3,896
passengers

1,437
kilometers travelled in driverless mode

0
accidents. The obstacle detection system and emergency stop allowed the shuttle to avoid obstacles encountered along the route, be they vehicles, pedestrians or cyclists.

15 km/h
vehicle speed

2.6 km
round trip route

LEGEND

- 🔴 Shuttle stop
- → Shuttle route
- ···· Reserved shuttle route (existing bollards)
- ▨ No parking (15m) Shuttle stop marking
- Existing traffic light
- Temporary traffic lights May to June 2019
- P3 Pilot project panel
- ⊘ No parking
- ⚠ Attention slow vehicle
- Pedestrian crossing
- Pedestrian crossing prohibited

Knowledge is power

Both concurrent to and post-deployment, monitoring and evaluating the AV operation provides insight into the performance and success of the project. AVs are connected and outfitted with many sensors. This provides the opportunity to evaluate operational efficiencies, performance, and safety like never before. Collecting and analyzing the data enables stakeholders the ability to document performance and lessons learned to optimize the automated mobility system.

MONITORING AND EVALUATION PHASE TASKS:
- Finalize data collection and evaluation
- Audit the operational safety and AV performance
- Gather customer input
- Conduct after-action reviews with stakeholders
- Provide regular reporting to stakeholders

Key questions to consider when evaluating an AV system:

1. At what intervals are data analyses and reporting necessary?
2. What are the processes and tools for performance verification?
3. In what format will data and reporting need to be communicated to stakeholders and/or the public?
4. Who will perform data collection, evaluation, reporting, and storage?
5. Have we reviewed and considered public records requests?
6. How will we communicate findings on the project to continue momentum?
7. What are next steps to refine and support scaling of technology in our state, community, or project site?

THIRD PARTY SAFETY VERIFICATION (Example Report)

Title (description): Title goes here
Date: 00/00/2022
Timeframe for evaluation: 00/00/2022 - 00/00/2022
AV Runtime: 00/00/2022 - 00/00/2022

Passenger Information

# of Passengers	Passenger Ratings	Key Feedback/Responses
4,020	★★★★⯪	TBD

AV Performance

of Disengagements/Unprogrammed Stops with Primary Cause

5

# of Emergency Stops with Brief Descriptions

2 stop due to unexpected object in road
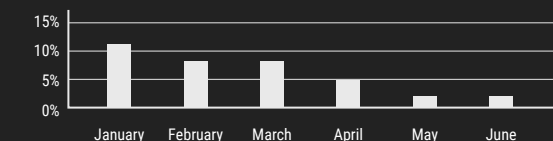stop to avoid collision with cyclist

# of Safety Incidents	# of Near Misses
0	**1**

Total Unscheduled Downtime with % Up vs. Down

Drive Performance

Key Performance Indicator	Number of Incidents/ Anomalies	Description
Speed	0	No recorded speed anomalies. Average speed 12mph. Max speed 24mph.
Lane Keeping	0	No recorded anomalies.
Crosswalks	1	One recorded encroachment (4 inch encroachment. No pedestrians present.)
Traffic Signals	0	No recorded anomalies.
Stops Signs	0	No recorded anomalies.

Meet our team

Ready to start planning your AV deployment or need help getting to the next step? Our GenerationAV™ team is here to help.

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Shane Blackmer
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Marie-France Laurin
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Thank you

LET'S CONNECT

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