City of Adrian Rising Tide AV Project Grant Proposal

U.S. Department of Transportation
Notice of Funding Opportunity Number 693JJ319NF00001
"Automated Driving System Demonstration Grants"

March 21, 2019

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OPPORTUNITY & PACKAGE DETAILS:

Opportunity Number:	693JJ319NF00001
Opportunity Title:	Automated Driving System (ADS) Demonstration Grants
Opportunity Package ID:	PKG00247169
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Competition ID:	
Competition Title:	
Opening Date:	12/21/2018
Closing Date:	03/21/2019
Agency:	DOT Federal Highway Administration
Contact Information:	Sarah E Tarpgaard Contracting Officer E-mail: sarah.tarpgaard@dot.gov Phone: 202-366-5750

APPLICANT & WORKSPACE DETAILS:

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PART I: PROJECT NARRATIVE AND TECHNICAL APPROACH

03/05/2019

U.S. Department of Transportation
1200 New Jersey Ave SE
Washington, DC 20590

To Whom It May Concern:

The City of Adrian, Michigan, is excited to share its plan to implement the first fully autonomous electric bus system to provide public transportation in North America in Project Rising Tide Automated Driving System Demonstration. Currently, the City only has a traditionally fueled paratransit system called Dial-A-Ride, which runs on limited hours and an on-demand basis. Due to the many market failures that have risen from the current transit system, the City has continuously investigated alternatives and explored ways to support a fixed route system. At one point the City developed and leveraged private funds to run a demonstration fixed route pilot that confirmed market demand, however, sustainable funding to extend or make permanent the project was not available.

While Michigan has largely rebounded from the economic recession of the late 2000s, many communities still struggle to meet their economic potential. The City of Adrian was hard hit during the Great Recession and has never recuperated its loss. With a population of 20,800 people less than half are employed with a poverty rate nearing 30%. The City lost nearly 40% of its tax base and will not see pre-recession levels for more than a decade. As such, the City has expanded its community development and cross-sector collaboration efforts across public, private, philanthropic and independent sectors to build true collective impact and leverage further resources.

Therefore, the City is applying for this project to be launched as part of its "Project Rising Tide" program, an initiative developed by former Governor Rick Snyder and the Michigan Department of Talent and Economic Development (MDTED) providing at-risk communities with the tools they need to build successful, vibrant communities. In 2018 ten communities were chosen as Rising Tide communities based on a series of economic factors including poverty levels, unemployment rates and labor participation rates. These communities receive significant technical assistance and resources to help them strengthen local economic health.

It was through this Rising Tide program that citizen leaders identified transportation as a priority focus area. After a series of stakeholder meetings throughout 2018, the City in partnership with MDTED and the Community Economic Development Association of Michigan agreed that there is a compelling need for a fixed route system in the City of Adrian, and thus decided to set the goal of implementing the first fully autonomous electric bus service in North America. In particular, the areas largest employers noted a critical need for workforce transportation. Adrian's two college campuses highlighted safety challenges and need for connection to downtown regions. Additionally, regional human resources collaboratives through the Rising Tide program asserted the limitations of current Dial-A-Ride offerings are difficult to access with limited hours of operation and associated stereotyping.

As a result the City has partnered with EasyMile, an autonomous vehicle technology company, to develop and deploy a system consisting of three EZ10 buses. These three buses would serve three route areas including residential, college, industrial and business districts. The EZ10 is a completely electrical and self-driving shuttle, and the driverless software package is a fleet management system that collects data and relevant metrics and reports to support City, State, and Federal planning and policy efforts.

The City's current Dial-A-Ride system runs from Monday through Friday, 6:00am to 5:00pm with last call accepted at 4:30pm. Many people work past 4:30pm, do not have a car, and may not have the financial means to use a ridesharing service. As a city with two four+year post-secondary institutions, Adrian does not currently provide sufficient transportation support to students without their own means of transportation.

Because of these and other factors, an autonomous vehicle bus system would help facilitate travel to and from these institutions and to the downtown Adrian area. In addition, older adults and people with disabilities may not be able to drive, or may have a difficult time walking long distances. An autonomous bus system would make it easier to extend operating hours into the night and on weekends. Lastly, a fully electric transit system will have fewer environmental consequences than the current gasoline-powered system.

Therefore, the City of Adrian is requesting $2,425,144.00 in federal funding from the U.S. Department of Transportation for Project Rising Tide Automated Driving System Demonstration implementation. Our estimated total cost for the project is $2,625,144.00. Of this amount, the City plans to fund the remaining costs through a

$200,000 commitment from the City of Adrian Fund Balance, as designated by a resolution passed by the Adrian City Commission on March 18, 2019.

We sincerely appreciate the U.S. Department of Transportation's time and consideration. This project is a top priority on our agenda, as well as a Michigan Rising Tide program focus area. We will continue to increase accessibility and the functionality of public transportation in the City of Adrian for all citizens. Please do not hesitate to connect with the City of Adrian's Economic Development Director, Christopher Miller, at (517) 264-4804 with any questions or concerns.

Respectfully submitted,

Chris Miller, City of Adrian Economic Development Director
Mary ZumBrunnen, MS, MBA, Project Rising Tide MDTED Fellow
Elizabeth Chon, U of M Ford School of Public Policy Student Intern

Summary Table	
Project Name/Title	City of Adrian Project Rising Tide Automated Driving System Demonstration
Eligible Entity Applying to Receive Federal Funding (Prime Applicant's Legal Name and Address)	Chris Miller Community Development Department 3rd floor of City Hall 135 E Maumee Street City of Adrian, MI 49221
Point of Contact (Name/Title; Email; Phone Number)	Chris Miller; cmiller@adrianmi.gov; (517) 264-4804
Proposed Location (State(s) and Municipalities) for the Demonstration	Adrian, MI
	L4 automation, 3G and 4G connection,

Proposed Technologies for the Demonstration (briefly list)	GPS, RTK (real-time kinematic) positioning, LIDAR (Light Detection and
Proposed duration of the Demonstration (period of the performance)	3 years
Federal Funding Amount Requested	$2,425,144.00
Non-Federal Cost Share Amount Proposed, if applicable	$200,000.00
Total Project Cost (Federal Share + Non-Federal Cost Share, if applicable)	$2,625,144.00

b) Project Narrative and Technical Approach

1. EXECUTIVE SUMMARY.

   The City of Adrian is interested in introducing and showcasing autonomous technology throughout the city and in its downtown. EasyMile is proposing to demonstrate a fleet of three autonomous shuttles to serve the three proposed routes of Project Rising Tide Automated Driving System Demonstration. This is an opportunity for the City to showcase autonomous shuttles as an additional mobility option and a "first and last mile connection" - all with the goal of increasing the number of people using the region's public transit system, increasing employment and reducing mobility barriers while being environmentally responsible. Strong focus will additionally prioritize rigorous data collection including: before and after study of public acceptance, academic partnering for additional research projects, state and federal policy development as well as civic engagement.

   EasyMile focuses on enabling autonomous transportation adoption through:

   - Developing driverless software for vehicles operating on open roads
   - Integrating driverless technology into different vehicles to address a variety of use cases
   - Developing methodologies to efficiently and safely deploy fleets of automated vehicles

   EasyMile collaborates with several well-known and trusted partners:

   - Alstrom — In January 2017, Alstom, a world leader in integrated railway systems, invested €14M in EasyMile. As a promoter of sustainable mobility, Alstom develops and markets systems, equipment and services for the railway sector. Alstom manages the widest range of solutions in the market – from high-speed trains to metros and tramways – customized services (maintenance and modernization), infrastructure and signaling solutions. Alstom is a world leader in integrated railway systems. It recorded sales of €8 billion in 2017/18. Headquartered in France, Alstom is present in over 60 countries and employs 31,000 people.
   - Continental — In July 2017, the technology company Continental acquired a minority share participation in EasyMile in order to cooperate closely in the fields of environmental sensors, braking systems and driving safety technologies. Continental develops pioneering technologies and services for sustainable and connected mobility of people and their goods. Founded in 1871, the technology company offers safe, efficient, intelligent and affordable solutions for vehicles, machines, traffic and transport. In

2017, Continental generated sales of €44 billion and currently employs more than 227,000 people in 56 countries.

- Bpifrance — In September 2018, Bpifrance invested €6.5m in EasyMile. Bpifrance is the French national investment bank: it finances businesses – at every stage of their development – through loans, guarantees, equity investments and export insurances.

The Project Rising Tide Automated Driving System Demonstration will focus on delivering the following transport solutions within the Adrian area in order to:

- Provide a new mobility solution within the City;
- Introduce the potential of autonomous shuttles to better understand customer mobility needs and improve their mobility experience;
- Understand the physical and digital infrastructure required to enable and support the ongoing operation of autonomous shuttles in a real-life setting;
- Continue to offer safe, secured and on-demand transport services;
- Provide a unique opportunity to partner with EasyMile and generate useful metrics regarding autonomous vehicle usage;
- Assist to educate the public on autonomous vehicle transportation including building positive cultures of public transportation and acceptance;
- Work with the University of Michigan Gerald R. Ford School of Public Policy to craft sound state and federal policy recommendations;
- Increase employment opportunity and staffing where it's needed most, and;
- Identify future autonomous vehicle project potential

This new system is significant improvement from the City of Adrian's current transit system in regards to helping transportation-challenged populations. EasyMile's EZ10 is the most deployed autonomous shuttle in the world. Since 2015, EasyMile has successfully deployed their vehicles more than 250 times in over 23 countries on four different continents. Over 300,000 people have travelled with these vehicles for more than 200,000 miles.

EZ10 has experienced several environments (city centers, university campuses, corporate campuses, amusement parks, etc.), traffic conditions (segregated road, mixed traffic with bicycles and pedestrian, mixed traffic with low speed cars, etc.), and various weather conditions (hot countries, snow, rain, etc.). A fleet of EZ10s are well-suited for short trips (0.3 to 3 miles) and can be available on-demand 24 hours a day. Thanks to EasyMile's "Safety First" approach, there

have been no accidents involving our vehicle in operations. EasyMile's resource and development, testing, and deployment processes with a focus on risk assessment and management make its vehicle the safest on the market.

Project Deployment

EasyMile has created a scalable process of programming, deployment and training that allows us to effectively meet quality and safety standards across all of our projects. From contract signing to deployment, this project is estimated to be successfully operational in three months. Some of the key deployment steps are as follows:

- **Site Assessment:** Before the vehicles have arrived on-site, one of EasyMile's experienced deployment engineers will identify and document all potential risks and mitigation strategies along the proposed route. Based on these findings, the EasyMile team will develop a Site Assessment Report, which summarizes EasyMile's requirements and recommendations for the site, and gives the scope and conditions of the operations on this specific site.
- **Vehicle Validation:** The EasyMile team will ensure that a staff person is on-site to unload the vehicles and validate the vehicle and all associated technology have shipped safely and is assembled appropriately.
- **Vehicle Set-Up:** Once on site, a trained EasyMile deployment engineer will manually drive the EZ10 on the agreed-upon routes with the purpose of "pre-learning" its possible routes and operating environment.
- **Training:** While the City of Adrian will provide the operations and maintenance staff, EasyMile will provide the training necessary to ensure the project's success.
- **Support:** EasyMile has developed a Customer Support process to make sure every Customer feedback or complaints is taken care of promptly and efficiently.
- **Data Sharing/Reporting:** EasyMile can share data with the City via its Application Programming Interface (API) in addition to training the City's Customer Service Ambassadors (CSA) on how to collect useful operating data throughout the service.

Members of our County Collective Impact Group (CORE) are some of our key autonomous vehicle stakeholders as CORE consists of most of the human service organizations in the county. In regards to our local team at the City of Adrian, we have an engineering department, transportation operations and maintenance, department of public works, city police and fire, and administrative staff. Below is the map of our proposed routes:

Below is a chart of the pre-project schedule, including the deployment schedule:

Task	Timeline	Responsible Party
EasyMile Receipt of Order	3 months before vehicle delivery*	City of Adrian
Vehicle shipping		
Vehicle Procurement	It takes usually one week to prepare the vehicles with the right options	EasyMile

Vehicles importation	EasyMile will submit an application to NHTSA for importation approval once project is confirmed. NHTSA approval can take up to 60 days.	City of Adrian and EasyMile
Vehicle Shipping	SeaFreight - Around 6 weeks Air Freight - Around 3 weeks	EasyMile
Vehicle Arrival On-Site	1 week before on site deployment. Requires vehicle importation to be completed	EasyMile and site owner
Deployment schedule		
Site Visit	Completed 3 months prior to deployment	City of Adrian, land owner, EasyMile
Site Assessment	Completed 2 months prior to deployment	EasyMile
Authorizations and Regulation Navigation	1 week prior to deployment	City of Adrian, Michigan DOT, EasyMile
Requested site adaptations	If required, completed one week before on site deployment	Site Owner
On Site Deployment and Testing	Duration depends on site complexity and will be fixed after site assessment. EasyMile estimates the following deployment durations: - Tech loop - short: 3 weeks - Tech loop - long: 4 weeks Deployment needs vehicle delivered on site and Site Adaptations being completed	EasyMile
Operator Training	1 week per 4 operators to be trained All trainings need to be completed before operations start	EasyMile, City of Adrian

Operations Start		
Operations		EasyMile and City of Adrian
Optional additional trainings		
Training Officer Training	1 week per trainee This training requires the use of one vehicle, and additional CSAs to be trained	EasyMile and City of Adrian
M1 Maintenance Training	1 week per 2 trainees This training requires the use of one vehicle and access to a workshop	EasyMile and City of Adrian
L1 Setup Training	1 week per trainee This training requires the use of one vehicle	EasyMile and City of Adrian

2. GOALS. Describe how your proposed demonstration aligns with and/or satisfies the goals contained in NOFO Section A:
    a. Safety;

Redundancy — Similar to complex transportation systems like commercial aircrafts, the EZ10 is equipped with multiple layers of redundancy in order to maximize the safety of the passengers, other road users and the vehicle itself.

- Redundant coverage by sensors
- Independent obstacle detection function
- Fail-safe and redundant braking system
- Redundant industry-grade emergency buttons

Redundant Braking System

Braking safely is crucial. The EZ10 is equipped with several independent braking systems.

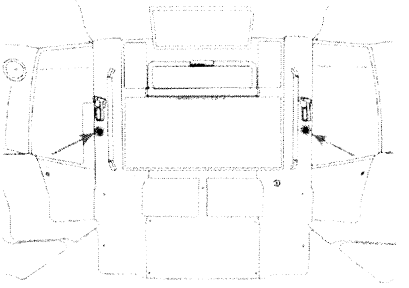
- During normal operations, the autonomous system can change its speed to smoothly decelerate, using the regenerative braking system. For harder deceleration the system can also use the electrical callipers.
- In case of an Emergency Stop, the autonomous system uses all the previous braking systems but additionally includes the hydraulic braking.

- In case of complete power loss, or when the vehicle is turned off, fail-safe braking is automatically activated.

This architecture mitigates the risk of failure in two braking systems and even a failure in the battery system that would lead to complete loss of electric power.

Manual e-Stop

- In case of an emergency situation, passengers of the EZ10 shuttle can trigger an Emergency Stop using one of the three E-Stop buttons strategically located inside the vehicle. Those buttons are continuously monitored by the PLC in such a way that if an error is detected, an E-Stop is automatically triggered by the vehicle. This monitoring can prevent a short-circuit, for instance.



Feedback from Transportation Operators

- Since its inception EasyMile has been working closely with global leaders in transportation operations receiving day-to-day feedback to improve the passenger experience. The EZ10 fully meets the quality and safety criteria for people transportation.
- The vehicle's subway-like sliding doors, anti-slip flooring, and hand grips are all sourced via leading suppliers within the public transportation industry. Additionally, the vehicles are equipped with fire extinguishers, emergency hammers and upon request can be fitted with seat belts. Passengers can contact the supervision center by pressing the emergency button at any time during their journey.

Passenger Counters

- EasyMile uses passenger counters based on calibrated weights. This data is updated every half second.
- EasyMile uses internal video cameras passenger counters.
- EasyMile is equipped with the industry leading IRMA MATRIX, an Automatic Passenger Counting (APC) sensor with high resolution.

Charging and Storage

To keep the vehicles in good condition and minimize curative maintenance tasks, EasyMile recommends that their storage area fulfills the following conditions:

- Distance < 400 feet from the EZ10 route
- Closed shelter, workshop, garage, or storage area
- Charging equipment
- 215 square feet per vehicle for storage
- Minimum height: 10 feet
- Minimum width: 10 feet
- Load capacity of 2 tons
- 11 square foot (minimum) locker for tools and spare parts storage
- Wifi connection
- Temperature inside storage from 40°F to 95°F

EasyMile Sensor Stack on the EZ10

The software has been designed to know the vehicle's exact position with centimeter-level precision at all times. By merging the types of data below, the software can obtain this level of precision:

- Laser scanning the environment
- Cameras
- Differential GPS
- Visual location
- Estimation using an Inertial Measurement Unit (IMU)
- Odometry estimation
- *(More details on these technologies are below)*

Environmental Laser Scanning — LiDARs

- EZ10 is equipped with several different LiDars to ensure redundancy in information collection.
- 4 LMS, also called Safety LiDARs are on the EZ10:
    - One at each corner of the vehicle
    - Strategically positioned 12 inches off the ground
    - Single layer LiDAR
    - Range of 130 feet
    - 270-degree horizontal scanning
    - Used for obstacle detection by high-level software
    - Used for obstacle detection by the Safety Chain
    - Used for navigation by the high-level software
- There is currently no certified LiDAR on the market, which is why EasyMile has chosen to include redundant sensor coverage sourced from different suppliers. This architecture mitigates any risk of failure of a single sensor.

- The four Lidars (each scanning 270°) located at each corner of the vehicle, offer a 360° redundant perception of the environment. Any obstacle within 130 ft of the EZ10 will be detected by at least two to three LiDARs.
- 2 LDRMS, also called Localization LiDARs on the EZ10
    - Strategically positioned on the roof of the EZ10 to detect fixed elements in the environment (buildings, statues, tree trunks, signs, streetlights, etc.) without being disturbed by moving elements in the environment that are usually smaller or that will not be in the sensor's field of view (pedestrians, cars, bicycles, etc.)
    - 4 layers
    - Range of 720 feet
    - 110-degree horizontal scanning
    - 3.2-degree vertical opening
    - Used for navigation by the high-level software
- 2 VLP16, also called 3D LiDARs on the EZ10
    - One at the front and one at the rear of the vehicle (bi-directional vehicle)
    - LiDARs 16 layers
    - Range of 260 feet
    - 180-degree horizontal scanning
    - 32-degree vertical opening
    - Used for navigation by the high-level software
    - Used for obstacle detection by high-level software

Cameras — the EZ10 has indoor and outdoor cameras. EasyMile completes the development and validation of the use of these cameras for navigation and environmental detection.

Differential GPS — The EZ10 is equipped with a GNSS antenna from the Canadian manufacturer Novatel. This antenna allows the EZ10 to find its way through space thanks to the constellations of GPS, Glonass and Galileo satellites. EasyMile also uses the services of a GNSS - Real Time Kinematic correction provider referred to as "SmartNet" to refine the vehicle's position, with centimeter accuracy. GNSS corrections are received via the 3/4G network, and are determined using a set of SmartNet reference bases. They do not require the installation of an additional reference base dedicated to this project, which are often problematic and vulnerable to cyber attacks.

Inertial Measurement Unit (IMU) — The EZ10 is equipped with an inertial unit capable of integrating the vehicle's movements (acceleration and angular velocity) to estimate its orientation (roll, pitch and heading angles), linear velocity and position.

Odometric Estimation — The EZ10 has sensors on the wheels to measure the vehicle's movement. Odometry is based on the measurement of wheel movements to reconstruct the overall movement of the vehicle. Starting from a known initial position and integrating the measured displacements, the current position of the vehicle can be calculated at any time.

Software Architecture:
Independent Obstacle detection function — The processing power needed to run an autonomous vehicle is huge. There is no certified processing unit with enough computing power to enable obstacle detection functions. Our approach is based on adding an independent safety layer: the Safety Chain. This architecture mitigates the risk of processing unit failure (due to hardware or operating system fault).

By design, the EZ10 is composed of two main levels:

1. An industrial-grade computer with a tailor-made version of Linux enabling better control of processing and cyber-security than commercial OS (Operating Systems). Complex filtering algorithms are embedded on this computer to monitor obstacles around the shuttle, calculate collision probabilities and adapt its behavior accordingly.
2. A Safety Chain based on a certified PLC (Programmable Logic Controller) is independent from the main computer. It uses very simple algorithms and can perform emergency stops should the main computer fail to anticipate the potential collision.

Focus on the PLC — The PLC used in our Safety Chain is SIL3 certified (according to IEC 61508 Functional Safety standard) and PLe certified (according to ISO 13849 "Safety of machinery - Safety-related parts of control systems" standard).
The PLC performs the following tasks with a high safety level inherent to its certification:

- Continuous monitoring of critical components (such as steering and traction controllers, braking systems, LiDAR sensors, emergency buttons, main computer, etc).
- Triggering of an emergency stop, in case of Safety Chain, emergency button activation or detected failure of monitored components. This will enable to ensure that vehicle and its passengers are safe.
- Safe Door and Automatic Ramp management (opening and closing) - one of the most critical function in transportation systems because of potential injuries, failures and unavailability.

The PLC outputs are always considered with the highest level of priority over the other robotics, electronic or computer systems. In case the PLC encounters a failure, its certification level ensures that it will reach its fail-safe state. In this state, our fail-safe brake will be automatically activated to enable vehicle to stop.

Supervision — System Brain

EasyMile has developed EZ Fleet, its own Fleet Management system able to handle a fleet of any type of autonomous vehicles based on real field data from the ongoing projects around the world. The EZ Fleet is the electronic brain of the whole system. It is designed to be flexible and modular, so as to enable different operating scenarios and to adapt to the various needs of our customers.

EasyMile's Driverless Software Stack

Localization and Navigation Capabilities

- Known Environment and Pre-Programmed Paths — To move autonomously, the vehicle runs along a pre-programmed route designed by a deployment engineer. Thanks to localization techniques, the vehicle knows its position on the route and moves from one station to another following its trajectory. During deployment, the engineer makes an acquisition by driving in manual mode with the vehicle (trajectory, environment, GPS position, etc.). This acquisition is then cleaned, the trajectories reworked to be comfortable for passengers, and serves as a reference map for the vehicle during operations. This map contains the programmed speed for each road section, the activation of the indicators or bell if necessary, the presence of red lights, traffic signs (Stop, Yield, etc), stations, etc.
- Data Fusion and Interpretation — The high-level software collects, fuses and interprets data from the above-mentioned sensors. In particular, a technique called S.L.A.M (Simultaneous Localisation And Mapping) laser, consists in measuring, using laser beams (our LiDARs), the distance from surrounding objects (buildings, trees, rocks, etc) and thus makes it possible to create a mapping of its environment. This system requires sufficient "hang points" for the laser detectors that are used to locate the vehicle in its environment. The environment around the road planned for the EZ10 in Adrian is very rich in "hang points" for LiDAR localization. The fusion of data from the various sensors ensures redundancy and robustness in the vehicle's localization with the weak points of one system being compensated by the strong points of the others. The presence of trees on the route, or indoor traffic are excellent examples of situations where GNSS coverage will be very low or non-existent. The system is then able to detect that the uncertainty related to GNSS information is too high (0 or very few satellites detected when the vehicles normally detect between 10 and

15) and to reject the information from this sensor. The fusion of data from the other sensors is good enough, so the vehicle will continue to run without any problems.

- Intersection Management — Connected Traffic Lights
    - Intersections with Signage — At a Stop or Yield intersection, EZ10s are able to scan the environment and take the decision to cross the intersection when the area is free.
    - Pedestrian Crossing — Like Yield intersections, EZ10s are to scan a pedestrian crossing and make sure there is no pedestrian crossing or about to cross before going through.
    - Intersections with Traffic Lights - DSRC — Vehicle to Infrastructure (V2I) communication is a key component of EasyMile's technology. The EZ10 can communicate with traffic signals via a communication network (DSRC, ITS-G5, 3G, 4G, or 5G networks) and with other infrastructure (e.g., railroad crossings), as needed. The ultimate goal is to leverage these technologies in order to introduce more complex traffic situations without human intervention.
- Obstacle Detection and Appropriate Behavior:
    - Anti-collision software — This software module is based on the different LiDARs on the vehicle to slow, brake and stop the vehicle when an obstacle is perceived on the path, before calculating a circumvolution strategy. The braking capacity and speed of the EZ10 are taken into account to determine whether the perceived object is likely to cause a collision. When an obstacle is detected within the detection area covered by the vehicle, the vehicle reacts according to the position and distance of the obstacle:
        - If it is located in front of the vehicle on its trajectory, the vehicle slows down. The distance from which the vehicle begins to slow down depends on its speed. The closer the EZ10 gets to the obstacle, the slower it slows down, until it stops completely if necessary.
        - If it is located on one side of the vehicle, the EZ10 also slows down, but reaction distances are reduced.
        - If it is located at the rear of the vehicle, the EZ10 does not take it into account.
        - The stopping time of the vehicle, following the detection of an obstacle, depends on its speed. The higher the speed, the more the vehicle anticipates its stop and begins to slow down early.

- Safely proceeding when the route ahead is blocked — Sometimes when in operation, the predefined route (trajectory) can be blocked by a parked car, construction, fallen tree etc. Within a preprogrammed area, defined during the Setup by the deployment engineer based on the Site Assessment Report, the EZ10 is able to accurately assess this hazard, and if it is safe to do so, perform an overtake of this hazard. Following the successful overtake of the hazard, the EZ10 is able to resume normal operations.
- Safety chain — In the event that an obstacle is suddenly detected in the vehicle's safety zone in front of it or its side while running, the Safety Chain triggers an emergency stop. This happens, for example, if a pedestrian suddenly crosses in front of the vehicle or a car rapidly leaves a parking spot just in front of the EZ10. During an emergency stop, the vehicle is programmed to strongly decelerate in order to stop the vehicle quickly, but with minimal risk of the passengers falling.

b. Data for Safety Analysis and Rulemaking;

The City of Adrian has a long-standing and close relationship with the Gerald R. Ford School for Public Policy at the University of Michigan, and for this project will partner with staff and students, and will hire several contract employees identified by the Ford School.

This partnership and the significant capacity of the Ford School and the University of Michigan will ensure that data gathered is comprehensively shared with the USDOT, the public, and organizations, communities, and governments. Further, as a public policy focused institution, the Ford School will continue and expand its work on public policy as it relates to autonomous vehicles, being particularly well-informed because of its role in the City of Adrian demonstration project. The City is within a 45 minute drive to the University of Michigan, and that proximity will enhance the understanding, the efficacy of data-gathering, and the ability to speak with first-hand on-the-ground experience.

c. Collaboration:

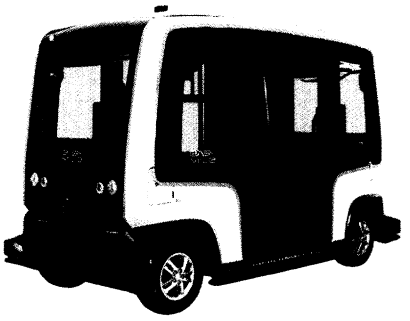
The City will collaborate with the University of Michigan Program in Practical Policy Engagement to fulfill the data management and reporting requirements indicated by the ADS NOFO, after the autonomous bus system is deployed. The City will also work closely with a variety of stakeholders, including transportation-challenged populations to seek feedback on the demonstration.

3. FOCUS AREAS. Describe how your proposed demonstration aligns with and/or satisfies the focus areas contained in NOFO Section A:

This project has been developed to cater to the needs of older populations in the City of Adrian, as they are some of the most transportation-challenged individuals who would benefit most from an autonomous bus system. The buses will also provide significant benefits to individuals working past 4:30pm (last call for Dial-A-Ride) and do not have a car. Especially for people from low and moderate-income backgrounds who do not own a car, depending on ridesharing services can be financially straining.

In addition, individuals with disabilities may not be physically able to walk long distances. Access to a reliable public transit system is critical to many residents of the City. The autonomous bus system will also allow for the City to have public transit with extended hours so that people who work late into the evening and on weekends will be able to utilize the bus system. EasyMile has already developed autonomous shuttles that have been deployed all over the world — the City plans to have a transit system consisting of three of these buses to circulate the City.

EZ10 Platform Presentation



Characteristics

The EZ10 is a driverless and electric shuttle. Up to 15 people (10 people seated, 5 people standing) can enjoy a ride on-board the EZ10, including passengers with reduced mobility. With no steering wheel or pedals, the EZ10 can navigate autonomously and travel up to 15 hours. This mobility service can provide scheduled or on-demand service and it can operate on a fixed route or provide door-to-door services within a specific road network. As such, the EZ10 is adaptable to meet the unique needs of every customer.

Operational characteristics

Description	Public transportation system for "last mile applications"
Trademark	**EasyMile EZ10 Gen2**
Type of vehicle	Electric automated shuttle
Vehicle driving automation	Level 4 - High Automation (according to SAE J3016)
Passenger capacity per vehicle	12 to 15 passengers depending on interior configuration, recommended 12 people
Seated / Standing	Up to 10 seated / 5 standing
Target passengers	Public (shared), private, or reserved/VIP operation Access for passengers with reduced mobility
Driving modes	Automated mode (normal mode) Manual driving mode with on-board remote controller (exclusively reserved to Operator use)
Driving directions	Both directions alike, vehicle is front/rear symmetrical
Service operation modes	Non-stop, Scheduled or On-demand (depending on the operating conditions and on the embedded software version)
Centrally managed fleet & Supervisory Control System	Available with EasyMile Fleet Manager solution
Peak capacity	12/15 passengers per vehicle * vehicle frequency (depending on the operating conditions)
Service frequency	Peak hours: Non-Stop or scheduled (adaptable frequency) Off-peak hours: On-demand
Times of operation	Up to 24/7 with fleet management (depending on the operating conditions)
Connections	Fixed route, network, on-demand
Track length	Last mile applications, typically < 3 miles
Number of stations	Typically one station every 700 - 1,400 feet (depending on the operating conditions)
Berths per station	Single or multiple berth stations (depending on the operating conditions and on the embedded software version)

Weather conditions	Vehicle is pending validation in the following weather conditions: • heavy rain • snow • fog • hail • temperature < 10°F and > 100°F

Specifications

Chassis and frame	Aluminium and steel
Body	Composite - Polyester resin reinforced with fiberglass Internal and external shells made of non-flammable materials
Windshield and windows	Windshield: Laminated glass, heated Windows: Tempered glass
Net vehicle weight (estimate)	4,475 lbs (4 battery packs and enhanced A/C)
Max. load capacity	2,205 lbs (up to 15 people + light luggage)
Gross Vehicle Weight (GVW)	6,680 lbs (4 batteries and enhanced A/C)
Load space	4.9 ft * 4.9 ft = 24 sq ft
Dimensions (LxWxH)	13.2 x 6.5 x 9.4 ft
Minimum turning radius	16.4 ft (measured in the middle place of the vehicle)
Wheelbase	9.2 ft
Wheel space	9.6 ft
Ground clearance	Approx. 6.7 in running - 3.5 in in station (lowered suspensions)
Vehicle floor height	Approx. 13.8 in running - 10.6 in in station (lowered suspensions)
Energy	Electric
Battery type and capacity	Lithium Iron Phosphate (LiFePo4) - 4 packs (30.72 kWh)

Charger	Wired, on-board Charging power: up to 5.7 kW in accelerated mode, compatible with 110/230 V in slow mode
Charging time	6 hours with charging stations and 30.72 kWh battery, in accelerated mode
Traction & Engines power	2 independent asynchronous electric motors - 2 * 8 kW nominal
Transmission	4 wheel drive
Direction	4 steering wheels (electrical actuators)
Max. speed	Maximum speed 30mph, electronically limited to 15mph
Max. slope	15 % @ GVW
Service brake	Redundant electrical (regenerative) and hydraulic (on discs) brakes
Parking brake	Electrical calipers (one per wheel)
Emergency brake	Fail-safe brake
Suspension	Independent / Type MacPherson
Shock absorber	Variable height pneumatic damper Automatic height adjustment
Wheel rims	15 inch steel, optional aluminium rims
Lights	Projectors, indicators, daytime running lights, stop lights, retro-reflectors Lights are front/rear symmetrical All lights modules have EC automotive approval
Connectivity	Wireless RCU (UHF) for manual driving GSM / EDGE / UMTS / LTE modem Wi-Fi modem (optional) V2X module (optional)
Disabled access	Automated electric access ramp Ramp command inside/outside Accessible E-Stop button and touch screen Wheelchair anchors points

4. REQUIREMENTS. Describe how your proposed demonstration satisfies the Requirements contained in NOFO Section A:

The City of Adrian's demonstration for the proposed bus system is fully committed to the research and and development of automation and ADS technology, and is an L4 system.

- All EasyMile's vehicles (including the EZ10) are Level 4 according to the SAE definition of Driving Automation Systems for On-Road Motor Vehicles - J3016_201806. A Level 4 system is an Automated Driving System (ADS) that can itself perform all driving tasks and monitor the driving environment – essentially, do all the driving – in certain circumstances. The human need not pay attention in those circumstances.

The City will have a physical demonstration and include the gathering and sharing of all relevant and required data with the USDOT throughout the project, in near real time. All appropriate data will remain accessible to USDOT and/or the public for at least five years after the award period of performance expires. Each demonstration will include input/output user interfaces on the ADS and related applications that are accessible and allow users with varied abilities to communicate route information and to access information generated by the ADS.

- User interface screen — The main 29" internal information screen in the vehicle provides a wealth of information including audible and visual alerts to passengers about their journey, including progress, next station, arrival time, etc. The screen can also be used to broadcast media, advertisements, explanatory videos and other media as per our customer needs, synchronizing with the vehicle localization to enhance passengers' experience.
- Emergency call button — Passengers may call the supervision center via an emergency call button located inside the vehicle, to the right of the doors. Communication is instantly established between the supervision center and passengers via cameras, microphones and loudspeakers onboard the vehicle.

Each demonstration will also address how the bus system can be scaled to be applicable across the nation to similar types of road environments, and will include an outreach task to share demonstration status, results, and lessons learned with other jurisdictions and the public, in furtherance of technical exchange and knowledge transfer. Strong focus will be placed on public acceptance utilizing before and after studies working with the University of Michigan. Data collection will also be used to help inform future autonomous vehicle studies and policy needs at the state and federal levels.

5. APPROACH

EZ10 Shipping and Importation

Through significant global shipping experience, EasyMile has developed an expertise in managing the shipment of the EZ10s. EasyMile is proposing to arrange for the shipment of the vehicles from Francazal (EasyMile's test and quality assurance site) to an agreed-upon location in the City of Adrian. EasyMile will coordinate with the City to ensure there is a forklift and/or crane and loading dock to ensure the vehicles may be safely and efficiently unloaded from its container.

Setup: First Steps with the Vehicle on the Ground

Vehicle Validation — The EasyMile Team will ensure that a staff person is on-site to unload and validate the vehicles including all associated technology having been shipped safely with appropriate assemblage. The EasyMile staff person will ensure the latest software updates have been installed and confirm the vehicle is ready for operations.

Vehicle Setup and Reference Map Creation

Once on site, a trained EasyMile deployment engineer will manually drive the EZ10 on the agreed-upon routes with the purpose of "pre-learning" its possible routes and operating environment. Over the following days, the vehicle creates a "reference map" that represents all the routes and site environment. Every intersection and station is defined in this map as well as speed limitations. The use of bell/indicators are also programmed so the EZ10 knows exactly what to do and where. This process enables the vehicle to know its exact position by comparing its perceived environment to the "reference map". Once the map and trajectories have been validated with one EZ10, the deployment engineer is able to transfer the information to the rest of the fleet and test with all the vehicles. The graphic below provides a sample reference map.

Regulations

Federal Level

EasyMile is required to get a federal exemption from NHTSA to operate on public roads (as no autonomous shuttle complies with the current FMVSS standards). In October 2018, NHTSA updated their process for granting these approvals and EasyMile was the first to apply and be approved for projects via this new process.

EasyMile was at the forefront of this change with the federal government during this process. This is a testament to the level of experience that EasyMile has deploying

autonomous technology around the world and resulting in them as global leaders in this space. They continue to work closely with NHTSA, the Federal Transit Administration (FTA), Federal Highway Administration (FHWA), Volpe, and other branches of the federal government and work continually with California, Colorado, and other states as driverless regulations are developed and refined.

The updated federal process requires the importer to submit vehicle and project-specific information. Once the application is submitted, the process is estimated to take less than 60 days. To date, EasyMile has successfully imported all of our vehicles (around 20 vehicles) and received approvals for all of projects (over 30 project-specific approvals).

EasyMile is committed to providing data and participating in the evaluation of the safety outcomes of the autonomous electric bus system, and will note measures of effectiveness in other arenas, such as mobility. EasyMile is proud to be of global assistance refining the regulations around autonomous vehicles to ensure the United States remains at the forefront of innovation. Lauren Isaac, Director of Business Initiatives, continues to influence the national discussion on autonomous vehicles as the co-chair of ITS America's Autonomous Vehicle Taskforce.

State Level

It is our understanding is that there is nothing in the existing or proposed new regulations that prohibit this project from proceeding. The City of Adrian and EasyMile value government partnership and we will work with the Department of Transportation and other stakeholders to ensure current and future legislation is aligned with EasyMile's driverless technology.

Local Level

There are no City of Adrian regulations that would provide any barriers to this project; however, EasyMile will be happy to work with local regulators and policy makers to educate them on the safety of the EasyMile technology and ensure they are comfortable with the project proceeding.

Safety and Insurance

EasyMile has a comprehensive insurance package that it offers as part of all of the company's vehicle leases, and has the backing of some of the largest insurance companies in the world. From product and commercial general liability, automobility

insurance, marine insurance and workers compensation to name just a few of EasyMile's policies.

After conducting a study of the EZ10 architecture and EasyMile safety processes, EasyMile's partners including Allianz Worldwide Partners, AXA, AON and HDI Global are key partners offering EasyMile's worldwide policies. EasyMile signed an International Framework Agreement with these companies, and as of January 2017, Allianz Worldwide Partners offers third party liability and motor own damage insurance coverage for EasyMile's EZ10 driverless electric vehicles. Since the start of this global agreement, projects have already been leveraging this insurance partnership in many countries including the US.

Maintenance Operations

During its life cycle, several preventive maintenance interventions are scheduled on the vehicle and corrective maintenance tasks can be necessary. These tasks fell into three main categories according to the skill level needed to achieve the tasks:

- L0 - Tasks performed by operators:
    - Functional tests of the vehicle subsystems: infotainment, air conditioning, lights, etc.
    - Windshield wiper replacement
- L1 - Tasks performed by EasyMile or a technician trained and certified by EasyMile
    - Replacement of wearing parts: tires, brake discs, brake pads, etc. (according to manufacturer's specifications and wear and tear)
    - Draining of fluids (according to manufacturer's specifications)
- L2 - Tasks performed by EasyMile staff
    - Localization and safety pieces of equipment calibration (yearly)
    - Software updates (twice a year)

Human Operator's Role

At the end of 2018, EasyMile introduced its first project without a safety operator. This project originally included a safety operator and then, once the project met very specific criteria, EasyMile (in partnership with the client) decided it would be safe and acceptable to the passengers to remove the safety operator. Projects like Adrian's are at the edge of what technology is able to provide today. This means that a safety operator will be necessary for at least the next few years. This is an EasyMile decision; however, it is reinforced by Michigan State law.