

Kansas City Area Transportation Authority

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“Show-Me” ADS Demonstration

Part 1:

Project Narrative and Technical Approach

March 21, 2019

RideKC

March 21, 2019

United States Department of Transportation
1200 New Jersey Avenue, SE
Washington, DC 20590

Dear Madam or Sir:

The Kansas City Area Transportation Authority (KCATA) is pleased to submit our application for funding under the U.S. Department of Transportation's (DOT) Automation Driving System Demonstration (ADS) grant program. This demonstration will be critical for developing policy around how this technology is incorporated onto the roadway infrastructure and how to increase roadway safety, identifying efficient means for increasing commerce, and maximizing the value of infrastructure investments. Additionally, KCATA believes that incorporating this technology into the public transportation network will allow for addressing consumer and employer needs in a more holistic manner, resulting in bolstering local economies and positively affecting quality of life.

The KCATA is a recognized public transportation leader in identifying and implementing projects that utilize public-private partnerships to improve how services are delivered to consumers. Over the past five years KCATA has focused on delivering services focused on improving the economy and providing access to jobs and healthcare. The KCATA has done this by partnering with the private sector to unleash and harness the creativity and know-how of the private sector. This approach has provided notably positive results in the emerging on-demand service model focusing on both the general public and persons with disabilities. We have provided more than 1 million free bus trips to Veterans under a partnership agreement that allows Veterans to access needed services and jobs. Finally, our third bus rapid transit line will be operational in December 2019 and incorporates state of the art technology designed to provide an enhanced customer experience and provide much needed local economic stimulation along the corridor where it will operate.

KCATA's proposal to demonstrate automated vehicles on public roads builds on efforts of the last few years to make the transportation system in the KC region more customer-centric, accessible and focused on access to jobs. It also is aligned with our mission of connecting people to opportunities. Our Board, community and employees stand at the ready to implement this important project and are excited about this very promising opportunity. We look forward to your feedback.

Respectfully,



Robbie Makinen
President and Chief Executive Officer

Summary Table

Project Name/Title	“Show-Me” ADS Demonstration
Eligible Entity Applying to Receive Federal Funding (Prime Applicant’s Legal Name and Address)	Kansas City Area Transportation Authority (KCATA)
Point of Contact (Name/Title; Email; Phone Number)	Jameson Auten/Vice President, Regional Service Delivery and Innovation Division JAuten@kcata.org (816) 346-0895
Proposed Location (State(s) and Municipalities) for the Demonstration	Kansas City, Missouri
Proposed Technologies for the Demonstration (briefly list)	Level 4 ADS Technology, including: EasyMile Sensor Stack: LiDAR, cameras, differential GPS, inertial measurement unit (IMU), odometric estimation EasyMile’s Driverless Software Stack: Yocto Linux operating system, obstacle detection, localization and navigation, anti-collision, vehicle-to-infrastructure communication, black box EZFleet fleet management: vehicle to cloud communications Cybersecurity
Proposed duration of the Demonstration (period of performance)	3.5 Total Years (2.5 Years of Demonstration)
Federal Funding Amount Requested	\$4,308,954
Non-Federal Cost Share Amount Proposed, if applicable	\$499,666
Total Project Cost (Federal Share + Non-Federal Share, if applicable)	\$4,808,620

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1 EXECUTIVE SUMMARY.

1.1 Vision, Goals, and Objectives

Kansas City Area Transportation Authority (KCATA) is continuously searching for ways to provide safe and efficient transportation options for residents and visitors to the Kansas City area. Toward that end, KCATA will perform three phases of “Show-Me” Automated Driving System (ADS) demonstrations over the next four years. The goal of the demonstrations is to assess the viability of autonomous vehicles for transit in the Kansas City area. Specifically, KCATA seeks answers to the following questions:

- Do the autonomous vehicles perform safely and provide effective service, particularly sharing the roadways with other traffic and with Kansas City’s weather and road conditions?
- How willing are Kansas City residents and visitors to accept autonomous transit?

1.2 Key Partners, Stakeholders, Team Members, and Others

KCATA will partner with Mid-America Regional Council (MARC), engineering firm TranSystems technology company EasyMile and University of Kansas (KU) to complete the “Show-Me” ADS demonstrations. KCATA will partner with manufacturer Navya for Phase I (not included in the grant application).

The riders of public transit in the Kansas City area—residents, workers, and visitors—are key stakeholders in the ADS demonstration. The businesses, employers, and urban housing facilities along and near the demonstration routes are also stakeholders. Many of these businesses may serve as minor partners. KCATA will also utilize TranSystems Corporation to perform engineering and planning services. KCATA will coordinate the “Show-Me” ADS demonstrations with the City of Kansas City and local services, including law enforcement, emergency response services, and public transit authorities.



1.3 Issues, Challenges, Technology, and Performance Improvements

KCATA expects it will face many challenges with its “Show-Me” ADS pilot program.

- Physical: Some of the physical challenges will be extreme weather conditions with hot, humid summers and sub-zero temperatures, snow and ice in winter, all which contribute to less than optimal roadway conditions. The urban environment of the demonstrations will entail a variety of roadway traffic. In addition to passenger vehicles, the roadways selected for ADS demonstrations are also used by transit buses, streetcars, commercial trucks, bicyclists, and pedestrians. Roadway maintenance crews may also be present.
- Cultural: Midwesterners may be more skeptical about driverless vehicles than residents of more high-tech areas, such as Silicon Valley or Seattle. Missourians, in particular, have to be shown to be convinced. Accordingly, KCATA has selected some highly visible routes for its “Show-Me” ADS demonstrations so it can maximize public exposure.
- Technological: While KCATA’s partner, EasyMile, has implemented its autonomous shuttles in numerous locations worldwide.

Geographic Area and Jurisdiction

KCATA will conduct Phase II of its ADS demonstrations within the city limits of Kansas City, Missouri (KCMO), through urban areas that include some of Kansas City’s most historical and iconic sites. Phase II will provide first and last mile of transit along 18th Street between Main Street on the west terminus and Prospect Avenue on the east. This east-west thoroughfare currently has limited transit options, though several cross streets do have north-south routes including RideKC Streetcar on Main and the Troost and Prospect MAX corridors. **Figure 1** illustrates the demonstration corridor. Phase I of the demonstrations, not officially part of the “Show-Me” ADS demonstration grant request, will be conducted on less traveled roadways, including parking areas of the Zona Rosa shopping center in KCMO.

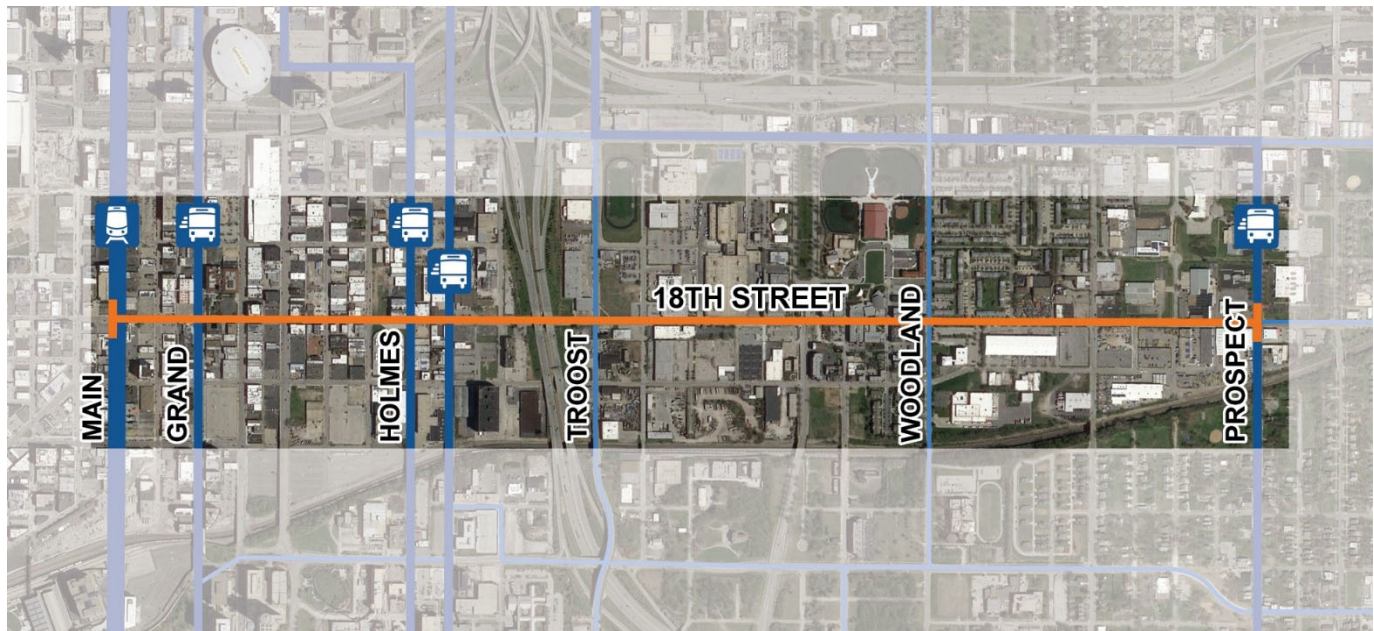


Figure 1: Phase II "Show-Me" ADS Demonstration Corridor

1.4 Period of Performance

KCATA and its partners will begin project planning immediately after USDOT awards the grant. As suggested in the NOFO, a kickoff meeting will be held within three (3) weeks of the award, followed by development of the Project Management Plan (PMP), the Data Management Plan (DMP), and establishing a Project Evaluation Plan (PEP).

KCATA will order the equipment, five EZ10 shuttles within the first month of award to minimize the impact lead time in procuring the equipment will have on the demonstrations. Two to three months before the EZ10 equipment is delivered to Kansas City, EasyMile staff will perform a site assessment of the planned route. After delivery of the equipment, deployment and testing will be performed, including manual operation of the vehicles over the route to “acquire” the trajectory for the ADS. Just prior to the demonstrations, EasyMile will conduct training for the attendant/ambassadors.

A proposed schedule for Phase II demonstrations is as follows:

Project Task	2019					2020					2021					2022																
	J	F	M	A	M	J	J	A	S	O	N	D																				
Grant Award																																
Project Planning																																
Procurement																																
Site Assessment																																
Deployment																																
Training																																
Demonstration																																
Reporting																																
Management																																
Communication																																

Figure 2: Phase II "Show-Me" ADS demonstrations schedule.

2 GOALS.

While KCATA’s priorities for the “Show-Me” ADS demonstrations lean toward assessment of public acceptance of the technology, it will also be designed to satisfy United States Department of Transportation’s (USDOT) goals as described in the notice of funding opportunity (NOFO).

The program will focus on delivering the following transport solutions within Kansas City area in order to:

- Provide a new mobility solution within the City;
- Introduce the potential of autonomous shuttles and buses 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 and buses in a real-life setting;
- Offer safe, secured and on demand transport services.

2.1 Safety

Transportation with autonomous driving systems (ADS) have the potential to be safer than vehicles with a human driver precisely because they can eliminate common human errors, such as driving while distracted, while drowsy, or while impaired. ADS may also improve upon human driving performance because it will consistently follow speed limits and other traffic laws and can gauge distance more accurately than human perception. When incorporated into a transit environment with multiple passengers per vehicle, safety benefits of ADS extend to more people. “Show-Me” ADS demonstrations will test whether automatous shuttles and a full-sized bus can operate efficiently and safely integrate with mixed traffic on Kansas City’s city streets.

2.2 Data for Safety Analysis and Rulemaking

“Show-Me” ADS demonstrations will gather and share project data. Through EasyMile’s application programming interface (API), we will provide numerous data points to determine reliability, feasibility, and safety of the EZ10. Examples of the data include the number of disengagements, battery life of the vehicle, real time position, and unexpected obstacles. This data will be available in real time and can be provided to the USDOT. We will also collect data on operating performance to determine the viability of the AVs on the road. These data points include, but are not limited to, mileage, speed, and number of ramp deployments.

EasyMile collects thousands of data points by fusing and interpreting data from the sensors. This data is collected and can be presented in numerous forms to allow for analysis. We are able to generate daily reports for KPIs and also provide real time feed through our APIs.

For this demonstration we will be providing the following data points digitally to allow for a thorough analysis of the performance of the vehicle

- Real Time Position: latitude (radian WGS84) / longitude (radian WGS84) / theta (radian)
- Speed (m/s)
 - Average
 - Top Speed
- Battery level (%)
- External/Internal temperatures (°C)
- Doors: open/closed
- Vehicle Activity
- # of Ramp Deployments
- % time in Autonomous Mode Versus Manual
- % Availability
- Schedule Adherence
 - Vehicle Pullout
 - On time Performance by Stop

- Passenger Counts (insert Partner APC)
- # of uses of vehicle accessories
 - Wipers
 - Bells/Horns
 - Cameras

In addition our software will be collecting some key metrics to provide a better risk analysis of the vehicle performance. Our technology is premised on two major practices: Localization and Navigation while ensuring obstacle detection and avoidance. Thus the best metrics to evaluate the success of those practices are through a variety of data available around disengagements which require the intervention of the safety operator.

By CA DMV definition a disengagement is “deactivation of the autonomous mode when a failure of the autonomous technology is detected or when the safe operation of the vehicle requires that the autonomous vehicle test driver disengage the autonomous mode and take immediate manual control of the vehicle”.

EasyMile is able to collect this data both digitally and through reports provided by the safety operator, we will be able to provide information on

- The total number of disengagements
- Circumstances and/or testing conditions
- Location
- Expected Cause of the disengagement
- Total number of miles between disengagements

Examples of causes for disengagements could be

- Unexpected environmental changes
- Loss of Localization, causing a proper safety stop
- Poor driving road user
- Pedestrian not paying attention
- Unwanted movement of the vehicle causing safety system to stop vehicle
- System detects potential software malfunction
- System detects potential Hardware Malfunction
- Obstacle that cannot be circumvented
- Passenger discomfort requesting a stop

Analyzing frequency and cause of disengagements, provides the best metric on how the autonomous technology is performing. This data from this metric will be key to identify risks, opportunities, and insights to advance rulemaking in parallel with the evolution of AV system capabilities including:

- Optimum speeds for AV’s that provide the highest level of accuracy in obstacle detection

- Optimum speeds for speed limits on other road users
- Education of for pedestrians along AV Routes
- Initial environmental conditions, such as warm sunny climates, and evolving into rain and snowier areas
- Passenger behaviors that affect performance of the AV
- Parking rules along AV routes
- Infrastructure improvements to support better localization for AVs
- Introduction of connected corridors to provide better information for AV's

Finally, KCATA also plans to gather information about public opinion toward autonomous vehicles (AV) and transit using ADS. KCATA plans to use researchers from University of Kansas (KU) to survey individuals about their comfort with AV before and after riding the autonomous shuttles and bus, as well as those who opt not to ride. KU will then analyze and report the results of the survey. The University of Kansas will serve as an independent researcher to gather and analyze data about the public's perception of the ADS transit being demonstrated and to analyze data gathered by the ADS technology to make conclusions about its safety. The following are the topic areas and research questions that will be analyzed by the team at the University of Kansas:

- Public Perception and Acceptance
- Customer Adoption
- Safety and Performance
- Ridership and Mobility Characteristics
- Implementation

2.3 Collaboration

“Show-Me” ADS demonstrations will be a collaboration of KCATA, the foremost authority of transportation issues in Kansas City; EasyMile, an ADS technology leader with autonomous vehicles operating world-wide; and University of Kansas (KU), a member of the Association of American Universities with a record for research innovation. These major partners will apply their expertise to conduct and document ADS demonstrations with real, mixed-use urban traffic.

KCATA plans to involve additional stakeholders in the demonstrations. Businesses along the routes and Visit KC (visitors' bureau) will be kept informed and will be asked to help publicize the “Show-Me” ADS demonstrations. Law enforcement will be involved in the demonstration set-up and patrol of the areas to help ensure the demonstrations are safe. The public will be invited to ride and provide their feedback about the experience.

3 FOCUS AREAS.

The "Show-Me" ADS demonstrations align with the Focus Areas contained in NOFO Section A, as follows:

3.1 Significant Public Benefits

"Show-Me" ADS is an ambitious project for advancing the public benefits of autonomous vehicles in a transit application. The most significant benefits will be the knowledge and experience gained regarding ADS transit, both regarding the system's effectiveness and the public's acceptance of the technology. This information can subsequently be applied to potential deployments on a permanent basis in Kansas City and other communities throughout the U.S. The expected benefits of automation include safety and operational improvements, generating cost savings. Because autonomous vehicles can avoid errors made by humans while driving, such as driving while distracted or disobeying traffic laws, ADS may prove to be safer, avoiding accidents with other vehicles and pedestrians. Using ADS for transit can also minimize myriad scheduling and cost issues related to human drivers because the ADS will never have the flu, request time off for bereavement leave, nor require overtime pay.

Automation could be used to implement new forms of transit service, such as incremental service for the first and last mile like that in the Phase II route, that provide a competitive alternative to the private automobile. For those unable to drive or without access to an automobile, autonomous transit can increase mobility, flexibility, and convenience.

Electric vehicles are especially well suited to automation because the duty cycle of an autonomous vehicle can be much longer than a non-autonomous one (e.g., it does not require a change of driver after meeting hours of service limit). Electric vehicles generate savings in both energy and maintenance costs compared to vehicles running on fossil fuels, as well as produce zero emissions.

The "Show-Me" ADS demonstrations are also designed to provide safe and effective transit services while they are conducted.

Phase II demonstrations will provide incremental public transportation for the first and last mile of travelers' trips. The 1.7 Mile route along 18th between Main Street and Prospect is home to residents in Kansas City that most often rely on public transportation for access to school, employment and shopping. With Kansas City attractions such as the Negro League Baseball Museum and the 18th and Vine jazz district served on the route, "Show-Me" ADS demonstrations will provide a transportation option to residents and visitors alike.

A query of the U.S. Environmental Protection Agency (EPA) Environmental Justice Screening and Mapping Tool (V. 2018) was performed on March 18, 2019. The boundaries of the corridor are from 16th Street on the north to 20th Street on the south. The west boundary began at Main

Street and extended to Prospect Avenue on the east. The 2012-2016 American Community Survey (ACS) Estimate reported the following population estimate for the studied corridor:

A field survey was completed of this area to examine economic conditions due to the rapidly changing nature of the corridor. Use of existing buildings included art galleries, retail spaces, food and beverage establishments, and multi-unit office spaces. Approximately 235 commercial properties appeared to be in use. This number includes some buildings that were partially occupied and may have had one or more units for lease at the time of the survey.

Data was also obtained using the 2013-2017 American Fact Finder estimate online database. This data was used in order to provide a broader picture of the two census tracts (158 and 161) associated with the corridor. The total population of the two census tracts is estimated at 3,369. The population 16 years and older of Census Tract 158 is estimated at 1,489 and had approximately an 80% Labor Force Participation Rate. The estimated population 16 years and older for Census Tract 161 is listed 1,657 with a Labor Force Participation Rate of 65%. 1,548 persons aged 16 to 64 had a full-time year-round work status in the last 12 months.

3.2 Addressing Market Failure and Other Compelling Public Needs

East – West transit connections along Kansas City’s Urban Core to Downtown need improvement. The ability to serve low-income residents, seniors, and persons with disabilities with lower cost services, harnessing technology is vital to connecting people to opportunities, services, and jobs. Implementation of automated vehicles will allow KCATA to address a these issues by connecting to three high-frequency service modes. Additionally, the launch of the Prospect MAX BRT line, which will connect to this project, includes technology that has proven effective at helping to reduce crime in other corridors. This service, along with this project, will address safety issues that negatively impact disadvantaged groups being able to access the region.

3.3 Economic Vitality

While EasyMile’s EZ10 shuttles are manufactured in Vichy, France and its base ADS technology has already been developed in Europe, knowledge gained through the demonstrations will facilitate the domestic industry’s future deployment of ADS transit vehicles.

3.4 Complexity of Technology

“Show-Me” ADS demonstrations will test Level 4 ADS small shuttles with room for 15 passengers. The ADS technology has already been successfully integrated into EasyMile’s EZ10 shuttle.

EasyMile’s ADS technology scans the environment using LiDAR and cameras; monitors vehicle location using GPS, inertial measurement, and odometry; and navigates the vehicles over pre-programmed routes. The technology uses both vehicle to vehicle and vehicle to infrastructure (V2I) communications. The ADS not only avoids collisions, but can lead the vehicles around obstacles in its path. See Part 2, Section 3.1 for more details about the capabilities of EasyMile’s ADS technology.

3.5 Diversity of Projects

“Show-Me” ADS demonstrations are expected to be different from previous ADS testing. Most ADS pilot programs have tested passenger vehicles or heavy trucks, with fewer testing transit applications. “Show-Me” ADS demonstrations will test L4 automation in transit vehicles, both in a “first and last mile” situation. 18th Street, the site for Phase II testing, has limited transit connectivity.

Among prior ADS demonstrations for transit, some have entailed controlled environments, such as Minnesota Department of Transportation’s 2017-18 testing on its test track (MnROAD) and on city streets temporarily blocked to other traffic, while other entailed areas with limited use, such as Regional Transportation District’s (Denver) current demonstration taking place on public roads having minimal traffic. “Show-Me” ADS will be conducted on 18th Street a heavily traveled thoroughfare in Kansas City with high-profile attractions along the route, providing “real world” ADS transit testing.

3.6 Public Transit Propensity

Individuals may be transportation-challenged for many reasons: Populations who often rely on public transportation include older adults, persons with disabilities, low income and/or zero car households. For these groups of people, additional transit options, such as transit with ADS, will improve the accessibility to employment, medical, shopping, and entertainment destinations.

The EZ10 shuttles are equipped with ramps so that those in wheelchairs may easily enter and exit the vehicles. Attendants/ambassadors will also be on hand to assist, as necessary. The Phase II “Show-Me” ADS demonstrations will test EasyMile’s existing EZ10 vehicles in mixed traffic in Kansas City’s urban environment.

3.6.1 Federal Level

EasyMile is required to get a federal exemption from National Highway Transportation Safety Administration (NHTSA) to operate on public roads since no autonomous shuttle complies with

the current Federal Motor Vehicle Safety Standards (FMVSS). In October 2018, NHTSA updated their process for granting these approvals. EasyMile was the first to apply and be approved for projects via this new process, a testament to the level of experience that EasyMile has deploying the autonomous technology around the world.

Because the “Show-Me” shuttles will be manufactured in Vichy, France, EasyMile will submit vehicle and project-specific information, following the updated federal process for importers. Once the application is submitted, the process is estimated to take less than 60 days. To date, EasyMile has successfully imported all of its vehicles (around 20) and received approvals for all of its projects.

3.6.2 State and Local Level

KCATA is not aware of any Missouri or City of Kansas City regulations that would prohibit the “Show-Me” ADS project from proceeding. Should any such regulations be identified, KCATA will work with EasyMile and the appropriate government agencies to secure any needed exemption(s). If necessary, the team will discuss the safety of the EasyMile technology with state and local regulators and other stakeholders to ensure all are comfortable with “Show-Me” ADS demonstrations proceeding on Kansas City streets.

4 REQUIREMENTS.

The proposed “Show-Me” ADS demonstrations satisfy USDOT’s Requirements contained in NOFO Section A:

4.1 ADS technology

Both Phase II and Phase III “Show-Me” ADS demonstrations will focus on the research and development of L4 automation and ADS technology (per the SAE definitions), with Phase II using a smaller shuttle vehicle and Phase III using a 35-foot electric bus. While the vehicles will have an attendant/ambassador onboard during the demonstrations, the vehicles will operate autonomously.

EasyMile’s EZ10 shuttle has already been developed and placed in service in a number of locations around the world.

4.2 Physical demonstration

“Show-Me” ADS will entail two separate physical demonstrations, both in the urban environment of Kansas City, Missouri, and are planned to entail public ridership, encountering a variety of traffic conditions.

KCATA will conduct Phase I ADS demonstrations—not part of the ADS demonstration grant request—on less traveled roadways, including parking areas of the Zona Rosa shopping center in KCMO and on the Johnson County Community College campus in Overland Park, Kansas. KCATA will learn from this experience to inform and improve its test plan for Phases II and III, which will run on highly traveled urban roadways.

Both phases of demonstrations will last six months, so will encounter Kansas City’s wide range of weather conditions. The graphs below (**Figure 5**) from rssWeather.com illustrate that temperatures range from average lows in January approaching 0°F to average highs in July approaching 90°F. Actual temperatures are occasionally less than negative 10°F or over 100°F. Precipitation includes rain, fog, snow, sleet, and hail. Severe weather, including tornadoes, is common in the spring and summer months.

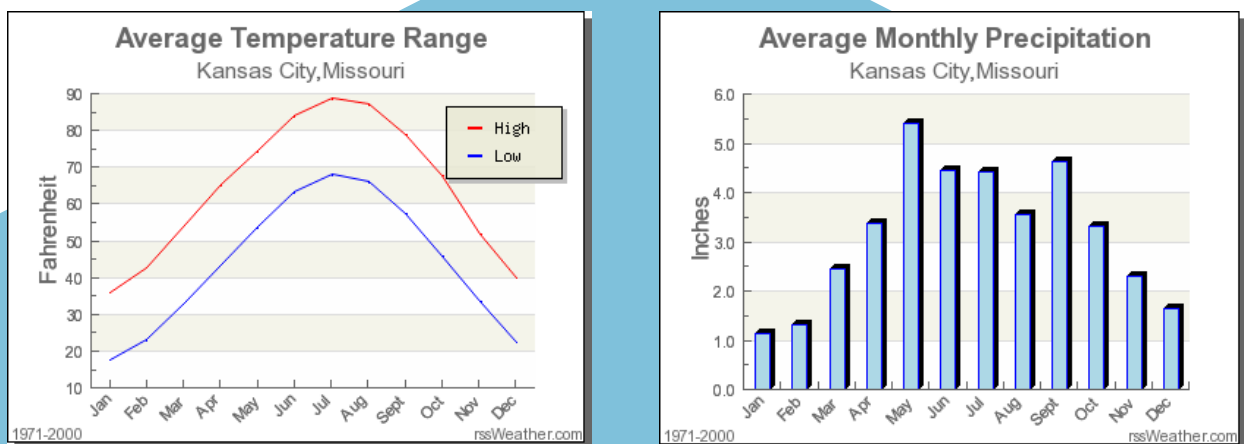


Figure 1: “Show-Me” ADS demonstrations will entail Kansas City’s wide-ranging climate.

4.2.1 Phase II demonstration

Phase II will entail a shuttle route up and down 18th Street between Main Street and Prospect Avenue, approximately 1.71 miles each direction. Along the route is 18th and Vine, KC’s Jazz District and the Negro League Museum (see **Figure 6**), as well as numerous small businesses.



Figure 2: KC's historic jazz district and Negro League Baseball Museum.

Challenges for this “Show-Me” ADS route (Phase II) entail the following:

- Traffic: Average annual daily traffic on 18th Street is about 2,700 on the western end and 1,400 on the eastern end. There are six (6) traffic signals and two intersections with four-way stops along the route.
- Stops: Stops along the Phase II route have yet to be determined, but will likely be every three to four blocks and located conveniently for area businesses and attractions.

4.3 Data sharing

Both “Show-Me” ADS demonstrations will include the gathering and sharing of all relevant and required data with the USDOT throughout the project, in near real time. During the planning stage, the “Show-Me” ADS team will work with USDOT to identify exactly what data is desired to achieve USDOTs and the team’s goals. EasyMile will make the agreed upon data available through an API or real time reports. EasyMile will also store the data and make it accessible to USDOT for up to five (5) years.

4.4 Input/output user interfaces

Both of the “Show-Me” ADS demonstrations will have well-defined Operational Design Domains (ODDs). The ODDs will be very limited and may only include the specified transit routes and the route(s) to/from charging, maintenance, and storage areas. The input/output interface available to demonstration staff will only allow the user to order the vehicles go to a destination that is part of the ODD. The input/output interface available to public participants will be limited to communication about the available destinations along the route, such as estimated arrival time.

The input/output interface will be designed to be intuitive so that users with varied abilities will be able to use it.

4.5 Scalability and knowledge transfer

This program will be a scalable process of programming, deployment and training that will effectively meet quality and safety standards. 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 KCATA 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 APIs in addition to training the City’s Customer Service Ambassadors on how to collect useful operating data throughout the service.

5 APPROACH.

We have developed phased approach to this pilot program:

- 1) Comprehensive Site Assessment
- 2) Setup – First Steps
- 3) Specifications
- 4) Safety Plan
- 5) Pilot Deployment

5.1 Comprehensive 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.

The team will then review the findings with KCATA, assess the feasibility of the proposed routes, and ensure that all of these recommendations are appropriately addressed prior to finalizing the vehicles’ route location and operating assignment.

5.2 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 would create a “reference map” that represents all of the routes and site environment.

Every intersection and station is defined in this map; and speed limitations and the use of bell/indicators are 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.

5.3 Specifications

The main objective of this phase is to clearly define the behaviors of the vehicle within its environment and how the operators will be able to interact with it. This work consists of discussing and specifying the project goals and the associated performance metrics that can be evaluated and reviewed throughout the duration of the project.

5.4 Safety

This work will consist of assessing all the possible risks that are linked to a pilot program defining the corresponding safety levels and explaining how the autonomous vehicle will bring an answer to all these dangerous situations.

Several documents will be the deliverables of this phase:

- **Safety requirements:** it will consist of a safety plan definition, a HARA (Hazard analysis And Risk Assessment) and the safety goals definition (PL / SIL)
- **Functional safety concept:** it corresponds to the definition of the functional safety requirements based on the architecture (allocation of safety level on the components of architecture) it is done jointly with the technical safety concept work. It defines what component is answering to each safety situations
- **Technical safety concept:** it defines the technical specification (HW & SW), the final architecture, and provides the redundancy analysis

5.4.1 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 and other road users to remove the safety operator.

Projects like Kansas City's are at the edge of what the technology is able to provide today, which 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 regulations.

Today, daily operations still requires some human intervention, including, for example, starting the service at the beginning of the day, conducting a test run and ensuring the trajectory is clear, and cleaning and charging the vehicle at the end of the service day.



EasyMile has the following requirements for CSAs:

- The operator will be trained and certified by EasyMile staff and will be always able to take the control back and drive the vehicle manually.
- An industrial grade wireless remote control enables this transition very easily. While driving in manual mode, the safety chain remains enabled to avoid human error.
- Steering the EZ10 using the remote control requires to be in manual mode. Switching to manual mode requires to switch ON a physical button inside of the vehicle, to prevent any unintentional manipulation while driving in autonomous mode.

5.5 Pilot Deployment

The deployment will be carried out by the EasyMile team and the service will be operated by trained EasyMile team members.

The successive steps for deploying efficiently the service will be:

- **The site analysis and preparation:** An EasyMile Engineer will review the selected customer site, analyze all the potential risks due to the environment and other site users. A document named SAR (site assessment report) is edited to explain all the risks and the eventual mitigations needed to be installed in order to ensure the safety on site. These mitigations should be carried out by the customer with the project team support
- **The setup on site:** During this task, the vehicle is delivered on the customer site, the EasyMile engineers create the cartography and the paths of the site, and the shuttle is deployed and tested along the route to ensure it is ready for operations. Additionally, local safety operators are trained. **The support during the service:** During the duration of the pilot, the EasyMile engineers remain available to support the operators in case of a remaining bug or if something happens and a modification of the site cartography is needed

5.6 Legal, regulatory, environmental, and/or other obstacles

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 the autonomous technology around the world, resulting in us being recognized as the leader in this space. EasyMile continues to work closely with NHTSA, Federal Transit Administration (FTA), Federal

Highway Administration (FHWA), Volpe, and other branches of the federal government as driverless regulations are developed and refined.

5.6.1 Exemptions from safety standards

The EZ10 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. We intend to apply for this exemption for the demonstration routes immediately after award.

5.6.2 Exemptions from Buy American

The “Show-Me” ADS project will require an exception from the NOFO’s requirement that the final assembly of all vehicles occur in the United States. The basis is that there are no other autonomous shuttles available on the market that meet the following requirements:

- Commercially available Level 4 automated shuttle that can operate on public roads
- Has an automatically deploying wheelchair ramp and tie-downs for wheelchairs

5.7 Commitments

KCATA is fully committed providing near-real time data related to project results. Additionally the University of Kansas will publish a report and project findings which will inform the transportation industry and policy-makers.

5.8 Risk management

KCATA recognizes the risk associated with this project and has addressed our approach in the management plan. The risk management process emphasizes proactive planning to identify potential risks to the Project and develop appropriate responses. A key element to this process is frequent and timely communication on how the project risks are trending. Communicating risk management strategies will be included in regular project meetings. Risk management is basically broken down into five distinct activities:

- Risk Identification
- Risk Assessment
- Risk Response
- Risk Management and Control Activities
- Risk Monitoring

5.9 Cost sharing

KCATA staff time will serve as in-kind match for this project.