DOT-OST-2016-0233

CONTINUING THE SPIRIT OF INNOVATION AT WILLOW RUN

PROPOSAL FOR DESIGNATION OF AUTOMATED VEHICLE PROVING GROUNDS

SUBMITTED BY THE AMERICAN CENTER FOR MOBILITY TO THE U.S. DEPARTMENT OF TRANSPORTATION

December 19, 2016

American Center for Mobility

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CONTAINS CONFIDENTIAL BUSINESS INFORMATION (CBI)

Introduction and Facility Overview

Advanced mobility technologies, including connected and automated vehicles, shared usage, connected road networks, and transportation-focused communication systems have the potential to significantly improve safety, mobility, energy efficiency and equity. To maximize these benefits, the technologies must be developed and verified in a way that ensures a focus on these advancements, and provides many stakeholders across numerous government and industry organizations an opportunity to work with and learn from each other in a coordinated manner. Specifically, the technology development requires the establishment of a network of testing facilities, proving grounds, campuses, roadways and other "tools" to achieve these goals.

Facility Description

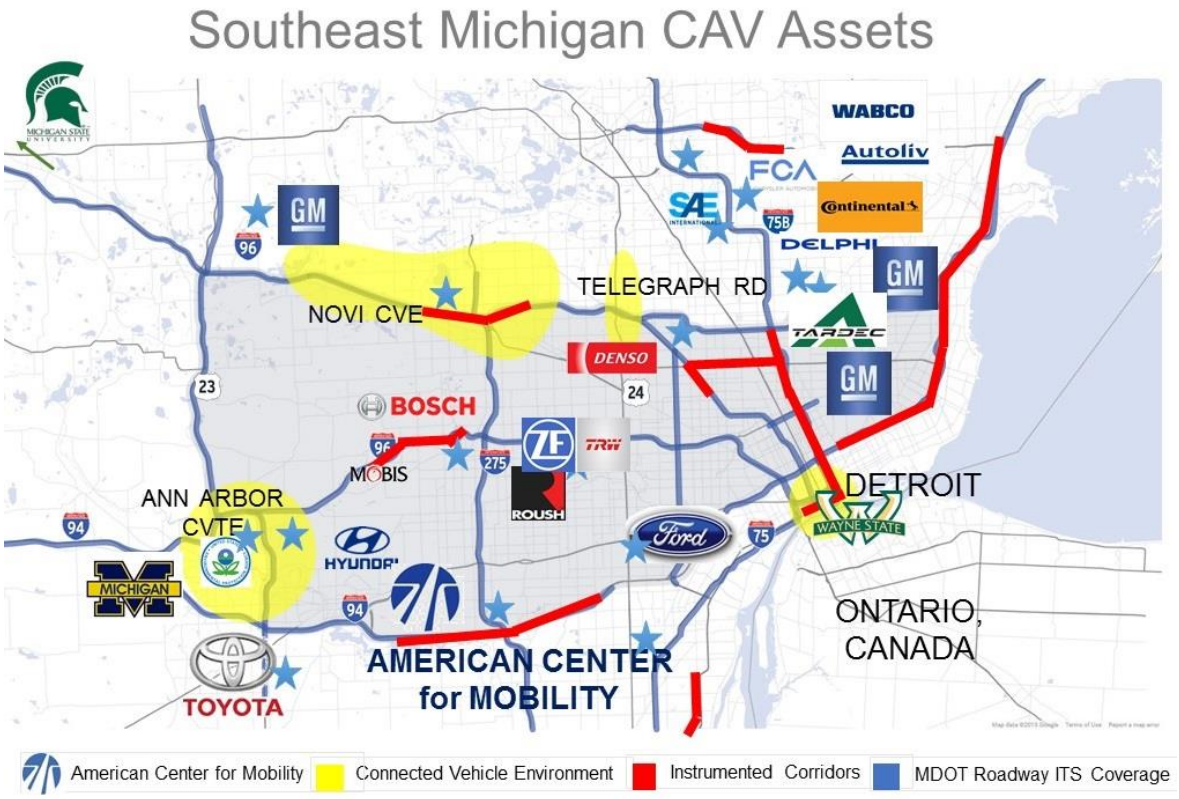
The American Center for Mobility (ACM or the Center) is a non-profit innovation, testing and product development facility and proving ground for future mobility, designed to enable safe testing, validation, and self-certification of connected and automated vehicle (CAV) mobility technology, accelerate the development of voluntary standards, and provide educational opportunities. ACM incorporates a purpose-built test track environment directly integrated with active highway corridors and a combined corporate/academic technology park campus to facilitate effective government and industry collaboration and information sharing, as well as a focus on educating and developing the mobility workforce for the future.

With $130M in direct or incorporated investment, and leveraging an additional $115M of regional assets, ACM is designed to be the premiere national proving ground for shared-use mobility and advanced automotive testing. Founded in early 2016, ACM is a non-profit joint initiative among the State of Michigan, including the Michigan Department of Transportation (MDOT) and Michigan Economic Development Corporation (MEDC), the University of Michigan (U-M), Business Leaders for Michigan (BLM), and Ann Arbor SPARK. ACM is strategically located in southeast Michigan and is recognized as a centerpiece of the state's "Planet M" initiative representing the collective mobility efforts across the state defining Michigan as the global center of mobility.

Facility Location

A groundbreaking ceremony was held on November 21, 2016 at the ACM facility, encompassing more than 468 acres at the Willow Run site in Ypsilanti Township, between Detroit and Ann Arbor Michigan, including 115 acres of repurposed public road right-of-way. Willow Run has historic significance as both an economic hub for the region and as a center of innovation. Henry Ford applied principles of mass production at Willow Run in support of the allied effort in World War II, employing more than 40,000 people and producing an average of one B-24 Liberator bomber every 55 minutes. Willow Run was the iconic workplace of the real "Rosie the Riveter," symbolic of the contributions made by women to the war effort. As this site once contributed to the innovative transformation of national defense, it now will contribute to the transformation of transportation and mobility for the future.

The Center's location in southeast Michigan is not only in the birthplace and current epicenter of the automotive industry, but also in the heart of a state that has an unparalleled concentration of industry resources, assets, and innovation. Michigan is ranked #1 nationally for the number of advanced automotive industry jobs and businesses, and #1 for the concentration of engineering talent (89,000 engineers). Michigan is home to 13 original equipment manufacturer (OEM) assembly plants, 35 OEM component plants, and 375 automotive research and development facilities, including "tech industry" new entrants. A large number of these companies and facilities are very active in the development of CAV technology, and a significant amount of engineering expertise and assets are being applied to design, testing, and validation, through all stages of research and product development.



Project Partners

ACM is a top priority of the State of Michigan, with strong support and a $37.5M direct investment from the Governor and many state agencies. ACM and MDOT, one of the country's most progressive and innovative state transportation agencies, share common goals involving the safe, but rapid, deployment of connected and automated transportation technology to achieve significant benefits for the transportation system and society as a whole. MDOT and ACM have been working together on the concept and design of the facility, incorporating both public and private rights-of-way and assets to enable the creation of the facility, including a $17.5M direct investment from MDOT. The MEDC's Michigan Strategic Fund (MSF) has invested $20M directly to ensure that the societal and economic benefits of this technology are achieved in a manner that serves and leverages the vast assets and expertise of this region. Ypsilanti Township is extremely supportive of this project, as it represents a powerful opportunity to revitalize a hard-hit community, with significant economic, education, and transportation-equity improvements for the public.

BLM, including 80 of the largest businesses in the state, has made this facility one of their top priorities, and is providing guidance and leadership, as well as engaging in private investment efforts. There is strong demand for this facility amongst these industry partners, including numerous companies developing CAVs and their associated technologies, right now. Many of these have demonstrated their support and provided significant technical guidance and input on design, equipment, and operation. Ann Arbor SPARK, as the originating "spark" of this project, has been an invaluable foundational partner to ensure that this project meets the economic, community, educational, and business development goals of the State and Local Governments, and industrial sectors.

ACM maintains a strategic partnership with U-M, a demonstrated leader in a wide variety of aspects of the technology, including transportation, engineering, law, public policy, business, urban design, amongst others. U-M has formed the Mobility Transformation Center (MTC), the premier consortium of industry and academia focused on pre-competitive research and education in all of the areas above, with over 70 member companies. MTC also manages Mcity, a first-of-its-kind purpose-built CAV test facility. In December, U-M's Transportation Research Institute (UMTRI), with a 50-year history in automotive safety,

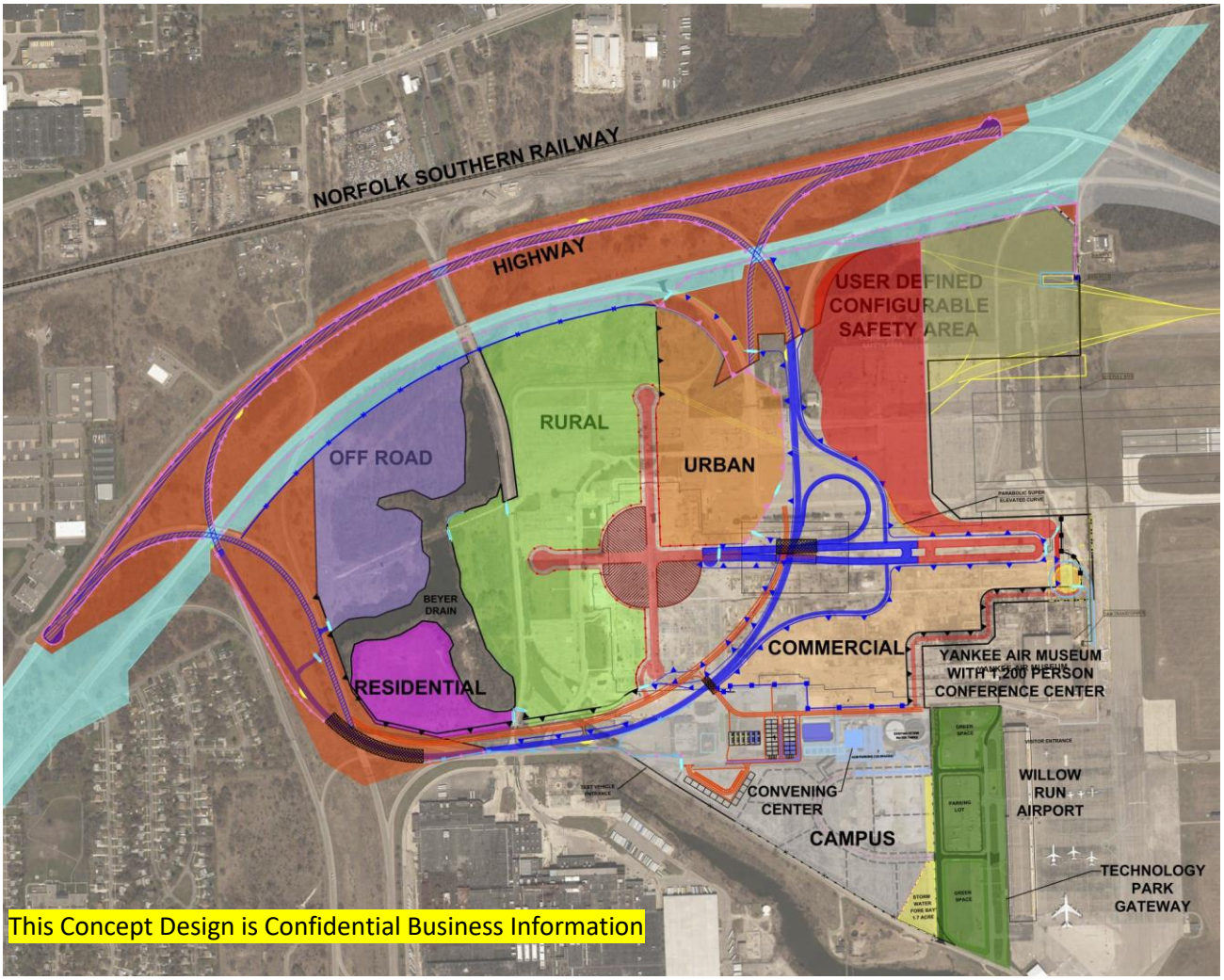
was awarded a $2.4M University Transportation Center (UTC) grant for connected and automated transportation that will explore advanced mobility policy design and community and public acceptance of self-driving vehicles.

In addition to these foundational partners, ACM will be announcing in early January, 2017 a significant relationship with AT&T Mobility LLC - CONFIDENTIAL, including a direct investment to support the build-out and optimization of a cellular network and Internet of Things (IoT) infrastructure that will serve the facility, and meet the testing, research, and product development needs of industrial and government partners. ACM is also finalizing partnerships with other private entities who have expertise in designing, deploying, simulating, and operating test environments and tools and expects to have announcements in the first quarter of 2017, including additional significant private investment.

Significant Features

ACM's capability to provide national and regional leadership in testing and deployment of CAV technologies is unparalleled in three keys respects: 1) the unique purpose-built design and capabilities of the facility: 2) ACM's relationship and proximity to leaders in the automotive industry; and 3) ACM's commitment to accelerating the development of CAV standards.

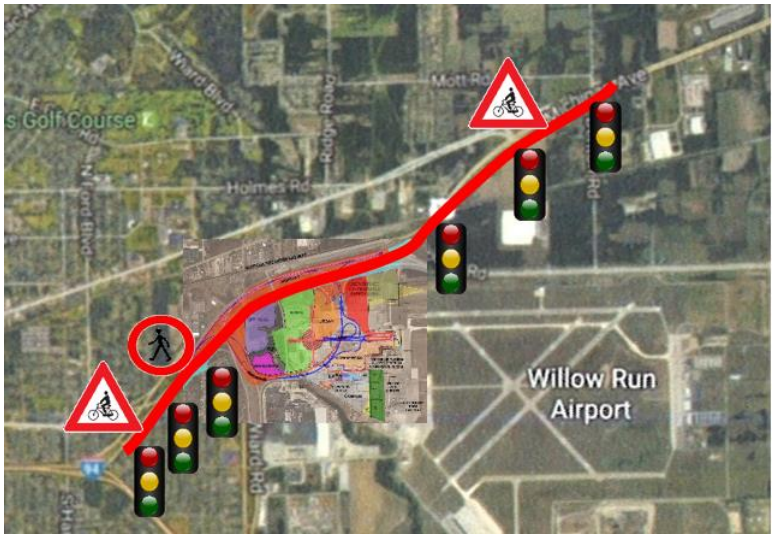
ACM is a large-scale test facility that offers real-world track testing, simulation, and on-road testing at one location. To our knowledge, there is no other such test facility like it in the US. ACM, along with Mcity, will create a "matched pair" of facilities to span the required range of technology development from basic and applied research through product validation and certification. ACM's design uniquely incorporates nine real-world representative testing environments, built over three phases, designed to address a wide range of variations of 37 NHTSA-identified fatal pre-crash scenarios, including variable but controllable critical near miss scenarios as shown in the Concept Design below:



Phase 1 – Operational by December 2017

Highway Loop: The Willow Run facility will include a 2.5 mile continuous highway speed loop to test real life scenarios, including straights, curves (standardized, fixed, and changing radius), elevation changes, varying lane configurations and widths, merging and exiting, bridges, underpasses, and tunnels. The testing speeds along this loop will vary between 50 and 75mph "posted speeds", or higher in both clockwise and counter-clockwise directions. It will feature various two, three, and four lane configurations, all with representative geometry, surfaces, markings, guardrails, signage, lighting, etc. An additional and adjacent 1.3 mile straight/gently-curving roadway segment will complement the loop to simulate rural 55mph 2-way traffic. These will be capable of testing variable, critical, and failed-condition scenarios in a safe manner, including light and heavy/commercial vehicles.

Public Road CAV Corridor on US-12: ACM and MDOT will deploy a 3.2-mile public road corridor on US-12 Michigan Avenue with traffic signals and pedestrian and bicycle crossings, equipped with DSRC/Cellular ITS devices and data acquisition equipment, including all features necessary for testing and developing connected and automated vehicles and applications. Testers and users registered with the ACM facility will be able to transfer data directly to and from the ACM communications systems, as well as to and from MDOT's DUAP ITS data system and V2X applications.



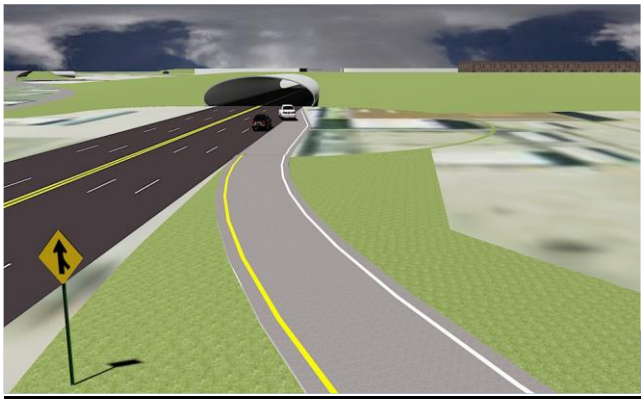
Phase 2 - Operational by December 2018

Urban: Urban scenario testing will be available with the capacity to simulate all conditions and mimic the visual and electromagnetic interference of actual buildings. The main street will allow for multiple lane layouts, and the capacity to test V2I and adaptive traffic control systems, as well as other applications. Pedestrian crossings, sidewalks, street lighting, traffic circles, roundabouts, a railway crossing, and other robotized road users (e.g. "balloon" target vehicles, bicycles, pedestrians) will complete these scenarios. The centerpiece of the urban section, and first constructed, will be a 6-by-6 lane, 55mph surface street intersection developed specifically to accommodate numerous and variable critical and "near-miss" crash scenarios in a safe, variable, repeatable, and controllable manner.

User-Defined Configurable Safety Area: This area will feature an open-slab safety testing space for users who want to define and create additional or unique conditions and scenarios, will be readily configurable with appropriate markings and equipment, will be wet-able for low-mu conditions, and will have two separate, but adjacent areas, one for light vehicles and one for heavy/commercial vehicles.

Phase 3 - Operational by December 2019

Commercial: The commercial area will feature commercial/retail area layouts, with a divided 55 mph boulevard, cross streets, driveways, and multiple different parking lot and garage layouts for both light and commercial/heavy vehicles and will accommodate critical commercial/freight vehicle scenarios, including parking, docking, maneuvering, unloading, and multi-modal interaction with light vehicles, rail, and even air modes, including UAVs.



Suburban/Residential: The Suburban/Residential areas will feature typical residential road layouts, including residential geometries, roundabouts, traffic circles, cul-de-sacs, etc., simulating a mixed traffic environment and pedestrian proximity found in general residential neighborhoods in the United States.

Rural: The Rural area will include multiple loops of rural roads of varying geometries, with curves, shoulders, markings, signs, elevation changes, minimal lighting, and a mixture of degraded surface conditions, unpaved surfaces, as well as rural vegetation and mature trees and water features. It incorporates multiple existing railroad grade crossings, including one signalized crossing that will be integrated into the test site layout.

Off-Road: The Off-Road area will contain gravel and dirt road surfaces with significant vegetation, water features, and changes in elevation, and can accommodate other vehicles such as military, recreational, and light agricultural.

Communications: ACM will incorporate a dedicated communications testing environment spanning the entire facility and portions of nearby public roads. Communication technologies, including DSRC, Wifi, GPS, 4G LTE cellular (Phase 1), and eventually 5G infrastructure (later Phases), will be enabled for product and service testing and development.

The ACM facility campus area will enable Community of Practice (CoP) gatherings, information sharing, and educational activities, anchored by a Convening Center, which will accommodate groups of up to 350 people, such as technical experts, testing engineers, visiting professionals, students, faculty, etc. It will also house ACM operations, as well as an emerging consortium of universities. The campus will include laboratory space, 52 garage/vehicle development facilities for both light and heavy/commercial vehicles, fueling, car wash, vehicle servicing and maintenance, etc, and will also allow colocation of future industry and government partners who want to construct and occupy their own development buildings or laboratories.

Mandatory Selection Criteria

1) Designated Safety Officer

ACM has appointed Dr. Edward Straub, the Center's Technical Program Director and Safety Compliance Officer, as Designated Safety Officer (DSO) with overall responsibility for safe facility and testing operations, including a comprehensive safety management plan. Dr. Straub will lead ACM's participation in the CoP, including leadership and participation of its regular quarterly meetings of Safety Officers. Dr. Straub has direct experience in establishing, deploying, and operating automated vehicles, as well as significant general experience in automated ground vehicles.

2) Commitment to Sharing Safety Approaches and Data

The American Center for Mobility's core mission is to enable the safe development of automated vehicles as part of a future transportation system. To perform that mission, ACM commits to develop and share safety-related approaches, information, and data in both test facility design and test operations, as well as explore and create data sharing opportunities for non-confidential, non-PI, testing and operation data, as part of a similarly-committed Community of Practice, while maintaining and protecting consumer privacy and manufacturer/tester confidentiality and security.

ACM commits to working with other facilities, government agencies, academia, industry, and like-minded experts, to share best practices and innovations for testing operator safety, facility design concepts and details, facility operational best practices and lessons learned, data acquisition and analysis system concepts, and testing and analysis equipment best practices and standards. ACM will convene operators and designers of other test facilities to lead the effort in the formation of this Community of Practice. ACM will also involve standards organizations, such as Society of Automotive Engineers International (SAE), IEEE, ISO, NIST, ASTM, and others in these sharing discussions at the appropriate time, and will work with those bodies to enable voluntary standards as appropriate.

HAVs present both challenges and opportunities regarding data and data sharing, requiring that a large amount of data and information be sensed, acquired, amalgamated, analyzed for rapid decision-making, and acted upon through control decisions and operational monitoring. This same data enables understanding of what is going right, or wrong, with an HAV, and if shared, provides an opportunity for many vehicles to learn from the experience of one. While data best-practices for HAVs are still under significant development by vehicle manufacturers, testers, suppliers, and service operators, generally, these data practices will likely include established processes for the collection of in-use event, incident, and vehicle information data for crashes, near crashes, malfunctions, degradations, failures, and unintended operation outside established operational domains. It is expected that this information will become extremely useful for vehicle development and operations activities as well as accident/event reconstruction purposes.

ACM, through its ability and focus to convene technical experts, numerous automotive development users, and standards bodies will establish a user group to develop a uniform approach or voluntary standard to data sharing. While it is unlikely that any manufacturer or tester will share all of its vehicle and incident data, this user group will act to establish a process to share noteworthy scenarios, and to define a subset of data and data retrieval/access methods, that they can agree to share.

In the event that ACM is conducting testing or collecting data on behalf of a government agency or public organization, ACM commits to making available all data as per the requirements of that agency or organization, subject to the protection of consumer privacy and security. ACM will fully protect consumer and public privacy and security, and will take steps to ensure that any data or information sharing activities do not violate, hinder, or compromise integrity of any consumer privacy/security agreements or arrangements put in place by manufacturers testers, agencies, public entities, or by ACM itself. Similarly, ACM commits to maintaining the confidentiality and security of proprietary confidential business information and data on behalf of its users, testers, and private partners.

Proposed Contributions

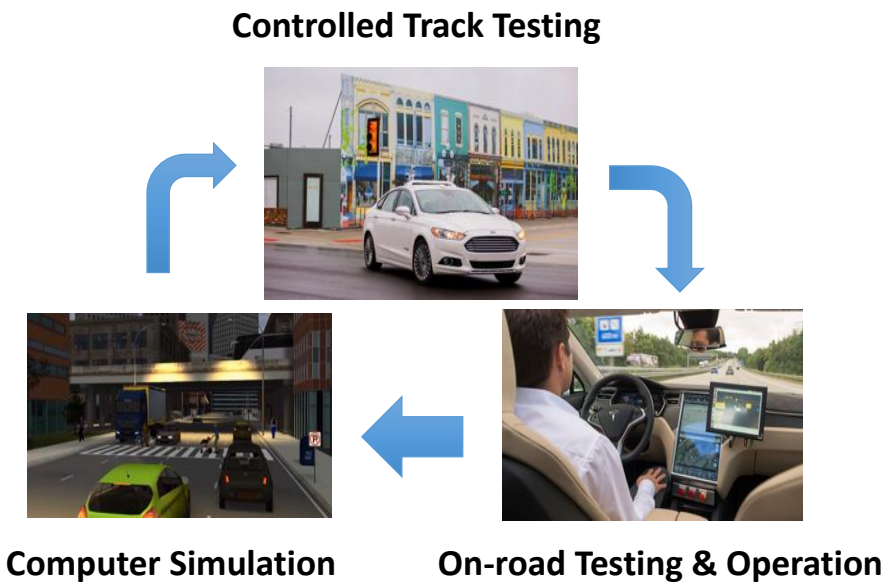
3) Automated Vehicle Program

ACM's automated vehicle program will focus on 3 activity pillars: testing/validating, standard setting, and education. CAV technology, including communication, infrastructure, and cyber security, is developing very rapidly. All three of these key "pillar" activities should be advanced simultaneously to ensure that the technology is developed to maximize safety, mobility, energy, transportation equity, and other benefits.

a. Testing and Validation

ACM's testing and validation capability is based on real-world representative testing environments designed to address a wide range of variations of pre-crash scenarios, including variable but controllable critical near miss scenarios. This testing is critical to the proper development and validation of CAV products and will serve AV developers' needs for both hardware and software. ACM's testing assets will also be critical to the work of government agencies and academic researchers collaborating on safety, mobility, and energy aspects of a CAV-based transportation system.

ACM's AV testing program includes three key complementary and fully integrated tools: Test-track and laboratory tests that validate the components, systems and full vehicles under realistic, variable, repeatable, and controlled conditions; on-road tests that verify the systems' robustness in real life situations, including some that can't be implemented, or even imagined, in the above tools; and detailed simulations, including roadway, traffic, vehicle, sensors, drivers, infrastructure, etc. that mathematically model the millions of technology and environmental variations.



These testing tools and methodologies must be used in combination in an iterative fashion. Simulation results help prioritize and define the initial round of test-track tests. The test-track allows a safe, controllable, and repeatable environment for development of functionality in numerous scenarios, and provides sufficient confidence to begin on-road testing, but can never accommodate all scenarios. On-road testing provides identification and validation to real-world behavior, including unanticipated, key scenarios, but often does not allow repeatability, so key critical scenarios must be reproduced in simulation and track testing. This process must be rigorously planned and executed to validate artificial intelligence as a substitute for decades of experience of a human driver. These new methodologies are not yet defined, and are the subject of intense research.

b. Standard Setting

CAV technology is being developed and is advancing at a much faster rate than the standards process can accommodate. ACM's partnerships with standards bodies will enable an accelerated process that will allow the standard setting experts to convene at ACM and participate in testing and demonstrations that inform the strategy, details, and ultimately decisions on the standards that are created. This is described in further detail below.

c. Education

As its third pillar, ACM will have a strong education component in collaboration with universities, community colleges, schools, and other organizations, who will offer a CAV curriculum to students, professionals and the workforce. Areas of learning will include hands-on testing and validating for both simulation and physical testing and applicable research, and communications, infrastructure, cyber mobility, energy use, and commercial vehicle operations.

4) Leadership in National and Regional Mobility Challenges

ACM is uniquely suited to provide regional, national, and international leadership for short-term and long-term efforts, through its focus on testing, standardization, education, and deployment of connected and automated technology.

a. Ability to Accelerate the Development of National Voluntary Standards

Standards setting for safe CAV technologies is lagging compared to the rapid advance of technology. As already discussed, ACM will provide a unique venue to contemporaneously develop and validate standards in rapid cycles and serve as a convening center where industry and standards bodies can collaborate and accelerate the development of critical standards.

In furtherance of this objective, ACM has entered into a Memorandum of Understanding (MOU) with the Society of Automotive Engineers (SAE) the core competency of which is voluntary consensus standards development. This is in line with the mission of ACM, which includes convening and accelerating the development of standards for the mobility ecosystem including CAVs, communication network and systems providers, and road and infrastructure systems.

As part of the MOU, the parties agree to cooperate as follows: Identify technical areas requiring standards acceleration for development and deployment; identify methods, processes, organizations and business practices that will accelerate the development and deployment of voluntary technical standards; promote testing as a key element of standards development; jointly promote the acceleration of standards development with government agencies and key automotive stakeholders; identify future technical standards requiring validation and conformance testing; establish an ongoing exchange of information through respective organizational structures to provide a mechanism for identification of future testing requirements.

b. Ability to Partner with National and Regional Stakeholders

As noted in our introduction and throughout this proposal, Michigan is home to the U.S. auto industry, with more than 70% of auto industry R&D located here and over 1.1 million (11%) of Michigan's citizens employed by the automotive industry. The state leads the nation in patents relating to navigation and smart mobility, with over 25% of all automotive patents generated here, nearly three times as many as any other state.

ACM has received enthusiastic support from the automotive industry and expressions of interest to use the facility once it is opened. To date, forty OEMs, Tier 1 suppliers, service providers, government bodies, and other organizations, have provided letters of support for ACM, including Ford, GM, Toyota, Delphi, and Bosch; many of these companies helped to design the features of the facility to meet their needs and requirements.

Southeast Michigan is also an international hub for the automotive industry. In 2015, Michigan was ranked No. 1 in North America's auto sector, producing nearly 2.4 million vehicles, while Ontario was a very close second, producing 2.25 million. In 2016, the Governor of Michigan and Premier of Ontario signed an agreement to cooperate and support innovation in the Michigan – Ontario cluster, and Ontario is fully supportive of ACM's proposal to be named a designated proving ground.

In addition, ACM is working with the State of Michigan to form three co-located, state-of-the-art cyber labs that will contribute to setting best practices and standards, enable industry and government to improve the common understanding of cybersecurity issues, mitigations, and countermeasures and provide educational opportunities. The CyberMobility Lab will connect to a communications network to evaluate system-level test scenarios that are well beyond simple lab tests, and also includes simulation capability to create a virtual vehicle network to assess ECUs in accelerated development processes. The Cyber Analytic Center will collaborate with Auto ISAC, federal partners, and other stakeholders to review results from test and validation exercises to fuse vulnerability and mitigation data discovered in the real-world test environment at ACM. The Cyber Learning Center will contribute to standards setting and host educational opportunities including hands-on training and curricula. These labs will have multi-modal capability, including light and heavy ground vehicles, rail, and air. ACM is collaborating with Merit Network's Regional Cybersecurity Education Collaboration (RCEC), which is collaboration amongst key universities and private sector partners to build a workforce, prepare industries, and establish public/private partnerships.

5) Contributing to the Community of Practice

ACM will lead the formation of a specific Community of Practice focused on safe CAV testing, as a proposed subgroup of the International Committee for Proving Ground Safety (ICPGS) established to enable the rapid sharing of information, best practices, and data including the following aspects: Best safety practices specific to CAV testing, including vehicles, infrastructure and communication; driver training (remote and in vehicle); safe conduct of testing and operations; safety management plans and protocols; common safety incident reporting protocol; and common data format and agreement to share non-proprietary/non-confidential data. It is proposed that in addition to members of ICPGS, certain subject matter experts (SMEs) be engaged from road infrastructure and telecommunications to further accelerate the rate of learning.

6) Working Relationship with USDOT Research Programs

ACM works closely with researchers and policy makers at USDOT, and across multiple agencies, to define strategies, research needs and approaches, priorities, and action plans to ensure the safe deployment of HAVs. ACM has contributed substantially to technical and policy discussions and analyses regarding the operation of connected and highly automated vehicles in both closed test track and public road environments, including the Federal AV Policy. As a leader in the CoP, ACM will continue to maintain a very positive and collaborative working relationship with USDOT and its relevant multimodal research offices including but not limited to OST-R and the ITS-JPO, NHTSA, FHWA, FMCSA and the Secretary's Advisory Committee on Automation in Transportation.

The University of Michigan, ACM's founding partner, has proven itself a pre-eminent leader in transportation safety research for over 50 years, and maintains significant research programs for USDOT, including numerous programs on CAV and driver assistance technology and data. ACM will continue to leverage this partnership to provide valuable collaboration with USDOT.

Commitment to Safety

7) Safety Management Plan

ACM's core mission is to enable the safe development of automated vehicles as part of a future transportation system. ACM, working with its experienced partners, is developing a comprehensive and robust safety management plan that addresses all of the components required to manage test environments, test vehicles and fuel types, driver/tester training and certification, as well as develop rules for proving ground access and control and requirements for vehicle inspection and secure anchoring of any data collection or analysis equipment. Safety teams will be established to guarantee the safety of the users and address emergencies; accident response procedures will detail all aspects of detection, communication, investigation, and reporting of accidents.

8) Specific Safety Considerations

ACM will employ a team of dedicated and trained personnel committed to the safe operations of the test facility, including an emergency response team, a controller (dispatcher) who will manage and control traffic on test grounds to ensure compliance with the facility rules and regulations, and a track supervisor who will monitor the grounds to ensure all users are observing the rules and regulations of the test facility.

For public road testing, in addition to ensuring adherence to the USDOT AV Policy, ACM is leveraging decades of experience of its operating partner in preparing a complete protocol for AV road-worthiness, and procedures for both vehicles and drivers in performing AV testing on public roads. To ensure safety for testers and other road users, applicants will be required to provide a technical description of the vehicle characteristics, the tests that it would like to perform on the public road, and the functionalities that it will test. Routine inspection of the vehicle will include external projections, interior space, condition of wheels or fastening of instrumentation/ballast, de-identification, exterior, engine bay, interior, wheels, and underbody. Depending on the functionalities to be tested and test conditions, initial dynamic validation may include testing the vehicle to ensure that the driver can always override the automated mode; validating the brakes to ensure that it functions without automated mode; validating longitudinal and lateral control functions; and validating road sign recognition/detection/knowledge and corresponding compliance

Research, Application, and Data Sharing

9) Regional Solutions for Improved Mobility

The U.S. is transitioning from an ownership-centric society to one of a sharing—rides, offices, homes. Michigan is leading this transformation, and automated intelligent vehicles and infrastructure in a connected environment are just the start. ACM, partnering with the MDOT, is well-positioned to provide extremely effective AV solutions for the broader region, as well as the U.S. as a whole. Unlike other potential test sites, ACM is advantageously located within the single largest available CAV & ITS network in the country. ACM is located within 8 miles of UMTRI which hosts the largest single V2X deployment within the Ann Arbor Safety Pilot environment, and Mcity a 32-acre CAV research facility on the UM campus which has been operational since July 2015 ($37M asset value combined).

MDOT and General Motors have established a Smart Corridor partnership in southeast Michigan centered around a base 120-mile highway loop, encompassing several active federal V2I test beds and state deployments, and has committed to expand through further infrastructure deployment. MDOT has also deployed a network of 104 DSRC roadside units and other ITS equipment along with fiber-equipped instrumented corridors ($18M value). ACM is intentionally located within the footprint of this designated Smart Corridor, which allows ACM the ability to effectively integrate into this Smart Corridor environment and expand their testing and validation capabilities well beyond the 468-acre site. ACM is also nearby other test beds, including the USDOT's test bed in Oakland County and the deployment in the City of Detroit.

On December 9, 2016, the Governor of Michigan signed into law CAV legislation that opens up the entire transportation network in the State of Michigan to CAV operations. This entire roadway network, totaling 279,935 miles, can now legally be utilized for operations and subsequently available to advance CAV testing and validation activities.

MDOT's connected vehicle vision over many years of sustained investment encompasses communities outside of the metropolitan Detroit area, resulting in “connected regions” and a “connected state.” This vision is shared at both regional and national levels which is demonstrated through continued support and partnership with the USDOT and partner states in the AASHTO and the V2I Coalition.

ACM is working with other significant and influential partners and other assets in the region, including mobility service providers, the Wayne County Airport Authority (WCAA) and the Norfolk Southern Railway. WCAA, which operates the Willow Run Airport, is pursuing a sub-license to test UAVs from Griffiss International Airport in N.Y., one of six FAA designated UAS Test Sites in the U.S. ACM believes that there is no such test facility in the United States that has the capability for such intermodal testing in a real-world environment.

10) Research and Extension Resources

Given its location to and relationships with the automotive industry and academic communities, ACM has extensive resources available to facilitate research development and CAV advancements in the automotive industry. ACM also has access to a network of 15 universities and colleges, many of which have nationally ranked undergraduate engineering programs and four of which also have nationally ranked graduate programs. Many of these universities and colleges have research programs in CAV. Three of these universities – the University of Michigan, Michigan State, and Wayne State – form the University Research Corridor (URC) which plays a direct role in automotive innovation by spending over $60M annually on auto-related R&D. Washtenaw Community College has a very robust automotive program training the technical workforce of tomorrow, as well as providing ongoing professional education programs. ACM is forming a consortium of universities which will be resident on ACM campus and will identify, conduct, and disseminate basic and applied research that aligns with ACM's mission.

A key university partner is the University of Michigan which conducts research in many areas of CAV research including engineering, robotics, and big data, and houses the Michigan Transformation Center which operates Mcity, a simulated urban and suburban environment for CAV testing that was built on 32 acres at the University of Michigan in 2015. With a shared mission of CAV testing, and complementary but varied programs, research can be shared and benefit both test facilities.

In addition, ACM is reaching out to other universities in Michigan and other states, including Michigan Technological University, Kettering University, Ohio State University, Carnegie Mellon University, Texas A&M University, and others, to begin the discussion on how these top-tier schools can work together around key topics for CAV research, including cybersecurity, simulation, data collection and analysis, and others.

11) Disseminating Results through Education Program

ACM is committed to disseminating the non-proprietary/non-confidential results of CAV research undertaken at the proving ground in a systematic manner – through the Community of Practice as described above, as well as conferences, papers, regular technical briefs, and other methods. Moreover, ACM will collaborate with SAE to host an annual international mobility conference where results of R&D projects are shared with a variety of industry, academia, and government participants. ACM's education partners together with industry will provide avenues for educating researchers, professionals, the workforce, and students of the testing and advancements in CAV developments.

12) Open Data and Sharing

As described above, ACM commits to develop and share safety-related approaches, information, and data in both test facility design and test operations, as well as explore and create data sharing opportunities for non-confidential, non-PI, testing and operation data, including performance metrics and objective test results, as part of a similarly-committed CoP, while maintaining and protecting consumer privacy and manufacturer/tester confidentiality and security.

Demonstrated Investments

13) Capital Improvements

The State of Michigan has committed $37.5M to the ACM facility, including $20M received $20M from the State of Michigan via its Michigan Strategic Fund, and $17.5M from MDOT. On November 4, 2016, ACM acquired rights to the property under a 35-year ground lease, with options for multiple 50-year extensions. These state investments will fully fund the construction of the first phase of the test facility, scheduled to begin in April 2017. Pre-construction site preparation and rehabilitation is already underway. MDOT's investment will repurpose US-12 to convert the eastbound lanes to a bi-directional roadway and to incorporate the westbound lanes into ACM's highway loop. MDOT and Washtenaw County are dedicating a 115-acre portion of decommissioned public road rights of way and associated facilities for use in the highway environment. Based on MDOT calculations, it is estimated that the existing total infrastructure assets including the multi-lane roadways, two tri-level structures, a pump station, overhead sign structures, and right of way property available to establish physical separation, screening, and other support features within the ACM testing environment represent $88M in construction value. ACM has also secured $4M in private funding, with more announcements expected in Q1 2017.

14) Proving Ground Authorization

The State of Michigan Legislature and Governor enacted legislation, signed into law by the Governor on December 9, 2016, specifically establishing Mobility Centers, including ACM, and authorizing its focus on the safe testing and validating of CAVs. This approach reduces and removes many significant legal barriers to the testing and operation of automated vehicles in Michigan, making it the most progressive in the United States and includes expanding the AV operational footprint to include all 279,357 miles of public streets and highways. The law, which complements the Federal AV Policy, also allows vehicle "platooning," provides for shared mobility by permitting on-demand automated vehicle networks to link passengers and various forms of transportation with automated vehicles, and includes cyber security provisions that target and penalize abuses of automated technology for mischief or more serious public safety situations. Finally, it includes the creation of the Council on Future Mobility to continually update policy makers on future changes needed to remove regulatory barriers.

15) Feasibility Testing and Deployment

Testing has not yet begun at the ACM facility, as construction phasing dictates that the site preparation work must be undertaken and completed before constructing the purpose-built environments and surfaces. Nonetheless, ACM has already been approached with multiple requests to begin testing on the site by companies conducting active AV development in Michigan and other locations around the U.S. This shows the strong demand for the concept, capabilities, and location of this proving ground.

Readiness

16) Facility Timetable

ACM will open for operation during or before December, 2017, and has sufficient funds to complete that milestone. Phases 2 & 3 come online as described above. Both the closing on the Willow Run property and the official groundbreaking ceremony took place in November, 2016. All key milestones in the acquisition of the property and the design and construction of the test facility have been met, and in most cases exceeded.

17) Multiple Users and Data Sharing

ACM is a multi-user, equal access, test facility. For highly sensitive testing, a user may reserve the entire facility. In most cases, a user will reserve exclusive use of a specific environment or elect to share a specific environment, or conduct interoperable testing concurrently with other users.

ACM's to-be-announced operating partner is a recognized world-leader, with 20 years of experience in managing its track facility where, on average, a total of 95 vehicles per day were tested, a maximum of 250 vehicles per day and a maximum of 110 vehicles at one time. The safety of all users will be controlled using a highly instrumented transponder system that monitors activities of all users.

ACM's data-sharing approach is described above, and users have the option to share all or portions of their data.

18) Designated Point of Contact

ACM has a talented and diverse team of accomplished professionals, including over 150 years of combined experience in automotive research, design, testing, validation, safety, standards, regulations, manufacturing, deployment, convening, business development, university research, technology transfer, transportation, communications, business operations, etc.

The Designated Point of Contact is:

John Maddox, President & CEO, American Center for Mobility
860 Willow Run Airport, Ypsilanti, Michigan 48198
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John Maddox
President & CEO

Laurel Champion
Chief Operating Officer

Soraya Kim
Chief Innovation Officer

Andrew Smart
Chief Technical Officer

Dr. Ed Straub
Safety Officer

Mark Chaput
VP Construction

19) Community Input for Use of Public Roads

ACM is engaged with many community leaders including representatives of Ypsilanti Township, Washtenaw County, Wayne County, and the City of Ypsilanti, amongst others, all of whom are very strong supporters of ACM's development. The creation of the Center has tremendous economic value for Ypsilanti Township which has been hard hit by the loss of tens of thousands of jobs and a drop in its tax base by 38%. The creation of this technology hub has brought interested companies wanting to locate near ACM and has significantly increased the real estate value of the properties in the area. Township Supervisor Stumbo has stated that, "ACM is making our future bright, breathing life into an area that was dead."

In September of this year, MDOT organized an open house to share with the community the scope of the project and to answer any questions and address any concerns community participants may have in response to the developments in the area. Members of the ACM were present to support MDOT's efforts. Comments were collected from the residents, all of which were evaluated and considered for incorporation into the project scope and design. A number of significant changes related to safety, especially pedestrians and bicyclists, were made to MDOT's project based on the collective comments from the public including the modification of the intersection at US-12 and Dorset Road which has been the location of a number of fatalities over the years.

To facilitate continued community input, ACM has created a Community Advisory Committee (CAC), co-chaired by the President and CEO of the MEDC and the Supervisor of Ypsilanti Township. Comprised of 13 members representing various constituents and business leaders, the Committee is a venue for discussion and exchange through which ACM will provide updates to the members on its development and activities, and address any issues and concerns.

In developing the site, ACM is working closely and collaborating with many government agencies including the USEPA, State DEQ, Washtenaw County Water Resources Commission, and the Ypsilanti Community Utility Authority. The redevelopment will vastly improve the environmental conditions on the site, transforming it from a contaminated property into a world class, state of the art CAV test facility and technology hub that will bolster the entire region and the U.S. Moreover, ACM believes that its core mission and activities in the testing and validating of CAVs will transform personal and commercial mobility for the U.S., which will offer new options and alternative modes of transportation to all people, regardless of their financial situation.

Adherence to Laws, Regulations, and Federal Policy

20) Adherence to Laws and Regulations

All vehicles, communication devices, traffic operation devices, and traffic control systems and devices, as well as the facility itself, will be operated and equipped in a way that meets all applicable local, state, and federal laws, as well as ensures safety.

As part of the development of Mcity, the U-M Law School has conducted a very thorough legal study regarding a wide range of legal aspects of CAV testing and operations in test facility and multi-state on-road environments. ACM is incorporating those findings in establishing operational strategies, policies and procedures, as well as incorporating

significant lessons learned from the operation of Mcity. ACM is committed to remain engaged in pioneering discussions and to continue contributing to policy-setting efforts regarding the inevitability of newly arising issues and requirements.

ACM will require that all registered facility users who are performing AV testing or operations on the public road portions of the ACM facility, and are registered as using ACM's on-road data systems, show evidence that they comply with the State of Michigan's laws for the safe design, development, testing, and operation of automated vehicles. In most cases, the presence of a Michigan Manufacturers Plate (M-Plate) will be evidence of satisfaction of that requirement. In rare cases on the closed portion of the test facility, where compliance is unknown or not clear, perhaps due inherently to the design or nature of the vehicle, ACM will require evidence from the tester(s) that they ensure that safe testing operations, including the requirement for thorough safety case documentation, including reasons for not fully or specifically conforming to any state or local requirements, if any.

21) Adherence to USDOT AV Policy: Accelerating the Next Revolution in Roadway Safety

ACM has contributed substantially to numerous technical and policy discussions and analyses regarding the Federal AV Policy specifically, including providing input and comment on operation of connected and highly automated vehicles in both closed test track and public road environments. ACM is incorporating those discussions and concepts in establishing operational strategies, policies and procedures for all portions of the facility. Specifically, per the four major subsections of the Policy:

a. Vehicle Performance Guidance for Automated Vehicles

ACM will require that all registered facility users who are performing L3-L5 vehicle testing or operations on the public road portions of the ACM facility, and are registered as using ACM's on-road data systems, must show evidence that they have filed with NHTSA the appropriate 15-point Safety Assessment Letter for the safe design, development, testing, and deployment of highly automated vehicles, and that they self-certify that the vehicles meet all applicable FMVSS or have an appropriate exemption from NHTSA. ACM will accept a sworn statement from the testing company or organization as evidence of submittal of this information, and will follow these procedures if and when ACM itself conducts such tests.

b. Model State Policy

As stated above, all vehicles will be operated and equipped in a way that meets all applicable local, state, and federal laws, including Michigan's newly enacted automated vehicle laws, which are in complete concert with the USDOT Federal Model State Policy.

Additionally, ACM will be well-positioned to perform research, testing and educational programs around other aspects of AVs, such as licensing, registration, enforcement, infrastructure design, markings, operations, and maintenance, which is also in concert with the concepts laid out in the Policy. ACM has expressed strong interest to the State of Michigan to participate in its Council for Future Mobility, and intends to continue to work collaboratively through that body and other national-level bodies.

Lastly, ACM and the State of Michigan are in initial discussions with the Canadian and Ontario governments to begin to strategize on how the ACM facility and other Michigan-based assets might be utilized to create a coordinated approach to AV policy, testing, and operation across the international border.

c. Current Regulatory Tools

ACM believes that the current suite of NHTSA's and USDOT's regulatory tools have proven to be very effective over the last 50 years, as evidenced by the steady improvement in vehicle safety over that period. ACM is committed to providing a facility for the full utilization of those existing tools, including the capability for research, testing, development (vehicle, interpretations, and regulations themselves), petitions, benefits estimation, self-certification, and compliance and enforcement, and others. The ACM facility will be well-positioned to conduct rapid, but thorough, testing in support of any of NHTSA's regulatory activities, and especially those that include a collaboration with ACM industrial partners.

d. <u>Modern Regulatory Tools</u>

ACM is committed to researching, testing, developing, and providing a new and complementary set of tools to industry, academia, and USDOT itself to ensure safe validation of AV technology. ACM believes that USDOT is correct that new tools, including closed test facilities, on-road, and simulation, must be explored and implemented to properly ensure safe deployment of HAVs, and that research efforts will be a critical and necessary first step towards any regulatory action. ACM believes that this facility will be instrumental in developing and providing those new tools, including new test methodologies, procedures (including variable), equipment, functional safety approaches, risk-mitigation strategies, data-collection and reporting, knowledge and data-sharing regimes, and certification regimes, amongst others.

ACM fully supports the establishment of a network of experts and commits to providing engaged expertise through comments, meetings, workshops, and more formal activities including volunteered participation in an expert committee. In addition, the ACM facility will serve a very important purpose to educate the current and next generation of engineers, policy-makers, lawyers, and strategists and, in league with a consortium of universities and community colleges, will develop a curriculum to ensure that expertise is generated and available for hiring or appointment throughout industry, government, and academia. ACM is also interested in exploring possibilities for resident engineers, from government or industry, to be stationed at our facility to effectuate that collaboration.

Summary

The American Center for Mobility is a national-scale proving ground facility dedicated to innovation, testing product development, education, standardization, and certification for future mobility. ACM incorporates a unique purpose-built test track environment directly integrated with active highway corridors and a combined corporate/academic technology park campus to facilitate effective collaboration and information sharing, as well as a focus on educating and developing the mobility workforce for the future.

ACM is strategically located in southeast Michigan and is recognized as a centerpiece of the state's "Planet M" initiative representing the collective mobility efforts across the state defining Michigan as the global center of mobility. The State of Michigan has invested $37.5M to date and has committed another $88M of repurposed transportation assets. Private companies are now beginning to invest.

ACM will serve as a powerful national asset for government, industry, and academia to ensure the safe development and deployment of Connected and Automated Mobility technologies in a way that delivers on the promise for improvements in safety, mobility, energy use, equity, and economic competitiveness.