## Connected and Automated Vehicle Strategic Plan

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Prepared with support from



WSP USA 500 Griswold Street Suite 2600 Detroit, MI 48226 This page intentionally left blank

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#### SECTION 1

## Introduction

There have been a myriad of changes in transportation infrastructure and technology over the past decade, and with promises of more transformations to come, state departments of transportation (DOTs) face a critical juncture in how they go about short and long-range planning efforts.

- How can they make sound decisions amid rapid change?
- How can they comprehend all the technology advancements and how they may affect planning capabilities?
- How will they pursue the best investments that address current and future realities?

The Michigan Department of Transportation (MDOT) Intelligent Transportation Systems (ITS) Program Office has developed this Connected and Automated Vehicle (CAV) Strategic Plan to help the department prepare specifically for CAV technology, as it is likely to change much of how MDOT establishes its roles and responsibilities. This plan is intended to encourage thinking about implications, challenges, gaps, and opportunities of CAV, while reflecting on what has already been done in Michigan and defining a path forward for technology preparedness and implementation.

The purpose of this plan is to articulate the guiding mission, vision, and goals of the CAV program, leveraging lessons learned from educating, engaging, and hearing from offices and divisions across the department. Strategic planning, policy, and meaningful public engagement are intended to ensure that no users of MDOT's transportation system are excluded from CAV's potential benefits. To do so, MDOT is prioritizing strategies that address safety, accessibility, equity, and sustainability. The MDOT CAV Strategic Plan will guide the agency's investment decisions and policies in the coming years, as CAV technology continues to advance.

### Background

To support the development of the department-wide CAV Strategic Plan, stakeholders throughout the department were engaged to solicit feedback on program direction and to help identify gaps. These workshops were used to inform the development of recommendations to address these gaps, as well as to define the underlying goals of the program, and to link these goals with the strategies and actions that will align the day-to-day, technical choices that are made by the department with an overarching, program-level vision.

Each stakeholder workshop began with a round of introductions and initial thoughts on CAV technology. The project team then presented a series of slides on the intent of the strategic planning process, an overview of CAV technology, and a deeper dive into potential impact and opportunity areas, including:

- Work zones
- Pavement markings
- Bridges/pavement conditions
- Traffic signals
- Probe data
- Roadway layout
- Travel demand
- Cybersecurity and privacy

The remainder of each workshop was allocated for a guided discussion, that covered these potential impact and opportunity areas as well as other topics depending on the group.

#### Regional

A known gap in MDOT's CAV program is that much of the attention and investment in CAV technology in the state so far has concentrated primarily on Southeast Michigan. This is particularly true for private investment, which is not surprising because the larger automakers and technology developers are located in that part of the state, and it is the mostly densely populated region. However, moving forward, it would be favorable for MDOT to increase the level of testing and piloting of technologies in other parts of the state in order to ensure the





technologies are designed with the needs of those areas in mind, and to address the unique use cases and conditions each region offers.

To help form a better understanding to guide this future approach, workshops were conducted with all seven regions of MDOT, shown in *Figure 1*. Representatives from each region were all familiar with CAV technology, primarily through past outreach from within MDOT, but outside of the Metro Region, and to a lesser extent Grand and University Regions, they generally had limited first-hand experience with the technology beyond signal projects. Representatives without much first-hand experience generally voiced that they hoped to see more outreach and education to all MDOT staff, local agencies, and the general public in their region in the coming years. This outreach could include local pilots and demonstrations to help form a better understanding of how their region would need to adjust in order to accommodate and plan for these emerging trends, as well as to engage the local public.

#### **Functional**

The other approach the MDOT CAV Strategic Planning team took to outreach was a functional approach. This was initiated by pulling out MDOT's org chart and identifying the offices, bureaus, and divisions that are expected to be impacted most by the emergence of CAV technologies. The resultant meetings covered:

- Office of Organizational Development
- Bureau of Development and Design Division
- Office of Passenger Transportation
- Enterprise Information Management
- Construction and Work Zones
- Planning
- Bridge Authorities
  - > Mackinac Bridge Authority
  - International Bridge Administration
  - > Blue Water Bridge Authority
- Bureau of Bridges and Structures
- Communications
- Transportation Systems Management Operations Division
  - > Maintenance, Congestion, and Mobility
  - > Operations, ITS, and Signals
  - Traffic and Safety

#### **External**

In addition to these workshops with MDOT staff from across the department, three workshops were conducted with the following organizations external to MDOT:

- Department of Technology, Management and Budget (DTMB): DTMB supports other state agencies in Michigan with a variety of services, including information technology, centralized contracting and procurement, and budget and financial management.
- Office of Future Mobility and Electrification (OFME): OFME was launched in 2020 to work across state government, academia, and private industry to enhance Michigan's mobility ecosystem, including developing dynamic mobility and electrification policies and supporting the startup and scale up of emerging technologies and businesses. OFME is working on many initiatives, including an Electrification Strategic Plan that is complementary to this CAV Strategic Plan.
  - > This initiative builds off previous work by the Michigan Economic Development Corporation (MEDC) and Planet M. MEDC strives to achieve long-term economic prosperity throughout the state of Michigan through economic development partnerships and supporting the marketing and growth of Michigan businesses. PlanetM is an initiative launched by MEDC specifically to support businesses in the realm of future mobility.
- Secretary of State (SOS) and Michigan State Police (MSP): The SOS is responsible for licensing drivers. MSP personnel most visible to the public are the uniform troopers whose primary responsibilities are to deter criminal activity, arrest those who break the law, investigate crimes, and improve traffic safety. Troopers are assigned to work locations statewide, with the authority to work across jurisdictional boundaries.

While there are many external partners that work closely with MDOT across a wide variety of topics, these three groups were chosen as highest priority for workshops because of their close working relationship with MDOT, their level of activity in the new mobility space, and/or the large impact CAV technology may have on their role.

### **Technology Overview**

The CAV Strategic Plan primarily addresses the following two emerging trends in transportation and how they intersect:

Automated vehicle (AV): A vehicle that uses on-board sensors, such as cameras, radar, and light detection and ranging (LiDAR), and software to take over some or all of the driving function from the human driver. If the vehicle has a high level of automation, where the human is not needed, it is often referred to as an autonomous or driverless vehicle.

Figure 2. Levels of Automation (for on-road vehicles). Source: SAE <u>https://www.sae.org/standards/content/j3016\_202104/</u>



- Society of Automotive Engineers (SAE) International, a standards-setting industry association of automotive experts and technologists, has developed a scale of driving automation, ranging from Level 0 to Level 5, shown in *Figure 2*. Level 0 indicates that the vehicle uses no automation of any kind, while Levels 1 to 4 have varying levels of abilities that can assist drivers on specific tasks and/or in certain conditions. Level 5 indicates that the vehicle can perform all driving tasks under all conditions.
- Levels 1 through 3 describe types of AV technology that have been introduced before vehicles are entirely self-driving, and many of these types are already available today. For example, Advanced Driver Assistance System (ADAS) components such as lane keeping, parking assist, emergency braking, and adaptive cruise control have been introduced on new vehicles to assist drivers without completely taking over the driving task.
- Alternatively, Level 1 through 3 vehicles may be fully automated within a certain operational design domain (ODD), or defined geographic conditions, such as roadway types and weather limits. A driver may be required to remain onboard the vehicle and monitor its operation, to ensure it is operating safely and is not outside its ODD.
- In the future, Level 4 to 5 highly automated vehicles will have a suite of ADAS components and on-board sensors that can analyze multiple types of sensory data to distinguish between vehicles, bicycles, pedestrians, and obstacles, and with advanced connectivity as described below, will be able to operate a vehicle on most or all types of roadway networks.
- Connected vehicle (CV): A vehicle that is equipped with a wireless communication device that allows it to share and receive information with other vehicles, other travelers, and roadside equipment such as traffic signals.

- > There are many potential mediums by which connectivity could be enabled. Satellite, cellular, Wi-Fi and other short-range communications all represent methods by which vehicles today are already connected, as industry converges into a single, interoperable solution.
- Connected and automated vehicles (CAV) employ both automated and connected technologies. These two technologies work together cooperatively to further enhance the safety benefits offered by each, as follows: While automated vehicles are expected to improve vehicle safety by limiting the impact of human error, connectivity enables additional safety benefits, as vehicles can then gain context beyond what a regular driver would know or have the ability to perceive visually. Similarly, while connectivity can enable alerts and warnings to a driver-operated vehicle, deploying these messages on an automated vehicle can streamline the links between information, decision making, and action.

There are three other emerging mobility trends that will also be covered in this CAV Strategic Plan:

- The first is **shared mobility**, or the use of mobility options that are pooled rather than privately owned. Many of the companies that are developing CAV technology are doing so as part of fleets rather than with direct to consumer sales, for liability, cost, and other reasons. Mobility options can be shared consecutively, meaning a vehicle is checked out by one user at a time before being checked back in and provided to a different user, or concurrently, meaning a vehicle can be shared by multiple users for some or all of their trip.
- Secondly, many CAVs, especially those with high levels of automation, are being designed on electric vehicle platforms, during a time in which electric and electrified vehicles are becoming increasingly more common. This could

Figure 3. Intersecting Mobility Trends

CONNECTIVITY



#### **AUTOMATION**

the automation of vehicle operation, partially or completely eliminating the need for human input into the dynamic driving task

#### SHARED MOBILITY

the use of pooled mobilty options, including cars, bikes and scooters, rather than personally-owned options

#### ELECTRIFICATION

and mobility information

the use of batteries and alternative sources to power vehicles impact the public sector role in providing infrastructure to support travel, as well as have revenue implications.

The third trend is pricing. Historically, people register a vehicle and pay the gas tax when they need fuel, and that's generally how transportation is funded. But there are changing ways to price mobility as both a policy tool and a replacement of shrinking revenues from traditional sources as a result of the previous two trends.

## **MDOT's Goals and Strategies**

MDOT has identified seven goals of its CAV program:

- 1. **Safety**: Leverage CAV technology to enhance the safety of the transportation system.
- 2. **Mobility and Accessibility**: Seek to enhance the movement of people and goods across all modes in an equitable manner using advanced technology.
- 3. **MDOT Workforce Development:** Position the department to attract, retain, and train the expertise needed to meet the demands of a state DOT in response to evolving mobility trends and implications for transportation infrastructure.
- 4. **Sustainability**: Plan for and develop a resilient future transportation system that increases social, environmental, and fiscal sustainability.
- 5. **Economic Development**: Continue to leverage, research, and build next generation transportation technologies as a force for economic growth in Michigan.
- Improved Business Processes: Explore innovative ways that CAV applications and data from CAV can be harnessed to support or improve current business processes.
- 7. **Increased Stakeholder Awareness:** Educate and coordinate with the public and policy makers to better understand the benefits and limitations of CAV technologies, to encourage safe, equitable, and effective deployment.

To ensure continuity across the department, these goals were developed in consideration of the vision outlined in MDOT's 2045 Long Range Transportation Plan (LRTP) that was concurrently under development:

In 2045, Michigan's mobility network is safe, efficient, future-driven, and adaptable. This interconnected multimodal system is people-focused, equitable, reliable, convenient for all users and enriches Michigan's economic and societal vitality.

Through collaboration and innovation, Michigan will deliver a well-maintained and sustainably funded network where strategic investments are made in mobility options that improve quality of life, support public health, and promote resiliency.

- source: http://michiganmobility.org/learn/goals\_principles.aspx

MDOT has also previously outlined its goals related to CAV and other emerging technologies in various documents, including a 2017 CAV Strategic Plan. Updates to these goals were made based on changes in the industry as well as the desire to broaden the vision beyond just technology deployment, to address how CAV can meet other statewide goals such as equity.

As shown in *Table 1*, this process has resulted in the development of seven goals, with varying numbers of strategies defined under each. Some strategies fall under multiple goals, so they are also presented in a two-dimensional matrix form that marks the alignment of each strategy to all of the goals it supports, with the primary goal shaded in gray.



		GOAL							
		Safety	Mobility and Accessibility	MDOT Workforce Development	Sustainability	Economic Development	Improved Business Processes	Increased Stakeholder Awareness	
STRATEGY		$\bigcirc$	$\ominus$	8	Ø	\$	$\odot$	Q	
1.1	Focus on adapting CV technologies to the current industry environment based on a continuous evaluation and reevaluation of industry trends.	~	~		~	~			
1.2	Continue strategic foundational investments in CAV systems.	~	~		~		~		
1.3	Research and plan for enhancements of traffic control devices and other roadway infrastructure to support the evolving needs of AVs.	~	~			~			
1.4	Support the development and deployment of CAV work zone, weather, and other dynamic condition applications.	~	~						
1.5	Increase attention on active transportation safety applications.	~	~						
2.1	Identify CAV use cases for near-term deployment, especially those that tie in with other statewide high-priority needs, through direct engagement with the business areas whose needs are being addressed.	~	~		~	~	~	~	
2.2	Ensure that all parts of the CAV transportation network are accessible and equitable.		~		~	~	~		
2.3	Continue supporting CAV applications in public transportation and other shared mobility modes.	~	~		~	~	~	~	
2.4	Support applications that enhance the movement of goods through the state and in partnership with neighboring states and Canada.		~	~		~		~	

		GOAL							
STR	ATEGY	Safety	Mobility and Accessibility	MDOT Workforce Development	Sustainability	60 Economic Development	D Improved Business Processes	D Increased Stakeholder Awareness	
3.1	Optimize hiring strategies with respect to civil service requirement constraints.			~		~	~		
3.2	Attract and retain skilled, experienced, and talented MDOT staff.			~	~		~		
3.3	Pursue a holistic department-wide workforce development strategy.			~	~		~	~	
4.1	Incorporate CAV and advanced technologies in planning efforts throughout the department.	~	~	~	~		~	~	
4.2	Develop policies on electric vehicles that define MDOT's role.			~	~	~			
4.3	Seek innovative funding models and partnerships to support the long- term sustainability of systems to support CAVs and future mobility.		~		~	~	~		
5.1	Establish and implement a CAV research agenda that leverages pooled funds and other national efforts, while bringing activity to Michigan.			~		~		~	
5.2	Develop and implement a consistent and equitable framework for streamlined private sector partnering for research, pilots, and deployments.			~	~	✓		~	
6.1	Continue efforts to develop CAV data use cases and understand how to leverage datasets to support departmental business processes.			~			~		
6.2	Invest in systems that support strong data management and governance, so collected data can be secured, used, and shared as needed.	~	~	✓	~	✓	✓		
6.3	Enable policy and legal structures that continue to support the variable nature of CAV deployments.			~	~		~	~	
7.1	Engage with the legislature, MDOT executive leadership, and other decision makers.			~	~	✓	~	~	
7.2	Continue coordination with internal partnering agencies.	~		~			~	~	
7.3	Build trust with the public on transportation technology trends.	~			~			~	

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#### SECTION 2

# MDOT Initiatives and Gap Analysis

As part of the MDOT CAV Strategic Plan development process, a gap analysis was conducted to reflect on the progress that has already been made in the state, and to begin to draw the vision of how this progress could be best implemented into the future.

Through assessment of activities undertaken by leading agencies and partners around the world and outreach to stakeholders within Michigan, gaps were identified between the role MDOT would like to play in the CAV space and the trajectory into which it is currently proceeding. The intent of this gap analysis was to identify a broad range of key activities that other stakeholders have identified which may represent opportunities for Michigan, as well as overall industry gaps observed that Michigan may consider taking a leadership role in. Recommendations on how to begin to address these gaps will be presented in Section 3.

## Current Department Initiatives

MDOT has an extensive history in CAV, as has been summarized in the 2017 CAV Program Strategic Plan and other documentation. One of the primary goals of efforts to date has been to support CAV as a tool to achieve towards zero deaths (TZD) initiatives. There have also been initial efforts to plan for changes to travel demand due to CAV, and building off that to plan for changes in traditional revenue sources due to CAV. MDOT has also championed the piloting of new mobility solutions through unique grant programs and pilots throughout the state.

To support these ambitions, MDOT and its partners have needed to address the infrastructure needs of AVs, including updating signing and striping standards and forming an understanding of the potential changes in loading and wear of bridges and pavements. MDOT has also deployed infrastructure and systems to

communicate with connected vehicles and support specific applications. Using data generated by vehicles, MDOT has begun to assess how to improve business processes, including through real-time assessment of pavement conditions, weather and road surface environments, and travel patterns.

By participating in national research and supporting on-road and off-road testing of CAVs through industry partnerships, MDOT has been able to actively engage in dialogues with peer agencies and technology developers on best practices and consensus approaches. This has helped to set both statewide and national policy regarding CAV use on roadways.

## Scan of Other Transportation Agency Initiatives

Despite the many projects and studies which demonstrate CAV technology, the timeline for their adoption and deployment remains uncertain. Meanwhile, many stakeholders throughout public and private sectors have begun to realize the potential wide-reaching impacts that CAVs might introduce. Therefore, several state agencies have taken it upon themselves to develop planning documents to guide the safe implementation of CAVs on their roadways. These documents are primarily designed to guide the jurisdictions with appropriate strategies for implementing the new technology.

Based on a review of CAV Strategic Plans other states have developed, the many listed objectives can generally be organized in two focus areas. The first involves internal organization. Every planning document discusses some form of development in their organizational structure. This may be a testament to the variety of impacts that CAV deployments and protocols could have on state transportation agencies. Recommendations range from strategic staffing, workforce training, internally promoting a culture of innovation, and establishing CAV working groups. The second area of emphasis involves external relationships and engagements. Every strategic plan displayed intention to grow in this regard. By corresponding with other stakeholders in the CAV space, an agency can develop a proper foundation for regulating in its domain. Both internal and external considerations are important for any transportation agency actively preparing for CAVs.

Out of the 49 peer state transportation departments that were reviewed, 27 states were actively involved in recent, present, or upcoming CAV activities and 22 states were not. In general, a state agency was considered to be involved if it has funded or endorsed the deployment of CAV technology, collaborated in CAV initiatives, established facilities for CAV testing/research, or obtained or distributed CAV-related grants. Activities ranged from three-day autonomous shuttle pilots to multi-million-dollar statewide deployments of V2X technology.

Only 6 out of the 49 states did not reveal any intention to engage in CAV activities in the near future. Despite not all being actively involved in the past, the large majority of state departments were willing to consider CAV technologies and deployments

in the future. Naturally, there are variations between states in their ability to fund and participate in CAV activities. A number of state agencies are also worried about the financial and safety risks associated with the current state of CAVs. Most state agencies simply want to stay ahead of CAV technology and ensure that their departments are well-equipped for the potential changes. To meet this need, many transportation departments have pursued methods of engaging with the CAV space without having to deploy the technology on public roads. These engagements comprised many different actions; some of the most common included dedicated CAV webpages, documents or reports (such as CAV roadmaps, strategic plans, presentations, or recommendation reports), CAV legislation changes, and executive orders to strengthen CAV activity.

This industry scan resulted in the identification of seven topic areas that MDOT should focus on for this Strategic Plan:

- 1. Capital expenditures
- 2. Research
- 3. Long-range planning
- 4. Partnering
- 5. Policy and regulation
- 6. Staffing and internal operations
- 7. Communications

These topic areas provided a preliminary outlook on the types of topics MDOT should consider for its updated, department-wide CAV Strategic Plan. They were then discussed with stakeholders from across the department prior to being integrated into the final goals, strategies, and recommended actions that this plan presents.

## Feedback from MDOT Stakeholders

Throughout workshops with MDOT staff, the survey tool Poll Everywhere was used to solicit feedback. While the content of the survey questions was adjusted based on experiences in the early workshops, the following four questions and answer options were finalized for most of the workshops.

The first question was presented during the group introductions, and asked participants to select from a list of options which best summarized their feelings and perspectives on CAV technology. Responses are shown in *Figure 4*.

Throughout all the workshops, not a single participant selected "fear" in response to the first question, even though the survey responses were anonymous. However, some voiced that some of the residents in their region or people they knew personally were more fearful of the technology. This demonstrates that while MDOT has done a good job internally educating staff to provide a certain level of comfort with CAV technology, outreach beyond the department could be improved.





The second question, which kicked off the discussion portion of the workshop, asked how often the group currently considers CAV when working on a typical project. How this question was phrased varied depending on the focus of the workshop, as some divisions and regions do more project-based work, while others are more focused on broader initiatives or providing overall support. This question was not asked for the three external partner groups. Results are shown in *Figure 5*.





How often does your group consider CAV when working on a typical project?

As expected, the distribution of responses to this question varied widely depending on the focus of the meeting. For workshops with TSMO groups and the Metro Region, results skewed towards "always", while for many others they skewed towards "rarely" or "never". For most participants, CAV technology is not something they consider on an everyday basis, but rather just for specific types of work, such as signal upgrade projects. The next question asked how much participants saw MDOT's role evolving due to CAV. This question often led to a discussion on what MDOT's role really is today, what it has been in the past, and what it should be in the future. Results are shown in *Figure 6*.



#### Figure 6. Responses to Third Poll Question

Overall, the sentiment was that MDOT's role of providing mobility to Michigan residents and visitors would not change, but how it would meet this role likely would. This could include conducting maintenance in a more proactive way, better monitoring operations in real-time, or managing what the department may become liable for.

The final question asked how soon participants expect CAV impacts to occur. While this question did require participants to speculate on the future readiness of the technology, answers could also be based on what their role is and how intertwined it is with the level of technology on roadways. Results are shown in *Figure 7*.





How soon do you expect CAV to

Most respondents saw the impact on their role happening within the next decade, and many stated that it had already occurred. While CAV were considered unlikely to change anyone's role at MDOT completely, changes were expected to occur to some degree, and to compound over time.

This survey was followed by a discussion focused on the group's specific roles and responsibilities. These discussions provided a platform for enhanced internal communication within MDOT as it relates to the future of CAV at the department. The discussions covered a variety of topics, and key gaps and opportunities that were identified are presented in the next section.

## Gaps and Opportunities

Feedback obtained during the workshops, as well as the expertise and previous research by the project team, resulted in the identification of various gaps that should be addressed by the MDOT CAV Strategic Plan. These gaps are generally classified in three broad areas: Policy, Communications and Partnerships, and Technology and Applications.

#### Policy

The following identified gaps relate to policy decisions by MDOT and, to the extent practical, more broadly by state government agencies (and/or interagency partnerships) to advance CAV in Michigan:

#### **PROGRAM GOALS**

The goals developed in the 2017 CAV Program Strategic Plan have not been updated since that time to reflect industry changes and to integrate broader statewide or even department-wide objectives. While measurable goals may not be possible until the technology is more mature, there are other updates that could be made now.

#### SPECIFIC POLICY AREAS

Further definition of MDOT or state policy is needed, including in the following areas:

- Liability: MDOT has addressed policies and guidance on liability of CAV systems, but more dialogue is needed with local agencies and other state government agencies to help communicate this and continue to move it forward.
- Equity: The CAV program and its goals have generally been technologyfocused, and not fully linked to other statewide objectives like equity. If the CAV program is to benefit all of Michigan's residents, and if the program is to

be coordinated with statewide and department-wide direction, equity needs to be brought into the CAV program as a core value.

- Funding: The amount of funding required for MDOT to make substantial infrastructure changes while continuing to operate and maintain its existing assets is simply not available. MDOT needs to fully consider and plan for future funding needs, and address the gap between these needs and how they will be paid for.
- Electrification: There has been limited consideration of and investment in the infrastructure necessary to support electric vehicles. This gap is particularly stark relative to other states. While there are various initiatives across the state, including OFME's Electrification Strategic Plan, that are addressing this gap, it should also be considered in MDOT's CAV program due to the many interfaces and complementary technology trends with CAV.
- Shared mobility: Public transportation has been included in the CAV conversation, but other types of shared mobility have largely been overlooked. MDOT needs to assess what its role in this space is, in terms of setting policy or leaving the responsibilities to private industry.
- Small cell co-location: There is also a policy gap specifically related to clarity on small cell co-location on the public right-of-way, which will be important for the roll-out of 5G (which relies on a larger number of smaller-sized infrastructure nodes compared to existing cellular networks).
- Pricing: There is a legislative limitation that is broader than the CAV program, related to the ability to toll interstate highways and some other roadways. This will limit the ability to consider tolling, road usage charging (RUC), and other emerging pricing strategies into the future. There are budding CAV projects across the country that are beginning to look into addressing this, but this topic still requires further attention if MDOT is interested in pursuing it as a way to price mobility.

#### STAFFING/STAFF DEVELOPMENT

There is a need for more guidance on an overall, CAV-related staffing strategy and policy changes required to achieve this vision:

- Staffing strategy: MDOT does not yet have a broader staffing strategy for retaining and recruiting people with the needed skillsets for future needs.
- Civil service requirements: State government job requirements typically do not have the required flexibility to easily create new positions for the types of skills that are becoming more necessary.

#### **Communications and Partnerships**

Opportunities exist for MDOT to strengthen internal and external communication regarding CAV, and the process by which partnerships are developed and formalized:

#### **EXTERNAL COMMUNICATIONS**

There is a need for the development of mechanisms to strengthen external communications, such as:

- Coordination across state government: There are currently many different CAV and future mobility groups throughout the state, including the new Office of Future Mobility and Electrification (OFME). Additional coordination or perhaps a reorganization is necessary to ensure the CAV program encompasses broader insight from across the department, including for policy, planning, deployment, and operations and maintenance considerations. This was part of the role envisioned for OFME, to coordinate a statewide mobility strategy that is championed by multiple state departments and offices.
- Local agency engagement: Despite there being many CAV working groups and company consortiums, including one led by MDOT, many workshop participants were not aware, and suggested this as a next step, particularly when it came to engagement with local agencies. This is likely in part because most existing groups are local to Southeast Michigan.
- Public education: MDOT has not yet fully decided what it wants its role to be in educating and communicating to the public about CAV trends. To define this role, MDOT needs to determine what the public needs to know about lower and higher levels of automation, and whether MDOT or another entity should be the one to educate the public on these topics. MDOT also needs to decide whether to always remain neutral on CAV, or whether there may be times when a public agency needs to step in to promote or push back on what the industry is saying, and whether this public agency should be MDOT.

#### **INTERNAL COMMUNICATIONS**

Internal communications and education on CAV has generally been fragmented one-time efforts, rather than pieces of a larger program or strategy. Need to consider communication strategies to keep staff across the department engaged in CAV and how it may impact them in their roles, as well as opportunities for growth and development. It should also address communication of changes in departmental policies related to CAV.

#### PARTNERSHIP STRATEGY

Many industry partnerships to date have been formulated on more of an ad-hoc basis as opportunities arise, rather than responding directly to needs identified by residents. There are more innovative or systematic approaches that could be adopted to prioritize between and select potential partners, and to accept unsolicited proposals in an equitable and defensible way.

#### LAW ENFORCEMENT INTERACTION PLAN

Michigan does not have requirements for CAV deployers to perform a law enforcement interaction plan. This is something many other states have developed, and it can benefit both law enforcement and transportation agencies by providing a more formalized understanding of what to expect and how to prepare as CAVs become more prevalent on public roadways.

#### **Technology and Applications**

The following are opportunities which address further specific technology areas or applications which were identified through both staff engagement and a scan of industry activities:

#### DATA

Several opportunities were identified that could further collection and management of data arising from, or in support of, CAV technology:

- Data ecosystem support: To date, MDOT has mostly been focused on creating and controlling their own internal data ecosystem. However, as higher volumes of data are collected, there will be a growing need to expand this system, possibly by exploring support from private providers, particularly when looking at cloud platforms.
- Cybersecurity and privacy: While MDOT follows best practices in CAV and data cybersecurity and privacy, many of these best practices are evolving and have not yet been formalized.
- Changes to asset management: Many of MDOT's assets are managed based on traditional uses, and there is a need to integrate changes based on consumer trends. An example is pavement markings, which are currently maintained based on the needs of most human drivers, though many drivers are increasingly being supported by advanced driving systems that have a higher reliance on pavement markings. Management of data on asset condition will enable MDOT to better support these needs.

#### **APPLICATIONS AND USE CASES**

There are many potential CAV applications available to MDOT. While not a comprehensive list, the following applications and use cases were identified for further exploration, as stakeholders felt they had not been sufficiently explored in past work and that they would be important to the future mobility landscape:

- Freight: Most of the focus of the CAV program to date has been on passenger transportation. However, freight use cases are often seen as earlier adopters of CAV technology than passenger transportation, because freight is often managed as a fleet (making new technologies easier to adopt at scale) and because there is a high potential for cost savings. Infrastructure changes are likely to be necessary to for freight movement, and should be considered further, especially since investments have decades-long lifespans.
- Work zones: Work zones are often talked about as an early use case of CAV technology, with high potential for safety and innovation. Some pilots have been conducted to date, but more attention is warranted due to the potential for impact.
- Pedestrian applications: There has been limited attention to use cases related to pedestrian safety and mobility, including how they are detected by and how they should safely interact with CAV.
- Micromobility applications: There has also been limited attention to use cases related to micromobility devices, including bicycles, e-bikes, scooters, e-scooters, skateboards, wheelchairs, and ground-based drones or delivery

robots. This includes both interactions between these vehicles and CAV, as well as these vehicles being CAV themselves (in the case of ground-based drones and delivery robots, of which there is currently private development going on in Michigan).

#### **APPLICATION CONTEXT**

Going forward, there is a desire to diversify applications in terms of location, mode, audience, and use case, as well as to foster the ability to sustain pilots and demonstration projects for the long term:

- Rural and suburban applications: Most of the focus of the CAV program to date has been on urban applications, rather than suburban and rural settings, though there have been some examples in all three contexts. Urban agencies have also been more engaged in the process so far than many of their more rural counterparts.
- Sustainability: There is an overall industry gap in converting short-term pilots and demonstrations to sustainably-funded, long-term deployments. This gap is beginning to be addressed through the development of long-term funding and operation models, but more attention is still needed.

#### SECTION 3

## Recommendations

This section presents recommended actions MDOT should take to support the goals and strategies of its CAV program, and essentially to implement the CAV Strategic Plan. The actions, organized under the goal and strategy they most directly support, are:

- Safety: Leverage CAV technology to enhance the safety of the transportation system. (p.28)
  - 1.1. Strategy: Focus on adapting CV technologies to the current industry environment based on a continuous evaluation and reevaluation of industry trends. (*p.29*)
    - 1.1.1. Action: Bring existing roadside units (RSU) to a minimum viable product (MVP) level. (*p.30*)
    - 1.1.2. Action: Continue deployment of V2I technology in concert with partners, focusing on deploying for specific identified needs and locations. (*p.31*)
    - 1.1.3. Action: Develop strategies to manage maintenance and updates of connected vehicle infrastructure. (*p.32*)
    - 1.1.4. Action: Further research and deployment of C-V2X technology, and any other emerging technology options, while assessing their readiness to be deployed in Michigan. (p.33)
  - 1.2. Strategy: Continue strategic foundational investments in CAV systems. (*p.34*)
    - 1.2.1. Action: Strategically invest in intersection upgrades. (p.35)
    - 1.2.2. Action: Evaluate uses of data from CAV, including by leveraging existing systems. (p.36)
    - 1.2.3. Action: Continue to support the safe testing and development of AVs. (*p.37*)
  - 1.3. Strategy: Research and plan for enhancements of traffic control devices and other roadway infrastructure to support the evolving needs of AVs. (p.38)

- 1.3.1. Action: Independently assess the infrastructure needs of AVs, with and without connectivity. (*p.39*)
- 1.3.2. Action: Explore pavement marking adjustments that support both CAV and conventional vehicles. (*p.40*)
- 1.3.3. Action: Plan for infrastructure needs by beginning project programming. (*p.41*)
- 1.4. Strategy: Support the development and deployment of CAV work zone, weather, and other dynamic condition applications. (*p.42*)
  - 1.4.1. Action: Develop a work zone application strategy and other fundamental systems engineering documentation that can support an eventual pilot deployment. (p.43)
  - 1.4.2. Action: Further assess the applicability of CAV weather applications to enhance the safety of Michigan roads today. (*p.44*)
- 1.5. Strategy: Increase attention on active transportation safety applications. (*p.45*)
  - 1.5.1. Action: Bring stakeholders into the process to identify needs and potential applications, highlighting this previously under-resourced travel mode. (p.46)
  - 1.5.2. Action: Explore piloting a CAV pedestrian detection system. (*p.47*)
- Mobility and Accessibility: Seek to enhance the movement of people and goods across all modes in an equitable manner using advanced technology. <u>(p.48)</u>
  - 2.1. Strategy: Identify CAV use cases for near-term deployment, especially those that tie in with other statewide high-priority needs, through direct engagement with the business areas whose needs are being addressed. (*p.49*)
    - 2.1.1. Action: Continue to identify and document partner agency and private sector user needs through engagement with Michigan CAV working groups. (*p.50*)
    - 2.1.2. Action: Refresh assessment of CAV pilot options in connection with potential funding opportunities. (*p.52*)
    - 2.1.3. Action: Continue investments in connected vehicle test corridors, and encourage third party testing, to determine the resources necessary to design, operate, and maintain these technologies in urban and rural environments. (*p.53*)
  - 2.2. Strategy: Ensure that all parts of the CAV transportation network are accessible and equitable. (*p.54*)
    - 2.2.1. Action: Create a process to consider the equity of technology investments. (p.55)
    - 2.2.2. Action: Conduct a review of accessibility barriers within existing CAV projects to inform future direction. (*p.56*)

- 2.2.3. Action: Ensure considerations of accessibility are part of all MDOT and partner-led CAV pilots and testing authorizations for private developers. (*p.57*)
- 2.3. Strategy: Continue supporting CAV applications in public transportation and other shared mobility modes. (*p.58*)
  - 2.3.1. Action: Fund testing and deployment of public transportation innovations and shared mobility modes through ongoing commitment via mobility challenges and/or other funding mechanisms. (*p.59*)
  - 2.3.2. Action: Support the statewide transfer of knowledge on Michiganbased, national, and international passenger transportation innovations. (p.60)
- 2.4. Strategy: Support applications that enhance the movement of goods through the state and in partnership with neighboring states and Canada. (*p.62*)
  - 2.4.1. Action: Continue to explore CAV initiatives that could enhance freight movement within the state. (p.63)
  - 2.4.2. Action: Identify regulatory and technical obstacles to seamless CAV operation in border crossing scenarios. (*p.64*)
  - 2.4.3. Action: Promote border crossing and state partnerships solutions such as the Smart Belt Coalition in CAV-focused pilots and project development. (*p.65*)
- 3. MDOT Workforce Development: Position the department to attract, retain, and train the expertise needed to meet the demands of a state DOT in response to evolving mobility trends and implications for transportation infrastructure. (*p.66*)
  - 3.1. Strategy: Optimize hiring strategies with respect to civil service requirement constraints. (*p.67*)
    - 3.1.1. Action: Conduct an audit of knowledge and skills gaps associated with advanced technology by identifying existing resources. (p.68)
    - 3.1.2. Action: Develop position descriptions and requirements for gap areas and other changes. (*p.69*)
    - 3.1.3. Action: Evaluate civil service barriers to hiring within gap areas. (p.70)
  - 3.2. Strategy: Attract and retain skilled, experienced, and talented MDOT staff. (p.71)
    - 3.2.1. Action: Understand employee satisfaction across MDOT, while evaluating familiarity and interest in CAV. (*p.72*)
    - 3.2.2. Action: Improve ongoing communication on CAV advancements and the department's strategic direction within the department. (*p.73*)

- 3.2.3. Action: Implement training programs that engage and educate staff on emerging technologies and the skills that will be required to support them. (p.74)
- 3.3. Strategy: Pursue a holistic department-wide workforce development strategy. (*p.75*)
  - 3.3.1. Action: Identify and utilize existing interdepartmental communication. (*p.76*)
- 4. Sustainability: Plan for and develop a resilient future transportation system that increases social, environmental, and fiscal sustainability. (*p.77*)
  - 4.1. Strategy: Incorporate CAV and advanced technologies in planning efforts throughout the department. (*p.78*)
    - 4.1.1. Action: Continue addressing impacts of CAVs in long-range planning efforts. (*p.79*)
    - 4.1.2. Action: Develop capabilities of considering changes due to CAV within travel forecasting models. (*p.80*)
    - 4.1.3. Action: Build a framework for evaluating CAV impacts in project development and NEPA initiatives. (*p.81*)
    - 4.1.4. Action: Evaluate need to update design guidelines for roads and bridges to support CAV adoption. (*p.82*)
  - 4.2. Strategy: Develop policies on electric vehicles that define MDOT's role. (*p.83*)
    - 4.2.1. Action: Develop a timeline for the electrification of MDOT's vehicle fleet. (p.84)
    - 4.2.2. Action: Develop policies for development of EV charging infrastructure. (*p.85*)
  - 4.3. Strategy: Seek innovative funding models and partnerships to support the long-term sustainability of systems to support CAVs and future mobility. (*p.86*)
    - 4.3.1. Action: Continue to pursue grant programs that match with departmental objectives. (*p.87*)
    - 4.3.2. Action: Continue exploration of innovative financial models and approaches. (*p.88*)
    - 4.3.3. Action: Research and assess the viability of a road usage charging pilot. (*p.89*)
    - 4.3.4. Action: Develop a Request for Information (RFI) for a public-private partnership C-V2X approach. (p.90)
- Economic Development: Continue to leverage, research, and build next generation transportation technologies as a force for economic growth in Michigan. (p.91)

- 5.1. Strategy: Establish and implement a CAV research agenda that leverages pooled funds and other national efforts, while bringing activity to Michigan. (p.92)
  - 5.1.1. Action: Continue involvement in existing and new pooled fund studies. (*p.93*)
  - 5.1.2. Action: Support research that further explores the connection between electric vehicles and CAV. (*p.94*)
  - 5.1.3. Action: Chart a path to promote additional consideration of geographic and social equity for future deployments throughout Michigan.  $(\underline{p.95})$
- 5.2. Strategy: Develop and implement a consistent and equitable framework for streamlined private sector partnering for research, pilots, and deployments. (p.97)
  - 5.2.1. Action: Create a framework for evaluating potential public-private partnerships. (p.98)
  - 5.2.2. Action: Develop a mechanism for acting on unsolicited/noncompetitive proposals. (*p.99*)
  - 5.2.3. Action: Provide CAV resources and support across the state to local and regional partners. (*p.100*)
- 6. Improved Business Processes: Explore innovative ways that CAV applications and data from CAV can be harnessed to support or improve current business processes. (*p.101*)
  - 6.1. Strategy: Continue efforts to develop CAV data use cases and understand how to leverage datasets to support departmental business processes.
    - 6.1.1. Action: Determine the continued role of existing data management systems to support this analysis. (*p. 103*)
    - 6.1.2. Action: Identify MDOT traffic safety and operations improvements that could be enhanced with data from CAV. (*p.104*)
    - 6.1.3. Action: Allow pilot projects to collect and analyze data received from CAVs and share MDOT data with vehicles or other third parties. (*p.105*)
  - 6.2. Strategy: Invest in systems that support strong data management and governance, so collected data can be secured, used, and shared as needed. (*p.106*)
    - 6.2.1. Action: Update data stewardship, retention policies, and privacy statutes to include data from CAV. (*p.107*)
    - 6.2.2. Action: Continue to invest in cybersecurity and data security. (*p.108*)
  - 6.3. Strategy: Enable policy and legal structures that continue to support the variable nature of CAV deployments. (*p.109*)

- 6.3.1. Action: Engage with other states and perform additional research to understand evolving best practices and be able to anticipate potential barriers. (p. 110)
- 6.3.2. Action: Engage and work with the legislature to address policy needs and foster an effective regulatory environment. (*p.111*)
- 7. Increased Stakeholder Awareness: Educate and coordinate with the public and policy makers to better understand the benefits and limitations of CAV technologies, to encourage safe, equitable, and effective deployment. (p.112)
  - 7.1. Strategy: Engage with the legislature, MDOT executive leadership, and other decision makers. (*p.113*)
    - 7.1.1. Action: Develop an assessment of legislative needs to support safe CAV adoption. (p. 114)
    - 7.1.2. Action: Review other statewide plans for potential implications and points of interface with CAV. (*p.115*)
    - 7.1.3. Action: Develop a legislative outreach and engagement plan. (*p. 116*)
  - 7.2. Strategy: Continue coordination with internal partnering agencies. (p. 117)
    - 7.2.1. Action: Coordinate with Secretary of State on vehicle licensing requirements. (*p.118*)
    - 7.2.2. Action: Engage with emergency responders to build an understanding of CAV technology impacts and opportunities and develop emergency responder interaction plans. (*p.119*)
    - 7.2.3. Action: Facilitate engagement with local public transit agencies on CAV. (p.121)
    - 7.2.4. Action: Coordinate with the Council of Future Mobility and Electrification. (*p.122*)
    - 7.2.5. Action: Continue partnerships with statewide and local economic development agencies. (*p.123*)
  - 7.3. Strategy: Build trust with the public on transportation technology trends. (*p.124*)
    - 7.3.1. Action: Host a statewide advisory council and/or statewide CAV workshops for stakeholders to share ideas and shape future policy. (*p.125*)
    - 7.3.2. Action: Develop CAV public engagement and communication plans. (*p.126*)
    - 7.3.3. Action: Continue to engage with students on CAV technology. (*p.127*)
    - 7.3.4. Action: Conduct public demonstrations throughout the state. (*p.128*)

The remainder of this section provides additional detail in support of each of these actions, including:

**Description**: Overview of the action and why it is something MDOT should pursue.

Priority level: Four attributes are ranked within the following scales:

- Time frame
  - > Immediately: Should be started right away, if it is not already happening
  - > 1-5 years: May require a ramp-up or start-up time, but should be pursued in the short-term
  - More than 5 years: Likely dependent on other actions or somewhat lower priority, and may not be achievable until at least 5 years in the future
- Cost implications
  - Low/none: Possible within existing budgeted funds, with mostly internal staff effort to support
  - > Medium: Moderate investment, such as vendor or consultant support
  - > High: Significant capital investment
- Internal/staff effort
  - > Low: Possible within existing staffing levels and capabilities
  - Medium: Will require training of existing staff and/or hiring of staff with new skills
  - > High: Will require significant staff augmentation
- Potential impact (could be both)
  - > Internal: Will affect agency procedures, with limited visibility to the public
  - > External: The impact will be directly perceived by the public

#### Interdependencies:

- Links to other goals, strategies, and actions
- Any necessary sequencing with other actions

#### Identified lead:

- Office or position who will be primarily responsible for implementation
- Other stakeholders and partners:
- Offices or positions of key stakeholders
- Could be entities internal or external to MDOT

#### Measures of success:

 Specific outcomes that measure success towards this achieving this action, and supporting its strategy and goal. This could include getting the programming and process in place and/or achieving measurable results.

## 1. Safety: Leverage CAV technology to enhance the safety of the transportation system.

As MDOT continues striving Towards Zero Deaths on its roadways, there are opportunities to leverage safety features of emerging technologies to support this high-priority statewide safety campaign and its underlying vision of reducing and eliminating property damage, injuries, and deaths on Michigan roadways. Connected vehicle technology can help transportation agencies better manage traffic and emergencies, prevent secondary crashes, and communicate vital safety information to and from vehicles. Automated vehicle technology can limit the impact of human error by supporting drivers and reducing reaction times.

Safety requires a multimodal approach, and success in this goal will include engagement with motorists, cyclists, pedestrians, transit, rail, and other partners. In addition, this plan assumes there will be a mixed fleet of CAV and human-driven, unconnected vehicles throughout its lifespan. Therefore, CAV will need to be designed to safely and efficiently interact with human-driven, unconnected vehicles and other modes in the transportation system.

## 1.1. Strategy: Focus on adapting CV technologies to the current industry environment based on a continuous evaluation and reevaluation of industry trends.

The deployment of CAV technology has always been subject to evolving regulatory action and industry trends. At this time, the regulatory landscape, particularly at the Federal level, continues to be uncertain. The communications network permitted for use by CVs and the amount of bandwidth available is subject to change. Safety standards and testing protocols have not yet been developed for AVs, and many questions to date have been answered by exemption or one-time action rather than as part of a larger strategy.

A patchwork of individual procurement and operating statutes across state and local jurisdictions is not conducive to long-term success, and there are many efforts underway to coalesce around more standard language across jurisdictional boundaries, as well as to ensure that once decisions are made they are valid for the lifetime of infrastructure that is deployed. However, while significant uncertainty continues to exist, it will be important to ensure that the investments made by MDOT and in the state of Michigan are flexible and can be updated as conditions require.

#### **Goal Alignment**

- O Safety
- → Mobility and Accessibility
- Ø Sustainability
- S Economic Development

### 1.1.1. ACTION: BRING EXISTING ROADSIDE UNITS (RSU) TO A MINIMUM VIABLE PRODUCT (MVP) LEVEL.

MDOT has deployed RSUs across the state, but not all are able to support the same core functions that would be necessarily for a seamless and comprehensive CV environment. As MDOT is reassessing the current industry environment, it should work to ensure that all RSUs across the state are able to support the same core functions rather than deploying a patchwork of RSUs with varying capabilities. This includes formalizing the definition of an MVP, and then first bringing already deployed units to the MVP level before ensuring that all future deployments meet the same MVP level. This MVP level will then need to be re-assessed and updated over time, and eventually integrated into MDOT business processes and specifications.

#### **Priority Level**

- Time frame: Immediately
- Cost implications: Medium
- Internal/staff effort: Medium
- Potential impact: Internal, External

#### Interdependencies

- RSU functionality upgrades can be done in parallel with other infrastructure upgrades (comms, cabinet space, etc.)
- A defined MVP can guide the framework for streamlined private sector partnering with vendors
- Some enhanced capabilities can be deployed on top of the MVP, for pilots and local needs

#### **Identified Lead**

ITS Program Office

#### **Other Stakeholders and Partners**

- Regional ITS Leads
- Department of Technology, Management, and Budget (DTMB)
- Construction Field Services Division
- Design Division

#### **Measures of Success**

- An MVP has been defined and guidance distributed, with procedures in place for future updates
- This MVP is deployed broadly across the state, and is flexible in design such that it can be consistently upgraded as necessary

1.1. Strategy: Focus on adapting CV technologies to the current industry environment based on a continuous evaluation and reevaluation of industry trends.

#### 1.1.2. ACTION: CONTINUE DEPLOYMENT OF V2I TECHNOLOGY IN CONCERT WITH PARTNERS, FOCUSING ON DEPLOYING FOR SPECIFIC IDENTIFIED NEEDS AND LOCATIONS.

Partnerships have been essential to the success of MDOT's CAV program to date, especially given the proximity of the industry developing this technology within the state. Continuing to leverage partnerships, with a department-defined framework, will help continue to move the CAV program forward and could help cover the costs of many CAV activities.

Working with partners will directly support MDOT in making sure that the investments it makes are used to support safety and other needs throughout the state. Partnerships with industry will be essential to ensuring that MDOT remains up to date on the current state of CAV technology. Partnerships with local governments will be essential to ensuring what is on the roads is meeting the needs of the local public, as well as being operated and maintained correctly.

#### **Priority Level**

- Time frame: Immediately
- Cost implications: Low/None
- Internal/staff effort: Medium
- Potential impact: Internal, External

#### Interdependencies

- Partnerships are often utilized as strategies for economic development, and should be distributed equitably across the state
- Private sector partnerships should be pursued in line with the consistent and equitable framework for streamlined private sector partnering

#### **Identified Lead**

Regional ITS Leads

#### **Other Stakeholders and Partners**

- ITS Program Office
- Any interested parties within or outside MDOT and the State of Michigan, including local transportation agencies, OEMs, and private sector developers and testers

#### **Measures of Success**

- An implemented framework for private sector partnering
- Open dialogue and investment throughout the state among public sector partners

1.1. Strategy: Focus on adapting CV technologies to the current industry environment based on a continuous evaluation and reevaluation of industry trends.

### 1.1.3. ACTION: DEVELOP STRATEGIES TO MANAGE MAINTENANCE AND UPDATES OF CONNECTED VEHICLE INFRASTRUCTURE.

Planning and deploying a project can be challenging, but these challenges do not end once a project has successfully become operational. This is particularly true when it comes to defining responsibilities between project partners for funding and performing operations and maintenance activities. Setting and monitoring quantitative performance measures such as system up-time, mean-time-tofailure, or average down-time during a deployment can also help better quantify the success of maintenance programs, leading to lessons learned for future deployments. In addition, there need to be provisions upfront for what to do if standards or regulations essential to the operation of a project change during the project's lifetime.

#### **Priority Level**

- Time frame: Immediately
- Cost implications: Medium
- Internal/staff effort: Medium
- Potential impact: Internal

#### Interdependencies

- Strong operations and maintenance procedures and provisions for updating infrastructure over time are essential to the sustainability of the transportation network
- Implementing this action will also support improved business processes

#### **Identified Lead**

ITS Program Office

#### **Other Stakeholders and Partners**

- Regional ITS Leads
- Any others involved in an individual deployment

#### **Measures of Success**

- Memoranda of understanding developed for each major deployment, in which all project partners agree to their prescribed roles, including financial and staff support
- Well-maintained CAV projects throughout the state
#### 1.1.4. ACTION: FURTHER RESEARCH AND DEPLOYMENT OF C-V2X TECHNOLOGY, AND ANY OTHER EMERGING TECHNOLOGY OPTIONS, WHILE ASSESSING THEIR READINESS TO BE DEPLOYED IN MICHIGAN.

MDOT has a strong history in Dedicated Short Range Communications (DSRC) deployment. However, many in the industry are moving toward C-V2X as an alternative to DSRC. To continue its position at the forefront of CV technology, MDOT will need to further assess the viability of C-V2X, and any other emerging alternatives, and potentially pivot focus if research and tests are favorable and/or regulations require it.

#### **Priority Level**

- Time frame: Immediately
- Cost implications: High
- Internal/staff effort: High
- Potential impact: Internal

#### Interdependencies

Much of the implementation of the CAV plan is independent of technology choice. However, there will be impacts to planning, maintenance, and other procedures laid out in other recommended actions throughout this plan

#### **Identified Lead**

ITS Program Office

#### **Other Stakeholders and Partners**

- Bureau of Transportation Planning
- USDOT and other federal agencies (in providing guidance)
- OBU and RSU technology vendors

#### **Measures of Success**

- Pilots demonstrating the viability of C-V2X
- Communications infrastructure that can support safety and is in compliance with industry and government standards

1.1. Strategy: Focus on adapting CV technologies to the current industry environment based on a continuous evaluation and reevaluation of industry trends.

#### 1.2. Continue strategic foundational investments in CAV systems.

Strategic foundational investments are modest and flexible to changes to other parts of the system that, made in coordination with industry partners, recognize that CAV technology is in its infancy and will change quickly. MDOT will need to work with industry while questioning assumptions, embracing new ideas and partners, and remaining nimble to shifts in technology in a rapidly changing environment to ensure its approach to CAV supports the safety and mobility needs of travelers while also building a sustainable infrastructure environment. MDOT should focus on foundational investments that are adaptable and can be upgraded as appropriate.

On the AV side, MDOT's role in supporting the safe testing and development of AVs needs to acknowledge the necessity of real-world on-road testing of AVs, while incorporating proper attention to safety to ensure the overall public interest is maintained. There are steps that MDOT can take to increase their awareness of ongoing testing and development using their roadways and to encourage dialogue and safety conversations with the developers, so that testing that is already occurring on Michigan roadways is leveraged to build a foundation for future investments in CAV systems that support MDOT's goals.

#### **Goal Alignment**

- O Safety
- ➔ Mobility and Accessibility
- Sustainability
- Improved Business Processes

#### 1.2.1. ACTION: STRATEGICALLY INVEST IN INTERSECTION UPGRADES.

Beyond just RSUs, MDOT will need to continue investing in appropriate cabinet space adjustments and underlying and backhaul infrastructure to support CAV. This includes strategically building out fiber optic and communications infrastructure as a foundation for future CAV and transportation systems management and operations (TSMO) investments.

According to the recently released NCHRP Web Report 289 "Business Models to Facilitate Deployment of Connected Vehicle Infrastructure to Support Automated Vehicle Operations", the cost of RSUs are only on the order of 15% of a total V2I deployment beyond the pilot stage.<sup>1</sup> Other technology-agnostic and mandatory CV infrastructure cost share estimates make up the majority of the costs of deployment, broken down below, and can be considered "no regret" investments as they less sensitive to shifts in technology availability and preferences throughout industry.

While industry uncertainty continues to have a significant impact, particularly on RSU and OBU technology development, focusing on these types of investments may be a more prudent use of MDOT's funds — Backhaul communications (fiber and IPv6 upgrade): 10%, CV back office: 15%, Signal controllers, cabinets, and other ITS equipment: 20%, Application software: 25%, and Training: 1%.

#### **Priority Level**

- Time frame: Immediately
- Cost implications: Medium
- Internal/staff effort: Low
- Potential impact: Internal

#### Interdependencies

- Identifying funding and financing options
- Understanding what technology will be deployed, though much of the underlying investment will be the same regardless
- A similar action to investments in data management, storage, and governance

#### **Identified Lead**

ITS Program Office

#### **Other Stakeholders and Partners**

- Bureau of Development
- Construction Field Services Division
- DTMB
- OtherTSMO groups

#### **Measures of Success**

 A near-term emphasis on "no-regret" infrastructure investments, that will support future CAV use without tying MDOT into specific technology constraints

1 http://www.trb.org/NCHRP/Blurbs/181272.aspx

### 1.2.2. ACTION: EVALUATE USES OF DATA FROM CAV, INCLUDING BY LEVERAGING EXISTING SYSTEMS.

The purpose of the TerraForm Manager (TFM), which replaced the Data Use Analysis and Processing (DUAP) tool, is to support MDOT and its partners in evaluating the uses and benefits of connected vehicle data. The need for managing CV data is only expected to increase in the future, so prioritizing this evaluation will be essential to the success of CAV at MDOT.

The benefits of this program can also begin to be expanded, in particular by increasing the connective tissue between TFM and the state's Advanced Traffic Management System (ATMS) software platform in the Transportation Operations Centers (TOCs). There is ample opportunity to eventually digest the large amounts of data stored in the TFM in the ATMS in pursuit of increasing system awareness and traffic management and travel information capabilities.

#### **Priority level**

- Time frame: Immediately
- Cost implications: Low/None
- Internal/staff effort: Low
- Potential impact: Internal, External

#### Interdependencies

- Actions related to supporting strong data management and governance
- Improvements to business processes related to data use cases

#### **Identified** lead

ITS Program Office

#### Other stakeholders and partners

- Enterprise Information Management
- DTMB
- ITS Program Office

#### **Measures of success**

- Better understanding of CAV data use cases and the systems needed to support them
- Investment in an interoperable system and adoption by stakeholders

### 1.2.3. ACTION: CONTINUE TO SUPPORT THE SAFE TESTING AND DEVELOPMENT OF AVS.

Enabling safe testing that further develops AV technologies will directly support MDOT's safety goals. However, there is currently a lack of national standards or federal regulations on what is meant by safe testing of AVs. MDOT can support the development of these standards and regulations through real world experience. In particular, incorporating some measure of voluntary or mandatory safety reporting to the state (even without specific metrics) can help the department better understand current AV capabilities and what precautions may be necessary to protect the public interest.

#### **Priority level**

- Time frame: Immediately
- Cost implications: Low/None
- Internal/staff effort: Low
- Potential impact: Internal, External

#### Interdependencies

• The safety of testing protocols is one thing that can be used to assess potential partnership opportunities through the partnership framework

#### **Identified** lead

ITS Program Office

#### Other stakeholders and partners:

Regional ITS Leads

#### **Measures of success**

• Recommendations on standards and regulations for the safe testing of AVs

# 1.3. Strategy: Research and plan for enhancements of traffic control devices and other roadway infrastructure to support the evolving needs of AVs.

Most of MDOT's experience and efforts in the CAV space to date have focused on the connected vehicle component of the technology. This is true for many infrastructure owner/operators, in large part because there is a larger infrastructure component to CV than there is to AV. However, as private companies continue to advance their AV offerings, it will be important for MDOT to coordinate with industry to ensure the state's roadways, signals, and other infrastructure meet the needs of AVs.

This is not to say that MDOT's infrastructure should be designed for any individual technology provider, or even for the AV industry as a whole. However, advancements to infrastructure that correspond with the evolving needs of travelers will help ensure that Michigan is ready to safely support AVs and other emerging technologies in the transportation system.

#### **Goal Alignment**

- O Safety
- Mobility and Accessibility
- S Economic Development

### 1.3.1. ACTION INDEPENDENTLY ASSESS THE INFRASTRUCTURE NEEDS OF AVS, WITH AND WITHOUT CONNECTIVITY.

The first step to addressing the needs of AVs is to understand what these needs are. Research has been conducted by various stakeholders in the past, but much of it is speculative, and a better understanding of what infrastructure owner/operators can do today will help maintain MDOT's position as a leader in CAV.

#### **Priority level**

- Time frame: Immediately
- Cost implications: Low/None
- Internal/staff effort: Medium
- Potential impact: Internal

#### Interdependencies

This will provide input into the strategy of establishing a CAV research agenda

#### **Identified** lead

ITS Program Office

#### Other stakeholders and partners

- Construction Field Services Division
- Bureau of Transportation Planning
- Bureau of Development
- Bureau of Bridges and Structures
- Office of Future Mobility and Electrification

#### **Measures of success**

 Published and distributed guidance identifying the infrastructure needs of AVs specific to Michigan, referencing existing guidance and research where available

1.3. Strategy: Research and plan for enhancements of traffic control devices and other roadway infrastructure to support the evolving needs of AVs.

### 1.3.2. ACTION EXPLORE PAVEMENT MARKING ADJUSTMENTS THAT SUPPORT BOTH CAV AND CONVENTIONAL VEHICLES.

One example of adjustments that are already being made by MDOT partially in response to the needs of CAV are changes in the width of pavement markings. The success of these changes should be assessed, and any additional best practices should also be identified. Changes to pavement markings are a relatively low-cost and flexible solution, so a good candidate for early changes and experimentation.

#### **Priority Level**

- Time frame: Immediately
- Cost implications: Low/None
- Internal/staff effort: Medium
- Potential impact: Internal

#### Interdependencies

 Coordination with legislators and local governments may be necessary to ensure consistency across the state

#### **Identified** lead

Bureau of Development

#### **Other Stakeholders and Partners**

- ITS Program Office
- Construction Field Services Division

#### **Measures of Success**

 Consistency in pavement markings across the state that conform to updated standards and best practices

1.3. Strategy: Research and plan for enhancements of traffic control devices and other roadway infrastructure to support the evolving needs of AVs.

### 1.3.3. ACTION PLAN FOR INFRASTRUCTURE NEEDS BY BEGINNING PROJECT PROGRAMMING.

As necessary changes to transportation infrastructure are identified, the next step towards implementation is to build out the programming of these recommendations, by identifying responsibilities across MDOT divisions, potential funding opportunities, and compatibility with existing processes and systems.

#### **Priority Level**

- Time frame: 1-5 years
- Cost implications: Medium
- Internal/staff effort: Medium
- Potential impact: External

#### Interdependencies

 Recommendations identified in the previous two actions will be further detailed, and funding and other steps toward implementation will begin to be identified

#### **Identified Lead**

ITS Program Office

#### Other stakeholders and partners

- Bureau of Development
- Construction Field Services Division

#### **Measures of Success**

- Project programming throughout the department, including plans and communication, that lay out how identified needs of CAVs can be accommodated
- Eventual deployment of solutions

1.3. Strategy: Research and plan for enhancements of traffic control devices and other roadway infrastructure to support the evolving needs of AVs.

# 1.4. Strategy: Support the development and deployment of CAV work zone, weather, and other dynamic condition applications.

There are many types of applications that are of interest to MDOT and its partners. One type of applications that MDOT should focus on are those that respond to and support operations in dynamic conditions, such as inclement weather and work zones. The current state of CAV technology can operate reliably under ideal conditions, but will only be safe to deploy widely once they can continue to operate once conditions have deviated from ideal.

Dynamic applications are also notable as an example of where connected and automated technologies can really support each other. In addition, national engagement with other states, especially those with similar conditions to Michigan, will be essential in advancing this strategy.

#### **Goal Alignment**

O Safety

Mobility and Accessibility

#### 1.4.1. ACTION DEVELOP A WORK ZONE APPLICATION STRATEGY AND OTHER FUNDAMENTAL SYSTEMS ENGINEERING DOCUMENTATION THAT CAN SUPPORT AN EVENTUAL PILOT DEPLOYMENT.

There are emerging onboard and roadside applications that help vehicles better understand and navigate work zones, and they can be especially effective for connected vehicles with some level of automation. A challenge for AVs is that work zones are complex and unmapped, so they are more difficult for AVs to understand than fixed assets. Using data and applications to improve work zone safety could improve travel by both CAV and conventional vehicles.

#### **Priority Level**

- Time frame: Immediately
- Cost implications: Medium
- Internal/staff effort: Medium
- Potential impact: External

#### Interdependencies

 Related to data use cases and improving business processes by leveraging them

#### **Identified Lead**

Construction Field Services Division

#### **Other Stakeholders and Partners**

- ITS Program Office
- Work Zones

#### **Measures of Success**

- Fully developed systems engineering products that guide an eventual deployment strategy
- Identification of deployment and funding opportunities for work zone pilots

1.4. Strategy: Support the development and deployment of CAV work zone, weather, and other dynamic condition applications..

### 1.4.2. ACTION FURTHER ASSESS THE APPLICABILITY OF CAV WEATHER APPLICATIONS TO ENHANCE THE SAFETY OF MICHIGAN ROADS TODAY.

The weather in Michigan, especially during winter months, can be unpredictable, localized, and can often result in dangerous travel conditions. MDOT has deployed CAV solutions to support weather applications, and the results of these pilots should be further assessed to guide future investment and distribute best practices.

#### **Priority Level**

- Time frame: Immediately
- Cost implications: Medium
- Internal/staff effort: High
- Potential impact: Internal, External

#### Interdependencies

 This has been identified as a use case for near-term deployment, and there could be applications across different modes

#### **Identified Lead**

ITS Program Office

#### **Other Stakeholders and Partners**

Regional ITS Leads

#### **Measures of Success**

- Assessment of existing pilots
- Investment in new pilots and/or transition of pilots into full-time deployments

1.4. Strategy: Support the development and deployment of CAV work zone, weather, and other dynamic condition applications..

#### 1.5. Strategy: Increase attention on active transportation safety applications.

Safety requires a multimodal approach, considering the needs of not just motorists but also cyclists, pedestrians, transit, rail, and other partners. Travelers using active modes of transportation are particularly vulnerable on the shared right-of-way, but supporting active transportation does not exclusively apply to the safety goal. This can also support the mobility, accessibility, and health of residents. It is also multimodal, as transit trips almost always involve active transportation as part of the full, end-to-end trip. Making sure this travel mode is a larger part of future efforts in CAV will be essential to ensuring safety and equity in transportation.

#### **Goal Alignment**

O Safety

Mobility and Accessibility

#### 1.5.1. ACTION BRING STAKEHOLDERS INTO THE PROCESS TO IDENTIFY NEEDS AND POTENTIAL APPLICATIONS, HIGHLIGHTING THIS PREVIOUSLY UNDER-RESOURCED TRAVEL MODE.

Rather than assuming that a particular application will work for the needs of a mode that has not had much CAV investment to date, the first step to supporting active transportation with CAV is to conduct bike and pedestrian stakeholder outreach and solicit feedback on how to integrate CAV into a multimodal system. This could be through existing stakeholder groups and outreach channels, by integrating best practices learned throughout the country, or by developing new methods to bring a wide range of stakeholders into the process.

#### **Priority Level**

- Time frame: Immediately
- Cost implications: Low/none
- Internal/staff effort: Medium
- Potential impact: External

#### Interdependencies

 Bringing more stakeholders into the process increases transparency and awareness of MDOT's CAV efforts

#### **Identified Lead**

ITS Program Office

#### **Other Stakeholders and Partners**

- Bureau of Transportation Planning
- Office of Future Mobility and Electrification
- Office of Passenger Transportation
- SEMCOG and other planning organizations throughout the state

#### **Measures of Success**

 Stakeholder engagement resulting in a widely-accepted plan for further development of an active transportation mode pilot

#### 1.5.2. ACTION EXPLORE PILOTING A CAV PEDESTRIAN DETECTION SYSTEM.

CAV pedestrian detection systems provide notifications and warnings to vehicle operators when there is a pedestrian in a crosswalk, midblock crossing, or other equipped location that conflicts with the vehicle's path of travel. Initial conceptual design of such a system has been conducted by MDOT, and should be developed into a real-world pilot.

#### **Priority Level**

- Time frame: 1-5 years
- Cost implications: Medium
- Internal/staff effort: Medium
- Potential impact: Internal, External

#### Interdependencies

A sustainable transportation network supports all modes

#### **Identified Lead**

ITS Program Office

#### **Other Stakeholders and Partners**

- Office of Future Mobility and Electrification
- Regional ITS Leads

#### **Measures of Success**

 A real-world pilot of a CAV application that supports the safety of pedestrians and cyclists

# 2. Mobility and Accessibility

Seek to enhance the movement of people and goods across all modes in an equitable manner using advanced technology.

CAV and other advanced technologies have the potential to significantly improve mobility and accessibility for all Michiganders. In-vehicle technologies such as automated driving systems and connected vehicle alerts and interventions can help prevent collisions and reduce bottlenecks. Data from connected vehicles and roadside infrastructure can enable MDOT and its partners better address incidents and actively manage the transportation system to reduce delays. Technology advancements are unlocking new modes, new ownership and payment models that promote shared mobility, and greater accessibility to transportation for non-drivers and the mobility challenged.

MDOT has already laid a strong foundation for advancing the technologies that support mobility and accessibility. An ongoing focus on intelligent transportation system (ITS) investment, employment of TSMO principles, and partnership with the many original equipment manufacturers (OEM) in the state provide strong building blocks for future activities. One of MDOT's most promising actions in promoting the mobility benefits of CAV, the \$8 Million Michigan Mobility Challenge, has the potential to be renewed with additional funding. Other ongoing and new initiatives could also be leveraged to support this goal within a framework of investment that distributes benefits across the state and in support of differing needs and use cases.

# 2.1. Strategy: Identify CAV use cases for near-term deployment, especially those that tie in with other statewide high-priority needs, through direct engagement with the business areas whose needs are being addressed.

Technology benefits its users when targeted at specific problems. Within statewide and local transportation planning and outreach efforts, MDOT and partners should identify mobility and accessibility challenges for a diverse set of system users. These challenges, coupled with ongoing learning and documentation of CAV and related technology applications, can produce a list of CAV use cases for near-term deployment. MDOT, in coordination with partners, should develop and maintain these use cases to support the strategic rollout of pilot applications, encourage private sector innovation with public benefits, and improve mobility and accessibility throughout the state.

There are several examples of existing documentation that can support this effort including the Michigan Council on Future Mobility Annual Report and PlanetM Mobility Challenge applications. Preliminary identified high-priority needs include healthcare access, systemwide accessibility, roadway maintenance, and transit network coverage.

#### **Goal Alignment**

- O Safety
- → Mobility and Accessibility
- Ø Sustainability
- (\$) Economic Development
- O Improved Business Processes
- Increased Stakeholder Awareness

#### 2.1.1. ACTION CONTINUE TO IDENTIFY AND DOCUMENT PARTNER AGENCY AND PRIVATE SECTOR USER NEEDS THROUGH ENGAGEMENT WITH MICHIGAN CAV WORKING GROUPS.

MDOT has supported the development, maintenance, and regular meetings of a CAV Working Group for many years. Many stakeholders across the state expressed interest in participating in such a group in the future, so there are ample opportunities to expand engagement and broaden the reach of the group or add more groups around the state. At the same time, there should be a push to make these working groups more active and exercise-focused to help define the path forward, rather than presentations on work that has already been done.

Working groups can provide diverse and expert insight into user needs. MDOT should determine a mechanism for collecting user needs, potentially an ongoing survey element, from these groups and other technology stakeholders and developers throughout the state. Planning partners, such as MPOs and municipalities, can be engaged as part of planning efforts and project development cycles. Other partners, such as the U.S. ArmyTank Automotive Research, Development and Engineering Center (TARDEC) in Warren, should be targeted for input. The resulting list or documentation of user needs could be used internally to MDOT or shared publicly.

MDOT's ongoing work in development of a CAV corridor (CAV-C), connecting Detroit and Ann Arbor along with key communities and destinations along Michigan Avenue and Interstate 94 in Wayne County and Washtenaw County, could serve as a foundation for defining user needs and opportunities along an urban corridor. User needs for other parts of the state, including other urban corridors as well as rural areas, could be solicited by expanding CAV working group to additional geographic areas.

#### **Priority Level**

- Time frame: 1-5 years
- Cost implications: Low/none
- Internal/staff effort: Low
- Potential impact : Internal, External

#### Interdependencies

Definition and identification of user needs can cover all CAV goal areas

#### **Identified Lead**

ITS Program Office

2.1. Strategy: Identify CAV use cases for near-term deployment, especially those that tie in with other statewide high-priority needs, through direct engagement with the business areas whose needs are being addressed.

#### **Other Stakeholders and Partners**

- Michigan CAV Working Group
- Office of Future Mobility and Electrification
- MPOs, municipalities, and RPOs
- Private sector developers and testers
- OEMs

#### **Measures of Success**

- A listing of CAV use cases
- Longer term, could potentially track implementation or maturity of technology solutions fulfilling listed use cases

### 2.1.2. ACTION REFRESH ASSESSMENT OF CAV PILOT OPTIONS IN CONNECTION WITH POTENTIAL FUNDING OPPORTUNITIES.

Technology-focused pilot projects enable MDOT to closely observe the feasibility, impacts, and sustainability of emerging technologies. MDOT should strengthen existing processes for identification and funding of CAV and related technology pilot projects targeted at specific user needs. MDOT should also implement an ongoing process for review of project funding opportunities such as federal transportation grant programs, research and demonstration challenges, and pooled fund demonstrations. A flexible, ongoing strategy for CAV pilots will ensure MDOT readiness for engagement with public and private sector partners to develop and test emerging technologies.

The results of the assessment could be a living document or repository of CAV funding opportunities and target projects.

#### **Priority Level**

- Time frame: 1-5 years
- Cost implications: Low/none
- Internal/staff effort: Low
- Potential impact: Internal

#### Interdependencies

 CAV pilots could deliver results across all goal areas, and are mentioned in many actions throughout the plan

#### **Identified Lead**

ITS Program Office

#### **Other Stakeholders and Partners**

- Office of Future Mobility and Electrification
- USDOT
- MPOs, municipalities, and RPOs
- Regional ITS Leads
- Private sector developers and testers
- OEMs

#### **Measures of Success**

- A living document or repository of CAV funding opportunities and target projects
- Longer term, could track implemented CAV pilots

2.1. Strategy: Identify CAV use cases for near-term deployment, especially those that tie in with other statewide high-priority needs, through direct engagement with the business areas whose needs are being addressed.

#### 2.1.3. ACTION CONTINUE INVESTMENTS IN CONNECTED VEHICLE TEST CORRIDORS, AND ENCOURAGE THIRD PARTY TESTING, TO DETERMINE THE RESOURCES NECESSARY TO DESIGN, OPERATE, AND MAINTAIN THESE TECHNOLOGIES IN URBAN AND RURAL ENVIRONMENTS.

When it comes to the deployment of CAV technology, the most likely relationship between MDOT (and other infrastructure owner/operators) and vehicle owner/ operators is that MDOT will be responsible for the roadside while the vehicle owner/ operators will be responsible for anything on the vehicle side. There are exceptions to this relationship, such as when MDOT equips its own fleet vehicles, but generally infrastructure is the area where MDOT should focus, similar to how it has in the past, to enable its industry partners to test and deploy in a safe manner to improve mobility throughout the state.

#### **Priority Level**

- Time frame: Immediately
- Cost implications: High
- Internal/staff effort: Medium
- Potential impact: Internal, External

#### Interdependencies

- Improved business processes and data analysis may help guide the identifications of corridors to invest in
- Many of these pilots will support mobility and accessibility as well as safety goals

#### **Identified Lead**

ITS Program Office

#### **Other Stakeholders and Partners**

- Regional ITS Leads
- Counties and municipalities
- Private sector developers and testers
- OEMs

#### **Measures of Success**

 Well-known and well-used test corridors that result in lessons learned and further advancement of CAV technology

# 2.2. Strategy: Ensure that all parts of the CAV transportation network are accessible and equitable.

Investments in CAV and related technologies are heavily driven by the private sector. In some areas such as safety and mobility, MDOT's goals will overlap. In others, there is less private sector incentive in place. MDOT will need to be an advocate for CAV contributions to spaces such as equity, mobility for the elderly and disabled, and accessibility. This plan makes clear that MDOT's vision for CAV includes strong accessibility and equity components. There are some actions MDOT can take to expand the reach of accessibility within CAV programming, and ensure that its programs reach out to different communities and regions across the state.

#### **Goal Alignment**

- → Mobility and Accessibility
- Ø Sustainability
- S Economic Development
- Improved Business Processes

### 2.2.1. ACTION CREATE A PROCESS TO CONSIDER THE EQUITY OF TECHNOLOGY INVESTMENTS.

Early investments in technology are often opportunity-based. As future opportunities mature, it will be important to ensure they expand their reach and serve communities that were previously overlooked. Developing a framework to guide programming by reviewing gaps in investment will help to ensure CAV opportunities are distributed equitably to all Michiganders as the program continues to expand.

#### **Priority Level**

- Time frame: Immediately
- Cost implications: Low/none
- Internal/staff effort: Medium
- Potential impact: Internal

#### Interdependencies

- Equity could be one lens considered within the partnership framework
- Geographic equity across the state is related to economic development, as is socioeconomic equity, though the latter is more closely tied to mobility and accessibility

#### **Identified Lead**

ITS Program Office

#### **Other Stakeholders and Partners**

- Regional ITS Leads
- Bureau of Transportation Planning
- Equal Employment Opportunity
- Office of Passenger Transportation

#### **Measures of Success**

An outlined process to guide considerations of equity within the CAV program

2.2. Strategy: Ensure that all parts of the CAV transportation network are accessible and equitable.

### 2.2.2. ACTION CONDUCT A REVIEW OF ACCESSIBILITY BARRIERS WITHIN EXISTING CAV PROJECTS TO INFORM FUTURE DIRECTION.

MDOT is undertaking an effort to identify and understand the needs of people with disabilities in order to develop future strategies for MDOT's Michigan Mobility 2045 (MM2045) statewide transportation plan. MDOT should build on goals, principles, and identified needs of MM2045 by additional documentation of where accessibility barriers exist and how CAV programming can support greater accessibility. MDOT research in this area can shape project selection as well as private sector development priorities and ensure that accessibility considerations are not solely limited to the vehicles but include all stages of a journey (for example considering the need for curb cuts at access points).

#### **Priority Level**

- Time frame: 1-5 years
- Cost implications: Medium
- Internal/staff effort: Low
- Potential impact: Internal, External

#### Interdependencies

 Improving the understanding of accessibility barriers can help with identification of transit-oriented projects

#### **Identified Lead**

ITS Program Office

#### **Other Stakeholders and Partners**

- Office of Future Mobility and Electrification
- Office of Passenger Transportation

#### **Measures of Success**

- Published and distributed guidance identifying accessibility barriers
- Pilots demonstrating CAV-related improvements to accessibility

2.2. Strategy: Ensure that all parts of the CAV transportation network are accessible and equitable.

#### 2.2.3. ACTION ENSURE CONSIDERATIONS OF ACCESSIBILITY ARE PART OF ALL MDOT AND PARTNER-LED CAV PILOTS AND TESTING AUTHORIZATIONS FOR PRIVATE DEVELOPERS.

Similar to the actions discussed under the border crossing strategy, MDOT can play a major role in shaping CAV pilots and development activities to be inclusive of accessibility. Accessibility could be included as a recommended option within the scope for future mobility challenges and as part of regular ITS and passenger transportation project selection. MDOT can also make accessibility a core consideration in the authorization of testing by private developers.

#### **Priority Level**

- Time frame: 1-5 years
- Cost implications: Low/none
- Internal/staff effort: Low
- Potential impact: Internal, External

#### Interdependencies

 Supporting the implementation of accessibility-focused projects can have safety benefits and improve stakeholder awareness

#### **Identified Lead**

ITS Program Office

#### **Other Stakeholders and Partners**

- Office of Future Mobility and Electrification
- Office of Passenger Transportation
- Transit service providers
- Private sector developers and testers
- OEMs

#### **Measures of Success**

- Formally updated project selection criteria and guidance emphasizing accessibility
- Pilots demonstrating CAV-related improvements to accessibility

# 2.3. Strategy: Continue supporting CAV applications in public transportation and other shared mobility modes.

CAV technology has the potential to transform the transportation industry's approach and assumptions regarding public transportation and shared mobility. Changes can be expected in types of services, providers, and vehicles that meet the needs currently served by traditional public transportation and personal vehicles.

MDOT is well-positioned to continue work with transit service providers and local transportation agencies to support testing and deployment of public transportation and other shared mobility modes to improve safety, mobility, and accessibility.

#### **Goal Alignment**

- Safety
- Mobility and Accessibility
- Ø Sustainability
- (\$) Economic Development
- O Improved Business Processes
- Increased Stakeholder Awareness

#### 2.3.1. ACTION FUND TESTING AND DEPLOYMENT OF PUBLIC TRANSPORTATION INNOVATIONS AND SHARED MOBILITY MODES THROUGH ONGOING COMMITMENT VIA MOBILITY CHALLENGES AND/OR OTHER FUNDING MECHANISMS.

MDOT has a history of promoting technology applications to improve mobility and accessibility. Innovative programs such as the \$8 Million Michigan Mobility Challenge have taken advantage of Michigan's strong university research programs and private sector innovators including and surrounding the strong Michigan OEM economy. MDOT has shown a commitment to increasing mobility in Michigan through the formation of the Office of Future Mobility and Electrification.

Given the success of previous rounds of the Mobility Challenge, and recognizing that private industry can often innovate faster than government, MDOT should identify or attract the funding to support innovative services through mobility challenges and other programming. The 2018 Mobility Challenge demonstrated a high demand for the funding opportunity (\$27M in submittals with \$8M in funding distributed) and an excess of promising ideas.

#### **Priority Level**

- Time frame: 1-5 years
- Cost implications: High
- Internal/staff effort: Low
- Potential impact: External

#### Interdependencies

- New public transportation modes and services will support development of workforce expertise, assuming training resources are provided
- Transit vehicle technologies and efficiencies will support sustainability

#### **Identified Lead**

Office of Passenger Transportation

#### **Other Stakeholders and Partners**

- Office of Future Mobility and Electrification
- ITS Program Office
- Transit service providers
- Counties and municipalities
- Private sector developers and testers
- OEMs

#### **Measures of Success**

New mobility challenge program development and implementation

2.3. Strategy: Continue supporting CAV applications in public transportation and other shared mobility modes.

#### 2.3.2. ACTION SUPPORT THE STATEWIDE TRANSFER OF KNOWLEDGE ON MICHIGAN-BASED, NATIONAL, AND INTERNATIONAL PASSENGER TRANSPORTATION INNOVATIONS.

Through MDOT's Office of Passenger Transportation, MDOT is in a position to continue supporting the statewide transfer of knowledge regarding effective innovation opportunities and to encourage ongoing innovation, as they are with electric vehicle adoption for buses. Many transportation service providers, especially in more rural areas, do not have the resources to support innovation on their own. There are many lessons, however, that can be learned from pilot testing done by Michigan's major urban transit providers, university research partners, and through mobility challenges and private sector innovation that enable pilots at the local level.

MDOT should review and supplement (as needed) their technology transfer programming. MDOT can communicate lessons learned and also help smaller and rural agencies understand where the opportunities exist for efficient onboarding of new technologies, for example conversion to electric vehicle fleets during regular vehicle turnover. As part of this, MDOT should also coordinate with transit service providers to ensure they are able to overcome any regulatory challenges with new services and help them recognize and prepare for challenges associated with new technology deployment.

#### **Priority Level**

- Time frame: Immediately
- Cost implications: Low/none
- Internal/staff effort: Low
- Potential impact: External

#### Interdependencies

- New public transportation modes and services will support development of workforce expertise, assuming training resources are provided
- Transit vehicle technologies and efficiencies will support sustainability

#### **Identified Lead**

Office of Passenger Transportation

#### **Other Stakeholders and Partners**

- ITS Program Office
- Office of Future Mobility and Electrification
- Transit service providers
- Counties and municipalities

#### **Measures of Success**

- Ongoing knowledge transfer activities
- Testing and deployment of internationally leading transit innovations by Michigan transit service providers
- Adoption of emerging technologies by smaller and more rural transit service providers

2.3. Strategy: Continue supporting CAV applications in public transportation and other shared mobility modes.

# 2.4. Strategy: Support applications that enhance the movement of goods through the state and in partnership with neighboring states and Canada.

One obstacle to valued CAV testing and early deployment is the potential issue of a regulatory "patchwork" that prevents vehicles from crossing jurisdictional boundaries. Differing regulations between Michigan and its neighboring states (Indiana, Ohio, Wisconsin) and Canada could stop CAV operators at the border. MDOT will work with the transportation agencies governing neighboring states and Canada to promote uniform approaches to regulation, which allow testers to freely utilize the full region when meeting applicable regulations.

Current coordination efforts and partnerships in international border crossing (including those with the Ministry of Transport Ontario and U.S. Customs and Border Patrol as well as member groups like the Eastern Border Transportation Coalition and Public Border Operators Association) and multistate initiatives (such as the Mid-America Freight Coalition and the Smart Belt Coalition) can serve as building blocks for technology and innovation-focused collaboration.

#### **Goal Alignment**

- Mobility and Accessibility
- MDOT Workforce Development
- Sconomic Development
- Increased Stakeholder Awareness

### 2.4.1. ACTION CONTINUE TO EXPLORE CAV INITIATIVES THAT COULD ENHANCE FREIGHT MOVEMENT WITHIN THE STATE.

Before moving to the challenges associated with interjurisdictional travel, there is significant research and activities that could be done to improve freight movement within the state, both along the state's freight corridors as well as related to last mile delivery. MDOT's Michigan Mobility 2045 statewide transportation plan includes an ongoing Freight Plan that touches on technology deployment, with a focus on "capturing for Michigan's advantage the benefits of new transportation, logistics and information technology". Including CAV as a source of these benefits could reveal research and piloting opportunities.

#### **Priority Level**

- Time frame: Immediately
- Cost implications: Medium
- Internal/staff effort: Low
- Potential impact: Internal, External

#### Interdependencies

- Improvements to goods movement will support economic development goals
- There may be many early action use cases identified through this exploration

#### **Identified Lead**

ITS Program Office

#### **Other Stakeholders and Partners**

Office of Future Mobility and Electrification

#### **Measures of Success**

 Published and distributed guidance identifying early use cases of CAV technology to support freight transportation within the state

### 2.4.2. ACTION IDENTIFY REGULATORY AND TECHNICAL OBSTACLES TO SEAMLESS CAV OPERATION IN BORDER CROSSING SCENARIOS.

MDOT has multiple major border crossings and an economy that is reliant on domestic and international goods movement, notably within the automotive sector. Given that border crossing issues have the potential to limit the adoption of CAV and related technologies, MDOT should conduct a review of potential regulatory and technical obstacles to seamless CAV operation in border crossing scenarios.

The resulting research, while specific to Michigan, can draw from national resources and a review of peer practices among other state DOTs that deal with similar border crossing challenges, for example New York and Texas.

#### **Priority Level**

- Time frame: 1-5 years
- Cost implications: Medium
- Internal/staff effort: Low
- Potential impact: Internal, External

#### Interdependencies

 Improvements to goods movement will support economic development goals, especially when conducted in partnership with other jurisdictions and private partners

#### **Identified Lead**

ITS Program Office

#### **Other Stakeholders and Partners**

- Regional ITS Leads
- Office of Future Mobility and Electrification
- Border crossing partners such as Ministry of Transport Ontario, Autonomous Vehicle Innovation Network (AVIN), Ontario, and Ontario Centre of Innovation (OCI)
- Multistate initiative partners such as the Smart Belt Coalition

#### **Measures of Success**

- Published and distributed guidance identifying regulatory and technical obstacles
- Actions to address obstacles

2.4. Strategy: Support applications that enhance the movement of goods through the state and in partnership with neighboring states and Canada.

#### 2.4.3. ACTION PROMOTE BORDER CROSSING AND STATE PARTNERSHIPS SOLUTIONS SUCH AS THE SMART BELT COALITION IN CAV-FOCUSED PILOTS AND PROJECT DEVELOPMENT.

Some existing CAV pilots have included border crossing as a key element. For example, in 2017 Magna International and Continental as well as TARDEC tested AVs that crossed into Ontario and back. MDOT should continue to encourage border crossing as an element in CAV testing and deployment. Border crossing demonstrations could be included as a recommended option within the scope for future mobility challenges.

Multistate testing could similarly be recommended, with a key opportunity area being the Smart Belt Coalition, a collaboration Michigan has with transportation agencies and educational institutions in Ohio and Pennsylvania. This group has released an RFI for "Truck Automation and Platooning," and additional topics areas of interest include work zones and truck parking capacity alerts.

Both international and state crossings can be promoted in traditional project selection as well. For example, the ITS Program Office maintains an ITS Project Request Form. Text asking about whether a project will promote multistate or international technology operation could be added to guide responses and shape future project programming.

#### **Priority Level**

- Time frame: 1-5 years
- Cost implications: Low/none
- Internal/staff effort: Low
- Potential impact: External

#### Interdependencies

Improvements to goods movement will support economic development goals

#### **Identified Lead**

ITS Program Office

#### **Other Stakeholders and Partners**

- Office of Future Mobility and Electrification
- Border crossing partners such as Ministry of Transport Ontario
- Multistate initiative partners

#### **Measures of Success**

- Formally updated project selection criteria and guidance emphasizing border crossing and interoperability
- Pilots demonstrating border crossing and multistate operation
- Increase of maturity level of border crossing technologies

2.4. Strategy: Support applications that enhance the movement of goods through the state and in partnership with neighboring states and Canada.

# 3. MDOT Workforce Development

Position the department to attract, retain, and train the expertise needed to meet the demands of a state DOT in response to evolving mobility trends and implications for transportation infrastructure.

MDOT's workforce is always progressing, evolving, and improving, regardless of the office, region, or division. MDOT's mission has historically focused on constructing and maintaining physical infrastructure that enables transportation and mobility, with some support of operations. MDOT's in-house expertise must adapt as transportation infrastructure becomes increasingly intertwined with new mobility services, digital communication, and CAVs.

Though the overall role of MDOT – providing safe mobility options throughout the state – will not change, this transition will impact many individual roles at MDOT. The department has the opportunity to take on and define these new roles, if the appropriate expertise is mastered. Leveraging CAV and other opportunities could enable the department to become more proactive than reactive, shifting how infrastructure is built and maintained and leading to new, more sustainable business models.

#### 3.1. Strategy: Optimize hiring strategies with respect to civil service requirement constraints.

There are some limitations within the hiring processes MDOT is required to use that preclude the ability to meet all the needs of CAVs and other emerging mobility trends. MDOT should thoroughly review the department-wide organizational structure and associated civil service requirements and other constraints. MDOT should then identify unnecessary constraints as well as new needs related to digital technology enabled transportation and mobility services.

This may not proceed directly to hiring, but starting to identify what is needed and how hard it may be to accomplish within the civil service framework is an important first step towards defining and setting up new, more flexible and relevant roles and categories.

#### **Goal Alignment**

- ADOT Workforce Development
- S Economic Development
- O Improved Business Processes

#### 3.1.1. ACTION: CONDUCT AN AUDIT OF KNOWLEDGE AND SKILLS GAPS ASSOCIATED WITH ADVANCED TECHNOLOGY BY IDENTIFYING EXISTING RESOURCES.

MDOT is already working to identify and address skills gaps to respond to trends such as CAV technology deployment. While there remains some uncertainty as to what skills are expected to be needed moving into the future, there are several areas of expertise that may prove beneficial, including data analytics, signal processing, and complex systems analysis, which may not be readily found in current MDOT roles.

These efforts coincide with national research and tools including the National Operations Center of Excellence (NOCoE), the National Network for the Transportation Workforce (NNTW), and the Institute of Transportation Engineers (ITE). Engagement with these groups can help further MDOT's understanding of anticipated needs. These efforts should result in an assessment of knowledge and skills needed relative to an internal review of current gaps, which will help prepare MDOT to define what new roles it needs to have filled.

#### **Priority Level**

- Time frame: Immediately
- Cost implications: Low/none
- Internal/staff effort: Medium
- Potential impact: Internal

#### Interdependencies

 Workforce skills needed to support CAV is an example of a topic that should be included in MDOT's CAV research agenda, in support of this action

#### **Identified Lead**

ITS Program Office

#### **Other Stakeholders and Partners**

- Office of Human Resources
- Office of Organizational Development

#### **Measures of Success**

Summary of knowledge and skills gaps within current MDOT capabilities

3.1. Strategy: Optimize hiring strategies with respect to civil service requirement constraints.
## 3.1.2. ACTION: DEVELOP POSITION DESCRIPTIONS AND REQUIREMENTS FOR GAP AREAS AND OTHER CHANGES.

To fill identified gap areas in hiring practices, MDOT should seek to formalize the process by which changes in hiring practices are made to assure that such changes are justified by evidence that there is a compelling need, in line with national efforts. This will include the development of position descriptions and requirements that can be used to describe what the needs of the department are.

These position descriptions can eventually be used to advertise for potential new hires to meet these needs. In the meantime, starting to encourage young engineers, planners, data scientists, and leaders through outreach efforts such as workshops, vehicle demos, and coding and data sharing events, can open up a career in transportation to those who have the skills sets needed for CAV.

## **Priority Level**

- Time frame: 1-5 years
- Cost implications: Low/none
- Internal/staff effort: Low
- Potential impact: Internal

## Interdependencies

 Describing workforce needs supports enhanced business process development

## **Identified Lead**

ITS Program Office

## **Other Stakeholders and Partners**

- Office of Human Resources
- All divisions and offices within MDOT

## **Measures of Success**

Position descriptions and requirements for gap areas

3.1. Strategy: Optimize hiring strategies with respect to civil service requirement constraints.

## 3.1.3. ACTION: EVALUATE CIVIL SERVICE BARRIERS TO HIRING WITHIN GAP AREAS.

MDOT's hiring practices are restricted by various legislative and regulatory requirements. Many of these frameworks were developed decades ago when the role of a DOT was very different, and in many ways simpler. MDOT should make a concerted effort to review all civil service requirements to understand how they may be impacting recruitment and retention. Any desirable amendments should be presented to the appropriate authority.

### **Priority Level**

- Time frame: 1-5 years
- Cost implications: Low/none
- Internal/staff effort: Medium
- Potential impact: Internal

## Interdependencies

This would improve the business process of hiring

## **Identified Lead**

ITS Program Office

## **Other Stakeholders and Partners**

- Office of Human Resources
- MDOT Leadership

## **Measures of Success**

- Recommendations for strategic changes to civil service requirements identified as barriers
- Eventual adoption of these changes resulting in the ability of MDOT to hire the right people for newly identified roles

## 3.2. Strategy: Attract and retain skilled, experienced, and talented MDOT staff.

MDOT's day-to-day operations and strategic long-term vision are the result of the actions its employees take to move the department forward. Improving the retention of talented employees, including by involving them in CAV or other emerging technology initiatives, as well as ensuring they have the training tools available to build the skills and experience they need to support the future of transportation, will be vital to MDOT's future success.

- ADOT Workforce Development
- Sustainability
- Improved Business Processes

## 3.2.1. ACTION: UNDERSTAND EMPLOYEE SATISFACTION ACROSS MDOT, WHILE EVALUATING FAMILIARITY AND INTEREST IN CAV.

As part of ongoing initiatives to assess employee satisfaction at MDOT, surveys and other outreach should include questions on their interest in CAV. Outreach for this strategic plan showed that there is interest across the department, and valid concerns and perspectives that people in different divisions and groups can add to the conversation. Finding the right people who are already at MDOT to support a roll-out of CAV that maximizes benefits to the department and the state can help engage employees, improve retention, and build expertise.

## **Priority Level**

- Time frame: Immediately
- Cost implications: Low/none
- Internal/staff effort: Low
- Potential impact: Internal

#### Interdependencies

 Increasing this understanding should lead to improved business processes at MDOT

## **Identified Lead**

Office of Human Resources

## **Other Stakeholders and Partners**

- ITS Program Office
- Interested staff across the department

## **Measures of Success**

 Identification of and engagement with key staff to support the roll out of CAV efforts as it relates to staff retention

## 3.2.2. ACTION: IMPROVE ONGOING COMMUNICATION ON CAV ADVANCEMENTS AND THE DEPARTMENT'S STRATEGIC DIRECTION WITHIN THE DEPARTMENT.

There are already various systems in place to facilitate communication on CAV advancements across MDOT, including engagement conducted as part of this CAV strategic planning process. Going forward, it will be important to go beyond explaining the technology and relevant use cases, to better clarifying how CAV relates to individual employees in their roles, including any potential workforce impacts, the timing of those impacts, and how to prepare for any changes, to garner interest in the CAV program and related training programs.

### **Priority Level**

- Time frame: Immediately
- Cost implications: Low/none
- Internal/staff effort: Medium
- Potential impact: Internal

#### Interdependencies

- Existing interdepartmental communication channels that are identified in that action can be utilized appropriately
- Part of increasing stakeholder awareness is making sure that internal stakeholders are knowledgeable on CAV, both for their own benefit and so they can help disseminate learnings to stakeholders they are engaged with

#### **Identified Lead**

ITS Program Office

## **Other Stakeholders and Partners**

Office of Communications

## **Measures of Success**

CAV communications plan

## 3.2.3. ACTION: IMPLEMENT TRAINING PROGRAMS THAT ENGAGE AND EDUCATE STAFF ON EMERGING TECHNOLOGIES AND THE SKILLS THAT WILL BE REQUIRED TO SUPPORT THEM.

Robust CAV focused training programs can be updated to integrate modern tools and techniques that empower MDOT staff to meet the identified skill and knowledge gaps. Cross training across divisions, encouraging conference attendance, and bringing in external training resources can build internal capacity and knowledge on CAV. Mentoring programs for those who are making changes can also help with the transition in work and responsibilities. National resources like the National Operations Center of Excellence can be leveraged to support identification of opportunities.

## **Priority Level**

- Time frame: 1-5 years
- Cost implications: Low/none
- Internal/staff effort: Low
- Potential impact: Internal

## Interdependencies

 Topics will correspond to the gap areas identified in the audit of knowledge and skills gaps

## **Identified Lead**

ITS Program Office

## **Other Stakeholders and Partners**

- Staff across MDOT who are interested
- Local agency partners who are interested

## **Measures of Success**

 A training program that demonstrates successful knowledge and skill acquisition

## 3.3. Strategy: Pursue a holistic department-wide workforce development strategy.

As CAV and other emerging technologies continue to expand in influence across the transportation system, it will be essential for MDOT staff across divisions and offices to pursue common understandings and objectives. There are different workforce development initiatives currently occurring in parallel across the department, so it will be important to coordinate these efforts and ensure each has a CAV and emerging technology component.

- ADOT Workforce Development
- Ø Sustainability
- Improved Business Processes
- Increased Stakeholder Awareness

## 3.3.1. ACTION: IDENTIFY AND UTILIZE EXISTING INTERDEPARTMENTAL COMMUNICATION.

MDOT has multiple methods of disseminating relevant information between various divisions within the department. However, there remains a need to improve internal communication, in this case particularly on ongoing CAV initiatives. This communication is bi-directional – ITS and CAV-related staff should receive input and feedback from other staff and departments, and also present how this feedback has been used to demonstrate results.

## **Priority Level**

- Time frame: Immediately
- Cost implications: Low/none
- Internal/staff effort: Medium
- Potential impact: Internal

## Interdependencies

 Results of this identification process can be used to improve ongoing communication on CAV advancements and the department's strategic direction within the department

## **Identified Lead**

ITS Program Office

## **Other Stakeholders and Partners**

All divisions and offices across MDOT

## **Measures of Success**

• List of existing interdepartmental communication options, with applications identified for each

# 4. Sustainability

Plan for and develop a resilient future transportation system that increases social, environmental, and fiscal sustainability.

With the emergence of CAV and other new mobility options, there is an opportunity to reassess how people move and how the transportation system is funded, with the potential to design a more resilient and sustainable transportation network. Success within this goal will require a balance between the three prongs of sustainability

- Environmental The system minimizes negative impacts to the environment so that it can continue to be usable far into the future.
- Fiscal The system is funded in a fair and practical manner, where users pay for what they use and investments are cost-effective.
- Social The system provides equitable access to opportunities, decreases barriers to mobility for disadvantaged communities, and is responsive to shifts in travel behavior.

Integrating planning efforts across the department, as well as beyond the department to support topics such as electrification, will be vital to fully integrating the impact of CAV into department activities, and ultimately being able to anticipate and design for the future needs of the system. Partnerships with industry and other government agencies can be leveraged to build on the outcomes of these planning activities.

# 4.1. Strategy: Incorporate CAV and advanced technologies in planning efforts throughout the department.

CAVs are being discussed within various groups and divisions across MDOT, and knowledge is increasing every day, but consistent guidance on how to accurately forecast their impending impact on the transportation network has not yet been generated and distributed. While there remain many unknowns, there are early findings and assumptions that should be integrated into planning processes across the department so they can be assessed and researched further. This is especially true for any planning efforts with long-term outlooks, like the Long Range Transportation Plan (LRTP).

- O Safety
- → Mobility and Accessibility
- MDOT Workforce Development
- Ø Sustainability
- Improved Business Processes
- Increased Stakeholder Awareness

## 4.1.1. ACTION: CONTINUE ADDRESSING IMPACTS OF CAVS IN LONG-RANGE PLANNING EFFORTS.

The impacts of CAV are beginning to be addressed in long-range planning efforts at MDOT. For example, scenario planning for the LRTP is considering different economic growth rates tied to CAV technology. These efforts should continue and be updated based on early findings and industry best practices.

## **Priority Level**

- Time frame: Immediately
- Cost implications: Low/none
- Internal/staff effort: Medium
- Potential impact: Internal

## Interdependencies

 Planning stakeholders will need to be engaged and educated on CAV to support incorporating CAV and advanced technologies in planning efforts throughout the department

## **Identified Lead**

Bureau of Transportation Planning

## **Other Stakeholders and Partners**

ITS Program Office

## **Measures of Success**

 The impacts of CAVs are addressed, or at least acknowledged, in all planning efforts throughout the department

## 4.1.2. ACTION: DEVELOP CAPABILITIES OF CONSIDERING CHANGES DUE TO CAV WITHIN TRAVEL FORECASTING MODELS.

Travel forecasting is a topic area where CAVs make planning difficult, especially given the many uncertainties involved with the deployment timeline and the cascading impacts CAVs may have. There are many assumptions that need to be set – related to the relationships with other technologies such as delivery drones and micromobility modes, as well as to better understanding how travel behavior and land use will adapt.

Increasingly bringing CAV into the modeling and forecasting process as real data streams become available will help embed the impacts of the technology into the forecasting process, building on the scenario planning efforts that are happening today. An understanding of CAV within travel forecasting models will help MDOT make updates to the transportation network that support mobility and accessibility, as well as other department goals.

#### **Priority Level**

- Time frame: 1-5 years
- Cost implications: Medium
- Internal/staff effort: Medium
- Potential impact: Internal

#### Interdependencies

 An MDOT workforce that is well trained to understand the impacts of CAV on the transportation network will be better able to support this action

## **Identified Lead**

Bureau of Transportation Planning

## **Other Stakeholders and Partners**

ITS Program Office

## **Measures of Success**

 Scenario planning with CAV that is currently being done is expanded as more data from CAV becomes available, eventually fully integrating CAV into travel forecasting activities

## 4.1.3. ACTION: BUILD A FRAMEWORK FOR EVALUATING CAV IMPACTS IN PROJECT DEVELOPMENT AND NEPA INITIATIVES.

Another aspect that CAVs should begin to integrate into is project development planning and National Environmental Policy Act (NEPA) analyses. Many MDOT projects and investments have decades-long lifetimes, so ensuring they are compatible with CAVs and that forecasting and other processes consider CAVs will help ensure that the investments that MDOT makes are useful throughout their lifespans.

## **Priority Level**

- Time frame: 1-5 years
- Cost implications: Low/none
- Internal/staff effort: Medium
- Potential impact: Internal, External

## Interdependencies

Enhanced business processes that integrate data and other applications to streamline a framework for evaluating CAV impacts will support this action

## **Identified Lead**

Bureau of Transportation Planning

## **Other Stakeholders and Partners**

- ITS Program Office
- Environmental Services Division

## **Measures of Success**

• A framework for evaluating CAV impacts in project development and NEPA initiatives that is used by planners throughout the state

## 4.1.4. ACTION: EVALUATE NEED TO UPDATE DESIGN GUIDELINES FOR ROADS AND BRIDGES TO SUPPORT CAV ADOPTION.

CAVs are likely to impact many of MDOT's roles, including the way MDOT builds and operates infrastructure. Using guidance from research and pooled fund studies MDOT has participated in, MDOT should begin to evaluate the need to update design guidelines for roads and bridges to support CAV adoption.

Updates to design guidelines should include new construction, updates to existing infrastructure, and maintenance on existing infrastructure. CAVs have implications for asset management, as they may use roads differently (i.e., more precisely within in a lane, or more closely following/platooning with nearby vehicles), there will be new data streams that can be utilized for reactive maintenance, and new infrastructure (such as ITS) will need to be maintained.

## **Priority Level**

- Time frame: More than 5 years
- Cost implications: Low/none
- Internal/staff effort: Medium
- Potential impact: Internal

## Interdependencies

- National/international research and recommendations on roadway and bridge design changes to accommodate CAVs
- Results of this assessment may guide future funding and investment decisions

## **Identified Lead**

Bureau of Development

## **Other Stakeholders and Partners**

ITS Program Office

#### **Measures of Success**

- Documented recommendations on which design guidelines need to be updated
- Eventual adoption of these guidelines

## 4.2. Strategy: Develop policies on electric vehicles that define MDOT's role.

Electric vehicles (EV) are being increasingly adopted by private vehicle owners and fleets across the state. Guidance from the federal level, and particularly its impact on the public vehicle fleet, is only expected to accelerate this trend. EVs are closely tied with CAVs, and in many ways their adoption could be a precursor to future adoption trends for CAVs, including concerns related to equity and accessibility.

MDOT's role as it pertains to supporting and providing infrastructure for EVs remains unclear. There are other statewide departments with larger defined roles in this space, but MDOT may have a role in providing supporting infrastructure on its roadways. In addition, the department will face revenue implications related to the gas tax, and must consider the potential impacts of expansion of EVs to the public vehicle fleet (such as transit, maintenance, or emergency vehicles). Better understanding these roles and responsibilities will ensure the state of Michigan is supportive of the roll-out of EVs on its roadways, and also that it can acquire lessons learned for the subsequent roll-out of CAVs.

- ADOT Workforce Development
- Ø Sustainability
- S Economic Development

## 4.2.1. ACTION: DEVELOP A TIMELINE FOR THE ELECTRIFICATION OF MDOT'S VEHICLE FLEET.

Electric vehicle technology has been rapidly advancing in recent years, and trends at the federal level imply that policy and funding opportunities may follow. As part of this, there are likely to be opportunities available for research and deployment of electric vehicle technologies within the agency fleet. MDOT should continue to monitor these opportunities, and decide when the time is right to encourage adoption of electric vehicle technologies for maintenance, transit, and other state vehicles. This transition timeline should consider the impacts of coinciding trends in CAV technologies.

## **Priority Level**

- Time frame: 1-5 years
- Cost implications: Medium
- Internal/staff effort: Low
- Potential impact: Internal

#### Interdependencies

 There will be an infrastructure component needed to support the needs of MDOT's electric vehicle fleet that should be considered as part of this process

## **Identified Lead**

MDOT leadership

## **Other Stakeholders and Partners**

- DTMB
- Construction Field Services Division
- Office of Future Mobility and Electrification
- ITS Program Office
- Office of Passenger Transportation (for state vehicle contracts and procurement)

## **Measures of Success**

Development of policy and timeline on MDOT fleet electrification

## 4.2.2. ACTION: DEVELOP POLICIES FOR DEVELOPMENT OF EV CHARGING INFRASTRUCTURE.

One of the reasons for hesitance towards EV adoption is range anxiety, given the limited amount of EV charging infrastructure relative to gas stations. MDOT can play a role in expanding this infrastructure, deploying charging systems that could be used by a variety of different vehicle types on its right of way. Further, as the department considers future electrification of its vehicle fleet, there may be increasing need for charging infrastructure at MDOT facilities, including maintenance facilities and office locations. This policy could consider the role of the private sector in providing publicly-available charging infrastructure at rest areas or park-and-ride locations on a revenue or advertising model which offsets the capital and on-going costs.

#### **Priority Level**

- Time frame: 1-5 years
- Cost implications: Low/none
- Internal/staff effort: Low
- Potential impact: Internal, External

### Interdependencies

- Charging infrastructure may also be needed in the appropriate locations to support MDOT's own electrified fleet
- This policy can be supported by the work of the Office of Mobility and Electrification

#### **Identified Lead**

Bureau of Development (for any construction within MDOT's right-of-way)

#### **Other Stakeholders and Partners**

- Bureau of Transportation Planning
- Office of Future Mobility and Electrification
- Maintenance Services

#### **Measures of Success**

• A policy for development of EV charging infrastructure at MDOT facilities that defines MDOT's role and the anticipated timeline for investments

# 4.3. Strategy: Seek innovative funding models and partnerships to support the long-term sustainability of systems to support CAVs and future mobility.

Infrastructure funding is constrained today, with needs increasing due to the aging of the nation's roads and bridges. This strain not only impacts maintenance of our current infrastructure, but limits the ability to consider deployment of new technologies to support CAVs and future transportation systems. In addition, changes to how we consume mobility (such as the expected increases in ride-hailing due to CAVs), and the rapid electrification of the fleet, will negatively impact funding based on the current fuel tax model. As such, in preparing for CAVs, MDOT must look for new funding approaches to support CAV deployment and broader infrastructure construction, operation and maintenance.

Current business models, on-board technology, and deployment scenarios for CAVs provide opportunities for new funding strategies, such as road usage charging or fleet-based deployment though public-private partnerships. Testing these sorts of strategies in early opportunity areas will provide MDOT with the experience to understand how CAVs can be leveraged to support the long-term fiscal sustainability of the transportation system.

- → Mobility and Accessibility
- Sustainability
- S Economic Development
- Improved Business Processes

## 4.3.1. ACTION: CONTINUE TO PURSUE GRANT PROGRAMS THAT MATCH WITH DEPARTMENTAL OBJECTIVES.

There have been many federal grant programs in recent years related specifically to CAV and other emerging mobility options, and this trend is expected to continue in the coming years. While these grant programs tend to be competitive, Michigan has been successful in several cases. To continue this success, it will be important to apply for grants that directly match with effective and needed projects seeking funding.

## **Priority Level**

- Time frame: Immediately
- Cost implications: Medium
- Internal/staff effort: Medium
- Potential impact: Internal

## Interdependencies

- Bringing federal funding to Michigan will also help meet economic development goals
- Federal grant programs are generally designed to promote transportation goals, so deploying projects that leverage these programs will help MDOT deploy CAVs safely and in support of enhanced mobility and accessibility

## **Identified Lead**

ITS Program Office and any regional/local partners

## **Other Stakeholders and Partners**

 Office of Passenger Transportation, or any other office or division whose needs meet the stipulations of the grant proposal

## **Measures of Success**

Successful grant applications that bring federal funding to Michigan

4.3. Strategy: Seek innovative funding models and partnerships to support the longterm sustainability of systems to support CAVs and future mobility.

## 4.3.2. ACTION: CONTINUE EXPLORATION OF INNOVATIVE FINANCIAL MODELS AND APPROACHES.

MDOT has conducted many partnerships with industry, particularly for pilots and deployments. Currently, MDOT's partnership with Cavnue is an example of a far-reaching partnership which could fundamentally change how infrastructure is delivered. Continuing to explore how these relationships can be leveraged to build public-private partnership models that include risk and cost sharing components, will help build new business models to sustainably support infrastructure investment and/or transportation operations.

Other innovative financial models beyond public-private partnerships should also be researched to uncover any newly emerging alternatives, particularly as they relate to CAV. This could include financing strategies, sources of external funding, or other ways to leverage MDOT's infrastructure to support its financial sustainability.

#### **Priority Level**

- Time frame: Immediately
- Cost implications: Medium
- Internal/staff effort: High
- Potential impact: Internal, External

#### Interdependencies

- The partnership framework will consider in-kind contributions, and publicprivate partnerships will be an important factor (as well as outcome) of that framework
- This builds on existing pilot and partnership activities, adding in a sustainable funding partnership component

#### **Identified Lead**

Bureau of Finance & Administration

#### **Other Stakeholders and Partners**

- MDOT leadership (in particular for any final approvals)
- Office of Economic Development
- ITS Program Office

#### **Measures of Success**

 A series of successful public-private partnership agreements, with results documented and assessed to guide further direction

4.3. Strategy: Seek innovative funding models and partnerships to support the longterm sustainability of systems to support CAVs and future mobility.

## 4.3.3. ACTION: RESEARCH AND ASSESS THE VIABILITY OF A ROAD USAGE CHARGING PILOT.

A parallel and often intersecting trend to CAV is exploring new ways to price mobility, in part because traditional funding streams such as the gas tax have not kept pace with inflation and may become even less effective in the future due to other intersecting trends such as electric vehicle adoption. Many other states are exploring alternative funding strategies and business models, and MDOT has had some success in this area as well, but it will be important for MDOT to continue to explore alternative ways to sustainably fund the transportation system to ensure the success of its CAV and other programs.

One option is known as road usage charging (RUC), wherein drivers pay per mile, based on their usage of transportation infrastructure. The emergence of CAVs creates an opportunity to further explore RUC because the current fleet-based business models and onboard technology provide supporting structures for implementation. The socialization of variable pricing through other fleet models (such as the widespread use of surge, or demand-based, pricing by transportation network companies) has also created opportunity for implementing RUC among some users, especially in urban areas.

## **Priority Level**

- Time frame: 1-5 years
- Cost implications: Low/none
- Internal/staff effort: High
- Potential impact: Internal, External

## Interdependencies

- Equity considerations in any RUC proposed for CAV may include geographic as well as economic factors
- Early exposure to new technology, through pilot projects and demonstrations, is key to ensuring public acceptance of RUC as well as CAV
- AV are likely to increase vehicle miles traveled by making travel more convenient, which could lead people to make more trips and to make longer trips. AVs will also enable zero-occupancy trips. These considerations will affect the results of a RUC pilot and should also be considered in the travel forecasting model

## **Identified Lead**

MDOT leadership

#### **Other Stakeholders and Partners**

- ITS Program Office
- Bureau of Finance & Administration (in particular for any final approvals)

#### **Measures of Success**

Documentation for a proposed RUC pilot

4.3. Strategy: Seek innovative funding models and partnerships to support the longterm sustainability of systems to support CAVs and future mobility.

## 4.3.4. ACTION: DEVELOP A REQUEST FOR INFORMATION (RFI) FOR A PUBLIC-PRIVATE PARTNERSHIP C-V2X APPROACH.

MDOT has many years of experience and investment in DSRC-based CV technology. However, several new and evolving mediums can provide high-speed low-latency communication that will enable a CV environment. This includes cellular (C-V2X), which will likely be permitted to use the transportation safety spectrum in the near future based on pending action by the Federal Communications Commission. To minimize risks to the department, MDOT should continue to explore whether C-V2X can also meet its CV needs, through a public-private partnership approach that leverages industry expertise. The first step to attempting this is to release an RFI that will identify potential partners and the overall feasibility of this approach.

## **Priority Level**

- Time frame: Immediately
- Cost implications: Low/none
- Internal/staff effort: Low
- Potential impact: Internal, External

## Interdependencies

- This will support further research and deployment of C-V2X technology, while minimizing risk to MDOT
- This could also be an example of where an alternate procurement method (such as a sole-source procurement) would be the recommended course of action, once RFI responses are assessed

## **Identified Lead**

ITS Program Office

## **Other Stakeholders and Partners**

- Regional ITS Leads
- C-V2X developers and deployers

## **Measures of Success**

- An RFI for a public-private partnership C-V2X approach
- Assessments of responses, leading to the decision of whether and how to pursue a procurement

4.3. Strategy: Seek innovative funding models and partnerships to support the longterm sustainability of systems to support CAVs and future mobility.

# 5. Economic Development

Continue to leverage, research, and build next generation transportation technologies as a force for economic growth in Michigan.

Through past and ongoing initiatives like Planet M and OFME, the State of Michigan has positioned itself as the place to safely test and deploy CAV to advance public benefits and encourage workforce and economic development. Other states and regions have also advanced in this space, and to continue its leadership role MDOT must continue to build a vision for how research and deployment of CAV can address local challenges and progress CAV development. This will include structures for how MDOT will partner with public and private entities to advance mutual goals and initiatives.

Using CAV technology to improve transportation equity and accessibility for all people will also ensure more Michiganders have access to the opportunities these developments will provide. Being strategic about making investments and encouraging partnerships where possible reflects an understanding that CAV technology is still in its infancy and will change quickly.

By building a strong foundation to support next generation transportation technologies, Michigan's historic role as the home of the automobile will be modernized to support a multimodal, connected, and automated transportation network of the future.

# 5.1. Strategy: Establish and implement a CAV research agenda that leverages pooled funds and other national efforts, while bringing activity to Michigan.

There are many research topics related to CAV that could further the state of the technology, as well as provide state and local governments with a stronger understanding of past activities, current capabilities, and future direction. MDOT, as well as other public agencies throughout the state, should continue to work with and lead regional and national policy and technical activities to advance CAV technology and ensure Michigan's voice is represented.

- ADOT Workforce Development
- S Economic Development
- Increased Stakeholder Awareness

## 5.1.1. ACTION: CONTINUE INVOLVEMENT IN EXISTING AND NEW POOLED FUND STUDIES.

In a nation of 50 states, there are many opportunities to learn from and teach each other, including by leveraging regional and national resources to support local research and deployment opportunities. To this end, MDOT has been actively involved with other states in CAV and other pooled fund studies that aggregate funding and use it to support shared lessons learned. This engagement is expected to continue to support CAV technology research and pilots, including by addressing uniform CAV design and safety standards so that CAVs traveling across state lines do not face unnecessary obstacles. Involvement should also encourage these pooled funds to utilize MDOT facilities to conduct future pooled fund pilot studies – which will provide additional benefits to Michigan residents, visitors, and freight haulers.

#### **Priority Level**

- Time frame: Immediately
- Cost implications: Medium
- Internal/staff effort: Medium
- Potential impact: Internal, External

#### Interdependencies

- Depending on the research topic, many of these activities will directly support MDOT's other CAV goals
- Engagement with national groups can also support stakeholder and public awareness, as findings are generally published publicly

### **Identified Lead**

ITS Program Office

### **Other Stakeholders and Partners**

• Any divisions or local agencies that are interested in a particular topic

#### **Measures of Success**

- Continued engagement with pooled fund studies, including resulting deliverables
- Resulting pilots and other activities in Michigan

## 5.1.2. ACTION: SUPPORT RESEARCH THAT FURTHER EXPLORES THE CONNECTION BETWEEN ELECTRIC VEHICLES AND CAV.

Most AVs are currently being designed on electric vehicle (EV) platforms. This is for a variety of reasons, ranging from business processes (OEMs co-locating their EV and CAV departments, and deploying CAVs as managed fleets) to timing (positive CAV developments coinciding with positive trends in battery technology), to cost efficiencies (reduced maintenance requirements, as well as CAVs having power requirements that can be better supported by EVs). Further research is warranted to determine whether this relationship is simply due to circumstance, or whether it will be integral to the future of both technologies. If the relationship is expected to continue, MDOT will also need to form a better understanding of what the public sector role and revenue implications of this trend will be, and what role MDOT should have in this space.

#### **Priority Level**

- Time frame: 1-5 years
- Cost implications: Low/none
- Internal/staff effort: Low
- Potential impact: Internal

#### Interdependencies

- EVs can support a more environmentally sustainable transportation network
- This research will help inform MDOT's policy and expected role regarding EVs

#### **Identified Lead**

ITS Program Office

#### **Other Stakeholders and Partners**

Office of Future Mobility and Electrification

#### **Measures of Success**

Documented understanding of the relationship between CAVs and EVs

## 5.1.3. ACTION: CHART A PATH TO PROMOTE ADDITIONAL CONSIDERATION OF GEOGRAPHIC AND SOCIAL EQUITY FOR FUTURE DEPLOYMENTS THROUGHOUT MICHIGAN.

Just as public agencies intervened to ensure electricity was supplied to rural areas and phones are affordable to more individuals, weaving strategies into CAV planning efforts that explore ways to ensure that the promise of CAVs will improve the lives of those who now face the most serious transportation barriers will be essential to their future adoption. Equity has been considered in MDOT's CAV activities in the past, but further highlighting this consideration as it guides future investment and activity will be essential to ensuring that, when it has been proven safe to do so, not only are CAVs deployed to support all Michiganders, but CAVs are also generally trusted and therefore more easily adopted by people across the state.

Efforts to support equity need to cover two major spheres outreach and investment. Outreach to all types of communities should continue, to better understand needs, gaps, and opportunities to expand CAV opportunities, giving planners insight into diverse needs and key equity measures such as cost, geographic access, and personal mobility. On the investment side, this includes supporting CAV application development in all geographic areas of the region, taking care to ensure that it includes those that might have seen limited deployment opportunities in the past. It also includes ensuring CAV pilot projects are accessible to users with varying abilities, including those with physical or cognitive disabilities, users of varying ages, socioeconomics, and demographics, and travelers across different modes, including pedestrians and bicyclists.

## **Priority Level**

- Time frame: Immediately
- Cost implications: Low/none
- Internal/staff effort: High
- Potential impact: External

## Interdependencies

- The consideration of equity should tie into all actions throughout the plan, particularly those related to mobility and accessibility as well as economic development
- Considerations of equity should also play a greater role in workforce development initiatives as a tool for workforce retraining, economic development, and workforce readiness for CAV

## **Identified Lead**

ITS Program Office

## **Other Stakeholders and Partners**

Any other project partners

## **Measures of Success**

- Distributed guidance identifying equity barriers and strategies to overcome
- Recommendations on pilots and activities that serve many different locations and use cases

# 5.2. Strategy: Develop and implement a consistent and equitable framework for streamlined private sector partnering for research, pilots, and deployments.

Over the past decade, partnerships and resulting pilots and deployments have been key to what has made Michigan sustainable in the CAV space. This has set the trend for the position the State is in today. Engagement of new and continuation of existing industry and government partnerships will be integral to the successful implementation of the CAV program in the decades to come.

However, partnerships in the past have often been developed in an ad hoc way, responsive to opportunities that arise rather than as part of a larger strategic vision. While flexibility will be important for any successful framework, it is also the case that a streamlined structure and process will enable MDOT to guide investment in the state in a more sustainable way. Moving towards this vision may involve building new types of business models and bringing in considerations that were historically overlooked. For example, the consideration of equity needs to play a major role in economic development activities, including by ensuring that technology is deployed in areas throughout the state as well as to meet varying needs of residents and travelers.

- ADOT Workforce Development
- Sustainability
- Seconomic Development
- D Increased Stakeholder Awareness

## 5.2.1. ACTION: CREATE A FRAMEWORK FOR EVALUATING POTENTIAL PUBLIC-PRIVATE PARTNERSHIPS.

Currently, many partnerships with private industry are opportunity-based, resulting from specific initiatives MDOT is pursuing or technologies vendors are interested in testing on public roadways. This has worked well for early pilots, but as the number of opportunities increases, MDOT needs to develop a more defined framework for assessing potential public-private partnerships. Potential lenses to assess viable public-private partnerships include the amount and type of in-kind contributions provided, the capital required from MDOT, how much MDOT staff time would be expected, how these solutions would be incorporated into existing business processes, the likely benefits to Michiganders, geographic location and local considerations, and the level of innovation this opportunity would enable.

## **Priority Level**

- Time frame: Immediately
- Cost implications: Low/none
- Internal/staff effort: Medium
- Potential impact: External

### Interdependencies

 Development of this framework will guide how many different actions throughout this plan are ultimately implemented, and who is partnered with

### **Identified Lead**

ITS Program Office

## **Other Stakeholders and Partners**

- Regional ITS Leads
- Office of Passenger Transportation

#### **Measures of Success**

 Distributed framework to guide the selection of public-private partnerships, that can be used by MDOT as well as by local agencies

5.2. Strategy: Develop and implement a consistent and equitable framework for streamlined private sector partnering for research, pilots, and deployments.

## 5.2.2. ACTION: DEVELOP A MECHANISM FOR ACTING ON UNSOLICITED/NON-COMPETITIVE PROPOSALS.

MDOT does not currently have a mechanism to act on unsolicited proposals that only one potential private partner can provide, even if they are willing to do so at little to no cost to MDOT. Other states have implemented challenges (similar to the Michigan Mobility Challenge, but on a rolling basis) and permanent calls for proposals, that allow vendors to present opportunities and MDOT to assess whether they are worth pursuing, rather than needing to initiate a procurement process after a good idea has been presented. MDOT should research what other states have done, identify best practices, assess whether they would be possible in Michigan, and then move towards implementing the resulting recommendations.

This does not have to be a reactive process – MDOT can proactively present a vision for industry to look towards, to encourage proposals that address certain high-level needs and use cases. This process can also be used to start conversations on what industry should be focusing on to meet common goals, while also allowing the opportunity for industry to present what they may need from MDOT to further their capabilities.

#### **Priority Level**

- Time frame: 1-5 years
- Cost implications: Low/none
- Internal/staff effort: Medium
- Potential impact: External

#### Interdependencies

- Depending on the proposal, success in developing a mechanism could enable various different goals to be met
- The framework for private partnerships can be used to assess these proposals

#### **Identified Lead**

ITS Program Office

#### **Other Stakeholders and Partners**

MDOT Leadership

#### **Measures of Success**

• A mechanism for pursuing unsolicited/non-competitive proposals that is transparent, fair, and flexible

## 5.2.3. ACTION: PROVIDE CAV RESOURCES AND SUPPORT ACROSS THE STATE TO LOCAL AND REGIONAL PARTNERS.

Smart development has equity at the forefront and is not achievable without strategic and strong infrastructure investment. In order to ensure smart development throughout the State of Michigan, and not only its most populated areas, resources will need to be distributed, and engagement with industry will need to be facilitated. This will also enable the state to support partnership activities, pilots, and deployments that address varying use cases. Resources could include direct funding of projects, expertise from staff throughout the state, additional staffing locally, or assistance with distributing project learnings and successes among local and regional partners.

## **Priority Level**

- Time frame: Immediately
- Cost implications: High
- Internal/staff effort: Medium
- Potential impact: Internal

## Interdependencies

- A sustainable transportation network will need to be interoperable across the state and beyond, so starting this engagement now will help ensure that is the case
- There may also be opportunities to leverage different funding sources for different use cases and partners

## **Identified Lead**

Regional ITS Leads

## **Other Stakeholders and Partners**

- ITS Program Office
- Counties and municipalities

## **Measures of Success**

• CAV pilots and other activities conducted in each region of MDOT

5.2. Strategy: Develop and implement a consistent and equitable framework for streamlined private sector partnering for research, pilots, and deployments.

# 6. Improved Business Processes

Explore innovative ways that CAV applications and data from CAV can be harnessed to support or improve current business processes.

As CAV technologies become more prevalent on Michigan roadways, there are increasing opportunities to better understand not only their current safety performance, but also the applications both their capabilities and the data they collect can be used for. Some of the data that CAVs will provide is already available through third party aggregators, smartphones, and other sources, so early use cases can begin to be formed. CAVs are also expected to add additional information and complexity to this data, as well as be available in real time rather than downloaded after a trip, as is often the case today.

Potential benefits include supporting operational efficiencies through CAV enhanced real-time management of traffic, transit operations, and fleet management solutions. The data generated by vehicles can also be used by traffic managers to better understand how travelers are moving under normal and abnormal conditions. For the public sector, applications of data may help enable travelers to plan the most efficient and safest trip, guided by real-time conditions and MDOT advisories. However, to ensure the data available to MDOT and travelers is used to improve business processes, strong data management, governance, and privacy policies and procedures will need to be put in place.

Beyond data collection and analysis, other business processes that could be enhanced include statewide transportation plans, pavement quality and other inventories, and dashboards that present information to stakeholders and the public. Engaging with statewide, national, and other industry groups on this topic can create opportunities for outreach with the public as well as elected officials to further understand these impacts.

# 6.1. Strategy: Continue efforts to develop CAV data use cases and understand how to leverage datasets to support departmental business processes.

The exponential amount of data that could become available will only be useful if it is gathered, secured, shared, and leveraged to support the appropriate use cases. The first step in meeting this challenge is to identify the CAV data use cases that would be valuable to MDOT and the communities it serves, by assessing MDOT's safety, operations, business, planning, asset management, and other goals and matching these with the opportunities and applications available. Once data use cases have been identified, the process of finding deployment-ready solutions can begin. Having engaged business areas across MDOT and the state more broadly early on will also increase the likelihood that they will adopt any data solutions once they are developed and implemented.

- ADOT Workforce Development
- O Improved Business Processes

## 6.1.1. ACTION: DETERMINE THE CONTINUED ROLE OF EXISTING DATA MANAGEMENT SYSTEMS TO SUPPORT THIS ANALYSIS.

MDOT has conducted substantial investment in data management systems, including the DUAP, CV ATMS, and TFM programs. These data aggregation tools were developed by MDOT to enable greater use of internal and external data sources for better management of the overall transportation system. This includes the ability to collect and process data on connected vehicle systems. MDOT fleet vehicles have already been outfitted to support current and future application development, including mobility-related applications (such as weather-responsive traveler information) as well as safety applications (pavement defect detection, surface roughness, hazardous condition detection, etc.). Moving forward, it will be essential to determine what the TFM's role will be and whether investment in this tool and/or other tools will be the best path forward. This should be done by first determining what MDOT use cases can be supported by data management tools, how existing tools are being utilized throughout the department, and what new tools may be useful as the system continues to be developed and built.

#### **Priority Level**

- Time frame: Immediately
- Cost implications: Low/none
- Internal/staff effort: Medium
- Potential impact: Internal

#### Interdependencies

- Results of this assessment will also support the strategy of investing in strong data management and governance systems
- A sustainable system is one that has leverages effective tools

#### **Identified Lead**

ITS Program Office

#### **Other Stakeholders and Partners**

- DTMB
- TFM program stakeholders

#### **Measures of Success**

 An assessment report identifying the role of data processing and management tools to support the analysis of CAV

6.

## 6.1.2. ACTION: IDENTIFY MDOT TRAFFIC SAFETY AND OPERATIONS IMPROVEMENTS THAT COULD BE ENHANCED WITH DATA FROM CAV.

Data from CAV is often spoken of in broad terms, as there are many uncertainties related to what data private vendors will be willing (or required) to share, how this data will look in terms of accuracy, volume, and timing, and what resulting data use cases will be valuable to MDOT and others. These uncertainties are currently being lessened as early datasets from CAV become available, and early assessments of how it can be used to improve safety and operations can take place. The ultimate configuration and value of data sets can be identified through both the results of pilot projects and activities by MDOT, as well as assessment of research and development activities happening elsewhere.

#### **Priority Level**

- Time frame: Immediately
- Cost implications: Low/none
- Internal/staff effort: High
- Potential impact: Internal

#### Interdependencies

 Identifying these data sets will help identify opportunity areas to improve the safety, mobility, and accessibility of the transportation network using CAV

#### **Identified Lead**

ITS Program Office

### **Other Stakeholders and Partners**

- DMTB
- Private sector developers and testers
- Office of Passenger Transportation
- Local transportation agencies

#### **Measures of Success**

 Initial and living list of data from CAV and CAV data use cases, as this understanding is likely to evolve over time

6.1. Strategy: Continue efforts to develop CAV data use cases and understand how to leverage datasets to support departmental business processes.
#### 6.1.3. ACTION: ALLOW PILOT PROJECTS TO COLLECT AND ANALYZE DATA RECEIVED FROM CAVS AND SHARE MDOT DATA WITH VEHICLES OR OTHER THIRD PARTIES.

There are many benefits to enabling CAV pilots on Michigan roads, including that they provide an ever-growing understanding of what a more widespread deployment of CAVs might look like. Continuing to support these pilots, and requiring or requesting them to share data with MDOT, will help support the development of CAV data use cases. In addition, MDOT can provide entities piloting their technology with data that can enable use cases they are pursuing and enhance the safety and operations of their offerings.

In this context, pilot projects refer to activities conducted in partnership with MDOT as well as activities by OEMs and others in the state that are permitted by state law, but not conducted in partnership with the state. For the latter group, setting expectation of data sharing will help MDOT benefit from activities it may not be directly involved in.

#### **Priority Level**

- Time frame: Immediately
- Cost implications: Medium
- Internal/staff effort: Medium
- Potential impact: External

#### Interdependencies

This recommendation ties into to any other actions or strategies related to pilot projects, in that they should all have a data component

#### **Identified Lead**

Enterprise Information Management (EIM)

#### **Other Stakeholders and Partners**

- ITS Program Office
- DTMB
- Secretary of State's office (if data sharing should become a requirement for licensing CAV)

#### **Measures of Success**

- Data sharing agreements with multiple partners
- A framework for distribution of publicly available data

6.1. Strategy: Continue efforts to develop CAV data use cases and understand how to leverage datasets to support departmental business processes.

## 6.2. Strategy: Invest in systems that support strong data management and governance, so collected data can be secured, used, and shared as needed.

To support CAV deployments and make best use of the data use cases they enable, MDOT will need to develop and/or support foundational systems and standards, including data management, backhaul communications, and IT and security standards. TFM and other systems that allow for enhanced management of data flows, conversion of data to actionable information, and the ability to generate infrastructure and vehicle based dynamic messages are essential to creating value for MDOT.

#### **Goal Alignment**

- O Safety
- → Mobility and Accessibility
- MDOT Workforce Development
- Ø Sustainability
- S Economic Development
- O Improved Business Processes

#### 6.2.1. ACTION: UPDATE DATA STEWARDSHIP, RETENTION POLICIES, AND PRIVACY STATUTES TO INCLUDE DATA FROM CAV.

To be able to effectively use collected data, there need to be data governance plans to manage and secure it. There will be a significant amount of data available within the CAV ecosystem, which MDOT is already tapping into via the TFM program and other data-related efforts. As proliferation of CAV technologies and increased public awareness increase, both the volume of data and public data requests will escalate. To prepare for this, a formal data governance policy should be developed to address data privacy and security, procedures for storing data, policies for sharing data, fulfillment of Freedom of Information Act (FOIA) requests, and other data-related requirements.

#### **Priority Level**

- Time frame: Immediately
- Cost implications: Medium
- Internal/staff effort: Medium
- Potential impact: Internal

#### Interdependencies

- Important data sets first need to be identified before they can be managed appropriately
- Then, data can be analyzed and leveraged to enhance safety, mobility, business process, and other goals
- Success in this area will impact more than just business processes, as new value and efficiencies that were unseen through automation or other approaches could also be enabled

#### **Identified Lead**

EIM

#### **Other Stakeholders and Partners**

- DTMB
- ITS Program Office

#### **Measures of Success**

Updated and adopted data governance policies

6.2. Strategy: Invest in systems that support strong data management and governance, so collected data can be secured, used, and shared as needed.

#### 6.2.2. ACTION: CONTINUE TO INVEST IN CYBERSECURITY AND DATA SECURITY.

Data management also includes developing and managing data security and addressing public concerns related to privacy. To address this challenge, MDOT should partner with DTMB and work with private industry to develop best practices and standards to secure the system, address installations, and create the required outside connections to reach security certificate and data management systems off the state network, as needed.

#### **Priority Level**

- Time frame: Immediately
- Cost implications: Medium
- Internal/staff effort: High
- Potential impact: Internal

#### Interdependencies

 Data security is part of data governance, and also related to building stakeholder awareness and trust in the technology

#### **Identified Lead**

EIM

#### **Other Stakeholders and Partners**

- DTMB
- ITS Program Office

#### **Measures of Success**

 Data security and privacy policies that are implemented in conjunction with the CAV program

# 6.3. Strategy: Enable policy and legal structures that continue to support the variable nature of CAV deployments.

To date, CAVs have operated within a patchwork of regulation, guidance, and standards, as lawmakers continue to develop a firmer understanding of the technology in order to guide policy development. This has allowed individual pilots and deployments to be conducted safely and legally, but has not fully opened the door for broader deployments to be set up immediately within the same framework, particularly when they work across jurisdictions or state lines. With early results now available, MDOT can help lawmakers understand known policy barriers and recommend best practices for future direction to overcome these barriers.

#### **Goal Alignment**

- ADOT Workforce Development
- Ø Sustainability
- O Improved Business Processes
- Increased Stakeholder Awareness

#### 6.3.1. ACTION: ENGAGE WITH OTHER STATES AND PERFORM ADDITIONAL RESEARCH TO UNDERSTAND EVOLVING BEST PRACTICES AND BE ABLE TO ANTICIPATE POTENTIAL BARRIERS.

Many states have been developing their CAV policies independently, and a patchwork of individual statutes and approaches is not conducive to long-term success. There are already many efforts underway to coalesce around more standard language across state and other boundaries. MDOT should continue to engage with these efforts and support a more uniform approach going forward, that learns from the best practices and pitfalls of others.

#### **Priority Level**

- Time frame: Immediately
- Cost implications: Low/none
- Internal/staff effort: High
- Potential impact: Internal, External

#### Interdependencies

- Engagement with pooled funds and other national efforts will help facilitate these conversations
- Communication to lawmakers and other stakeholders will be essential to ensuring the messages are brought to action

#### **Identified Lead**

ITS Program Office

#### **Other Stakeholders and Partners**

Secretary of State's office

#### **Measures of Success**

- Fulfilling engagement with other states
- More consistency across state and other borders

6.3. Strategy: Enable policy and legal structures that continue to support the variable nature of CAV deployments.

#### 6.3.2. ACTION: ENGAGE AND WORK WITH THE LEGISLATURE TO ADDRESS POLICY NEEDS AND FOSTER AN EFFECTIVE REGULATORY ENVIRONMENT.

The Michigan Vehicle Code currently permits research or testing of AVs and CV applications, such as platooning, subject to certain stipulations and restrictions. However, there will be a time when it is necessary to transition from allowing tests to enabling more widespread deployment. Safety standards and testing protocols for automated vehicles have not yet been developed, but these and results from research and pilot activities should eventually help guide a long-term policy outlook and effective regulatory environment for CAVs in the state of Michigan. MDOT can support the state in determining the best course of action.

#### **Priority Level**

- Time frame: 1-5 years
- Cost implications: Low/none
- Internal/staff effort: Medium
- Potential impact: Internal, External

#### Interdependencies

 Ensuring an effective regulatory environment will be essential to the safe and equitable deployment of CAVs on Michigan roadways

#### **Identified Lead**

MDOT leadership

#### **Other Stakeholders and Partners**

- ITS Program Office
- Secretary of State's office

#### **Measures of Success**

 An effective CAV regulatory framework that ensures safety while embracing innovation

# 7. Increased Stakeholder Awareness

Educate and coordinate with the public and policy makers to better understand the benefits and limitations of CAV technologies, to encourage safe, equitable, and effective deployment.

While MDOT will play a primary role in managing the rollout of CAV to benefit Michigan residents, there are many other stakeholders throughout the state who will need to be engaged and active participants to ensure this transition period is conducted equitably, safely, and sustainably. Facilitating increased awareness of the technology among the public, legislators, and state and local agencies will build trust as it is merited and enable lessons to be shared rather than needing to be independently re-learned.

A transparent response that embraces new ideas and partners while challenging assumptions when necessary will ensure Michigan remains nimble to shifts in technology in this rapidly changing environment, while understanding what policy and institutional changes are needed to safely deploy CAV. Enhanced communication and coordination will also help minimize the number of surprises that are encountered along the way.

# 7.1. Strategy: Engage with the legislature, MDOT executive leadership, and other decision makers.

State lawmakers have the power to shift the trajectory of CAV adoption in Michigan. Making sure they are engaged and educated on the technology and continue to coordinate with higher level leadership on any changes to policy with regards to transportation and specifically CAV, will help ensure that state-level policies and regulations that MDOT supports are implemented in a timely manner.

#### **Goal Alignment**

- ADOT Workforce Development
- Ø Sustainability
- S Economic Development
- O Improved Business Processes
- Increased Stakeholder Awareness

### 7.1.1. ACTION: DEVELOP AN ASSESSMENT OF LEGISLATIVE NEEDS TO SUPPORT SAFE CAV ADOPTION.

So far, Michigan's policies on CAV have allowed safe and effective research, development, and testing to occur within the state. However, as the technology continues to mature, there may be legislative updates that would help continue to support safe innovation that benefits Michigan residents. Michigan can look to other states and countries to see what they have done, and what has and hasn't worked, and in particular what benefits other states may be receiving that Michigan's policies currently do not enable (data sharing, incident reporting, requirements to serve underserved communities, etc.) This process will help identify what needs MDOT has that are not currently been pursued by CAV development within the state. It will be important for MDOT executive leadership to be well informed on the needs of the department in this space, so they can work with other decision makers to ensure that these needs are met.

While Michigan's policies may need to be updated in certain regards, it will be important to ensure the high-level vision stay the same – that CAV technologies continue to be piloted and deployed on Michigan roadways when it becomes safe to do so.

#### **Priority Level**

- Time frame: Immediately
- Cost implications: Low/none
- Internal/staff effort: Low
- Potential impact: Internal

#### Interdependencies

 Allowing safe testing within a partnership framework will enable benefits to the state to be maximized

#### **Identified Lead**

ITS Program Office

#### **Other Stakeholders and Partners**

- MDOT Leadership
- Michigan Legislators

#### **Measures of Success**

 Recommendations on updated policies that maximize benefits to Michigan residents, including continued safe testing and deployment of CAVs

#### 7.1.2. ACTION: REVIEW OTHER STATEWIDE PLANS FOR POTENTIAL IMPLICATIONS AND POINTS OF INTERFACE WITH CAV.

MDOT has many statewide plans that cover a variety of topics. Some have already considered the impacts of CAV, but others have not. An internal review should be conducted to identify gap areas where CAV have not yet been considered, and then engagement should be conducted to bridge the education gap.

#### **Priority Level**

- Time frame: Immediately
- Cost implications: Low/none
- Internal/staff effort: Medium
- Potential impact: Internal

#### Interdependencies

 Making sure planning efforts across the department are aligned is the first step in incorporating CAV and advanced technologies into other planning efforts

#### **Identified Lead**

ITS Program Office

#### **Other Stakeholders and Partners**

- MDOT Leadership
- Bureau of Transportation Planning

#### **Measures of Success**

- Distributed guidance on how to integrate CAVs into other statewide planning activities, with gaps identified in areas where this is not currently the case
- Set up of a process and metrics that encourage statewide plans to integrate CAV elements as appropriate

7.1. Strategy: Engage with the legislature, MDOT executive leadership, and other decision makers.

#### 7.1.3. ACTION: DEVELOP A LEGISLATIVE OUTREACH AND ENGAGEMENT PLAN.

MDOT has many individual partnerships with industry and lawmakers, but should be communicating beyond just existing partnerships. Conducting outreach that is publicly available and geared to enable positive change will help build future partnerships and share information on best practices of what MDOT wants to see in terms of updated policies and regulations in the future. A legislative outreach plan would lay out the steps to ensuring lawmakers are educated on CAV and how they can best be regulated within the state.

#### **Priority Level**

- Time frame: Immediately
- Cost implications: Low/none
- Internal/staff effort: Medium
- Potential impact: Internal

#### Interdependencies

- A statewide CAV working group will help support development of this plan
- Needs will result from the prior action of developing an assessment of legislative needs to support safe CAV adoption

#### **Identified Lead**

ITS Program Office

#### **Other Stakeholders and Partners**

- MDOT Leadership
- Michigan Legislators

#### **Measures of Success**

 A legislative outreach plan that leads to enhanced engagement with lawmakers

7.1. Strategy: Engage with the legislature, MDOT executive leadership, and other decision makers.

#### 7.2. Strategy: Continue coordination with internal partnering agencies.

MDOT works with many other state agencies and other public sector partners to achieve shared goals within specific topic areas. There is already substantial coordination that occurs between these agencies, but engagement with these stakeholders during the CAV Strategic Plan development process also revealed some opportunities to further this engagement in the future. The actions under this strategy identify a few key groups that need to be engaged to support the safe and effective introduction of AVs on public roadways, and there likely many other groups that are already involved or will someday be involved as well.

#### **Goal Alignment**

- O Safety
- MDOT Workforce Development
- Improved Business Processes
- Increased Stakeholder Awareness

### 7.2.1. ACTION: COORDINATE WITH SECRETARY OF STATE ON VEHICLE LICENSING REQUIREMENTS.

The Secretary of State's office currently works with OEMs and vehicle vendors to provide vehicles using CAV technology with manufacturer's places that allow them to test on Michigan roadways. This approach is similar to how the state allows any new vehicles to be tested, but there may be additional opportunities that the state is missing by not requiring more from CAVs in order to test on public roadways. Michigan should consider what other states are doing to inform its evolving approach to CAV permitting. This will also need to consider the driver's licensing component when human drivers are not fully responsible for vehicle behavior.

In MDOT's role in providing technical support to the Secretary of State's office on CAV trends, one set of topics that should be covered is vehicle registration and driver/operator licensing requirements. Vehicle licensing is handled at the state level, so it is an area where states can learn from each other to see what has and has not worked. Michigan's approach so far has enabled it to be a leader in CAV, but reassessing the benefits of this approach relative to what other states have done may enable additional benefits as the industry continues to evolve, as there are benefits and downsides to different approaches.

#### **Priority Level**

- Time frame: Immediately
- Cost implications: Low/none
- Internal/staff effort: Medium
- Potential impact: Internal, External

#### Interdependencies

- This topic should be part of the established research agenda that MDOT leverages pooled funds and other national efforts for, as it is something that this level of engagement could facilitate
- This is an example of a policy barrier to CAV deployment that has been identified, and recommendations on how to overcome this barrier

#### **Identified Lead**

ITS Program Office

#### **Other Stakeholders and Partners**

Secretary of State's office

#### **Measures of Success**

 Report on varying state approaches to CAV licensing that includes recommendations on potential updates to Michigan's approach

#### 7.2.2. ACTION: ENGAGE WITH EMERGENCY RESPONDERS TO BUILD AN UNDERSTANDING OF CAV TECHNOLOGY IMPACTS AND OPPORTUNITIES AND DEVELOP EMERGENCY RESPONDER INTERACTION PLANS.

Emergency responders, including police, fire, and ambulance personnel, not only play a large part in ensuring the safety of Michigan roadways, but also rely on the clear and consistent management of these roadways in order to reach destinations safety and quickly in emergency situations. Michigan State Police and other departments are assigned to work locations statewide, some with the authority to work across jurisdictional boundaries, so it will be important to ensure that they understand how to interact with any deployed CAV, and that the benefits of these technologies are leveraged to support use cases directly beneficial to emergency responders.

Many emergency responders across the state of Michigan already have a baseline understanding of CAV technology, but not all have been engaged to the same extent and there are many remaining questions and opportunities that need to be resolved. For example, could there be times when CAVs are programmed to violate traffic laws, such as to keep up with the speed of traffic or pass a disabled vehicle by using the shoulder or median? How will driverless CAVs be communicated with or pulled over? Are there opportunities for law enforcement to communicate more directly with in-vehicle systems to provide warnings and alerts of upcoming hazards? Can information related to a crash be communicated to emergency responders directly from the vehicle?

Engagement with emergency responders will help further the discussion of these and other related topics, determining the extent to which CAVs will influence or modify current training standards for emergency responders who may encounter CAVs on the road. For example, many other states have implemented requirements for law enforcement and transportation agencies to develop a CAV law enforcement interaction plan. This is documentation that outlines how to interact with and/or access CAVs in the case of an emergency. CAV law enforcement interaction plans also need to be developed at the national level by the time this technology is widely deployed. In the meantime, interim measures at the state level will guide safe deployment practices and eventual federal policy development.

#### **Priority Level**

- Time frame: Immediately
- Cost implications: Low/none
- Internal/staff effort: Medium
- Potential impact: Internal, External

#### Interdependencies

- This ties into workforce development, reaching to state and local public employees rather than just within MDOT
- Enhanced communication with these other stakeholders is also expected to improve business processes
- Law enforcement interaction plans are an example of a best practice brought from industry and/or other states that could be implemented in Michigan

#### **Identified Lead**

ITS Program Office

#### **Other Stakeholders and Partners**

- MDOT Traffic Operations Centers
- Michigan State Police
- Secretary of State's office
- Bureau of Transportation Planning
- Local emergency responder agencies

#### **Measures of Success**

- Engagement and relationship building between MDOT and emergency responders
- Implementation of any identified modifications to existing training standards
- An approved and implemented CAV law enforcement engagement plan

#### 7.2.3. ACTION: FACILITATE ENGAGEMENT WITH LOCAL PUBLIC TRANSIT AGENCIES ON CAV.

The State of Michigan has 82 public transportation agencies, including 21 urbanized transit organizations. Some of these agencies have experienced CAV pilots, while others are completely unaware. The MDOT Office of Passenger Transportation is responsible for direct engagement with these transportation agencies, and can play a role in disseminating information on the current status and future opportunities for deployment, ensuring these vital partners remain prepared for future travel needs and opportunities.

#### **Priority Level**

- Time frame: Immediately
- Cost implications: Low/none
- Internal/staff effort: Medium
- Potential impact: Internal, External

#### Interdependencies

 This will support the development of CAV applications in public transportation and other shared mobility modes

#### **Identified Lead**

• Office of Passenger Transportation

#### **Other Stakeholders and Partners**

- ITS Program Office
- Regional ITS Leads
- Local Transit Agencies

#### **Measures of Success**

• Engagement with local transit agencies across the state that results in better understanding of CAV and potential applications to begin pursuing

### 7.2.4. ACTION: COORDINATE WITH THE COUNCIL OF FUTURE MOBILITY AND ELECTRIFICATION.

The Council of Future Mobility and Electrification was established to provide the state government with recommendations on changes to state policy to ensure Michigan continues to be a world leader in emerging transportation technologies. While this group is independent of MDOT, it is important that MDOT engages directly with the group to help provide context on current efforts and understandings of CAV, while also ensuring work is not duplicated or contradictory.

#### **Priority Level**

- Time frame: Immediately
- Cost implications: Low/none
- Internal/staff effort: Low
- Potential impact: External

#### Interdependencies

This ties in directly to the electrification actions under the Sustainability goal

#### **Identified Lead**

ITS Program Office

#### **Other Stakeholders and Partners**

- MDOT leadership
- Office of Future Mobility and Electrification

#### **Measures of Success**

 Conversations and coordination that brings together MDOT's transportation expertise with a forward-looking vision that helps guide and learn from the Council of Future Mobility and Electrification

### 7.2.5. ACTION: CONTINUE PARTNERSHIPS WITH STATEWIDE AND LOCAL ECONOMIC DEVELOPMENT AGENCIES.

Another valuable partner for MDOT to support the development of CAV, as well as broader economic development throughout the state, is coordination with economic development agencies. Continuing current efforts at coordination can serve to align partnership opportunities with other state agencies, priorities, and resources, as well as support the development of business attraction and workforce opportunities related to CAV.

#### **Priority Level**

- Time frame: Immediately
- Cost implications: Low/none
- Internal/staff effort: Low
- Potential impact: External

#### Interdependencies

 Engagement with these groups will directly support the Economic Development goal

#### **Identified Lead**

ITS Program Office

#### **Other Stakeholders and Partners**

- Office of Future Mobility and Electrification
- Department of Labor and Economic Opportunity
- Any local or regional economic development groups

#### **Measures of Success**

 Continued relationships with economic development groups that support the goals of both partners

#### 7.3. Strategy: Build trust with the public on transportation technology trends.

Transparency with the public, peer agencies, and industry will help CAV stakeholders share ideas and lessons learned. It will also help to build trust, based on a developing understanding of CAV. Developing and providing guidance through outreach efforts that allow the public to experience technology trends in a safe and meaningful way is an effective strategy to achieve many of MDOT's goals, though it will require a significant level of effort.

MDOT's role in CAV is to support the public interest by providing objective information and guidance that balances industry marketing and public concerns, while building public trust in MDOT. MDOT is not in the business of marketing CAV, but of supporting the public interest, and ensuring that when safety benefits are proven, they are adopted. Providing objective information on successes, shortcomings, and failures, will build trust with the public and help prevent any hesitance from becoming a barrier to public adoption.

#### **Goal Alignment**

- O Safety
- Sustainability
- Increased Stakeholder Awareness

#### 7.3.1. ACTION: HOST A STATEWIDE ADVISORY COUNCIL AND/OR STATEWIDE CAV WORKSHOPS FOR STAKEHOLDERS TO SHARE IDEAS AND SHAPE FUTURE POLICY.

Many local agencies and members of the public may be interested in CAV, but not have an existing venue to obtain objective information and updates on how they are being deployed in their area. Hosting workshops at various locations throughout the state will help not only educate the public, but also obtain ideas that can shape MDOT's future direction.

#### **Priority Level**

- Time frame: Immediately
- Cost implications: Low/none
- Internal/staff effort: Medium
- Potential impact: External

#### Interdependencies

This can help enable stakeholder engagement, and kick off many new conversations to support recommendations identified throughout this plan

#### **Identified Lead**

ITS Program Office

#### **Other Stakeholders and Partners**

- MDOT Leadership
- Regional ITS Leads
- Bureau of Transportation Planning
- Any other interested stakeholders, including local agencies or the general public

#### **Measures of Success**

- Formation of a statewide advisory council
- Workshops hosted throughout the state, or possibly virtually with advertising across the state

#### 7.3.2. ACTION: DEVELOP CAV PUBLIC ENGAGEMENT AND COMMUNICATION PLANS.

Without strategic planning, strong policy direction, and meaningful public engagement, some may not be able to realize the potential benefits of CAV. MDOT must prioritize mobility strategies that address equity, accessibility, sustainability, and public health. To achieve this goal, MDOT will reach out to engage diverse voices from many perspectives and modes to understand their needs and solicit feedback on MDOT's CAV program to date.

#### **Priority Level**

- Time frame: 1-5 years
- Cost implications: Medium
- Internal/staff effort: Medium
- Potential impact: Internal, External

#### Interdependencies

 Soliciting feedback on all the actions conducted as part of the CAV program (including those recommended throughout this plan) will help guide MDOT's next steps as it progresses through implementation of this plan

#### **Identified Lead**

Office of Communications

#### **Other Stakeholders and Partners**

- ITS Program Office
- Bureau of Transportation Planning

#### **Measures of Success**

- CAV public engagement and communication plans
- Feedback from the public solicited and summarized through this process

#### 7.3.3. ACTION: CONTINUE TO ENGAGE WITH STUDENTS ON CAV TECHNOLOGY.

Working with students, from elementary school aged children with no knowledge of CAV to university students already pursuing a career in transportation and/or technology, is an important component of public communication and outreach. It will be valuable for MDOT to continue its efforts in working with students and providing them with first-hand experiences with CAV technology as well as direct engagement MDOT staff. This will help build trust in the public, raise awareness on transportation as an interesting career path, and build preparedness for the future of transportation.

#### **Priority Level**

- Time frame: Immediately
- Cost implications: Low/none
- Internal/staff effort: Medium
- Potential impact: External

#### Interdependencies

Engagement with students now will help prepare the future workforce for CAV

#### **Identified Lead**

Regional ITS Leads

#### **Other Stakeholders and Partners**

ITS Program Office

#### **Measures of Success**

 MDOT participation in events with primary and university student groups across the state

#### 7.3.4. ACTION: CONDUCT PUBLIC DEMONSTRATIONS THROUGHOUT THE STATE.

Public demonstrations allow Michiganders to see, touch, and better understand CAV technology. They can also help the public, policymakers, and industry understand how CAVs adapt to Michigan's cold weather climate and other unique conditions of the state. Ensuring these pilot projects are conducted throughout the state will open the opportunity to a wider range of stakeholders and support geographic equity.

#### **Priority Level**

- Time frame: More than 5 years
- Cost implications: High
- Internal/staff effort: High
- Potential impact: Internal, External

#### Interdependencies

- Geographic equity is an important component of equity to consider
- Testing and piloting will support progress towards safety, mobility, and accessibility goals

#### **Identified Lead**

ITS Program Office

#### **Other Stakeholders and Partners**

Regional ITS Leads

#### **Measures of Success**

Public demonstrations conducted throughout the state

# 8. Traceability Matrix

The following table summarizes the primarily responsibility for implementing the recommended actions, previously shown as the "Identified Lead" for each action, as well as other stakeholders and partners and the priority level for each action.

	Action	Identified Lead	Stakeholders and Partners		Priorit	y Levels	
				Time	Cost	Effort	Impact
1	SAFETY						
1.1	Strategy: Focus on adapting CV t and reevaluation of industry tren	echnologies to the o	current industry environment	t based or	n a contin	uous eva	luation
	<b>1.1.1</b> Bring existing roadside units (RSU) to a minimum viable product (MVP) level.	ITS Program Office	<ul> <li>Regional ITS Leads</li> <li>DTMB</li> <li>Construction Field Services Division</li> <li>Design Division</li> </ul>	<1	Med	Med	Both
	<b>1.1.2</b> Continue deployment of V2I technology in concert with partners, focusing on deploying for specific identified needs and locations.	Regional ITS Leads	<ul> <li>&gt; ITS Program Office</li> <li>&gt; Any interested parties within or outside MDOT</li> </ul>	<1	Low	Med	Both
	<b>1.1.3</b> Develop strategies to manage maintenance and updates of connected vehicle infrastructure.	ITS Program Office	<ul> <li>Regional ITS Leads</li> <li>Any others involved in an individual deployment</li> </ul>	<1	Med	Med	Internal
	<b>1.1.4</b> Further research and deployment of C-V2X technology, and any other emerging technology options, while assessing their readiness to be deployed in Michigan.	ITS Program Office	<ul> <li>&gt; Bureau of Transportation Planning</li> <li>&gt; USDOT and other federal agencies</li> <li>&gt; OBU and RSU technology vendors</li> </ul>	<1	High	High	Both
1.2	Strategy: Continue strategic four	ndational investmen	ts in CAV systems.				
	<b>1.2.1</b> Strategically invest in intersection upgrades.	ITS Program Office	<ul> <li>&gt; Bureau of Development</li> <li>&gt; Construction Field Services Division</li> <li>&gt; DTMB</li> <li>&gt; Other TSMO groups</li> </ul>	<1	Med	Low	Internal

Action	Identified Lead	Stakeholders and Partners	Priority Levels			
			Time	Cost	Effort	Impact
<b>1.2.2</b> Evaluate uses of data from CAV, including by leveraging existing systems.	ITS Program Office	<ul> <li>Enterprise Information Management</li> <li>DTMB</li> <li>ITS Program Office</li> </ul>	1-5	Med	Low	Both
<b>1.2.3</b> Continue to support the safe testing and development of AVs.	ITS Program Office	<ul> <li>&gt; Bureau of Development</li> <li>&gt; Construction Field Services Division</li> <li>&gt; DTMB</li> <li>&gt; Other TSMO groups</li> </ul>	<1	Low	Low	Both

1.3 Strategy: Research and plan for enhancements of traffic control devices and other roadway infrastructure to support the evolving needs of AVs.

<b>1.3.1</b> Independently assess the infrastructure needs of AVs, with and without connectivity.	ITS Program Office	<ul> <li>Construction Field Services Division</li> <li>Bureau of Transportation Planning</li> <li>Bureau of Development</li> <li>Bureau of Bridges and Structures</li> <li>OFME</li> </ul>	<1	Low	Med	Internal
<b>1.3.2</b> Explore pavement marking adjustments that support both CAV and conventional vehicles.	Bureau of Development	<ul> <li>&gt; ITS Program Office</li> <li>&gt; Construction Field Services Division</li> </ul>	<1	Low	Med	Internal
<b>1.3.3</b> Plan for infrastructure needs by beginning project programming.	ITS Program Office	<ul> <li>&gt; Bureau of Development</li> <li>&gt; Construction Field Services Division</li> </ul>	1-5	Med	Med	External

### 1.4 Strategy: Support the development and deployment of CAV work zone, weather, and other dynamic condition applications.

<b>1.4.1</b> Develop a work zone application strategy and other fundamental systems engineering documentation that can support an eventual pilot deployment.	Construction Field Services Division	<ul> <li>&gt; ITS Program Office</li> <li>&gt; Work Zones</li> </ul>	<1	Med	Med	External
<b>1.4.2</b> Further assess the applicability of CAV weather applications to enhance the safety of Michigan roads today.	ITS Program Office	> Regional ITS Leads	<1	Med	High	Both

	Action	Identified Lead	Stakeholders and Partners		Priorit	y Levels	
				Time	Cost	Effort	Impact
1.5	Strategy: Increase attention on a	ctive transportation	safety applications.				
	<b>1.5.1</b> Bring stakeholders into the process to identify needs and potential applications, highlighting this previously under-resourced travel mode.	ITS Program Office	<ul> <li>&gt; Bureau of Transportation Planning</li> <li>&gt; OFME</li> <li>&gt; Office of Passenger Transportation</li> <li>&gt; SEMCOG and other planning organizations throughout the state</li> </ul>	<1	Low	Med	External
	<b>1.5.2</b> Explore piloting a CAV pedestrian detection system.	ITS Program Office	<ul><li>&gt; OFME</li><li>&gt; Regional ITS Leads</li></ul>	1-5	Med	Med	Both
2	MOBILITY AND ACCESSIBILITY	1		1	1	1	
2.1	Strategy: Identify CAV use cases priority needs, through direct en	for near-term deplo gagement with the l	yment, especially those that pusiness areas whose needs	tie in with are being	n other sta addresse	atewide h ad.	nigh-
	<b>2.1.1</b> Continue to identify and document partner agency and private sector user needs through engagement with Michigan CAV working groups.	ITS Program Office	<ul> <li>Michigan CAV Working Group</li> <li>OFME</li> <li>MPOs, municipalities, and RPOs</li> <li>Private sector developers and testers</li> <li>OEMs</li> </ul>	1-5	Low	Low	Both
	<b>2.1.2</b> Refresh assessment of CAV pilot options in connection with potential funding opportunities.	ITS Program Office	<ul> <li>&gt; OFME</li> <li>&gt; USDOT</li> <li>&gt; MPOs, municipalities, and RPOs</li> <li>&gt; Regional ITS Leads</li> <li>&gt; Private sector developers and testers</li> <li>&gt; OEMs</li> </ul>	1-5	Low	Low	Internal
	<b>2.1.3</b> Continue investments in connected vehicle test corridors, and encourage third party testing, to determine the resources necessary to design, operate, and maintain these technologies in urban and rural environments.	ITS Program Office	<ul> <li>Regional ITS Leads</li> <li>Counties and municipalities</li> <li>Private sector developers and testers</li> <li>OEMs</li> </ul>	<1	High	Med	Both

2.2 Strategy: Ensure that all parts of the CAV transportation network are accessible and equitable.

Action		Identified Lead	Stakeholders and Partners	Pric		rity Levels	
				Time	Cost	Effort	Impact
<b>2.2.1</b> Create to consider t technology i	a process the equity of investments.	ITS Program Office	<ul> <li>Regional ITS Leads</li> <li>Bureau of Transportation Planning</li> <li>Equal Employment Opportunity</li> <li>Office of Passenger Transportation</li> </ul>	<1	Low	Med	Internal
<b>2.2.2</b> Conduct accessibility existing CAV future direct	ct a review of barriers within / projects to inform ion.	ITS Program Office	<ul> <li>&gt; OFME</li> <li>&gt; Office of Passenger Transportation</li> </ul>	1-5	Med	Low	Both
<b>2.2.3</b> Ensure of accessibil of all MDOT led CAV pilo authorization developers.	e considerations ity are part and partner- ts and testing ns for private	ITS Program Office	<ul> <li>&gt; OFME</li> <li>&gt; Office of Passenger Transportation</li> <li>&gt; Transit service providers</li> <li>&gt; Private sector developers and testers</li> <li>&gt; OEMs</li> </ul>	1-5	Low	Low	Both

2.3 Strategy: Continue supporting CAV applications in public transportation and other shared mobility modes.

<b>2.3.1</b> Fund testing and deployment of public transportation innovations and shared mobility modes through ongoing commitment via mobility challenges and/or other funding mechanisms.	Office of Passenger Transportation	<ul> <li>&gt; OFME</li> <li>&gt; ITS Program Office</li> <li>&gt; Transit service providers</li> <li>&gt; Counties and municipalities</li> <li>&gt; Private sector developers and testers</li> <li>&gt; OEMs</li> </ul>	1-5	High	Low	External
<b>2.3.2</b> Support the statewide transfer of knowledge on Michigan-based, national, and international passenger transportation innovations.	Office of Passenger Transportation	<ul> <li>&gt; ITS Program Office</li> <li>&gt; OFME</li> <li>&gt; Transit service providers</li> <li>&gt; Counties and municipalities</li> </ul>	<1	Low	Low	External

2.4 Strategy: Support applications that enhance the movement of goods through the state and in partnership with neighboring states and Canada.

	Action	Identified Lead	Stakeholders and Partners	Priority Levels			
				Time	Cost	Effort	Impact
	<b>2.4.1</b> Continue to explore CAV initiatives that could enhance freight movement within the state.	ITS Program Office	> OFME	<1	Med	Low	Both
	<b>2.4.2</b> Identify regulatory and technical obstacles to seamless CAV operation in border crossing scenarios.	ITS Program Office	<ul> <li>Regional ITS Leads</li> <li>OFME</li> <li>Border crossing partners</li> <li>Multistate initiative partners</li> </ul>	1-5	Med	Low	Both
	<b>2.4.3</b> Promote border crossing and state partnerships solutions such as the Smart Belt Coalition in CAV-focused pilots and project development.	ITS Program Office	<ul> <li>&gt; OFME</li> <li>&gt; Border crossing partners</li> <li>&gt; Multistate initiative partners</li> </ul>	1-5	Low	Low	External
3	MDOT WORKFORCE DEVELOPM	ENT					
3.1	Strategy: Optimize hiring strateg	ies with respect to a	civil service requirement cons	straints.			
	<b>3.1.1</b> Conduct an audit of knowledge and skills gaps	ITS Program Office	<ul> <li>Office of Human Resources</li> </ul>				

associated with advanced technology by identifying existing resources.	Once	<ul> <li>Office of Organizational Development</li> </ul>	<1	Low	Med	Internal
<b>3.1.2</b> Develop position descriptions and requirements for gap areas and other changes.	ITS Program Office	<ul> <li>Office of Human Resources</li> <li>All divisions and offices within MDOT</li> </ul>	1-5	Low	Low	Internal
<b>3.1.3</b> Evaluate civil service barriers to hiring within gap areas.	ITS Program Office	<ul> <li>&gt; Office of Human Resources</li> <li>&gt; MDOT Leadership</li> </ul>	1-5	Low	Med	Internal

3.2 Strategy: Attract and retain skilled, experienced, and talented MDOT staff.

<b>3.2.1</b> Understand employee satisfaction across MDOT, while evaluating familiarity and interest in CAV.	Office of Human Resources	<ul> <li>&gt; ITS Program Office</li> <li>&gt; Interested staff across the department</li> </ul>	<1	Low	Low	Internal
<b>3.2.2</b> Improve ongoing communication on CAV advancements and the department's strategic direction within the department.	ITS Program Office	<ul> <li>Office of Communications</li> </ul>	<1	Low	Med	Internal

	Action	Identified Lead	Stakeholders and Partners		Priorit	y Levels	
				Time	Cost	Effort	Impact
	<b>3.2.3</b> Implement training programs that engage and educate staff on emerging technologies and the skills that will be required to support them.	ITS Program Office	<ul> <li>&gt; Staff across MDOT who are interested</li> <li>&gt; Local agency partners who are interested</li> </ul>	1-5	Low	Low	Internal
3.3	Strategy: Pursue a holistic depar	tment-wide workfor	ce development strategy.	1		1	1
	<b>3.3.1</b> Identify and utilize existing interdepartmental communication.	ITS Program Office	<ul> <li>All divisions and offices across MDOT</li> </ul>	<1	Low	Med	Internal
4	SUSTAINABILITY						
4.1	Strategy: Incorporate CAV and a	dvanced technologi	es in planning efforts through	nout the d	lepartmer	it.	
	<b>4.1.1</b> Continue addressing impacts of CAVs in long-range planning efforts.	Bureau of Transportation Planning	> ITS Program Office	<1	Low	Med	Internal
	<b>4.1.2</b> Develop capabilities of considering changes due to CAV within travel forecasting models.	Bureau of Transportation Planning	> ITS Program Office	1-5	Med	Med	Internal
	<b>4.1.3</b> Build a framework for evaluating CAV impacts in project development and NEPA initiatives.	Bureau of Transportation Planning	> ITS Program Office	1-5	Low	Med	Both
	<b>4.1.4</b> Evaluate need to update design guidelines for roads and bridges to support CAV adoption.	Bureau of Development	> ITS Program Office	>5	Low	Med	Internal
4.2	Strategy: Develop policies on ele	ectric vehicles that d	efine MDOT's role.	-	-		I
	<b>4.2.1</b> Develop a timeline for the electrification of MDOT's vehicle fleet.	MDOT leadership	<ul> <li>DTMB</li> <li>Construction Field Services Division</li> <li>OFME</li> <li>ITS Program Office</li> <li>Office of Passenger Transportation</li> </ul>	1-5	Med	Low	Internal
	<b>4.2.2</b> Develop policies for development of EV charging infrastructure.	Bureau of Development	<ul> <li>&gt; Bureau of Transportation Planning</li> <li>&gt; OFME</li> <li>&gt; Maintenance Services</li> </ul>	1-5	Low	Low	Both

	Action	Identified Lead	Stakeholders and Partners		Priorit	y Levels	
				Time	Cost	Effort	Impact
4.3	Strategy: Seek innovative fundin support CAVs and future mobility	g models and partn y.	erships to support the long-t	erm susta	inability o	of system	is to
	<b>4.3.1</b> Continue to pursue grant programs that match with departmental objectives.	ITS Program Office	<ul> <li>Office of Passenger Transportation</li> </ul>	<1	Med	Med	Internal
	<b>4.3.2</b> Continue exploration of innovative financial models and approaches.	Bureau of Finance & Administration	<ul> <li>MDOT leadership</li> <li>Office of Economic Development</li> <li>ITS Program Office</li> </ul>	<1	Med	High	Both
	<b>4.3.3</b> Research and assess the viability of a road usage charging pilot.	MDOT leadership	<ul> <li>&gt; ITS Program Office</li> <li>&gt; Bureau of Finance &amp; Administration</li> </ul>	1-5	Low	High	Both
	<b>4.3.4</b> Develop a Request for Information (RFI) for a public- private partnership C-V2X approach.	ITS Program Office	<ul> <li>Regional ITS Leads</li> <li>C-V2X developers and deployers</li> </ul>	<1	Low	Low	Both
5	ECONOMIC DEVELOPMENT						
5.1	Strategy: Establish and impleme while bringing activity to Michiga	nt a CAV research a an.	genda that leverages pooled	funds and	d other na	ational ef	forts,
	<b>5.1.1</b> Continue involvement in existing and new pooled fund studies.	ITS Program Office	<ul> <li>Any divisions or local agencies that are interested in a particular topic</li> </ul>	<1	Med	Med	Both
	<b>5.1.2</b> Support research that further explores the connection between electric vehicles and CAV.	ITS Program Office	> OFME	1-5	Low	Low	Internal
	<b>5.1.3</b> Chart a path to promote additional consideration of geographic and social equity	ITS Program Office	<ul> <li>Any other project partners</li> </ul>	<1	Low	High	External

5.2 Strategy: Develop and implement a consistent and equitable framework for streamlined private sector partnering for research, pilots, and deployments.

for future deployments throughout Michigan.

<b>5.2.1</b> Create a framework for evaluating potential public-private partnerships.	ITS Program Office	<ul> <li>Regional ITS Leads</li> <li>Office of Passenger Transportation</li> </ul>	<1	Low	Med	External
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Action	Identified Lead	Stakeholders and Partners	Priority Levels			
			Time	Cost	Effort	Impact
<b>5.2.2</b> Develop a mechanism for acting on unsolicited/non-competitive proposals.	ITS Program Office	> MDOT Leadership	1-5	Low	Med	External
<b>5.2.3</b> Provide CAV resources and support across the state to local and regional partners.	Regional ITS Leads	<ul> <li>&gt; ITS Program Office</li> <li>&gt; Counties and municipalities</li> </ul>	<1	High	Med	Internal

#### 6 IMPROVED BUSINESS PROCESSES

6.1 Strategy: Continue efforts to develop CAV data use cases and understand how to leverage datasets to support departmental business processes.

<b>6.1.1</b> Determine the role of existing date management systems support this analy	ne continued ata tems to vsis.	ITS Program Office	<ul> <li>DTMB</li> <li>TFM program stakeholders</li> </ul>	<1	Low	Med	Internal
<b>6.1.2</b> Identify MDC safety and operat improvements tha enhanced with da	DT traffic ions at could be ita from CAV.	ITS Program Office	<ul> <li>&gt; DMTB</li> <li>&gt; Private sector developers and testers</li> <li>&gt; Office of Passenger Transportation</li> <li>&gt; Local transportation agencies</li> </ul>	<1	Low	High	Internal
<b>6.1.3</b> Allow pilot p to collect and ana received from CA MDOT data with v other third parties	projects lyze data Vs and share vehicles or s.	Enterprise Information Management	<ul> <li>&gt; ITS Program Office</li> <li>&gt; DTMB</li> <li>&gt; Secretary of State's office</li> </ul>	<1	Med	Med	External

6.2 Strategy: Invest in systems that support strong data management and governance, so collected data can be secured, used, and shared as needed.

<b>6.2.1</b> Update data stewardship, retention policies, and privacy statutes to include data from CAV.	Enterprise Information Management	<ul><li>DTMB</li><li>ITS Program Office</li></ul>	<1	Med	Med	Internal
<b>6.2.2</b> Continue to invest in cybersecurity and data security.	Enterprise Information Management	<ul><li>DTMB</li><li>ITS Program Office</li></ul>	<1	Med	High	Internal

#### 6.3 Strategy: Enable policy and legal structures that continue to support the variable nature of CAV deployments.

	Action	Identified Lead	Stakeholders and Partners	Priority Levels				
				Time	Cost	Effort	Impact	
	<b>6.3.2</b> Engage and work with the legislature to address policy needs and foster an effective regulatory environment.	MDOT leadership	<ul> <li>&gt; ITS Program Office</li> <li>&gt; Secretary of State's office</li> </ul>	1-5	Low	Med	Both	
7	INCREASED STAKEHOLDER AW	ARENESS	1	1	1	1		
7.1	Strategy: Engage with the legislature, MDOT executive leadership, and other decision makers.							
	<b>7.1.1</b> Develop an assessment of legislative needs to support safe CAV adoption.	ITS Program Office	<ul> <li>MDOT Leadership</li> <li>Michigan Legislators</li> </ul>	<1	Low	Low	Internal	
	<b>7.1.2</b> Review other statewide plans for potential implications and points of interface with CAV.	ITS Program Office	<ul> <li>MDOT Leadership</li> <li>Bureau of Transportation Planning</li> </ul>	<1	Low	Med	Internal	
	<b>7.1.3</b> Develop a legislative outreach and engagement plan.	ITS Program Office	<ul> <li>&gt; MDOT Leadership</li> <li>&gt; Michigan Legislators</li> </ul>	<1	Low	Med	Internal	
7.2	Strategy: Continue coordination	with internal partne	ring agencies.			1	1	
	<b>7.2.1</b> Coordinate with Secretary of State on vehicle licensing requirements.	ITS Program Office	<ul> <li>Secretary of State's office</li> </ul>	<1	Low	Med	Both	
	<b>7.2.2</b> Engage with emergency responders to build an understanding of CAV technology impacts and opportunities and develop emergency responder interaction plans.	ITS Program Office	<ul> <li>&gt; MDOT Traffic Operations Centers</li> <li>&gt; Michigan State Police</li> <li>&gt; Secretary of State's office</li> <li>&gt; Bureau of Transportation Planning</li> <li>&gt; Local emergency responder agencies</li> </ul>	<1	Low	Med	Both	
	<b>7.2.3</b> Facilitate engagement with local public transit agencies on CAV.	Office of Passenger Transportation	<ul> <li>&gt; ITS Program Office</li> <li>&gt; Regional ITS Leads</li> <li>&gt; Local Transit Agencies</li> </ul>	<1	Low	Med	Both	
	7.2.4 Coordinate with the	ITS Program	> MDOT leadership					

> OFME

Council of Future Mobility and

Electrification.

Office

External

Low

Low

	Action	Identified Lead	Stakeholders and Partners	Priority Levels			
				Time	Cost	Effort	Impact
	<b>7.2.5</b> Continue partnerships with statewide and local economic development agencies.	ITS Program Office	<ul> <li>&gt; OFME</li> <li>&gt; Department of Labor and Economic Opportunity</li> <li>&gt; Any local or regional economic development groups</li> </ul>	<1	Low	Low	External
7.3	7.3 Strategy: Build trust with the public on transportation technology trends.						
	<b>7.3.1</b> Host a statewide advisory council and/or statewide CAV workshops for stakeholders to share ideas and shape future policy.	ITS Program Office	<ul> <li>MDOT Leadership</li> <li>Regional ITS Leads</li> <li>Bureau of Transportation Planning</li> <li>Any other interested stakeholders</li> </ul>	<1	Low	Med	External
	<b>7.3.2</b> Develop CAV public engagement and communication plans.	Office of Communications	<ul> <li>&gt; ITS Program Office</li> <li>&gt; Bureau of Transportation Planning</li> </ul>	1-5	Med	Med	Both
	<b>7.3.3</b> Continue to engage with students on CAV technology.	Regional ITS Leads	> ITS Program Office	<1	Low	Med	External
	<b>7.3.4</b> Conduct public demonstrations throughout the state.	Regional ITS Leads	> Regional ITS Leads	>5	High	High	Both

#### SECTION 4

# Funding

The section provides appropriate background information on the applicability and constraints of potential funding sources so that MDOT is aware of the options and constraints for funding its CAV program.

MDOT's activities are currently funded by a combination of fuel taxes, vehicle registration fees, and federal funding, with some support from the state general fund, interdepartmental grants, private and local government revenue, and borrowing. The CAV program has been successful in winning several competitive grants, which have brought additional funding to Michigan to support specific deployments and research programs. Examples of these funding sources and future opportunities are presented in the *Potential External Funding Sources* section.

However, MDOT continues to experience a funding shortfall, which CAVs are likely only to exacerbate. Especially if CAVs tend to be electric, they are likely to inflict more wear and tear on roads through increased miles traveled, while paying little into the system through the fuel tax and other traditional means. Ideas for alternative methods of funding the transportation system, and particularly CAV use of it, are presented in the *Alternative Funding Sources and Approaches* section.

# **Potential External Funding Sources**

USDOT provides capital funding for standard and innovative transportation investments through several programs, administered by the Office of the Secretary of Transportation and several of its modal agencies, including the Federal Highway Administration (FHWA), Federal Transit Administration (FTA), Federal Motor Carrier Administration (FMCSA), and National Highway Traffic Safety Administration (NHTSA).

As of March 2021, the current transportation authorization passed by Congress outlines several grants for surface transportation infrastructure planning and investment. The Fixing America's Surface Transportation Act (FAST Act) is already in an extension year (continuing resolution), and Congress is poised to develop a replacement, typically referred to as "reauthorization." During that process, there will likely be changes to the current slate of grant programs. The USDOT maintains

a grants web page at <u>https://www.transportation.gov/grants</u> that should remain updated with the most current information. Discretionary grant programs to note include:

- Infrastructure for Rebuilding America (INFRA): The INFRA grant program is a USDOT grant program focusing on nationally significant freight and highway transportation projects that meet four key objectives: (1) support economic vitality at the national and regional level; (2) leverage federal funding to attract other, non-federal sources; (3) use innovative approaches to improve safety and expedite project delivery; and (4) performance accountability. As authorized by the FAST Act, these funds support primarily freight and highway projects of national or regional significance, and can also support some intermodal projects. The newest round of funding includes criteria for zero-emissions vehicles and V2X communications.
- Better Utilizing Investments to Leverage Development (BUILD): The BUILD grant program supports the capital costs of road, rail, transit, and port projects that have a significant impact on the nation, a region, or a metropolitan area. The program is extremely competitive, in FY19 USDOT selected 91 out of 851 applications. Many AV projects across the country are being funded by this program, including in Las Vegas and Jacksonville.
- Advanced Transportation and Congestion Management Technology Deployment (ATCMTD): This is an annual discretionary grant program for the development of model deployment sites for large scale installation and operation of advanced transportation technologies to improve safety, efficiency, system performance, and infrastructure return on investment. The program is particularly focused on the areas of multimodal integrated corridor management, installation of connected vehicle technologies at intersections and pedestrian crossing locations, unified fare collection and payment systems, freight community systems, technologies to support connected communities, infrastructure maintenance, monitoring, and condition assessments, and rural technology deployments.
- Congestion Mitigation and Air Quality (CMAQ): CMAQ provides a flexible funding source to state and local governments for transportation projects and programs to help meet the requirements of the Clean Air Act. Funding is available to reduce congestion and improve air quality for areas that do not meet the National Ambient Air Quality Standards for ozone, carbon monoxide, or particulate matter (nonattainment areas) and for former nonattainment areas that are now in compliance (maintenance areas). CMAQ funds can be used to support new transit services, including acquiring new vehicles with a positive impact on air quality (such as electric CAVs).
- Capital Investment Grants (New Starts and Small Starts): FTA's Capital Investment Grant (CIG) program funds transit "fixed guideway" capital investments, including heavy rail, commuter rail, light rail, streetcars, and bus rapid transit. Federal transit law requires transit agencies seeking CIG funding to complete a series of steps – typically over several years – prior to receipt of a grant. The FAST Act also requires projects to be rated by FTA at various points in the process according to statutory criteria evaluating project justification and local financial commitment. The CIG program is USDOT's largest discretionary program.
In addition to the previous recurring grant programs, from time to time the USDOT and its modal agencies will also provide discretionary research and innovation funding. These are often one-time programs that will offer grants for specifically targeted project types, demographic areas, or research topics. Previous grant programs that would be directly applicable to a CAV project include:

- Accelerating Innovative Mobility (AIM): To support and advance innovation in the transit industry, and help transit agencies explore new service models that provide more efficient and frequent service, which will help retain riders.
- Automated Driving System (ADS): To fund projects that test the safe integration of automated driving systems on US roadways. These grants aimed to gather significant safety data to inform rulemaking and foster collaboration amongst state and local government and private partners.
- Integrated Mobility Innovation (IMI): Intended for projects that demonstrate innovative and effective practices, partnerships, and technologies to enhance public transportation effectiveness, increase efficiency, expand quality, promote safety, and improve the traveler experience.
- ITS4US Complete Trip Program: For projects that will enable communities to showcase innovative business partnerships, technologies, and practices that promote independent mobility for all. It was also intended to create largescale, replicable deployments that generate increased mobility options across multiple modes of transportation to address the challenges of planning and executing complete trips.

These programs were advertised as one-time opportunities, but it is likely that additional funding opportunities with similar constraints will be available in the future. Once these opportunities are announced, MDOT should further assess whether and how a local CAV project would be eligible and be a good fit. This must include an assessment of the regulatory and legislative landscape, to ensure compliance and positioning for the program, as many federal funding opportunities come with strict requirements.

Outside of USDOT, there are other independent federal agencies that have grant funding opportunities that can be applied to transportation projects. Beyond federal grant programs, there are some private grant programs that could potentially be used to provide funding for CAVs. This could include private science foundations, philanthropists, or transportation vendors themselves. However, there is limited precedent of this being done in the past, and if there were a program it would likely be competitive and subject to certain restrictions, such as deploying in a specific location or to serve a particular need.

## Alternative Funding Sources and Approaches

Many other public agencies, both within the state of Michigan and in other states, have the same interest as MDOT in pursuing CAV technology. Potential opportunities to work together include the Automated Bus Consortium, which strives to accelerate the development of automated transit technologies by combining the purchasing power and collaborative decision-making of transit agencies nationwide. If implemented, the pilot projects will use full-sized, full-speed, accessible buses and enable Consortium members to collectively demonstrate and deploy automated technologies in live service environments. MDOT has been engaged with this consortium, and others like it. However, even if it is successful, funding will still need to be identified to cover MDOT and/or the local transit agency's portion of the procurement costs to have any vehicles deployed locally.

Working with private partners as well as other public partners could also be a way to distribute risk and funding responsibilities, while enabling more entities to learn about CAV technology and be seen as innovators in this space. Partnerships could potentially be pursued with local property developers, university and other campuses, utility companies, local agencies and city governments, and private transportation providers.

Other ways to support the agency's funding needs could be to leverage the value of MDOT's infrastructure and right-of-way. For example, MDOT has been installing fiber-optic communication lines in state rights-of-way for several years, and it may be possible to lease access to this infrastructure to telecommunications companies or others. The right-of-way itself could also be leased to allow these companies to build the infrastructure they need at these locations.

Another option to fund use of the transportation system by CAV is a road user charge (RUC), or a policy of charging motorists based on road usage. This charge is most often applied to vehicle miles traveled, sometimes with tiered fees related to weight or vehicle type. RUC may provide a viable and equitable alternative to the existing funding system. Due to socialization of pricing concepts within existing fleet mobility options, the addition of usage charges to fleets of CAVs is likely to be more palatable politically and to the public. Existing pilots have identified lessons learned and methods of mitigating additional challenges, such as privacy and enforcement concerns, and can be leveraged to introduce a new RUC specifically for CAVs. While some issues will continue to require study and improvement, CAVs provide technology and social opportunities to reduce the potential pain points for RUC implementation. However, equity concerns must be considered in any CAV RUC program. In addition to consideration of various income levels when designing a CAV RUC, geographic dispersion of users and vehicle miles traveled should be evaluated. A CAV RUC system would need to have a way to minimize disincentives for rural or low-income drivers to be more widely supported and accepted.

Lastly, transportation revenue could also be generated through charging for the use of specific infrastructure. Similar to how the major bridges in Michigan are currently tolled, access to premium facilities such as a CAV-only lane could be provided only if a vehicle meets certain requirements – whether they be high occupancy, energy source (i.e., electric), or level of automation. The model would be similar to a high occupancy toll (HOT) lane, where certain infrastructure can be used by high occupancy vehicles and other exempt vehicles without charge, as well as to other vehicles with a variable fee that can be adjusted in response to demand.

## SECTION 5

## Conclusions

For well over a decade, MDOT has been a leader in supporting and advancing CAV technologies, building on its unique position as the home of the U.S. automotive industry, and guided by departmental expertise in ITS. As the department looks forward, there is a broad understanding that the CAV industry is going to continue to change, and continue to impact MDOT's role in varying ways. This strategic plan offers recommendations to help guide this change – to support departmental goals, employ effective strategies, and implement initiatives that deliver benefits throughout the State of Michigan.

The MDOT CAV Strategic Plan is one of many plans that connects vision and policy direction for transportation in Michigan. Outreach and education of this plan are as important as development, to ensure CAV are being considered in planning and deployment activities throughout the department. This plan will also be updated every three to five years to reflect progress and guide continued strategic investment.

