Report of the

Governor's Steering Committee

on

Autonomous and Connected Vehicle Testing and Deployment

Submitted to

Governor Scott Walker

State of Wisconsin

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Report content contributed by committee members. Report compiled by WisDOT staff Brad Basten, Economic Development Officer and Ben Vondra, Program and Policy Analyst-Advanced.

Acronyms and Definitions

AAM	Association of Automobile Manufacturers
AAMVA	American Association of Motor Vehicle Administrators
ACC	Adaptive Cruise Control
ADAS	Advanced Driver-Assistance System
ADS	Automated (or Autonomous or Advanced) Driving System
AV	Automated Vehicle: vehicle with one or more of the driving tasks automated; if fully capable of all aspects of the dynamic driving task, also known as a self-driving, autonomous or driverless vehicle.
CAV	Connected and/or Automated Vehicle
CFIRE	Center for Freight and Infrastructure, Research and Education
CV	Connected Vehicle: vehicle with the ability to wirelessly communicate with other vehicles, road users, infrastructure, etc. Used to enhance the information available to a human driver, other road users or infrastructure purposes (e.g. adjusting traffic light timing, lane departure warning).
DATCP	Department of Agriculture, Trade and Consumer Protection
DDT	Dynamic Driving Task: All of the real-time functions required to operate a vehicle in on-road traffic, excluding selection of final and intermediate destinations, and including without limitation: object and event detection, recognition, and classification; object and event response; maneuver planning; steering, turning, lane keeping, and lane changing, including providing the appropriate signal for the lane change or turn maneuver; and acceleration and deceleration.[1]
DET	DOA Division of Enterprise Technology
DHS	Wisconsin Department of Health Services
Disengagement	"[D]eactivation of the autonomous mode when a failure of the autonomous technology is detected or when the safe operation of the vehicle requires that the … driver disengage the autonomous mode and take immediate manual control of the vehicle, or in the case of driverless vehicles, when the safety of the vehicle, the occupants of the vehicle, or the public requires that the autonomous technology be deactivated."[2]
DMV	WisDOT Division of Motor Vehicles
DNR	Wisconsin Department of Natural Resources
DOA	Wisconsin Department of Administration
DOJ	Wisconsin Department of Justice
DOR	Wisconsin Department of Revenue
DPI	Wisconsin Department of Public Instruction
DSRC	Dedicated Short-Range Communication
EDR	Event Data Recorder
FHWA	Federal Highway Administration

FMVSS	Federal Motor Vehicle Safety Standards
FTC	Federal Trade Commission
Geofence	A virtual geographic boundary, defined by technology such as GPS or RFID, with which hardware and software can interact.
GHSA	Governor's Highway Safety Association
HAV	Highly Automated Vehicle (i.e. level 4 or 5 on SAE vehicle automation scale)
ITE	Institute of Transportation Engineers
LIDAR	LIght Detection And Ranging
MaaS	Mobility as a Service
Minimal Risk Condition	A low-risk operating condition that an ADS automatically resorts to either when a system fails or when the human driver fails to respond appropriately to a request to take over the dynamic driving task.[3]
NCHRP	National Cooperative Highway Research Program
NCSL	National Conference of State Legislatures
NHTSA	National Highway Traffic Safety Administration
OCI	Office of the Commissioner of Insurance
OCR	Office of the Commissioner of Railroads
ODD	Operational Design Domain: specific operating domain(s) in which an automated function or system is designed to properly operate, including but not limited to geographic area, roadway type, speed, environmental conditions (weather, daytime/nighttime, etc.) and other domain constraints.[4]
Platoon	A group of vehicles connected by a wireless communication link traveling in a unified manner at electronically coordinated speeds.
RADAR	RAdio Detection And Ranging
RTI	Request to Intervene: notification by the ADS to a driver indicating that s/he should promptly perform the DDT fallback.
SAE	Society of Automotive Engineers International
Sonar	SOund Navigation and Ranging
TOPS Lab	University of Wisconsin-Madison – Department of Civil and Environmental Engineering - Traffic Operations and Safety (TOPS) Laboratory
USDOT	United States Department of Transportation
USGAO	United States Government Accountability Office
V2I	Vehicle to Infrastructure Communication
V2X	Vehicle to Device Communication
V2V	Vehicle to Vehicle Communication
VMT	Vehicle Miles Travelled
WAVPG	Wisconsin Automated Vehicle Proving Grounds
WEDC	Wisconsin Economic Development Corporation
WisDOT	Wisconsin Department of Transportation
WLC	Wisconsin Legislative Council

I: Statement from Steering Committee

The Honorable Scott Walker
Governor of Wisconsin
115 East, State Capitol
Madison, WI 53702

Dear Governor Walker:

We are pleased to present the final report of the Governor's Steering Committee on Autonomous and Connected Vehicle Testing and Deployment. The following report includes a brief overview of connected and automated vehicles (CAVs) and provides a discussion of their potential impacts. Specific recommendations are organized by five sections corresponding to the five unique mission points identified in Executive Order #245, part 6. The steering committee met over nine months and engaged industry groups, vehicle manufacturers, technology firms, state agencies, research groups and Wisconsin businesses. The steering committee embraced a wide range of perspectives and incorporated them into this final report.

The steering committee believes the ongoing deployment of CAVs has the potential to provide Wisconsin residents, visitors and businesses with enhanced mobility, safer travel and economic opportunities. There are opportunities to build on emerging lessons learned from across the spectrum of connected and autonomous vehicle testing occurring worldwide. While significant market penetration of fully automated vehicles will take time, the steering committee recognizes that partially automated vehicles are currently operating on Wisconsin roads, and encourages the state to respond quickly to important emerging issues identified in this report.

The primary recommendation of this report is to remove or modify Wisconsin laws that are barriers to the safe testing and deployment of connected and automated vehicles in Wisconsin. In addition, clarifying or updating laws that are ambiguous will help Wisconsin residents and businesses realize the beneficial potential of these technologies.

The secondary recommendation of the steering committee is for the state to continue to stay abreast of CAV testing and deployment through the creation of an ongoing working group. CAV technology is advancing quickly and a working group can maintain a dialog with manufacturers, the public, lawmakers, state agencies and the research community while serving as the principal conduit for the state to respond to frequent and ongoing advancements in the sector. The steering committee's other findings and recommendations are included in the body of this report.

The CAV industry is emerging from its infancy and growing quickly. The rapid pace of progress means information available on the impacts of automated vehicle testing and deployment is not complete and often contains a high degree of uncertainty. Therefore, this report is not an exhaustive discussion of all potential issues related to CAV testing and deployment in Wisconsin. Rather, the steering committee prioritized evaluation of near-term issues that are more concrete in nature.

The steering committee appreciates the opportunity to offer input on CAV deployment and testing in Wisconsin and hopes that you find this report useful for continued policy development.

Respectfully submitted,

Governor's Steering Committee on Autonomous and Connected Vehicle Testing and Deployment

II: Steering Committee Roster

Secretary Dave Ross, Chair, ex officio
Wisconsin Department of Transportation

Steven Caya
Roadview

Steven Cyra
HNTB Corporation

Trooper Tracy Drager
Wisconsin State Patrol

Representative Jason Fields
Wisconsin State Assembly

Mark Hogan, ex officio
Wisconsin Economic Development Corporation

George Ivanov
Waymo

Senator Chris Kapenga
Wisconsin State Senate

Representative Mike Kuglitsch
Wisconsin State Assembly

Senator Frank Lasee
Wisconsin State Senate
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Jeff Lewandowski
MGA Research Corporation

Anne Marie Lewis
Alliance of Automobile Manufacturers

Ric Mellon
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Sheriff Steven Michek
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Representative Adam Neylon
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Commissioner Ted Nickel, ex officio
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Dr. David Noyce
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Peter Rafferty
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Senator Fred Risser
Wisconsin State Senate

Lisa Schrader
Uber Technologies, Incorporated

Chris Snyder
Wisconsin Automobile & Truck Dealers Association

Tom Still
Wisconsin Technology Council

Senator Patrick Testin
Wisconsin State Senate

Jason Tolleson
Harley-Davidson Motor Company

Jacob VandeLoo
Schneider National

Eric Williams
Tesla, Incorporated

III: Introduction

Driven by rapid advances in vehicle connectivity, automation, electrification and data acquisition/analytics, transportation is on the cusp of a transformation. While many unknowns remain, there is little doubt that these changes will be disruptive and far-reaching. Planning methodologies, business models, partnerships, policy and regulation, research, workforce, land use, environmental, infrastructure design and operations are several of the many elements that are or will be impacted by these emerging mobility opportunities.

The emphasis of this report are the impacts that connected and automated vehicles (CAVs) may have in Wisconsin. CAVs have the potential to enhance safety, increase mobility and generate economic opportunity. These cars may also disrupt industries[5], increase traffic congestion, transform land use and impact the environment.[6]

The degree and timeframe for these impacts is unclear.[7] However, the adoption of informed polices can help ensure that the potential positive changes are realized.[8] Because CAVs are new and development is progressing quickly, many questions remain unanswered, such as:

- How will Wisconsin residents, businesses and state agencies respond to this rapidly changing technology?
- How can the state position itself to take advantage of the positive potential of connected and automated vehicles?
- Will self-driving cars require Wisconsin to update laws and upgrade infrastructure?

To help answer these questions, Wisconsin can leverage its strong history of innovation and leadership in the technology and automotive industries, and its numerous advanced manufacturing businesses, research universities and start-up businesses. As an illustration, the US Department of Transportation (USDOT) selected the University of Wisconsin – Madison as one of ten "Proving Grounds" to serve as a focal point for research and testing of "smart" vehicles and infrastructure.[9] Continuing to invest in the technology and automotive industries, while removing barriers to testing and deployment, is a critical component in the path to realizing the advancement promised by CAVs in Wisconsin.

This report is the final product of the Governor's Steering Committee on Autonomous and Connected Vehicle Testing and Deployment. The committee, created by Executive Order #245, was chaired by the Wisconsin Secretary of the Department of Transportation and membership included state legislators, industry representatives, business leaders, law enforcement officials, academic researchers and others. The committee's task was to advise Governor Walker "on how best to advance the testing and operation of automated and connected vehicles in the State of Wisconsin." Member's expertise, combined with staff research and information from presenters, informed the recommendations in this report. The committee met monthly between the fall of 2017 and summer of 2018 and, in accordance with Executive Order #245, dissolved after submitting this final report to Governor Walker.[1]

[1] *Electronic versions of this report, committee meeting minutes, presentations and other materials are available at the following URL:* http://wisconsindot.gov/Pages/about-wisdot/who-we-are/comm-couns/avcommittee.aspx

List of Recommendations

The report's recommendations were based on the best information available at the time, and the committee recognizes that the fast-paced development of CAVs and supporting technologies may impact the future relevancy of the recommendations. Section V, beginning on page 9, contains background information on each recommendation.

Recommendation A
Identify the Department of Transportation as Wisconsin's lead state agency to support CAV testing and deployment, respond to emerging issues and engage the public and business community on CAV topics.

Recommendation B1
Create a working group with the ongoing responsibilities of responding to CAV technology and deployment, promoting CAV research development, providing policy advice and coordinating the state's response.

Recommendation B2
Work with the legislature to generate and formally authorize a CAV testing framework that defines expectations for manufacturers which test automated vehicle technologies on Wisconsin's public roads.

Recommendation B3
Recognize USDOT *Automated Driving Systems 2.0: A Vision for Safety* report and the report's regulatory roles regarding responsibilities of state and federal government to the maximum extent possible. Recognize the AAMVA *Jurisdictional Guidelines for the Safe Testing and Deployment of Highly Automated Vehicles* report. Defer to FMVSS standards for future CAV equipment standards in order to maintain consistency for manufacturers, states and consumers.

Recommendation C
Support legislative and administrative efforts to update and clarify state statute and administrative rules regarding CAV operation and liability.

Recommendation D
Promote the entire state of Wisconsin as "Open for CAV deployment". Highlight current connected corridor projects.

Recommendation E
Highlight and pursue existing, near-term strategic partnerships while continuing to explore new strategic social, economic, and environmental partnerships through the creation of a CAV working group.

IV: Connected, Automated and Platooning Vehicles

This section describes the basic types of CAV technologies and vehicle capabilities, and presents an introduction on CAV deployment.

Connected Vehicles

Generally, a connected vehicle has the capability to wirelessly exchange information with other vehicles (V2V), roadway infrastructure (V2I), other devices (V2X) and information in the cloud, such as online maps or road conditions. CV systems in isolation do not directly control vehicle operation, and the driver is still responsible for all aspects of the dynamic driving task (DDT). There are many CV applications, such as driver alerts for enhancing safety or efficiency. For example, a CV may sense that it is approaching an intersection too fast, and alert the driver through an audible or visual warning. These technologies are currently being tested in pilot projects and have limited deployment in vehicles available to the public. However, automakers, states and municipalities have shown interest in adopting these technologies. Recently, several municipalities have participated in pilot projects to test and showcase CV interactions with infrastructure.[10]

Automated Vehicles

Aided by increases in computing power and advanced sensors, vehicle manufacturers are increasingly introducing more advanced technologies into vehicles, with advanced capabilities to match. These technologies include hardware and software for data integration, decision-making and vehicle control, paired with wireless communications and sensors such as LIDAR, RADAR, optical cameras and sonar. Together, these technologies can automate some or all the driving tasks.

SAE has developed, and NHTSA has adopted, an automation classification system, ranging from no automation (level 0) to fully autonomous (level 5). Most vehicles currently on the road are considered a “level 0”. There are currently no “level 4” or “level 5” vehicles available on the consumer market.

Level 1

Level 1 automation includes “driver assistance” features such as blind spot monitoring, emergency brake assist and adaptive cruise control (ACC), which maintains a safe following distance by adjusting to a vehicle ahead. These automated technologies are limited in their responsibilities and require that the human driver constantly monitor the driving environment. There are many technologies in this category and they are increasingly common on new vehicles.

Level 2

More advanced driver assistance features offer a combination of systems that can control the throttle, braking and steering in response to changes in the driving environment. These systems are considered partial automation, or level 2, on the SAE scale. Commercially available vehicle models that have level 2 automation include those equipped with Tesla’s “Autopilot” feature and the 2018 Cadillac CT6, which is equipped with GM ‘s “Super Cruise” system.

Level 3

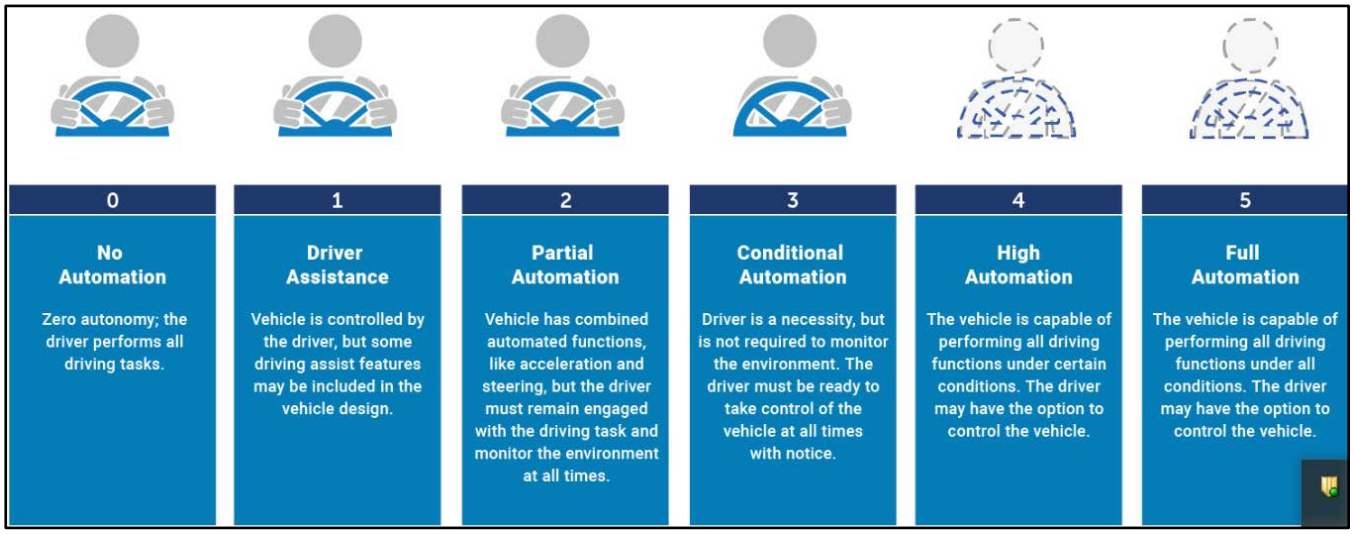
Level 3 and above are considered highly automated vehicles (HAVs) and can monitor the driving environment in certain situations, relieving the human driver from doing so. Examples of companies currently researching and testing HAVs include GM, Ford, Uber Technologies, Inc. and Waymo (subsidiary of Alphabet, Inc.). Audi offers level 3 automation to consumers in its A8 model, but not yet in the United States.

Some vehicle manufacturers, researchers, professional organizations and technology companies have recognized a major safety concern with level 2 and/or level 3 vehicles. Specifically, because a level 2 or 3 system cannot operate in all conditions, certain situations require that the human driver retake control of the dynamic driving task quickly. This transfer may create an unsafe situation, and may not allow the human driver enough time to regain situational awareness and resume the responsibility of safely operating the vehicle. Recent crashes under partial automation in 2018, some fatal, embody this concern. This safety concern is so great that multiple companies have decided against publicly releasing level 2 or 3 vehicles, choosing instead to eventually offer level 4 and/or 5 to the consumer market.[11]

Levels 4 and 5

The terms "autonomous", "driverless" and "self-driving" refer to a vehicle that has the capability to perform at automation level 4 or 5. This level of automation can operate in nearly all circumstances. Certain conditions may require that a human driver take responsibility for the dynamic driving task in a vehicle with level 4 technology. Technology companies and vehicle manufacturers claim that the most advanced self-driving technologies will eventually take responsibility for the all aspects of the DDT in all conditions, creating a fully autonomous vehicle (level 5). Ultimately, a fully autonomous vehicle may be built without traditional controls for human drivers, such as a steering wheel or brake pedal.

Figure 1: SAE scale of vehicle automation



Platooning Vehicles

A platoon is a group of vehicles connected by a wireless communication link traveling in a unified manner at electronically coordinated speeds. Platooning technology can control the throttle and braking of each vehicle simultaneously. The human drivers of all vehicles in a platoon are still in control of steering and other functional driving tasks, and may resume complete control of all driving tasks at any time. Because the vehicles can accelerate and brake simultaneously, they can travel more closely together than they otherwise could. Traveling closely together has the potential to reduce fuel consumption and maximize the use of road lanes. Concerns have been raised about platoons creating "rolling roadblocks" and a platoon's interaction with other vehicles, especially at highway interchanges. Platooning technology is currently deployed in the US in commercial truck fleets on limited-access highways, usually with two vehicles.

Current Status of Connected and Automated Vehicle Deployment

The following is a selected list of CAV deployment activities and not exhaustive in nature. For continued reading, a list of resources is available at the end of this report.

- Vehicles with low levels of automation (driver assist features) are currently available to consumers.
- Vehicles with partial automation are currently in a small number of vehicle models for sale (e.g. Tesla Models, 2018 Cadillac CT6).
- Vehicles with connected technology (i.e. V2V, V2I, V2X) are being piloted around the world.
- Testing of highly automated vehicles is occurring in at least twelve US states.
- At least one HAV shuttle has operated on Wisconsin's public roads during a pilot project.[12]
- In January 2017, USDOT chose UW-Madison as one of ten national automated vehicle proving grounds.

Current Status of Connected and Automated Vehicle Legislative Actions

At the time of this writing, 41 states and Washington D.C. have considered legislation related to automated vehicles and 22 states have adopted legislation specifically authorizing their operation. Executive orders related to automated vehicles have been issued in at least five states, including Wisconsin.[13] The implications of AVs and CVs are different, and though the emphasis from nationwide legislation tends to be on AV, there are elements of CVs that may be addressed differently. Wisconsin recently updated state law to exempt platooning trucks with a gross weight of more than 10,000 pounds from minimum following distances.[14] Further legislation may be required to address this recent legislative change, such as signage to notify motorists that a platoon is in operation. Other states have enacted legislation to clarify motor vehicle laws, created a framework for regulation of testing on public roads or enacted administrative changes that allow for increased state action on CAV deployment, such as planning activities. As part of Executive Order #245, the steering committee reviewed state law to identify potential barriers to CAV testing and deployment.

Recently, the US House of Representatives passed the SELF DRIVE Act (HR 3388), which asserts federal primacy regarding automated vehicle testing and deployment. A companion bill with similar language, referred to as the AV START Act, is currently under consideration in the US Senate.

Additionally, the USDOT has issued guidance in the *Automated Driving Systems 2.0: A Vision for Safety* report in late 2017. Version 3.0 of the report is expected in 2018.

Potential Impacts of Connected and Automated Vehicle Deployment

Over time, CAVs will begin to comprise a higher share of total vehicles on the road, and impacts will become more apparent. While there is a high degree of uncertainty about what those impacts may be, they may include positive outcomes such as increased safety, economic development and mobility. However, CAVs may increase current risks or create new potential risks such as increased cybersecurity vulnerability, traffic congestion, additional land use sprawl or disruption to certain industries. [15]

The following table provides a partial list and brief description of potential impacts of CAV deployment. It does not represent an exhaustive review of all potential CAV impacts but, rather, identifies topics that are often cited in government reports, industry statements, academic research or steering committee discussions. The committee presents this list as a starting point for further discussions, and stresses that this list should not be construed as a prediction of CAV impacts. Potential impacts may apply differently in scale or scope to connected vehicles and automated vehicles.

Figure 2: Potential impacts of CAV deployment

TOPIC	POTENTIAL IMPACT OF CAV DEPLOYMENT
Industry disruption	Adoption of CAVs may impact industries such as freight hauling, vehicle maintenance and repair, law enforcement and others.
Public safety	CAVs impact on public safety is currently uncertain. Advocates claim CAVs will eventually reduce crashes caused by human error, but some analysts note that this will require widespread adoption of CAVs and that CAVs may begin to create entirely new types of crashes, especially when CAVs begin to operate alongside human-operated vehicles in larger numbers.
Personal mobility	AVs have the potential to increase mobility among non-driving populations.
Economic opportunities	The testing and deployment of CAVs may result in a number of potential economic impacts and merits further study and monitoring as the technology advances. CAV testing and deployment may impact opportunities for business and supply chain development, greater mobility for individuals, access to reliable, cost effective transportation, including last mile options, to connect workers with job opportunities. CAV deployment may impact automobile collision repair, insurance, health care and legal services due to anticipated reductions in accidents. New types of jobs and skill requirements may be developed to serve the industry. CAV deployment may also impact land use and infrastructure needs in communities including the potential for a reduction in the need for parking.
Inconsistencies with Wisconsin state law	While no state statute currently prevents operation of CAVs on Wisconsin's roads, other potential unforeseen inconsistencies may exist between CAV deployment and certain provisions of state statute or administrative rule.
Impacts to state agencies	CAV deployment will impact activities of state agencies such as WisDOT (especially DMV and State Patrol) and Office of the Commissioner of Insurance.

Infrastructure investment	The safe or efficient operation of CAVs may benefit from updates to public infrastructure, such as improved travel lane markings or standardized signage. CAV deployment may precipitate changes in infrastructure such as allowing for narrower travel lane width, reducing the quantity of traditional traffic control devices, accommodation of truck platooning or increasing the demand for passenger loading and unloading zones.
Interaction with law enforcement *(additional detail on page 10)*	An AV's interaction with law enforcement is unclear and could create confusion, or possibly increase risk to first responders or the public. Some reports discuss how AV deployment should consider law enforcement interaction considerations. The State of California requires AV manufacturers who wish to test on public roads to submit a law enforcement interaction plan. Additionally, AAMVA published sixteen recommendations for jurisdictions (US states and Canadian Provinces) regarding law enforcement considerations, such as *"6.5.1. Define what enforcement actions can be taken and who or what is responsible when there is no human on board an automated test vehicle."*[16]
Automotive and liability insurance	Deployment of CAVs may warrant consideration of the access to and the security of collected data, levels of financial responsibility, and criteria used to determine how insurers can appropriately match price to risk when determining rates for drivers and vehicles.
Public perception	The public's perception and acceptance of self-driving technology will play an important role in the testing and adoption of AVs.
Parking demand	Automated vehicles, especially when paired with taxi or car-sharing services (i.e. MaaS) may impact demand and location for car parking.
Car sharing	While car-sharing is not a new phenomenon, automated-vehicles have the potential to create new models of car sharing services.
Automated taxi or ride-hailing services	These services are already under development by some companies such as GM and Uber as "driverless taxis". Their deployment will warrant additional consideration.
Socio-economic impacts	It is likely that the deployment of CAVs will be unevenly distributed geographically, and among social and economic groups. As with other technologies such as broadband internet, this uneven distribution of CAVs may warrant further consideration among policy makers.
Vehicle miles traveled (VMT)	VMT may increase or decrease during deployment of CAVs. VMT changes may be influenced by the timing and scale of adoption of CAVs in relation to social trends.

Ethics	CAVs must make decisions when confronted with several options. How will these decisions be reconciled with the ethical standards that are currently applied (formally and informally) to human drivers? Will these decisions vary by the ethical standards of the manufacturers that programmed the CAV software? If a crash is imminent and unavoidable, will the CAV be programmed to minimize the risk of the vehicle's occupants at the expense of other road users?
Cybersecurity	CAV operations will be governed by onboard systems controlled by millions of lines of software code, and most likely will be connected to the internet (and, possibly, other devices). As with any highly complex computer system, CAVs will need to have robust security features to defend against external threats and must minimize errors in software code.[17]
Data privacy	Several major automakers have adopted a set of voluntary "Privacy Principles" regarding the data collected by vehicles from occupants but no federal or state law or guidelines currently exist that directly deal with data privacy of CAVs.
Pollution and environmental impacts	AVs have the potential to directly impact the environment through land use changes, transportation emissions and others. The net impact AVs will have on pollution and the environment is unknown, and depends on how AVs are adopted, what policies are enacted and other factors.[18]

V: Executive Order Deliverables

The following section provides background information on each of the steering committees recommendations. The committee's efforts prioritized recommendations that impact near-term, important CAV issues that contain more certainty.

Executive Order Part 6(A)

Identify all agencies of the State of Wisconsin with pertinent jurisdiction to support the testing and deployment of automated and connected vehicles.

Recommendation A
Identify the Department of Transportation as Wisconsin's lead state agency to support CAV testing and deployment, respond to emerging issues and engage the public and business community on CAV topics.

Background A
The steering committee identified two state agencies with primary jurisdiction over CAV deployment and testing. The Wisconsin Department of Transportation and Office of the Commissioner of Insurance (OCI) each have responsibilities that will impact CAV deployment and will be impacted by CAV deployment. Several other state agencies may also have incidental interaction or relation to CAV deployment and testing including DATCP, DHS, DNR, OCR, DOR, Department of Tourism and DOJ.

Wisconsin Department of Transportation
WisDOT's organizational structure includes the Division of State Patrol and the Division of Motor Vehicles. Thus, WisDOT's activities include a large breadth of responsibilities, such as vehicle registration, law enforcement, infrastructure investment, transportation project delivery and vehicle operator licensing, which impact CAV testing and deployment. Therefore, the steering committee recommends WisDOT be identified as the lead agency for the state's response to CAV deployment and testing. Additional discussion of WisDOT's activities related to CAV testing and deployment is below.

WisDOT DMV - Permitting of AV testing on public roadways
Several states explicitly permit manufacturers to test and deploy AV technology on public roads. These states have instituted an application process which includes the submission of documents and self-certification requirements. AV application processes have aimed to provide sufficient background information for the state and law enforcement personnel to know who, how, where and what testing is occurring, while avoiding the creation of unnecessary barriers.

WisDOT DMV - Operator licensing
The DMV has responsibility for educating, testing and licensing drivers. Driver education curricula may need updates to contain information on automated vehicle technologies. Additional training may be required for both driver license instructors and examiners regarding CAVs. Alternatively, the state may choose not to require licensure, sobriety, or clean driver history in order to allow non-drivers/consumers to make use of deployed Level 4 and Level 5 vehicles. Additionally, several states require that AV test drivers receive training before operating AVs on public roads.

WisDOT DMV - Vehicle registration

The DMV has responsibility for titling and registering vehicles kept in Wisconsin and maintaining accurate information regarding each vehicle and its owner. The state may choose to place a notation on the registration credential or electronic record of each CAV (manufacturer or after-market). By establishing uniform record notations, the state can assist law enforcement and first responders by communicating important vehicle attributes, while facilitating tracking these vehicles within mixed-fleet operations. Registration frameworks for automated vehicles has been adopted by other states, such as Michigan, Nevada and Utah. Consistency amongst states' record notations will be especially important until a national tracking solution, such as a VIN check digit or indicator, is established.

WisDOT - Transportation investment management

WisDOT allocates and invests transportation infrastructure dollars in accordance with applicable law, statute and administrative rule. It is likely that infrastructure investment will be influenced by the deployment and testing of ADS capable vehicles. Indeed, a request for information process conducted by FHWA during the National Dialogue on Highway Automation[19] suggests that widespread deployment of automated vehicles would benefit from "greater uniformity and quality in road markings and traffic control devices".[20] Replacement and upgrades to these transportation assets to benefit automated vehicle deployment would compete with other transportation funding requests.

WisDOT – Transportation project delivery and traffic operations

WisDOT's project delivery and traffic operations responsibilities will be influenced by CAV testing and deployment. Some CAV technologies may require infrastructure support such as enhanced road markings, robust cellular or wireless data signals and/or dedicated short-range communication (DSRC) equipment. WisDOT may be asked to incorporate such considerations in future project delivery.

WisDOT – Wisconsin State Patrol

The Division of State Patrol has the responsibility of enforcing Wisconsin traffic and criminal laws, inspecting certain classes of vehicles, including school buses, and assisting local law enforcement agencies as needed. CAV testing and deployment will interface with several State Patrol actions including traffic enforcement, crash investigations and others. For example, State Patrol often utilizes crash data obtained from a vehicle's event data recorder (EDR). EDRs in CAVs may be more complex and State Patrol staff may require additional training or equipment in order to access and analyze the data. State Patrol's experience will be invaluable as CAV testing and deployment progresses in Wisconsin.

State Patrol can provide insight on additional law enforcement considerations of testing and deployment of CAVs. These considerations are well characterized in AAMVA's *Jurisdictional Guidelines for the Safe Testing and Deployment of Highly Automated Vehicles* report issued in May 2018. The report identified eleven law enforcement considerations. Examples included "crash and incident reporting", "first responder safety" and "vehicle identification". The report also identified sixteen recommendations for law enforcement consideration, such as "6.5.1. Define what enforcement actions can be taken and who or what is responsible when there is no human on board an automated test vehicle". AAMVA's report, along with State Patrol insight, will be a critical component of future discussions regarding the safe testing and deployment of CAVs on Wisconsin's roadways.

Moreover, several states require CAV manufacturers to develop and implement a "first responder interaction plan". The plan covers topics that may arise during an incident that involves an automated vehicle. The purpose of the plan is to provide first responders with information necessary to safely and efficiently respond to incidents. State Patrol's incident response experience will be a critical component of crafting a potential state-wide "first responder interaction plan" requirement.

Because platooning trucks can follow more closely than traditionally operated trucks, the state's weigh-in-motion scales may identify two trucks incorrectly as one truck. This may trigger an alert that the truck is operating with too many axels. As the deployment of platooning trucks increase State Patrol can assist with creating operational responses to these challenges.

Finally, Wisconsin law enforcement ensures vehicles are safe to operate through the inspection of commercial vehicles and enforcement of rules-of-the-road, such as headlamp illumination and seat belt use. How law enforcement will continue to apply rules-of-the-road enforcement and their applicability to CAVs may be a continued point of conversation.

Office of the Commissioner of Insurance

OCI's primary responsibilities include protecting insurance consumers and ensuring a competitive insurance environment. Consistent with Wisconsin laws and rules, OCI performs a variety of tasks including: conducting examinations of domestic and foreign insurers, monitoring the financial solvency of licensed companies, educating and assisting insurance consumers, and issuing licenses.

The testing and deployment of automated vehicles on Wisconsin roadways raises questions pertaining to insurance and liability. For example, if an automated vehicle is involved in a crash and is determined to be at fault, will the automated driving system or operator be liable? The committee believes OCI should have an ongoing role in CAV policy discussions.

Earlier this year, OCI conducted a voluntary survey of property and casualty insurers operating in Wisconsin regarding the testing and deployment of CAVs in Wisconsin. The survey was distributed as an effort to provide feedback for the Governor's Steering Committee on Autonomous and Connected Vehicle Testing and Deployment. The survey asked insurers if there are any existing OCI statutes, administrative codes, and/or reporting requirements that should be revised which may impede the testing and deployment of CAVs in Wisconsin. The survey also allowed insurers to share any concerns regarding CAV deployment in general. The survey results provided OCI with valuable information on some of the key issues industry stakeholders have identified. Highlights of the survey results include:

- Insurers, OCI and other CAV stakeholders should continue to work together to help develop standards and regulations moving forward.
- Generally, no specific OCI laws or administrative rules have yet been identified to prohibit the testing or deployment of CAVs in Wisconsin. However, there may be areas needing clarification.
- Access to data and the security of data collected by CAVs is critical to insurers as they consider matching price to risk. Cyber security is also a general concern with CAV data and operations.
- Understanding levels of financial responsibility is an area of interest and concern.

DOA and DET

CAVs may be connected to the internet, collect and receive data from various technologies and communicate with infrastructure. Currently, it is unclear how such electronic activity will be implemented or regulated. The steering committee presumes CAVs also will collect, store and transmit sensitive personal information such as travel habits.[21] While federal agencies such as the FTC, FCC and NHTSA may advise data collection, transmission, privacy and ownership, the state may be interested in continuing to monitor these issues.

Several high-profile incidents have shown that vehicles with advanced technologies may be vulnerable to hacking, raising fears of automated vehicles being virtually "attacked" or "weaponized".[22] Further, software malfunctions or hardware failures may cause unintended vehicle operation or failure.[23]

Several major automakers have adopted the Auto Alliance's set of voluntary privacy principles[24] for vehicle technologies and service. A recent US GAO report recognized the importance of this effort but recommended that NHTSA better define and communicate the federal government's role in vehicle data privacy.[25]

WEDC

The testing and deployment of CAVs may result in several potential economic impacts and merits further study and monitoring as the technology advances. In a recent Issue Brief by the US Department of Commerce, occupations most likely to be affected by business adoption of autonomous vehicles were identified and were divided into "motor vehicle operators" and "other on-the-job drivers."[26] In Wisconsin, the estimated number of individuals employed as motor vehicle operators in 2017 was 90,810 or a 3.2% share of employment.[27] With adoption of automated vehicles, the need for motor vehicle operators may be reduced. An estimated 53.3% of Motor Vehicle Operators (48,400) fall into the category of Heavy and Tractor-Trailer Truck Drivers. A recent study by the American Trucking Association projected the truck driver (class 8 tractor-trailer drivers) shortage was expected to surpass 50,000 by the end of 2017 in the US "Other on-the-job drivers" may be impacted in other ways and may benefit from greater productivity and better working conditions.[28]

Other economic impacts may include:

- Opportunities for business and supply chain development to support the CAV industry, including businesses that support the testing of new vehicles.
- Greater mobility for individuals who are not able to drive or do not have access to traditional automobiles or transportation options. Increased access to reliable, cost effective transportation, including last mile options, to connect workers with job opportunities.
- The potential for reduced need for services related to automobile collision repair, insurance, health care and legal services due to anticipated reductions in accidents. CAV technologies may also present opportunities to provide new services in these areas.
- New jobs and skill requirements to serve the CAV industry.
- Impacts on land use and infrastructure needs in communities including the potential for a reduction in the need for parking.

Executive Order Part 6(B)

Coordinate with the identified agencies and discuss how best to administer the testing and study of autonomous and connected vehicles on roads in relation to issues such as vehicle registration, licensing, insurance, traffic regulations, equipment standards, and vehicle owner or operator responsibilities and liabilities under current law.

The committee makes three recommendations related to executive order #245 deliverable 6(b), listed below and followed by background discussion of each.

Recommendation B1
Create a working group with the ongoing responsibility of responding to CAV technology and deployment, promoting CAV research development, providing policy advice and coordinating the state's response.
(see page 14 for background discussion)

Recommendation B2
Work with the legislature to generate and formally authorize a CAV testing framework that defines expectations for manufacturers which test automated vehicle technologies on Wisconsin's public roads.
(see page 16 for background discussion)

Recommendation B3
Recognize USDOT *Automated Driving Systems 2.0: A Vision for Safety* report and the report's regulatory roles regarding responsibilities of state and federal government to the maximum extent possible. Recognize the AAMVA *Jurisdictional Guidelines for the Safe Testing and Deployment of Highly Automated Vehicles* report. Defer to FMVSS standards for future CAV equipment standards in order to maintain consistency for manufacturers, states and consumers.
(see page 17 for background discussion)

Background B1

The steering committee recognizes that issues related to CAV deployment and testing are complex, numerous and ongoing. Moreover, CAV technologies are being developed and deployed rapidly. A working group could provide the state with a nimble response to emerging issues on all fronts. A working group could advise the Governor's office on pressing issues and stay abreast of ongoing opportunities for CAV deployment and investment in the state. Other states – including Michigan, Oregon and Pennsylvania - have adopted, or will soon create, a working group or task force model to coordinate the initiation of CAV technologies and their state's response to CAV deployment.

The steering committee proposes that the working group consist of stakeholders with relevant expertise and near-term interests. The working group should meet at least quarterly and would benefit from dedicated staff support. The proposed working group roster should be made up of knowledgeable and active members of the existing steering committee. Existing members may choose to opt-in to the future working group. It is recommended that the working group continue to include representation from the following:

- Wisconsin state legislators
- WisDOT representative
- OCI representative
- CAV technology/manufacturer representatives
- Research, academic or non-profit representative~~s~~
- State/local law enforcement representative

The steering committee has generated a list of issues which this working group may consider. The committee recognizes that the pace of CAV development and deployment may warrant adjustments to the membership of the working group. The table below summarizes these issues, along with the committee's ratings of relative importance and time-frame.

Figure 3: Table of issues for review by working group (issues are sorted by time-frame, then importance)

TIME-FRAME	IMPORTANCE	WORKING GROUP ISSUE
short	high	Prioritize the safe and efficient integration of CAVs with existing or vulnerable road users such as human-operated automobiles, motorcycles, bicycles, agricultural equipment, horse carriages and pedestrians.
short	high	Review Wisconsin Administrative Code to identify potential conflicts with deployment, testing and/or operation of CAVs. *(see page 18 for more information)*
short	high	Clarify ambiguous language in statute that may create confusion or delay CAV deployment. Develop legislation to remove barriers to CAV testing and deployment. *(see page 19 for more information)*
short	high	Create a framework, program or application process to register CAV manufacturers which are testing in the state. Program may include vehicle registration, licensing or data reporting requirements. *(see page 16 for more information)*
short	medium	Establish a formal point of contact within (a) state agency(ies) to serve CAV businesses, the public, investors, etc.
short	medium	Develop licensure, identification and outreach to automated vehicle manufacturers and/or operators. *(see WisDOT DMV section on page 9 and 10 for more information)*
short	medium	Develop a formal comprehensive state-wide CAV strategic plan.
mid	medium	Develop a strategy for the state to serve as a resource for local municipalities which interact with CAV companies. *(see WisDOT DMV section on page 9 and 10 for more information)*
mid	medium	Monitor economic impact and prioritize opportunities for development. *(see WEDC section on page 12 for more information)*
long	low	Determine funding strategies, priorities or pilot programs for future CAV infrastructure.

Background B2

The committee reviewed other states' frameworks for authorizing automated vehicle testing and considered USDOT's *Automated Driving Systems 2.0: A Vision for Safety* to generate the following list of actions the state may take to guide the development of Wisconsin's automated vehicle testing authorization.

1. Develop an application process which outlines self-certification, documentation and operation requirements. The application may contain basic requirements such as:
    - Data sharing specifications
    - Proposed geographic test area
    - Proposed testing time frames
    - Proposed testing operational design domain (ODD)
    - Self-certification that the ADS/vehicle has been tested in each ODD before being deployed on public roads
    - Self-certification that the ADS/vehicle and/or test drivers will operate in accordance with the state's motor vehicle laws
    - Self-certification that the test drivers have undergone a training program and provide documentation of the training program at the state's request
    - Self-certification of minimum liability standards ($5 million minimum)
    - Self-certification of applicable minimum product liability standards
2. Require that the testing entity enter into an agreement with (and/or) communicate vehicle and testing information with all local municipalities that have traffic enforcement and emergency response responsibilities within the testing area.
3. Require that the test vehicles be operated with a test driver physically present in the test vehicle, unless the state has authorized a program by which no test driver must be present.
4. Report basic test vehicle information to DMV, such as VIN, make, model and model year.
5. Report "disengagements" to the state DMV quarterly.
6. Report crashes, including those where the test vehicle and/or test driver was not at-fault, to the DMV as defined by the working group. Include all related vehicle data prior to and during the crash.
7. Identify all automated test vehicles so that emergency responders and the state DMV are aware of the vehicles' capabilities or limitations, and so that emergency responders can interact with or identify all such vehicles, drivers and or manufacturers safely and quickly.

The committee recognizes the need to further develop these principles into an actionable framework. The committee recommends further development be conducted by the working group in consultation with the legislature.

Background B3

The committee recognizes the roles and framework adopted by USDOT and NHTSA in the *Automated Driving Systems 2.0: A Vision for Safety* report, as summarized in the table below. Additionally, the committee agrees that vehicle equipment standards remain the responsibility of NHTSA. If states were to adopt additional equipment standards for CAVs, they likely would not be consistent. Both CAV manufacturers and the committee recognize that inconsistent vehicle equipment standards for CAVs would discourage successful CAV testing and deployment in Wisconsin. USDOT is currently developing an updated version of an automated driving systems report, with an expected release in 2018.

Figure 4: Table of federal and state responsibilities. Adopted from NHTSA Automated Driving Systems 2.0, A Vision for Safety

NHTSA'S RESPONSIBLITIES	STATES' RESPONSIBILITIES
Setting Federal Motor Vehicle Safety Standards (FMVSSs) for new motor vehicles and motor vehicle equipment (with which manufacturers must certify compliance before they sell their vehicles)	Licensing human drivers and registering motor vehicles in their jurisdictions
Enforcing compliance with FMVSSs	Enacting and enforcing traffic laws and regulations
Investigating and managing the recall and remedy of noncompliances and safety related motor vehicle defects nationwide	Conducting safety inspections, where states choose to do so
Communicating with and educating the public about motor vehicle safety issues	Regulating motor vehicle insurance and liability

The steering committee also reviewed the USDOT report's discussion of "Best Practices for Legislatures" and "Best Practices for State Highway Officials" sections. The steering committee notes important points in these sections, including:

- maintaining a "technology neutral" environment;
- creating licensing and registration procedures;
- identifying a lead state agency; and
- reviewing laws that may create barriers for CAV testing and deployment.

A full list of "Best Practices" are contained in the USDOT report.

Executive Order Part 6(C)

Review existing state statutes and administrative code and identify specific laws or rules that impede the testing and deployment of automated and connected vehicles on roads.

Recommendation C

Support legislative and administrative efforts to update and clarify state statute and administrative rules regarding CAV operation and liability.

Background C

The steering committee believes that Wisconsin law does not explicitly prohibit the operation of connected or automated vehicles. However, the operation of these vehicles introduces important questions about (1) how current Wisconsin law should be applied to the operation of vehicles of different automation levels, and (2) whether laws should be created or modified with regards to automated vehicle operation. Several states, including California, Connecticut, Michigan and Nevada, have updated laws or proposed legislation to clarify the various issues that arise when automated vehicles are operated on public roads.[29]

According to a preliminary review of statute by the Wisconsin Legislative Council (WLC), "legislative changes would likely be beneficial to provide clarity regarding the operation of certain automated vehicles on Wisconsin highways." WLC has identified several issues in statute relevant to automated vehicle operation. For example, the current statutory definition of "operator" may need modification to apply to automated vehicles and/or such a vehicle's owners or "driver".[30] Additionally, the Alliance of Automobile Manufacturers (AAM) has identified Wisconsin statutes that may create barriers to CAV deployment in Wisconsin. Overlap exists between the lists generated by WLC and AAM.

The following table identifies chapters in state statute that may require changes to clarify their applicability in relation to CAV deployment and operation. The committee was unable to exhaustively review Wisconsin administrative code to identify potential conflicts or barriers to CAV deployment and operation.

Figure 5: Wisconsin state statute potential applicability to CAV testing and deployment

TOPIC	CHAPTER	DESCRIPTION OF ISSUE
Definitions	340	Definitions of terms may need clarification (e.g. “operate”, “operator”, “drive”). New terms may need definitions (e.g. “automated vehicle”, “driverless vehicle”, “operational design domain”)
Vehicle registration	341	All vehicles must comply with FMVSS standards to be eligible for registration. Exempting some vehicles from this requirement may facilitate CAV testing.
Vehicle title and anti-theft law	342	Currently, no person may leave a vehicle “unattended…as to cause the vehicle to reasonably appear to have been abandoned.” May cause confusion for fully automated vehicles that are operating without anyone inside.
Operators' licenses	343	Consider automated vehicle endorsement, registration or education components related to the licensing of drivers operating automated vehicles. Consider registering the manufacturer or AV itself.
Financial responsibility	344	Consider impact of change in nature of insurance from owner/operator liability to product liability. Or additional liability requirements for operators of AVs.
Rules of the road	346	• Clarification of applicability to vehicles operated in automated mode. Clarify who is responsible for reporting in the event an AV is involved in a traffic infraction or crash. • Construction zones and school zones may warrant enhanced consideration of AV operation. • AV interaction with emergency vehicles. • Statute requires operators to slow to an appropriate speed in certain situations. Would this warrant disengagement of automated mode? • AV interaction with pedestrians and bicyclists. • Operating/riding in an autonomous vehicle while intoxicated may be prohibited under current statute. • Current law prohibits inattentive driving. Future modifications may consider what degree of attention is required when operating an AV. • AV compliance with regulatory and warning signs, traffic signals, pavement marking and related traffic control devices.
Equipment of vehicles	347	Requires the person operating a vehicle be restrained by a seatbelt. Unclear how this would apply to an autonomous vehicle “operating itself”.
Powers of state and local authorities	349	Local authorities may request flexibility in adopting and enforcing traffic laws that allow for CAV pilot projects not in strict conformity with state law.
Automotive and liability insurance		At this time, no particular insurance statute has been identified as a barrier to the testing and deployment of CAVs. However, there may be areas needing clarification in the future.
Others		How to classify and record hours-of-service while operating a platooning CMV. Vehicle information ownership and accessibility to law enforcement.

Executive Order Part 6(D)

Identify roads for designation as special corridors for automated and connected vehicle testing or operation innovation.

Recommendation D

Promote the entire state of Wisconsin as "Open for CAV deployment". Highlight current connected corridor projects.

Background D

The steering committee believes that touting specific CV or AV projects within Wisconsin is a suitable strategy to promote CAV deployment. For instance, the University of Wisconsin - Madison was selected as one of ten nationwide USDOT "Proving Grounds" for automated vehicles. Maximizing the marketing of this effort and incorporating it into current transportation planning efforts would maximize potential benefits.

Currently, the only known active testing program for connected vehicle technologies on public roads in Wisconsin is being conducted by the Wisconsin AVPG consortium, in the City of Madison and on the UW-Madison campus.[31] This program is beginning to incorporate transit vehicles, emergency vehicles and infrastructure in the Park Street corridor and campus environment to better utilize connected technologies to more efficiently move people and traffic. Additionally, the state is in preliminary discussions regarding creating a "smart" connected corridor on Interstate 94 in southeast Wisconsin with the goal of improving freight hauling.

While the steering committee recognizes that promoting connected corridors for pilot programs is a meaningful strategy to encourage CAV deployment, it envisions a campaign wherein all of Wisconsin is promoted as "open for CAVs". The steering committee believes that Wisconsin offers considerable benefits to potential CAV testing and deployment due to the variability in road type, weather and traffic conditions. Wisconsin hosts significant Interstate highway miles, dense urban centers and miles of scenic rural roads. Additionally, the Wisconsin AVPG provides a network of resources to complete closed-track testing of CAV technologies before implementation on the public roadway system. This variability can be touted as a benefit to CAV companies seeking testing locations.

Currently, most automated vehicle testing is limited to geofenced areas, on mapped roads and/or in favorable weather conditions. However, companies wishing to market CAV technology throughout the country or world will need to prove their technologies have mastered challenging environments. Wisconsin offers such environments. Wisconsin's roads are often covered in snow and ice creating slippery roads and obscured pavement markings, contain unexpected hazards such as animal crossings and are host to a variety of road users including motorcyclists, snowmobilers, horse riders and bicyclists.

The steering committee recognizes that local municipalities will play an important role in supporting and hosting CAV deployment and testing. Therefore, the state could engage and support local communities in their efforts to host CAV deployment and testing. The state's support may be technical in nature, through a financial matching program, or through other means. For example, the state may generate CAV guidance and generate template documents for municipalities to create a grant program that partially covers the cost of supporting deployment.

Alternatively, the state legislature may consider that local municipalities may prefer to exercise a greater level of control over the operation and testing of CAVs within their jurisdictional boundaries. State support may include serving as a resource to municipalities that have concerns or questions about CAV deployment and testing.

Further, the state could facilitate meetings between municipalities and CAV companies that wish to begin testing. Moreover, the legislature may decide to develop a program, in consultation with local officials and emergency response personnel, where local municipalities or roadways can “opt-out” of CAV deployment and testing.

Additionally, the committee recognizes the state’s need to determine whether and how to publicly fund CAV testing and deployment efforts and potential infrastructure projects. The proposed working group should lead this exploration. Until now, private investment has contributed most significantly to funding the testing and deployment of CAV technologies.

Executive Order Part 6(E)

Identify strategic partnerships to leverage the social, economic, and environmental benefits of automated and connected vehicle technology.

Recommendation E

Highlight and pursue existing, near-term strategic partnerships while continuing to explore new strategic social, economic, and environmental partnerships through the creation of a CAV working group.

Background E

The steering committee hosted fifteen presenters during nine months of meetings. Presenters came from diverse stakeholder groups including automotive manufacturers, non-profit groups, industry, academia, technology companies and more. These presenters helped the steering committee identify potential strategic partnerships to leverage social, economic and environmental benefits of CAV technology.

The steering committee identified eight types of partnerships, described below. The committee recommends that the proposed working group continue to explore and promote these types of partnerships.

Figure 6: Potential CAV partnerships

PARTNERSHIP	POTENTIAL ENTITIES	DESCRIPTION
1. State and federal regulators	• USDOT • NHTSA • WisDOT	• Continue information sharing related to CAV deployment. • The state may assign staff time to the specific task of staying abreast of federal CAV guidance development.
2. State agencies and CAV manufacturers	• WisDOT • DMV • WEDC • DNR • OCI • DHS • State Patrol • CAV manufacturers	• DMV and testing companies may have the ability to work together on sensible tracking, registration and licensing creation. • WEDC may assist with supply chain management and small business development. • DNR and platooning companies may highlight increased efficiency of platooning trucks and cleaner air. • OCI and CAV manufacturers can identify insurance issues. • Highlight increased mobility offered by CAVs through DHS programs (e.g. Medicare transport companies, IRIS). • State Patrol and trucking companies utilizing platooning technology on Interstates.

3. Academia and state agencies	• WisDOT • WAVPG • UW – Madison (numerous departments may contribute)	• Highlight CAV research in order to attract investment • Cooperatively identify policy best practices • Partner on federal and private grant opportunities • Highlight Wisconsin Automated Vehicle Proving Grounds https://wiscav.org/ o Testing environments range from sensor simulation, to the Connected Park Street test bed, to driverless public road tests. o Multidisciplinary collaboration beyond just technology o A triple helix of academia, industry, and government collaboration and partnerships WiscAV team includes private test tracks and industry partners, bringing diverse technical expertise in evaluation and assessment; mechanical, electrical, systems, and transportation engineering; robotics, hardware, computer science, and big data; sensing systems and high resolution basemapping; human factors; and simulation and modeling.
4. CAV manufacturers and local municipalities	• CAV manufacturers • Cities • Towns • Villages • Counties	• Highlight CAV testing and development • Identify appropriate geo-fenced areas • Highlight special pilots or test cases (e.g. UW-Madison campus, shared-ride CAV deployment and CAV deployment in public transit) • May develop a list of “opt-in” municipalities
5. Local municipalities and state agencies	• WisDOT • WEDC • local municipalities	• CAV deployment “handbook for municipalities” development • State is central repository for tracking experiences of local municipalities
6. Third-parties and CAV manufacturers	• CAV companies • social entities such as: o churches o local chambers o clubs o daycares o schools o nursing homes o economic entities	• Non-profits and/or interest groups may experience benefits of driverless transportation (e.g. senior transportation groups) and may wish to partner with the state or CAV manufacturers. • Research groups can inform CAV manufactures of industry trends, economic benefits, etc. • Do CAVs have the ability to improve motorcycle detection and avoidance? • Trucking companies and CAV manufacturers, such as platooning technologies and Wisconsin trucking companies. • Driving automation has been incorporated into advanced agriculture equipment, with some farm equipment able to navigate autonomously throughout a field. • Wisconsin School Bus Association

7. Social organizations and CAV manufacturers	• DHS • Wisconsin Association of Mobility Managers (WAMM) • Wisconsin Public Transit Association (WIPTA) • other human services organizations • citizen organizations	• Public outreach and education is critically important as new technologies are introduced into conventional transportation and mobility services. • Collaborative partnerships and engagement opportunities should be pursued and supported. The following are examples, and this list is not intended to be exhaustive: o State transit and mobility associations o Other human services organizations o Federal Transit Administration (FTA) programs implemented in Wisconsin o Programs that are specifically targeted at rural mobility or underserved populations
8. State agencies and CAV businesses	• WEDC • WisDOT	• Promotion of freight companies and networks. • Highlight contracts between state and CAV companies. • I-94 north-south freeway smart corridor development.

VII: Further Reading

- Wisconsin Governor Walker Executive Order #245
- Wisconsin Legislative Council Memo TO: Senator Frank Lasee RE: Statutory Changes to Facilitate Operation of Autonomous Vehicles
- USDOT, *Automated Driving Systems 2.0: A Vision for Safety* (September 2017)
- WisDOT Office of General Counsel, *Memo RE: Highly Automated Vehicles; current and future impacts on Wisconsin Law and/or statement?* (December 2017)
- AAMVA, *Jurisdictional Guidelines for the Safe Testing and Deployment of Highly Automated Vehicles* (May 2018)
- Wisconsin Automated Vehicle Proving Grounds, https://wiscav.org/
- Autonomous Vehicles in Delaware, *Analyzing the Impact and Readiness for the First State* (April 2017)
- Iowa DOT, *Automated Vehicle Technologies Project. Vision Document Final* (March 2017)
- Report to Utah Legislature, *Best Practices for Regulation of Autonomous Vehicles on Utah Highways* (October 2016)
- Nebraska Legislative Research Office, *The Future is Now: The technology and policy of self-driving cars* (September 2017)
- AASHTO, *CV/AV Research Roadmap, NCHRP 20-24 (98)*
- US Government Accountability Office, *Report 18-132 Automated Vehicles; Comprehensive Plan Could Help DOT Address Challenges*
- Governor's Highway Safety Association, *Autonomous Vehicles Meet Human Drivers: Traffic Safety Issues for States*
- National Safety Council, https://mycardoeswhat.org/safety-features/ (accessed May 15, 2018)
- RAND Corp., *Why Waiting for "Perfect" Autonomous Vehicles May Cost Lives* (November 2017)
- RAND Corp., *Driving to Safety: How Many Miles of Driving Would It Take to Demonstrate Autonomous Vehicle Reliability?* (2016)
- RAND Corp., *Autonomous Vehicle Technology, A Guide for Policymakers* (2016)
- NCHRP, *Research Report 845: Advancing Automated and Connected Vehicles: Policy and Planning Strategies for State and Local Transportation Agencies* (2017)
- Connected Vehicle Pilot – Tampa, https://www.tampacvpilot.com/ (accessed May 2018)
- Transportation Research Board, *Economic Effects of Automated Vehicles* (2017)
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- Virginia Tech Transportation Institute, *Automated Vehicle Crash Rate Comparison Using Naturalistic Data* (January 2016)
- NHTSA, *Federal Automated Vehicles Policy, Accelerating the Next Revolution in Roadway Safety* (September 2016)
- Center for the Study of the Presidency & Congress, *The Autonomous Vehicle Revolution, Fostering Innovation with Smart Regulation* (March 2017)
- National Conference of State Legislatures, *Autonomous vehicles webpage,* http://www.ncsl.org/research/transportation/autonomous-vehicles.aspx
- KPMG International, *Autonomous Vehicles Readiness Index: Assessing countries' openness and preparedness for autonomous vehicles.* kpmg.com (2018)

Endnotes

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[2] Adopted from State of California; Title 13, Division 1, Chapter 1, Article 3.7 – Testing of Autonomous Vehicles

[3] SAE International J3016, *International Taxonomy and Definitions for Terms Related to Driving Automation Systems for On-Road Motor Vehicles* (September 2016)

[4] Adopted from State of California; Title 13, Division 1, Chapter 1, Article 3.7 – Testing of Autonomous Vehicles

[5] L.M. Clements and K.M. Kockelman, *Economic Effects of Automated* Vehicles (2017) and Ernie Perry, Ph.D., UW-Madison CFIRE, *Presentation to steering committee* (March 28, 2018)

[6] Dave Cieslewicz, Emeritus Director, Wisconsin Bike Fed, *Presentation to steering committee* (March 28, 2018)

[7] Todd Litman, Victoria Transport Policy Institute, *Autonomous Vehicle Implementation Predictions; Implications for Transport Planning* (February 2018)

[8] NCHRP, *Advancing Automated and Connected Vehicles: Policy and Planning Strategies for State and Local Transportation Agencies* (June 2015) and GHSA, *Autonomous Vehicles Meet Human Drivers: Traffic Safety Issues for States* (January 2018)

[9] https://www.transportation.gov/briefing-room/dot1717

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[29] http://www.ncsl.org/research/transportation/autonomous-vehicles-self-driving-vehicles-enacted-legislation.aspx (accessed May 2018)

[30] Wisconsin Legislative Council Memo to Senator Frank Lasee RE: Statutory Changes to Facilitate Operation of Autonomous Vehicles (October 10, 2017)

[31] More information is available at www.wiscav.org