MINNESOTA GOVERNOR'S COUNCIL ON CONNECTED AND AUTOMATED VEHICLES

2024 ANNUAL REPORT

February 2025

This report was prepared by the Minnesota Department of Transportation's Office of Connected and Automated Vehicles.

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Prepared with support from:
AECOM

MESSAGE FROM COUNCIL CO-CHAIRS

In 2024, Minnesota continued to be a national leader with its connected and automated vehicles (CAV) academic research, industry work, and partnerships with state and local governments. Minnesota's on-going AV pilot project in Grand Rapids, Minnesota, goMARTI, continues to gain national and international recognition for both its emphasis on AV technology advancements and increasing accessibility for folks with limited transportation options.

After a pause in 2023, the Governor's Council on CAV restarted in 2024 with new members, and was a year rich in accomplishments, making progress on established recommendations. This iteration of the Council strives to be more action-focused and establish clear CAV-based recommendations for Minnesota by looking at what our state needs, where there is opportunity, and where there is risk. The members represent a variety of backgrounds, bringing valuable perspectives which enhance the discussion and provide recommendations that support all Minnesotans.

Our Council kicked things off by establishing four Innovation Alliance Committees that helped steer the work of the greater Council. The four committee focuses included 1) safe testing of CAVs, 2) traffic safety and regulations, 3transportation infrastructure, and 4) cyber security, data privacy, and data governance.

Throughout the year, the Council and Innovation Alliance Committees met more than the required times. They also gathered for a one-and-a-half day MN CAV Summit to dive deep into discussion of all four focus areas. The Summit also included various panels consisting of legislators, local agencies, and communities experiencing transportation barriers who all shared their perspectives on how CAV technology could benefit all users of the transportation system in Minnesota.   The Council has truly been engaged and, as you will see in this report, identified clear recommendations for 2025. Our Council intends on acting on those to ensure Minnesota continues to be as prepared as possible for the changes of our transportation system.

We want to thank all the Council members and ex-officio members for their contributions and dedication over the past year and are excited about their planned work in 2025.

This annual report has been prepared to inform the Governor and the Minnesota Legislature of the work of the Governor's Council on Connected and Automated Vehicles in 2024.

NANCY DAUBENBERGER AND DAMIEN RIEHL

CHAIR AND CO-CHAIR OF THE GOVERNOR'S COUNCIL ON CAV

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1. COUNCIL'S VISION AND GOALS

Background

Formed in 2018, MnDOT's CAV Office actively plans and prepares for the impact of technology on Minnesota's transportation future. Connected and automated vehicles (CAV) are integral to that future, with basic levels of CAV technology already on Minnesota roadways. However, vehicles that are fully automated in all settings are still years away. Infrastructure that accommodates connected vehicle technology—such as fiber optic cable, sensor networks, and smart traffic signals—is currently being tested and deployed.

Minnesota is at the forefront of testing and understanding connected and automated vehicle technology, with a particular focus on safety and winter weather. MnDOT's CAV Office and our CAV partners are advocating for not just testing the technology, but also making sure it supports how people live, work, and play.

This report highlights the work done in 2024 by MnDOT's CAV Office to help prepare Minnesota for the future of transportation.
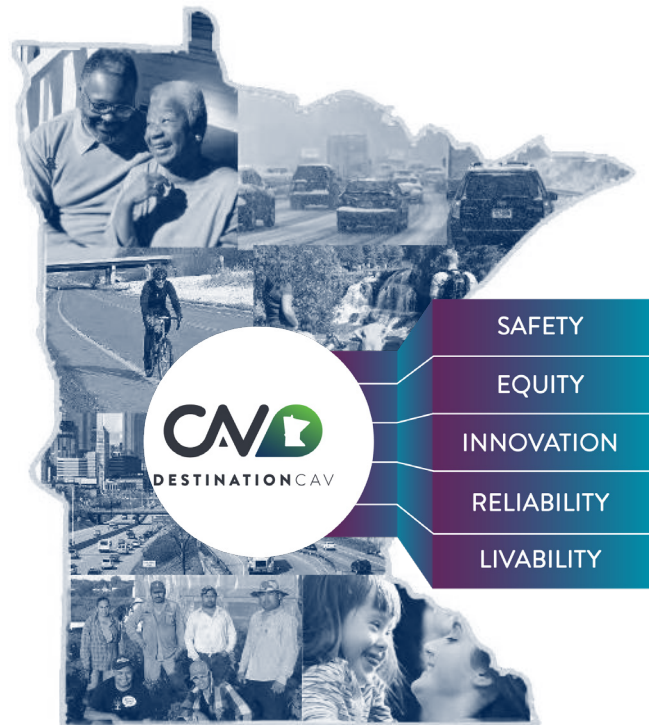

Figure 1: MnDOT CAV Office values: safety, equity, innovation, reliability, and livability

Minnesota's CAV Goals

Equity, Mobility, and Accessibility
CAVs have the potential to reduce transportation barriers for people with disabilities, older adults, and low-income families. They could also improve access to jobs, health care, and other transportation modes.

Economic Development and Small Business
Advancing CAV policy could grow Minnesota businesses, attract new ones, and expand opportunities for small businesses.

Jobs and Workforce Development
CAVs present opportunities to reskill and upskill workers, attract new talent to the STEM field, and develop jobs of the future while protecting the jobs of today.

Public Health and Sustainability
CAVs could help reshape the way we plan communities to prioritize health and sustainable multimodal transportation. Because many CAVs are electric, they could reduce emissions to advance sustainability goals.

Safety and Efficiency
CAVs could reduce congestion and crashes by addressing some aspects of human error that contributed to approximately 400 fatalities on Minnesota highways in 2023.

MnDOT CAV Staff Presenting Work at Industry Conferences

2. WHAT IS CAV?

Connected and automated vehicle technology encompasses a broad range of connectivity and automation, functioning both independently and cooperatively. These technologies are designed to enhance the transportation experience—making it safer, more efficient, and more accessible.

Connected Vehicles

Connected vehicles use technology to communicate with each other; connect with traffic signals, signs, and other road items; and/or obtain data from the cloud. This information exchange can enhance safety and improve traffic flow.
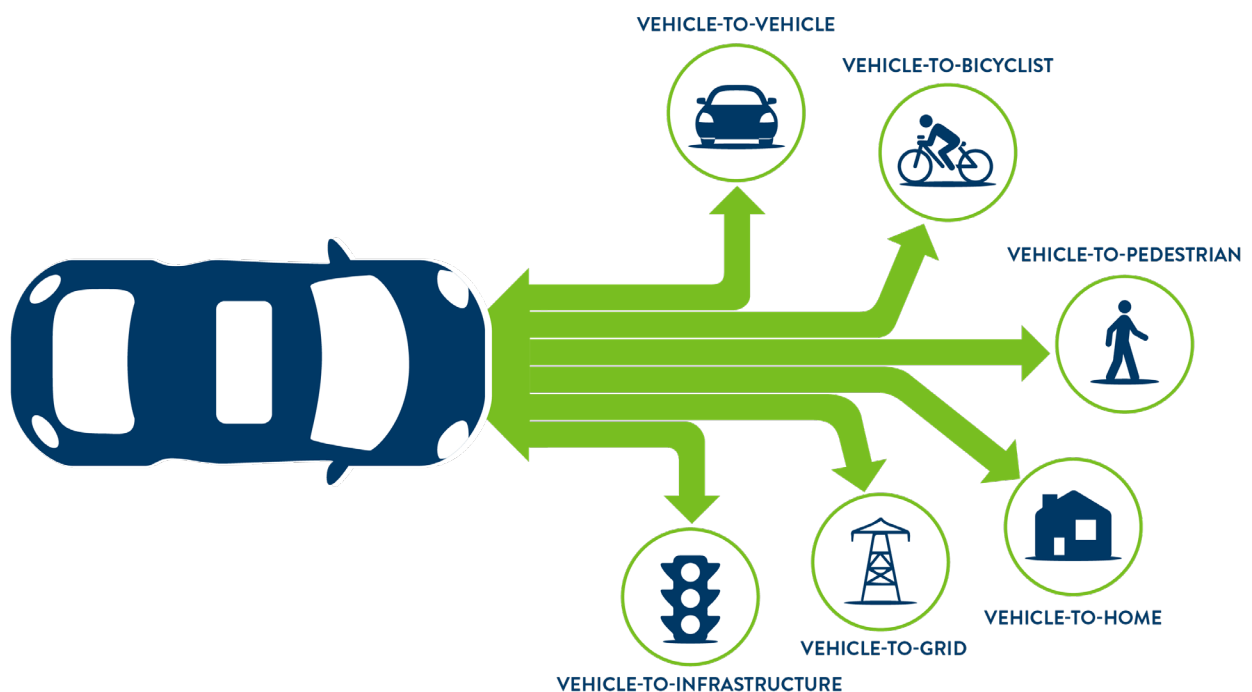
Figure 2: Sample connected vehicle interactions

Automated Vehicles

Automated vehicles use technology to perform driving functions, such as steering, accelerating, and braking, with little to no human input. Some vehicles still require a person to monitor the roadway, while others operate without human intervention.

CAMERAS GPS LIDAR (LASER MAPS) RADAR

ULTRASONIC SENSORS SHORT-RANGE RADIO

CELL TECHNOLOGY CENTRAL COMPUTER

Figure 3: Example technologies used for automated vehicles

2024 MN CAV Summit

3. COUNCIL'S 2024 WORK

The Council is required to meet at least four times per year to review developments in CAV and emerging technologies, explore partnership opportunities for the State of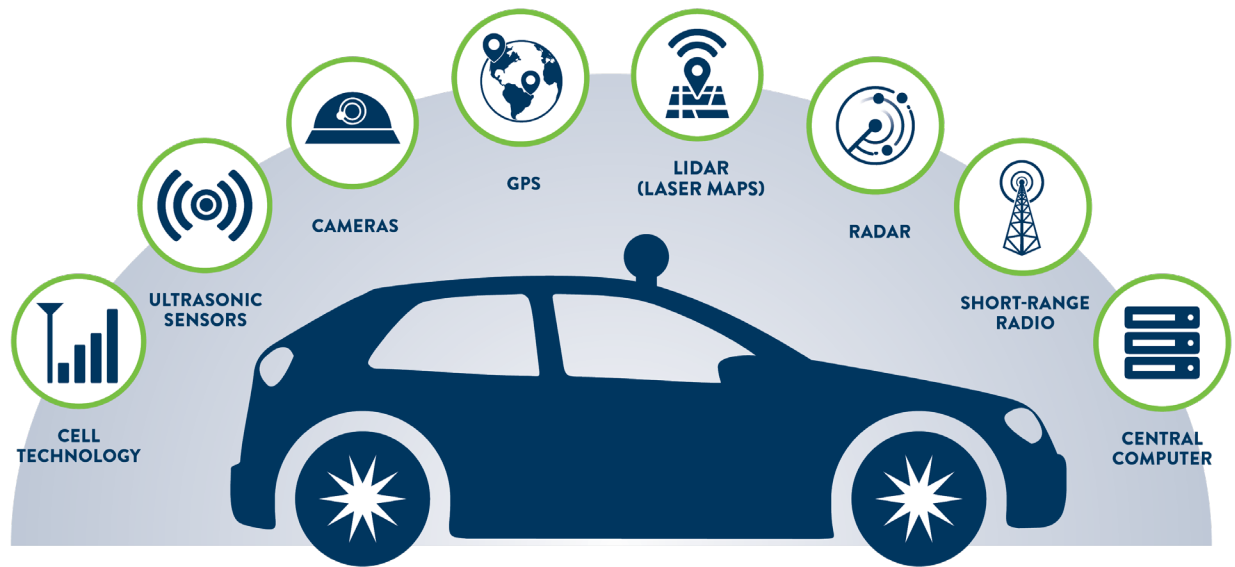 Minnesota, propose policies to safely test and deploy CAVs, implement recommendations from the 2018 Council, engage communities facing transportation barriers, and advise on the safe testing and deployment of CAV technology. **Figure 4** illustrates how the Council has fulfilled its responsibilities followed by summaries of the Council's 2024 meetings. Additional details on the Council and reflections for 2024 are available in Section 8 – Appendix A: Governor's Council on Connected and Automated Vehicles 2024 Progress Report.

	Meeting Requirement	Review Developments	Explore Partnerships	Propose Policies	Implement Recommendations	Engage Communities	Advise On Testing and Deployments
February Meeting	YES	YES	YES	NO	YES	NO	NO
June Meeting	YES	YES	NO	NO	YES	NO	NO
August Meeting	YES	YES	NO	NO	YES	NO	NO
October CAV Summit	YES	YES	YES	YES	YES	YES	YES
December Meeting	YES	YES	NO	YES	YES	NO	YES

Figure 4: *Summary of 2024 council meetings*

2024 Meetings

February Meeting

The Council kicked off its first official meeting of 2024 by welcoming new, returning, and ex-officio members. The meeting included an overview of the Council's history and requirements, along with highlights of past and ongoing CAV work in Minnesota. The Council established plans for 2024 by reviewing the recommendations from the 2022 CAV Executive Report and identifying priority focus areas.

Four Innovation Alliance committees were established: 1) Safe Testing of CAV; 2) Transportation Infrastructure; 3) Traffic Regulations and Safety; and 4) Cybersecurity, Data Governance, and Data Privacy. The chairs and co-chairs for each committee were also confirmed.

June Meeting

The Council's second official meeting of the year focused on updates from the Innovation Alliance committees and planning of the MN CAV Summit.

Committee updates:

- The Cybersecurity, Data Governance, and Data Privacy committee highlighted its work in identifying the types of CAV data available to Minnesota, how this data is used, and how it should be governed for Minnesota. The committee is also developing a triage system to determine when identifiable data must be collected.
- The Safe Testing of CAVs committee described its work on identifying ideal use case scenarios for testing for Minnesota and identifying how these align with national gaps and opportunities.
- The Transportation Infrastructure committee highlighted its efforts in summarizing what other states are doing with CAV infrastructure standards and guidance.
- The Traffic Safety and Regulations committee shared its research on Minnesota crash reports and how the use and engagement of Advanced Driver-Assistance Systems (ADAS) could improve future documentation.

Details of the MN CAV Summit were confirmed, including date, time, location, objectives, panel focus areas, and potential speakers.

August Meeting

The purpose of this meeting was to provide brief committee progress updates and finalize plans for the MN CAV Summit.

Committee updates:

- The Safe Testing of CAVs committee reported that it had constructed a document that defines "safe" in the context of CAV testing and was nearing completion of a summary of the national testing landscape.
- The Transportation Infrastructure committee shared that it was compiling a list of existing infrastructure that supports CAV operations, with the goal of identifying opportunities for Minnesota.
- The Traffic Safety and Regulations committee provided an update on insights gained on crash reporting, governance by state regulations, and challenges with the current reporting process.
- The Cybersecurity, Data Governance, and Data Privacy committee reported that it had identified many types of CAV data and was working to determine ownership and usage rights.

Final details of the MN CAV Summit were discussed, including the final panels and invited speakers.

October Summit

The first MN CAV Summit was held in Inver Grove Heights, Minnesota. It provided an opportunity for the Council and ex-officio members to hear from new voices, discuss work accomplished and underway in Minnesota, and collaborate on the state's next steps.

The summit began with Innovation Alliance committee chairs providing an overview of their committees' goals and actions for the year. This session ensured that all participants understood the progress made over the last several months.

Next, a panel of elected officials shared their perspectives on CAV, discussed what the state can

do to prepare for CAV expansion, and highlighted opportunities they see for Minnesota.

Following that, the California DMV presented virtually on the permitting and regulatory process in their state.

The next session featured local government representatives, who discussed how planning for CAV and operations of CAV might affect them, and how their experiences could differ from those of the state.

In the final session, panelists shared their personal experiences with transportation barriers faced by rural communities, older individuals, those with physical disabilities, and neurodivergent people.

The first day concluded with an activity for all participants to provide input on the work of the Innovation Alliance committees, helping to identify the next steps for 2025.

The second day of the summit focused on a debrief between Innovation Alliance committees and council members, as well as finalizing documentation of the committees' work for the year.

The Minnesota CAV Summit Summary in Section 8 – Appendices provides more details on this event.

December Meeting

The final meeting of 2024 focused on summarizing and discussing the MN CAV Summit and Council and committee recommendations for 2025. The Council discussed highlights from the event and the value it provided for them to learn and work collaboratively. It was unanimously agreed to continue holding the MN CAV Summit in 2025.

The Council discussed pros and cons of inviting non-council participants and agreed on keeping a portion of the event to council members and ex-officio members only. Additionally, the Council proposed exploring the possibility of connecting a technology showcase with the event. A planning committee was identified to help plan the 2025 event.

Committees shared summaries of their work in 2024, and confirmed continuing their work in 2025, with the following specific recommendations:

- The Safe Testing of CAV committee recommended drafting policy recommendations for AV testing and operations in Minnesota by collaborating with stakeholders and highlighting the benefits to the state and industry partners.

- The Transportation Infrastructure committee recommended identifying priority communities, geographical areas, and areas with unmet transportation needs; assessing the costs of implementing United States Department of Transportation (USDOT) Vehicle-to-Everything (V2X) and Minnesota Manual on Uniform Traffic Control Devices (MMUTCD) recommendations; and enhancing statewide connectivity.

- The Traffic Safety and Regulations committee recommended continuing to learn from other states that have advocated change in ADAS reporting on crash reports, working with the Minnesota Department of Public Safety (DPS) on the current crash report rebuild process, partnering with original equipment manufacturers (OEMs) to understand the types of data collected in a crash, and advocating for crash reporting standardization at a federal level.

- The Cybersecurity, Data Governance, and Data Privacy committee recommended building out and finalizing the CAV Data Catalog, developing a triage framework for data based on Minnesota privacy laws, drafting security-by-design protocols that incorporate best practices in cybersecurity, and continuing to build connections with OEMs to understand data limitations.

Additionally, it was announced that each committee would have the opportunity to host an educational webinar for the Council in 2025. Council co-chairs expressed their appreciation for members' efforts in 2024 and excitement for upcoming work.

Interagency CAV Team

The Interagency CAV team did not meet in 2024, as efforts were focused on establishing the new Governor's Council and setting its priorities. All designated members of the Interagency CAV Team were invited to attend the MN CAV Summit to learn about the Council's ongoing efforts and gain insights from diverse perspectives in the CAV space. Based on the Council's recommendations for 2025, the

Interagency CAV Team will reconvene with key involvement from specific agencies, as some of the recommendations are more relevant to certain agencies than others.

CAV Innovation Alliance

The Council established the Innovation Alliance committees to address priority recommendations identified for action in 2024. Beginning in April 2024, each committee met several times to advance its respective goals, prioritizing work deemed most beneficial. Each committee produced a report summarizing its meetings, how its areas of focus impact Minnesota, and specific recommendations for 2025. These reports are included in the Governor's Advisory Council on CAV Progress Reports in Section 7 – Appendices.

Figure 5: *Innovation Alliance Committee Work Session*

Figure 6: *Innovation Alliance Committee Goals*

SAFE TESTING OF CONNECTED AND AUTOMATED VEHICLES

TRANSPORTATION INFRASTRUCTURE

TRAFFIC REGULATIONS AND SAFETY

CYBER SECURITY, DATA PRIVACY, AND DATA GOVERNANCE

OUR COMMITTEE GOALS:

Authorize and conduct testing of CAV technologies on Minnesota trunk highways and local roadways by determining policy, regulation, and infrastructure changes and needs to ensure safety for all roadway users

Strategically invest in infrastructure that provides value to the human drivers and ADAS systems today, and likely computer driving systems in the future, while also improving safety and user experience for all road users

Create policies and regulations that support human and automated driving, while also protecting vulnerable road users such as cyclists, pedestrians, aging populations, and transit users; reducing fatal and serious injury crashes; and increasing comfort for all

Ensure that CAV vehicles and CAV data are secure, reducing the risk of cyberattacks and bolstering privacy protections

goMARTI Self-driving Shuttle Operating in Minnesota winter

4. HOW MINNESOTA IS PREPARING FOR CAV

Minnesota continues to prepare for CAV and transportation technologies by observing trends and advances in vehicle automation, connected vehicle technology, and other emerging areas. Below are some examples of work done by Minnesota CAV partners in 2024 in the areas of testing, research, engagement, and partnerships.

Testing and Research

MnDOT continues to explore how CAV technology functions in our state and its challenging environmental conditions, how transportation infrastructure will support CAV technology, and what priorities should be set based on evolving technology and capabilities. Exploration of CAV helps us better prepare to realize the goals of safety, accessibility, mobility, and efficiency in the future.

Information and Data Sharing

MnDOT and its partners are collaborating on information and data sharing, with a focus on providing accurate and timely roadway information to those who need it. This includes:

- Evaluating the use of mobile advertisements to better inform travelers of future construction impacts and closures
- Testing how third-party mapping applications process Work Zone Data Exchange inputs (which confirmed that not all mapping applications convey timely and accurate roadway information)

- Identifying ways to improve the use of existing traffic control devices to provide more accurate information in the Work Zone Data Exchange feed

MnDOT is currently implementing new best practices based on the lessons learned from these projects.

Machine Learning and AI

MnDOT determined that there is significant potential to use machine vision systems to evaluate the condition of its field assets. The passive assessment of assets using existing MnDOT-owned camera footage is intended to improve the agency's understanding of its asset conditions, targeting manual inspection and response. This will enhance MnDOT's efficiency and improve safety on our roadways.

AV Technology Capabilities and Advancements

goMARTI

In December 2024, phase 1 of the goMARTI self-driving vehicle project in Grand Rapids, Minnesota concluded after 27 months of operation, having

served more than 18,000 riders. The project provided MnDOT and its partners with invaluable insights into the opportunities and challenges of deploying self-driving vehicles in a rural community with harsh winter weather. Key insights include:

- On-board operators are crucial for safe operation and public acceptance of the technology.
- Thoughtful consideration of stop locations and accessibility is critical.
- Having a local call center in a rural community adds significant value.
- Multi-year operation is necessary to improve and adapt the technology to winter conditions while gaining consistent and loyal ridership.
- To be successful, a pilot must address an existing transportation need.

Phase 2 of goMARTI, which is being funded by a federal ATTAIN grant, will launch in Spring 2025. Phase 2 includes introducing electric vehicles to goMARTI's fleet and expanding operating hours and geography.

Automated Truck-Mounted Attenuator (ATMA)

MnDOT faced significant technical struggles with the ATMA system this year. Staff developed valuable troubleshooting skills and improved their knowledge of the durability challenges faced by MnDOT maintenance automation equipment. MnDOT has ceased ATMA field operations and is evaluating the future evolution of ATMA and future deployments at MnDOT.

Snowplow Lane Keeping

MnDOT continued to work on its snowplow lane-keeping guidance system developed in partnership with the University of Minnesota. However, the system requires annual updates to its mapping and equipment, making it unsustainable as a long-term solution in its current form. The University of Minnesota is seeking a manufacturing partner to create more durable design components.

Additionally, MnDOT is documenting specific technology and equipment needs and plans to test other readily available systems, as feedback from maintenance staff operating the plow equipment has been overwhelmingly positive.

Planning

We are planning for a future transportation system that includes multiple unknown variables. To enhance Minnesota's infrastructure, MnDOT has focused its planning work on improving the state's CAV program and processes while also exploring the benefits and costs of V2X technology.

System Engineering Investigation

MnDOT conducted a systems engineering investigation to consider existing systems engineering practices related to its CAV projects, both within and outside of the CAV Challenge Program. The investigation evaluated existing systems engineering practices, identified needs and gaps, and developed recommendations for systems engineering improvements.

The key finding was that better training of systems engineers was necessary. This led to creation of a formal training resource document and a best practices guide for CAV project managers to consider during the contract negotiation stage of project development.

CAV Program Evaluation

In 2024, the MnDOT CAV program marked its fifth year, with projects focused on testing, research, demonstrations, and more. Over the last five years, knowledge has increased significantly, lessons have been learned, and technology has evolved rapidly. MnDOT engaged a consultant to review the program's projects, assessing accomplishments, key findings, lessons learned, and next steps. The evaluation identified key themes across the portfolio, identified gaps and opportunities for future projects, and outlined key areas of focus for the CAV program moving forward.

V2X Signal Upgrades for GPS-based EVP

MnDOT submitted a proposal for the USDOT SMART grant program to investigate and test new traffic signal control systems on three different metro area corridors. The proposed system would integrate normal traffic signal operations with connected vehicle Emergency Vehicle Pre-emption (EVP). Using wireless emergency vehicle equipment, the EVP would transmit location data to traffic controllers, requesting green lights along the emergency vehicle's entire route. The

goal is to reduce traffic conflicts for all signals along these paths by removing the line-of-sight limitations of current systems.

Though MnDOT was not awarded the SMART grant, this effort is moving forward in the interest of building MnDOT's V2X knowledge and capacity and evaluating the benefits of technology deployment and infrastructure upgrades.

Engagement

A focus on public engagement and education was one of 12 recommendations established by the previous Council. This continues to be a priority for Minnesota, and MnDOT in particular, as it relates to CAV.

Community-Driven CAV

In 2024, MnDOT worked with a consultant team, non-profit organizations, and a local St. Paul community to create a CAV engagement and planning framework. This framework is designed to help communities identify their unique transportation challenges and opportunities, learn about CAV and other transportation technology solutions, and advance solutions tailored to their specific needs. Emphasizing empowerment and inclusivity, the framework ensures that communities are informed and engaged in shaping their transportation future. It has been shared with numerous industry stakeholders, including city, county, and regional DOT partners, and has been met with enthusiasm.

MnDOT, in partnership with Indiana DOT as the lead agency, coordinated a 10-state Mid-America Association of State Transportation Officials (MAASTO) region application for the USDOT SMART grant funding program. The proposal aimed to deploy the above framework across diverse communities within the region, empowering them to better understand their transportation challenges and explore how technology could address their needs. Although the proposal was not awarded a SMART grant, discussions among MAASTO states continue to identify alternative ways to advance this effort.

CAV Trends and Policy Webinars

The MnDOT CAV Office has continued to focus on engaging and educating its MnDOT colleagues on the evolving technology environment through CAV Trends and Policy webinars. These webinars are open to all interested MnDOT employees and include industry updates and in-depth discussions about the Council's priority areas.

Conferences, Speaking Engagements, and National Leadership

Minnesota has established itself as a leader in CAV through a strategic focus on testing, learning, and understanding state-specific needs. Minnesota's CAV industry partners have presented at numerous conferences and events, such as the American Traffic Safety Services Association (ATSSA) "How To" Conference, Florida AV Summit, MAASTO CAV Conference, ITS America, the Transportation Research Board's (TRB's) Advancing Transportation Equity Conference, APA National Conference, Minnesota Transportation Conference, ITS MN Fall Forum, and others.

MnDOT also engaged in a peer exchange with Iowa DOT focused on Transportation Systems Management and Operations and collaborated with MCity, an AV test facility at the University of Michigan. Additionally, MnDOT contributed to the National Cooperative Highway Research Program (NCHRP) Domestic Scan team, participating as both a team member and chair for the study, "Recent Experiences in Advancing and Deploying Automated Vehicle Technologies."

Figure 7: *MnDOT and MCity staff at MCity Test Facility in Ann Arbor, MI.*

CAV Camp

The University of Minnesota's Center for Transportation Studies (CTS) hosted its fourth CAV Careers Pathway Camp in August 2024, engaging 20 students in grades 10–12. The camp was funded by the Federal Highway Administration (FHWA) and

CTS and administered by MnDOT's Office of Civil Rights. Programming partners included MnDOT, The Plum Catalyst, SICK Sensor Intelligence, Northland Community and Technical College, HDR Engineering, and Accelerated Vehicle Technology.

A highlight was a visit to the MnROAD pavement research facility, where students enjoyed seeing the sensors in action while riding in the University's research vehicle. Additionally, CTS staff presented on the camp in workforce development sessions at the ITS America Annual Meeting and TRB's Automated Road Transportation Symposium (ARTS).

Partnerships

The 2022 Minnesota's Governor's Council on CAV Executive Report identified "leadership and collaboration" as a formal recommendation for action by the next Council. This recommendation emphasized the importance of establishing formal groups and processes to guide stakeholders, foster collaboration, and advance the future of transportation as One Minnesota. Minnesota's CAV industry partners have worked together, and with national and international stakeholders, to make progress towards this goal in a number of ways.

Organizational Memberships and Participation

MnDOT and other Minnesota industry partners are members of Intelligent Transportation Society of Minnesota (ITS MN), Intelligent Transportation Society of America (ITS America), and Institute of Transportation Engineers (ITE), participating on committees, sharing information through webinars, and learning from other partners.

MnDOT is a member of several FHWA Transportation Pooled Funds, which allow state DOTs to pool funding, expertise, and resources to address shared research needs. Additionally, our industry partners from state agencies, the private sector, and academia, hold state, regional, and national board and leadership positions with the following organizations, among others:

- ITS MN
- MAASTO
- University of Minnesota Center for Transportation Studies Research Councils

- Center for Connected and Automated Transportation Technology Advisory Board
- AASHTO CAV Community of Practice
- Partners for Automated Vehicle Education (PAVE)
- Governor's Highway Safety Association

Accessible Transportation Resource Center Community of Practice

The Iron Range communities of Deer River and Ball Club were selected by the Accessible Transportation Resource Center (ATRC) to become Communities of Practice (CoP). This initiative aims to develop and implement solutions that make transportation more accessible for people with disabilities and older adults.

The Forward Health Foundation and other CoP team members are collaborating to identify transportation challenges and develop solutions that increase the availability and accessibility of transportation in historically underserved communities. Their plan includes working with a range of community partners, regional transportation service providers, and residents facing personal challenges in accessing services due to transportation gaps. By addressing these issues, they aim to foster a more inclusive, equitable, and vibrant community where all residents have the opportunity to thrive.

Center for Connected and Automated Transportation (CCAT)

Since 2023, the University of Minnesota has been a part of the Center for Connected and Automated Transportation (CCAT), the University Transportation Center for USDOT Region 5. Led by the University of Michigan, CCAT is a consortium of nine institutions conducting research on topics related to safety, congestion, connected vehicles, connected infrastructure, and autonomous vehicles.

The University currently has six active research projects funded through CCAT, covering subjects ranging from the operation of AVs in rural areas, to cybersecurity, to preparing road infrastructure treatments for AVs. In May, a student team from the University of Minnesota was a runner-up in the student poster competition at the CCAT Annual Global Symposium.

Panels and Moderators from the 2024 MN CAV Summit

5. COUNCIL'S PLANS FOR 2025 AND RECOMMENDATIONS

All four Innovation Alliance committees—Safe Testing of CAVs; Transportation Infrastructure; Traffic Regulations and Safety; and Cybersecurity, Data Governance, and Data Privacy—will continue to meet and advance their recommendations. The Council's priority recommendations for 2025 include the following:

- **Safe Testing of CAVs Committee:** Identifying a path to driverless AV operation in Minnesota

- **Transportation Infrastructure Committee:** Assessing the infrastructure cost impacts of deploying national V2X guidance on state and local governments in Minnesota

- **Traffic Regulations and Safety Committee:** Updating the Mn Crash Report used by law enforcement to document the extent to which involved vehicles were equipped with AV technology

- **Cyber Security, Data Governance, and Data Privacy Committee:** Cataloging CAV data to determine which data is essential, optional, or unnecessary based on Minnesota's laws

The Council will hold at least four formal meetings in 2025, in addition to holding the second annual MN CAV Summit to dive deeper in engagement and discussion among council members and with stakeholder partners.

Figure 8: *Council's Four Innovation Alliance Committees*

1. SAFE TESTING OF CAVS

2. TRANSPORTATION INFRASTRUCTURE

3. TRAFFIC REGULATIONS AND SAFETY

4. CYBER SECURITY, DATA GOVERNANCE AND DATA PRIVACY

INNOVATION ALLIANCE

CAV DESTINATIONCAV
SAFE, EQUITABLE, ACCESSIBLE TRANSPORTATION
DEPARTMENT OF TRANSPORTATION

COMMITTEES

2024 GOVERNOR'S COUNCIL ON CAV ANNUAL REPORT

Autonomous Truck Mounted Attenuator

6. GOVERNOR'S COUNCIL ON CAV MEMBERS

NANCY DAUBENBERGER, CHAIR

Commissioner, Department of Transportation

DAMIEN RIEHL, CHAIR

vLex Group

HANNAH ALSTEAD

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RYAN DANIEL

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SKIP FOSTER

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Willshire Consulting

7. APPENDICES

Appendix A: Governor's Council on Connected & Automated Vehicles (CAV) - 2024 Progress Report

Appendix A1: Literature search for Safe Testing of CAV Innovation Alliance Committee

Appendix A2: Definition of "Safe" – Draft definition prepared by Safe Testing of CAV Innovation Alliance Committee

Appendix B: 2024 MN CAV Summit Summary

Appendix B1: World Café Discussion Summary

Appendix A: Governor's Council on Connected & Automated Vehicles (CAV) - 2024 Progress Report

Governor's Council on Connected & Automated Vehicles (CAV)

2024 Progress Report

Executive Summary

In 2018, Governor Mark Dayton signed Executive Order 18-04 establishing the Connected and Automated Vehicle (CAV) Advisory Council, which was continued by Governor Tim Walz in 2019 with Executive Order 19-18. This executive order outlined the following duties for the Advisory Council:

- Review developments in CAV technology, explore partnership opportunities for the State of Minnesota to remain prepared for the widespread adoption of new technologies, and propose policies to safely test and deploy CAVs.

- Take action to implement recommendations in previous Council reports.

- Consult with communities experiencing transportation barriers that are not represented on the Council.

- Advise the governor, MnDOT, the Minnesota Department of Public Safety (MN DPS), and other governmental entities to support testing and deployment of CAVs.

Members of the 2018 council served for a one-year term, while 2019 council members served four-year terms, which concluded in 2022 with an executive report and future recommendations. During 2023, the governor appointed the next cohort of Council members, who began their work in January 2024 and will continue until the expiration of the executive order on January 4, 2027, barring an extension.

Work of the 2024 cohort is based on the recommendations outlined in the *Governor's Advisory Council on Connected & Automated Vehicles 2022 Executive Report*. The Council evaluated the twelve recommendation areas and voted on the top four priorities for the next phase of work:

- Safe Testing of Connected and Automated Vehicles

- Transportation Infrastructure

- Traffic Regulations and Safety

- Cyber Security, Data Privacy, and Data Governance

Four Innovation Alliance Committees were formed to further the work in each of these areas.

Also in this first year, the Minnesota Connected and Automated Vehicle Summit was held to bring together Council members, ex officio members, and Innovation Alliance Committee members to hear from diverse perspectives in CAV, engage in discussions with one another, provide input on committee findings and recommendations, document work of the past year, and prepare for the next year. This one-and-half-day event featured stakeholder panels, facilitated discussions, and committee work time focused on how to best prepare Minnesota for CAV and other transportation technologies.

Looking ahead to 2025, the Council has identified priority action items based on the four Innovation Alliance Committees. Additionally—cutting across all four committee topics— education and engagement for the public and elected officials emerged as a necessary focus area for the next year. To supplement the information developed in Council and Innovation Alliance Committee meetings, one-on-one interviews were conducted with each Council member to gather reflections, successes, and improvement areas for the Governor's Advisory Council on CAV. An electronic survey soliciting the same information was sent to all ex officio members. The results of those conversations are incorporated into the progress report that follows.

Governor's Council on Connected & Automated Vehicles (CAV)

2024 Progress Report

Council

The 2024 cohort of the Advisory Council on CAV is made up of 14 members:

- Nancy Daubenberger (Co-Chair), Commissioner, Minnesota Department of Transportation (MnDOT)

- Damien Riehl (Co-Chair), vLex Group

- Hannah Alstead, Teamsters Joint Council 32

- Ryan Daniel, St. Cloud Metropolitan Transit

- Stacy Davis, 3M

- Skip Foster, Freedom Companies

- Phil Magney, VSI Labs

- Myrna Peterson, Mobility Mania

- Tammy Meehan Russel, The Plum Catalyst

- Kyle Shelton, University of Minnesota Center for Transportation Studies (CTS)

- Heidi St. Clair, CHS Inc.

- Bret Weiss, WSB

- Patrick Weldon, Polaris

- Joan Willshire, Willshire Consulting

The Council is also supported by 20 ex officio member positions.

An important goal for the new Council cohort, particularly for Council members returning from the 2019 cohort, is to focus on action and moving recommendations forward. To begin this action-oriented approach, the Council evaluated the twelve recommendation areas outlined in the *2022 Executive Report* and voted on the top four priorities for the next phase of work. Those priority areas are:

- Safe Testing of Connected and Automated Vehicles

- Transportation Infrastructure

- Traffic Regulations and Safety

- Cyber Security, Data Privacy, and Data Governance

Within each priority area, the Council also ranked individual recommendations based on actions that could be taken in 2024. Four Innovation Alliance Committees were developed to further the work in each of these areas; additional details about their progress can be found in the next section.

The Council met five times in 2024—via hybrid meetings in February, June, and December; an abbreviated virtual-only meeting in August; and an extended one-and-a-half-day summit event in October. Aside from the summit, the Council meetings focused largely on updates and discussion of the committee work and Council planning for the rest of the year. When asked whether the 2024 format met the overall goals and mission of the Council, members largely agreed that it did. Establishing priorities and specific action items at the beginning of the year increased the group's productivity. Council members expressed gratitude for the leadership provided by MnDOT and CTS staff. Commissioner Nancy Daubenberger's attendance at every meeting of the Council was noted as a valued component, highlighting the importance and dedication of MnDOT and the governor to this work as well as validating the commitment that other members are providing to these voluntary positions.

Some Council members noted that they would like to have the group's meetings offered only in person to increase attendance and engagement; concern was expressed that it can be difficult to assign accountability to action items when conversations are not conducted face-to-face. Other members said they appreciated the hybrid option for accessibility reasons but noted the desire for additional in-person opportunities to work and spend focused time with other members of the group.

Another improvement suggested was to spend less Council time discussing committee work and instead provide more opportunities for group learning or work. Some members noted the lack of a clear delineation between the committee deliverables and the Council work. When asked about opportunities and priorities for the Council in 2025, four themes emerged across all Council member interviews:

1. **Hold an in-person working session during the first quarter.** Several members expressed a desire to have an extended working session in the first part of the year. The Minnesota Connected and Automated Vehicle Summit provided an opportunity for all members to engage in the priority work areas and glean clarity on potential next steps, but it felt late in the year to use that momentum and further advance the work.

2. **Increase public education.** During the last several convenings of the Council and in individual interviews, the theme of public engagement and education was highlighted as a top priority. The need to increase awareness of CAV technology and its potential benefits extends beyond the scope of any individual Innovation Alliance Committee and

is a potential focus area for the full Council in 2025. Special emphasis should be placed on educating Minnesota legislators.

3. **Draft policy language**. Numerous members encouraged the Council to craft language to be delivered in the 2026 legislative session. Putting 2024's lessons into policy will highlight any gaps and allow the Council to learn where legislators and other stakeholders may want changes. Creating policy will allow the Council and committee work to become more external facing.

4. **Build industry connections**. Increased engagement with the Minnesota business community emerged as an important opportunity for many members. Industry stakeholders will have a vested interest in how this technology changes the landscape of Minnesota. They may have resources and insights that could supplement the goals the Council is trying to achieve.

Overall, 2024 was an important year, setting the stage for the new cohort, identifying priorities and building on 2022 recommendations, and continuing the work of this Council. The establishment of a Governor's Advisory Council shows a commitment and coordination at the state level. The continued work of this group ensures that Minnesota will not let the opportunity to define how CAV technology integrates into its ecosystem pass it by.

Innovation Alliance Committees

The Innovation Alliance Committees began their work in April 2024. Each group started with the priority recommendations identified by the full Council. The following sections summarize the committee's work for the past year and recommendations for 2025.

Safe Testing of Connected and Automated Vehicles Committee

Goal

Authorize and test CAV technologies on Minnesota trunk highways and local roadways by determining the policy, regulation, and infrastructure changes needed to ensure safety for all roadway users.

Recommendations for 2024

1. Identify Minnesota's unique cases to attract and market companies to test, research, and deploy in Minnesota.

2. Identify all existing state policies and regulations affected by CAV testing and deployment and assess future needs, changes, and additions for clearer legislation, regulations, and definitions.

3. Determine if the state wants to establish requirements and/or registration for all testing conducted in Minnesota.

Summary of 2024 work and lessons learned

At its first meeting, the Committee agreed that understanding Minnesota's unique use cases would be critical for accurately addressing recommendations 2 and 3. To gain insight into how Minnesota stands out from other states that are leading in CAV technologies, the committee conducted a literature search with the help of CTS Library and Information Services Manager Marilee Tuite.

The literature search was focused on three requests:

1. Evaluate CAV legislation specific to safety and testing from Arizona, California, Colorado, Florida, Kentucky, and any northern states. Are there any identifiable best practices for safe testing?

2. Identify which companies are testing in winter weather and what the testing conditions are in those states.

3. Highlight available research from other cold-weather countries that focus on safe testing.

A review of the relevant legislation showed that Minnesota has a strong foundation for moving forward with additional regulatory frameworks surrounding safe testing. Both the American Association of Motor Vehicle Administrators and the National Highway Traffic Safety Administration have developed guidelines and best practices for the safe testing and deployment of vehicles with automated driving systems. The Automated Vehicles Act 2024 passed in the United Kingdom provides a thought-provoking example of nationwide policy. Additionally, Minnesota is uniquely situated to provide winter-weather testing locations. As of June 2024, the number of winter-weather tests conducted nationwide were limited, and Minnesota was prominently featured on the list of testing locations. (See Appendix A1: Literature search.)

In addition to researching the national landscape, the committee recognized that a common definition of "safe" will be required for all stakeholders, policymakers, and the public to have a shared understanding of future policy and regulations. A draft definition was crafted in 2024 that outlines key aspects of safety when operating a motor vehicle and key aspects of safe testing for CAVs. Safety overall is defined as acts that preserve life, health, and the bodily integrity of all individuals. (See Appendix A2: Definition of "safe.")

What this means for Minnesota

There are two key ways that Minnesota can attract and market companies to test, research, and deploy in our state. First is to establish testing facilities that are available and ready for companies to use. This includes both open- and closed-road facilities. Second, establish regulatory certainty, which will attract those companies ready to test or deploy; conversely, companies might hesitate to use resources in an environment that lacks a clear path.

Minnesota also possesses several benefits that could be better advertised to these companies:

- Number of highway miles available

    - Designating specific roads for testing opportunities could further enhance this benefit.

- Four seasons of weather

- State funding sources for testing and research

- World-class research and academic partners

- Existing closed test tracks (e.g., MnROAD, Automotive Environmental Center)

- A backbone built on intelligent transportation systems

Recommendations for 2025

During the next working year, the Safe Testing of CAV Committee recommends that the Governor's Advisory Council on CAV work alongside stakeholders to draft policy recommendations for the 2026 legislature. Steps involved in this endeavor, involving champions from the committee and other entities, include:

1. *Articulate why policymakers should care about bringing CAV technology to Minnesota*. Beginning in the first quarter of 2025, the Council should begin engagement and education efforts, focusing particularly on legislators. Key talking points include addressing transportation barriers for underserved communities, building economic development opportunities, proactively addressing the workforce shortage, and highlighting the ways that CAV technology issues cross partisan lines. This recommendation aligns with the priority areas identified by several Council members in their 2024 progress interviews. (Champion: Governor's Advisory Council on CAV)

2. *Identify, talk with, and document discussions with major stakeholders.* Before crafting policy, it is important to more specifically detail concerns and requests from major stakeholder groups. This will help the Council address the needs of various stakeholder groups proactively as well as more clearly define areas of conflict that may cause concern with proposed legislation. These stakeholder groups include, but are not limited to, operating equipment manufacturers, private and public research entities, local Minnesota businesses that could gain from the implementation of CAV technology, technicians and drivers, community users and underserved populations, and local government. (Champion: MnDOT with partners)

3. *Build stronger partnerships with commissioners of Minnesota's Departments of Human Services, Employment and Economic Development, and Public Safety.* Each of these state agencies have representatives on the Governor's Advisory Council on CAV as ex

officio members, but more relationship building is essential to increase engagement and identify opportunities for collaboration. Suggestions to increase engagement include allowing for additional proxies from each agency to join Council meetings, inviting staff to participate in the Innovation Alliance Committees, and potentially changing the executive order to allow increased participation from each agency. (Champion: MnDOT)

4. *Chart a path from testing to Minnesota deployment.* Companies want certainty before committing resources to testing and deployment in new areas. For this reason, the final step in crafting relevant policy is to establish best practices for safe testing in Minnesota and outline a step-by-step process for companies to move from testing to deployment in the state. Specific questions to address include: What improvements might be needed for Minnesota testing facilities? Can the state establish testing corridors that are ready for industry use? Who signs off that testing has been proven at a specific facility? And who is the authority governing this process? The committee will use the literature search research results, seek additional guidance from entities such as the Autonomous Vehicle Industry Association, and work with state agencies to develop this path. (Champion: Safe Testing of CAV Committee and relevant state agencies)

Transportation Infrastructure Committee

Goal

Strategically invest in infrastructure that provides value to human drivers and advanced driver-assist systems (ADAS) today, and likely computer-driving systems in the future, while also improving safety and user experience for all road users.

Recommendations for 2024

1. Identify and prioritize the expected infrastructure needed to aid safe operations of CAVs in the future as well as those that are known to aid safe operations for human drivers today.

2. Assess Minnesota's transportation infrastructure and ability to support current CAV technologies.

3. Expand partnerships with businesses—in particular, Minnesota businesses—to research and support CAV infrastructure and technology.

4. Enhance collaboration between state and local agencies related to advancing technologies and data sharing.

Summary of 2024 work and lessons learned

At the committee kickoff meeting, the group committed to assessing Minnesota's infrastructure and its ability to support CAV technologies as the first priority. Once there was an understanding

of where Minnesota stood in terms of technology, identifying priority infrastructure investments could begin.

The committee researched how other states are handling CAV infrastructure and found no uniform assessment process to evaluate CAV capabilities. At the time of investigation, formal standards or guidance from the federal level did not exist. Since then, the U.S. Department of Transportation's (USDOT) Federal Highway Administration released a National Deployment Plan for Vehicle-to-Everything (V2X) Technologies in August 2024. Additionally, an updated *Manual on Uniform Traffic Control Devices (MUTCD) for Streets and Highways* was released in September 2024. This updated edition provides guidance on signage and striping, both of which are critical infrastructure components for CAV-equipped vehicles. The group began an evaluation of the USDOT V2X and MUTCD recommendations to assess challenges and opportunities. This work, including full analysis of the costs of implementing these recommendations, will continue in 2025.

A key element to the work of this committee and the state of Minnesota is the fact that operating equipment manufacturers (OEMs) are not waiting for government guidance and infrastructure developments to create and deploy their technology. To determine which infrastructure investments should be made, it is important to continue to prioritize technologies that help human drivers and CAV vehicles in existence today. The committee concluded that connectivity, striping, and signing are all infrastructure investments that meet these criteria.

What this means for Minnesota

An asset and challenge for Minnesota is the number of miles and variety of roadway types across the state. Infrastructure investments that work in one jurisdiction will not serve other jurisdictions; for example, striping technology cannot be implemented on gravel roads. Connectivity will also have to be addressed in different ways depending on resource availability. Cellular service is not a viable connectivity option in rural areas. Implementing infrastructure upgrades in rural areas may allow for better testing and reveal limitations of the technology due to anomalies not present in metropolitan areas. However, upgrades in a metropolitan area would likely be quicker and more cost effective to implement.

Additionally, the newly released guidance from the FHWA will significantly impact cost and available funding for additional infrastructure investments.

Recommendations for 2025

The Transportation Infrastructure Committee offered four recommendations for 2025:

1. *Identify priority communities, geographical areas, or other spaces where transportation needs aren't currently being met to serve as use cases and testing opportunities*
   Better understanding community needs will contribute to an investment prioritization process that is more likely to succeed. Because Minnesota has widely varying roadway environments across its jurisdictions, developing test cases to understand the true costs and challenges of infrastructure investments will allow for more successful

implementation in the long run. When selecting these priority areas, several factors should be considered, including the willingness of the community and local government to participate and support these changes, the cost, and the needs that justify short- to medium-term investment. (Champion: Committee, for review by MnDOT, DEED, and local agencies)

2. *Identify costs of making USDOT V2X recommendations*
   The V2X deployment plan's short-term goals (implemented between 2024 and 2028) impact Minnesota's urban and rural communities. Specifically, V2X should be deployed on 20 percent of the National Highway System, and 25 percent of intersections in the metro area should be enabled for V2X. Before being able to suggest additional infrastructure investments, the full costs of these upgrades and the number of roadway users impacted needs to be understood. (Champion: MnDOT with the Minnesota County Engineers Association and City Engineers Association of Minnesota)

3. *Identify costs of MUTCD recommendations for different jurisdictions*
   Similar to the USDOT V2X recommendations, the updated MUTCD guidance will have cost implications that may impact the ability to invest in other infrastructure upgrades. Because of the various road types in different jurisdictions, the MUTCD recommendations will have varying impacts to local governments. Understanding the costs across these jurisdictions will allow for a better understanding of capacity for additional infrastructure investments and improvements. (Champion: MnDOT with the Minnesota County Engineers Association and City Engineers Association of Minnesota)

4. *Increase connectivity across the state*
   Increased connectivity was identified by the committee as an investment that benefits human drivers and CAVs. Rural areas with connectivity challenges make up a large portion of Minnesota's geography. Increasing connectivity will require several phases of support; the committee identified three goals to move the state forward:

   a. Connect with University of Minnesota researchers on relevant studies. (Champion: Committee)

   b. Identify opportunities to optimize federal funding. (Champion: Committee with support from MnDOT)

   c. Provide better access to investments that private industry wants to make. (Champion: Committee to advocate to Minnesota Legislature)

Traffic Regulations and Safety Committee

Goal

Create policies and regulations that support human and automated driving while also protecting vulnerable road users such as cyclists, pedestrians, aging populations, and transit riders; reducing fatal and serious-injury crashes; and increasing comfort for all.

Recommendations for 2024

1. Explore ways to include automation designation on crash reports.

2. Fund research on safety benefits of CAV technologies that can be realized in Minnesota.

3. Fund research on safety areas of concern for vulnerable road users with CAV technologies.

Summary of 2024 work and lessons learned

The Traffic Regulations and Safety Committee focused its 2024 efforts on gaining a group understanding of what crash reports contain, how they are used by different groups, and how a crash report can be changed or updated in Minnesota. Crash reports do not currently contain information about ADAS or CAV technologies engaged at the time of a crash; only basic vehicle facts are available without a post-crash warrant.

Crash reporting in Minnesota is governed by the Model Minimum Uniform Crash Criteria, a federal document, as well as state regulations through the Department of Public Safety. Minnesota crash reports are currently being updated through the Crash Data Users Group (CDUG). This group has been analyzing the sixth edition of the federal document, which includes guidance regarding ADAS and other advanced driver systems.

Several variables limit how ADAS and CAV technologies can be effectively added to Minnesota's crash reports:

● Automation levels are not defined by federal agencies.

● Drivers and officers may not know what ADAS features were in use at the time of a crash.

● Officers are not trained or expected to have knowledge of ADAS and CAV features for each vehicle. To effectively add these elements to a crash report, the process should be automated by Vehicle Identification Number (VIN) or other vehicle identifier.

In addition to those limitations, there is a lack of clarity regarding what data OEMs have that could be shared or used in this context. For example, is there a way to use the VIN to easily identify features that exist if an officer enters vehicle make and model into a crash report? Secondary to that question is, how would that data be obtained, managed, updated, and linked to the crash report system? If research determines that this type of linkage would be possible, the cost of building and maintaining a system would need further exploration.

What this means for Minnesota

As the Minnesota crash reporting system is currently undergoing a rebuild, an opportunity exists to be proactive, with the hope of easily identifying ADAS and CAV technologies at the time of a

crash in the future. Data and standardization gaps, both at the state and federal level, must be resolved prior to implementing any automated updates to the crash report.

Recommendations for 2025

The 2025 recommendations from the Traffic Regulations and Safety Committee focus on incremental steps toward including ADAS and CAV features in Minnesota's crash reports:

1. *Talk to other states that have advocated for a change in crash reports or vehicle registrations and identify what can be done at the state level*
   The Committee will define a list of questions and locations that have incorporated ways to identify ADAS technology into their state systems. For states that have successfully made these changes, this will be an opportunity to understand if incorporating this data point can provide useful statistics on how ADAS technologies impact crash rates or severity. (Champion: Committee)

2. *Capitalize on the current crash report rebuild process*
   As the CDUG continues the rebuild of Minnesota's crash reports, the opportunity exists to build capacity to include ADAS and CAV technology information into the system, whether or not it is available today. Conversations should take place with CDUG to understand the required parameters and costs for this type of update. (Champion: Department of Public Safety)

3. *Partner with OEMs to understand available data*
   As the leading innovators in this field, OEMs hold much of the information needed to implement the types of updates advocated by this group. Prior to seeking legislative action, conversations should take place with a handful of companies to understand what type of data is collected by a vehicle in a crash. Of that data, what does the vehicle and/or the OEM store and how could the State of Minnesota access that information? In talking with multiple OEMs, it will be important to search for consistency across manufacturers. If consistency does not exist, then that is an additional barrier to resolve prior to incorporating these technologies into crash reports. In addition to individually owned vehicles, the commercial vehicle industry could be a key partner in these conversations, as it has an incentive to conduct safer fleets. (Champion: Committee in partnership with Cyber Security, Data Privacy, and Data Governance Committee)

4. *Advocate for standardization at the federal level*
   A lack of consistency across stakeholders' understanding and definition of the levels of automation will continue to hinder updates to crash reporting and other important progress in this area. The State of Minnesota should advocate for standardization at the federal level so that agencies can more effectively incorporate these technologies into their systems. (Champion: To be discussed further in 2025)

Goal

Ensure that CAV vehicles and CAV data are secure, reducing the risk of cyberattacks and bolstering privacy protections.

Recommendations for 2024

1. Further develop a "security by design" platform for CAV data.

2. Monitor best practices for data encryption, standardization, and security for implementation as appropriate.

3. Identify what CAV data is available to Minnesota, how it is used, and how it should be governed.

4. Develop a triage system to determine when identifiable data must be collected, would be useful to collect but not required, or is unnecessary to collect in recommending updates to the Minnesota Data Practices Act accordingly.

5. Identify what CAV data can be shared across government and/or industry.

Summary of 2024 work and lessons learned

With five recommendations presented in the *2022 Executive Report*, the group took time to further prioritize the Committee goals and set the stage for its work in 2024. There was a consensus to refrain from mandating specific controls for security and data encryption, as technology moves too fast for the law to keep up. Historically, the legislature has taken a technology-neutral approach; recommendations for best practices tend to come from technical experts rather than government mandates. With those qualifiers, the group decided to focus on privacy and recommendation number four: develop a triage system to determine when identifiable data must be collected, would be useful to collect but not required, or is unnecessary to collect.

To develop an accurate triage system, the available and possible CAV data types needed to be properly identified. The group spent the first portion of 2024 cataloging types of CAV data and analyzing the privacy implications and cybersecurity risks of this type of data and data collection. Examples of CAV data include, but are not limited to, driver behavior data, geolocation and navigation data, vehicle health and diagnostic data, sensor data, V2X communication data, and biometric and personal subscription data.

Committee members reviewed the existing Minnesota Data Practices Act and proposed Consumer Data Practices Act and began to identify potential gaps in protecting CAV-related data. In addition to reviewing legal protections, the group identified existing and past Minnesota-based pilots that may provide helpful use cases for managing data collection and data sharing

among public and private partners. Lastly, the group explored data sharing incentives that could be used in a future framework for Minnesota's CAV data governance, security, and sharing.

What this means for Minnesota

Minnesota has the existing framework for legal data protection, including the Minnesota Data Practices Act and proposed Consumer Data Practices Act. However, the group acknowledged that the legislative process often moves slower than technology and cannot be the sole guidance for the state's data security and sharing practices. Additional best practices developed by content experts could help bridge the gaps of privacy laws.

When amending legislation and adopting best practices, Minnesota should be careful to balance privacy and security needs with the desire for continued business investment. When connecting with OEMs throughout this process it will be important to understand their hesitations and limitations in data sharing.

Recommendations for 2025

The Committee will continue work in the next year to build on the progress made in 2024:

Build out and finalize the CAV data catalog
The Committee will build on its draft lists and create a formalized catalog of available data. The catalog will include a taxonomy of use cases, ownership, user roles, and metadata management. The catalog will also list potential future data types that could have privacy implications. This work will take place in the first quarter of 2025 as an essential building block to the following recommendations. (Champion: Committee)

1. *Develop a data triage framework to distinguish essential, optional, and unnecessary data based on Minnesota's privacy laws*
   Using the data catalog and research into Minnesota's privacy laws, the group will sort data types into essential, optional, and unnecessary categories for collection. The group will connect with leaders of Minnesota-based CAV pilots to understand how data has been collected and shared between partners historically. These conversations will dig into successes and pain points to help identify how data sharing has worked in practice. (Champion: Committee)

2. *Draft security-by-design protocols*
   To address the limitations of legislation, the group will draft potential protocols that incorporate best practices in cybersecurity. This technology moves faster than the legal process, and a separate system will be built that can more easily adapt to changes in the field. (Champion: Committee for review by MnDOT and MN DPS)

3. *Continue building connections with OEMs*
   Throughout the work recommended in suggestions 1 through 3, the Committee will need to continue conversations with OEMs to understand data limitations and licensing agreement preferences. Questions include, what real-time data is captured? what data is

stored and for how long? And what data could be shared with the vehicle owner, pilot partners, the government? Knowing the types of available data and willingness of OEMs to participate in this process will lead to a more thorough understanding of how potential legislation or best practices may impact private investment in the state. These discussions could also include an exploration into potential incentives for data sharing. (Champion: MnDOT with Committee)

Minnesota CAV Summit

To build on the learnings and work of the past year, a summit was held in early October to bring together Council members, ex officio members, and Innovation Alliance Committee members. This one-and-a-half-day event combined stakeholder panels, facilitated discussions, and committee work time focused on how to best prepare Minnesota for CAV and other transportation technologies. Day one featured three panel sessions of key stakeholders sharing their perspectives. All panelists were asked about their excitement and concerns related to connected and automated technologies. Questions tailored to each group aimed to identify areas of focus for the Council and State of Minnesota as CAV technology develops.

The panel sessions and related discussions identified the following key takeaways:

- Reducing traffic crashes and fatalities as well as improving traffic flow, increasing access to transportation options, and reducing emissions are potential benefits that CAVs could provide in the future.

- To achieve the potential benefits, public confidence and trust in the technologies need to greatly increase. People who have ridden in AVs deployed as robotaxis or transit vehicles report a greater comfort level with the technology.

- More engagement is needed with legislators and local elected officials through information sharing and experiential opportunities with CAVs. Elected officials want to be prepared to answer questions from their constituents and be able to speak about what is happening in Minnesota regarding CAVs.

- Efforts should focus on use cases and how CAVs will address existing transportation challenges and lack of access to transportation. Technologies that address the needs of people experiencing transportation barriers will address the needs of everyone. And technologies that work in Minnesota's weather conditions will work everywhere.

- Consistency and collaboration are needed among state and local agencies on safe testing policies and regulations to provide clear guidance for researching and deploying CAV technologies in Minnesota.

- Continued engagement between the public and private sectors is needed to build understanding about each sector's priorities and concerns and to move toward mutually beneficial solutions.

Following the panel sessions, attendees participated in a world café-style activity that gave participants the opportunity to offer feedback and ideas that would inform the final results of each Innovation Alliance Committee's work in 2024. Table discussions were organized around the four Innovation Alliance Committees' topics. Day two reviewed highlights from the first day and gave Innovation Alliance Committees dedicated work time to focus on next steps for their small groups.

To read more about the summit and the key takeaways, a full event report can be viewed in the appendix. (See Appendix B: Governor's Council on Connected and Automated Vehicles 2024 MN CAV Summit Summary.)

Themes and Next Steps

Across all the work of the Governor's Council on Connected & Automated Vehicles and the Innovation Alliance Committees, several themes emerged for the priority action areas. These priorities will continue to build on the *2022 Executive Report* recommendations and will provide guidance for this cohort's work in the coming years.

Planning for the future, protecting in the "now"

Many decisions that must be made today, from infrastructure investments to the crash report rebuild, should consider how technology may change rapidly in the coming years. As more CAVs are deployed on Minnesota roadways, the way vehicles interact with these systems will change.

Importance of data

As vehicles become smarter, the volume and types of data collected will continue to increase. From protecting personal privacy to understanding how technologies contribute to safety, both individuals and agencies have a stake in developing a data governance plan that better accounts for CAV technologies.

Pathways to deployment

Both public and private stakeholders have expressed a desire for a more structured pathway to deployment. Building out a formal path, from research to testing to full deployment, will allow all parties to feel secure in protecting the safety of Minnesota's roadways while continuing to encourage investment from the CAV industry.

Federal involvement

The research of 2024 clearly shows that states are limited in progress without explicit guidelines from the federal government. Without a shared understanding and policies defining information such as levels of automation or what data OEMs should be required to share with state agencies, states are hampered in their ability to attract investment while continuing to build

safety guardrails for their citizens. Minnesota must decide how much it wants to advocate for change at the federal level and, if so, how to build a coalition of support.

Continued education and engagement

A key takeaway from every committee and the Minnesota CAV Summit was that public education and engagement must increase if the proposed recommendations from this Council are to succeed. Minnesota's legislators need more engagement with this technology and its benefits before the Council advises on policy changes. Similarly, stakeholders throughout the year identified public education on what CAV technology is and how it can benefit individuals, as well as highlighting what technology already exists in their communities, as key to continuing progress in the state of Minnesota.

Appendix A1: Literature search for Safe Testing of CAV Innovation Alliance Committee

Literature Search for CAV Innovation Alliance Committee

Marilee Tuite, Center for Transportation Studies

August 9, 2024

Request Summary

This literature search had three requests:

1. Evaluate AV legislation specific to safety/testing from AZ, CA, CO, FL, KY, and any northern states. What seem to be best practices for safe testing?

2. Which companies are testing in winter weather, and what are the testing conditions in those states (how safe, open road vs. closed road, etc.)?

3. Include any research from cold-weather countries and safe testing (Scandinavia, U.K., etc.).

Resources Evaluated

TRID, other relevant databases, and NHTSA tools were searched. Top resources are summarized below.

NCHRP LRD 91 Multistate Coordination and Harmonization for AV Legislation (TRB, June 2024)

This digest provides a review of AV legislation in all states and the District of Columbia and describes the differences in many research areas. See p. 20 for a table summarizing US Autonomous Vehicle Laws: Deployment and Testing.

Full text: https://doi.org/10.17226/27867

NCSL Autonomous Vehicles Legislation Database

This contains states' AV legislation for a specific year or all years going back to 2017.

https://www.ncsl.org/transportation/autonomous-vehicles-legislation-database

NHTSA AV TEST Initiative

https://www.nhtsa.gov/automated-vehicle-test-tracking-tool

This tool is self-reporting (opt in). Minnesota's pilots aren't listed.

NHTSA Standing General Order (2021)

The SGO requires manufacturers and operators to report to NHTSA certain crashes involving vehicles equipped with automated driving systems or SAE Level 2 advanced driver assistance systems. Crash data is available by state in a dashboard at https://www.nhtsa.gov/laws-regulations/standing-general-order-crash-reporting.

Safe Testing and Deployment of Vehicles Equipped with Automated Driving Systems Guidelines, Edition 3

AAMVA (American Association of Motor Vehicle Administrators), July 2022

The report contains several administrative recommendations as well as definitions of deployment and testing. These guidelines noted that a successful path to safe testing and deployment of technology must include appropriate government oversight developed with strong stakeholder engagement formed through partnerships.

https://www.aamva.org/getmedia/66190412-ce9d-4a3d-8b6e-28c1b80e3c10/Safe-Testing-and-Deployment-of-Vehicles-Equipped-with-ADS-Guidelines_Final.pdf

Request 1: State legislation and safe testing

Evaluate AV legislation specific to safety/testing from AZ, CA, CO, FL, KY, and any northern states. What seem to be best practices for safe testing?

Table 1: AV legislation specific to safety from AZ, CA, CO, FL, KY, northern states

State *has a CAV office or program	Law	Deployment or Testing	Operator Licensed	Operator in Vehicle	Insurance coverage	Local Authority Preemption
AZ	HB 2813 (2021)	Deployment	Depends on level of automation	Depends on level of automation	Yes	No
CA*	SB 145 (2017)	Deployment	Depends on vehicle	No	Yes $5M	No
CO*	SB 213 (2017)	Deployment	No	Not addressed	No	Yes
FL*	HB 7027 (2016); HB 311 (2019)	Deployment	Depends on level of automation; not required for SAE levels 4 and 5	Depends on level of automation; not required for SAE levels 4 and 5	Yes	Yes
KY	HB 7 (2024)	Deployment	The ADS is considered to be licensed to operate the vehicle	Not required after submitting law enforcement interaction plan to Transp. Cabinet and KY State Police	Yes $1M	Yes
MA*	EO 572 (2016)	Testing	Yes	Yes	Yes	No
MI*	SB 706 (2022)	Deployment	Yes	No	Yes	Yes

ND	HB 1418 (2019)	Deployment	Depends on level of automation; not required for SAE levels 4 and 5	Depends on level of automation; not required for SAE levels 4 and 5	Yes	Yes
NH	SB 216 (2019)	Deployment	Required for vehicle in testing phase	Depends on level of automation	Yes	Yes
NY	A 9508 (2018)	Testing requires direct supervision of NY state police	Yes	Yes	Yes $5M	No
OH*	EO 2018-04K (2018)	Testing	Yes	No	Yes	No
PA*	HB 1958 (2018)	Deployment	Yes	No	Yes $1M	Yes
VT	SB 149 (2019)	Testing	Yes	Yes	Yes $5M	No

Sources:

NCHRP LRD 91 Multistate Coordination and Harmonization for AV Legislation

NCSL Autonomous Vehicles Legislation Database

The table above focused on AZ, CA, CO, FL, KY, and northern states. As of June 2024, 37 states (including KY) have enacted legislation related to deployment and testing of autonomous vehicles. According to observations from NCHRP LRD 91 Multistate Coordination and Harmonization for AV Legislation:

- Regarding an operator in the vehicle, it seems to be required in states that do Testing (MA, NY, VT) except for Ohio. In states that do Deployment, an operator in the vehicle isn't required or is required only for SAE Levels 4 and 5. The requirement of an operator to be licensed doesn't separate neatly according to Testing vs. Deployment.

- Regarding insurance coverage, there is no uniformity. Each state must determine this issue on its own as vehicle insurance schemes are a state domain issue.

- Outside of early testing days, the trend is now toward local government preemption within state statutes.

This literature search didn't find any states in the table above with a condition that requires video or camera recording in the vehicle, like Texas. Some states have privacy laws that would prevent this.

AAMVA's recent guidelines validate some actions already taken in Minnesota, such as stakeholder engagement formed through partnerships. AAMVA makes several administrative recommendations:

- identify a lead agency and person to manage ADS-equipped vehicle committees

- develop strategies to address testing and deployment

- examine jurisdictional laws to identify barriers

- utilize NHTSA guidance

According to NHTSA SGO crash data for ADS-equipped vehicles, the states with the most crashes (as of June 17, 2024) are California (400), Arizona (133), Texas (60), Nevada (24), Florida (18), and Michigan (7).

Added August 15, 2024

In Section 2 of the 2017 Automated Driving Systems 2.0: A Vision for Safety (aka AV 2.0), NHTSA recommends several safety-related best practices when crafting legislation for ADS:

- Provide a "technology-neutral" environment

- Provide licensing and registration procedures

- Provide reporting and communications methods for Public Safety Officials

- Review traffic laws and regulations that may serve as barriers to operation of ADSs - for example, some States require a human operator to have one hand on the steering wheel at all times, and that law would pose a barrier to Level 3 through Level 5 ADSs.

Request 2: Companies testing in winter weather

Which companies are testing in winter weather, and what are the testing conditions in those states (how safe, open road vs. closed road, etc.)?

Table 2: Companies testing AVs in winter weather. All tests included an in-vehicle safety operator.

Company	State	Test/pilot name or description	Duration	Vehicle type	Open or Closed road	Involves public or test team
ADASTEC Corp	MI	[Michigan State University - Autonomous Bus Pilot](#)	Spring 2022 to Spring 2023; will continue in Fall 2024 with a 2nd bus	Bus (Karsan Autonomous Atak Electric)	Open	Public
EasyMile	CO	Autonomous Vehicles in Colorado Project [Mines Rover](#) in Golden, CO	Aug - Dec 2021	Shuttle x9 (EasyMile EZ10 GEN2)	Open	Public
EasyMile	MN	Med City Mover in Rochester, MN	Aug 2021 - Aug 2022	Shuttle x2 (EasyMile EZ10 GEN3)	Open	Public
EasyMile	OH	[Columbus Smart Cities Challenge](#)	Dec. 2018 - Sept. 2019; Feb. 2020 (on-board incident paused passenger operations, restarted as goods delivery)	Shuttle (EasyMile EZ10 GEN3)	Open	Public
EasyMile	OH	[Columbus Goods Delivery](#)	July 2020 - Apr 2021	Shuttle (EasyMile EZ10 GEN3)	Open	Test team (delivering goods)

GM/Cruise	MI	On-road testing in Milford, MI	Ongoing	Car (Bolt EV) x 40	Closed - GM Milford Proving Ground	Test team
May Mobility	MI	Grand Rapids Autonomous Vehicle Initiative (AVGR)	2019 - April 2022	Shuttle x4 (Lexus RX 450H)	Open	Public
May Mobility[2]	MN	goMARTI in Grand Rapids, MN	Sept. 2022 - present	Shuttle (5 x Toyota Sienna Autono-MaaS vehicles)	Open	Public
May Mobility[3] *launching soon*	MN	SouthWest Transit autonomous microtransit service in Eden Prairie, MN	On-road testing before launch in October 2024 - 2027	Shuttle (5 x wheelchair-accessible Toyota Sienna minivans)	Open	Public
Mobileye (Intel)	MI	Public Road testing in Detroit	Sept. 2022 - present?	Car (Ford Fusion hybrid)	Open	Test team
Motional	PA	Public Road testing in Pittsburgh	Feb. 2021-?	Car (Hyundai Ioniq 5)	Open	Test team
Toyota	MI	Testing in Ann Arbor, MI	unclear	Car (Lexus)	Open	Test team
Waymo	MI	Vehicle testing in Ann Arbor, MI	2017 - present	Mixed fleet	Open	Test team
Waymo	OH	Closed course testing in East Liberty, OH	Dec. 2020 - present	Mixed fleet	Closed	Test team

Waymo	WA	Vehicle testing in Seattle, WA	2022 - present	Mixed fleet	Open	Test team
University of Iowa	IA	ADS for Rural America in Iowa City, IA		Shuttle (Ford Transit purchased for project)[4]	Open	Test team
University of Minnesota[5]	MN	MnCAV Ecosystem project	2021-2022	Car (Chrysler Pacifica purchased for project)	Closed (MnROADfacility) and Open	Test team
ADASTEC Corp	MI	[Michigan State University - Autonomous Bus Pilot](#)	Spring 2022 to Spring 2023; will continue in Fall 2024 with a 2nd bus	Bus (Karsan Autonomous Atak Electric)	Open	Public
EasyMile	CO	Autonomous Vehicles in Colorado Project [Mines Rover](#) in Golden, CO	Aug - Dec 2021	Shuttle x9 (EasyMile EZ10 GEN2)	Open	Public

Sources:

For Table 2, most sources were found at [NHTSA AV TEST Initiative](#), unless otherwise noted with a superscript number.

[2]goMARTI, https://www.gomarti.com/

[3]SouthWest Transit, https://swtransit.org/news-media-press-releases/av-announcement-swt/

[4]Driving Safety Research Institute / On-Road Vehicles, https://dsri.uiowa.edu/vehicles

[5][Influence of Autonomous and Partially Autonomous Vehicles on Minnesota Roads](#)

Request 3: Research from cold-weather countries and safe testing

Include any research from cold-weather countries and safe testing (Scandinavia, U.K., etc.).

Canada

Canada hasn't passed any federal laws regarding AVs, however Transport Canada established [Guidelines for Testing Automated Driving Systems in Canada Version 2.0](#) in 2021 that outline the processes required to establish safe AV testing operating in conjunction with provincial laws and regulations.

Title: **Study of automated shuttle interactions in city traffic using surrogate measures of safety**

Source: Transportation Research Part C: Emerging Technologies (vol. 135; February 2022)

Abstract: …this study uses surrogate measures of safety (SMoS) to analyze the interactions between road users and low-speed automated shuttles that circulated in Montreal and Candiac, in Canada, during two pilot projects in mid and late 2019. Cameras were placed at seven intersections along the routes of the shuttles. More than 70 hours of footage were processed to extract the road user trajectories using computer vision techniques and compute various safety indicators: speed and acceleration at the road user level, time headway, time-to-collision (TTC), post-encroachment time (PET) and the speed difference at the interaction level. …The results indicate that these automated shuttles behave generally more safely: their speeds and accelerations are lower and their interactions are characterized by higher TTC and PET values, and lower speed differences. However, small headway times at one site with high-speed differences between the shuttles and other following vehicles raise concerns that warrant further research into the suitable context for these vehicles.

Full text available via U of M: https://doi.org/10.1016/j.trc.2021.103465

Finland

Title: **Icy roads and urban environments. Passenger experiences in autonomous vehicles in Finland**

Source: Transportation Research Part F: Traffic Psychology and Behaviour (July 2021)

Abstract: This study focused on identifying customers' real-life experiences, perceptions and feelings about traveling in different autonomous vehicles and in various operating conditions in Finland in 2018. Quantitative convenience sample (n = 141) were collected from passengers traveling on an autonomous shuttle bus in Helsinki. Qualitative data (n = 70) were gathered by interviewing passengers of a driverless shuttle bus in Helsinki and passengers of an autonomous car in winter conditions in Lapland. This research was the first one which included passengers' real-life experiences after using autonomous vehicles in winter conditions…. Results from passengers traveling in heavy winter conditions indicate that winter conditions do not significantly influence passengers' attitudes towards using autonomous vehicles….

Note about testing conditions for the winter trial: Sensible 4 Juto driverless car traveled a 1.3 km route for two days. The car held a passenger and a human operator who was a member of the project team.

Full text available via U of M: https://doi.org/10.1016/j.trf.2021.03.015

Finland / Estonia / Norway / Poland

Title: A cross-country comparison of user experience of public autonomous transport

Source: European Transport Research Review (vol. 13, no. 1; January 2021)

Abstract: …this paper compares user experiences of autonomous public transport across Baltic countries, with the final goal of gaining an increased insight into public needs. User experience was evaluated through questionnaires gathered along pilot projects implementing a public transportation line, using an automated electric minibus between 2018 and 2019. To have sufficient diversity in the data, the pilot projects were implemented in several cities in the Baltic Sea Area. The data analysed in this paper specifically refer to the cities of Helsinki (Finland), Tallinn (Estonia), Kongsberg (Norway), and Gdańsk (Poland).Across all cities, passengers provided remarkably positive feedback regarding personal security and safety onboard. The overall feedback, which was very positive in general, showed statistically significant differences across the groups of cities (Kongsberg, Helsinki, Tallinn and Gdansk), partially explicable by the differences in the route design…

Full text (open access): https://doi.org/10.1186/s12544-021-00477-3

Germany

In July 2021, a new German law allowed SAE L4 AVs to drive on public roads within certain operational design domains with state approval. The new law does not require a human driver to be in the vehicle and allows for deployments and operation of non-personal AVs. Although the law mentions commercial AVs, such as shuttles/people movers, there is no explicit restriction on privately owned vehicles.

Title: Simulating the impact of privately owned automated vehicles within the region Test Bed Lower Saxony, Germany

Source: Procedia Computer Science (vol. 201; 2022)

Abstract: This paper aims to analyze, the impact of privately owned automated vehicles on travel behavior in the region covering the Test Bed Lower Saxony in Germany. The main focus is laid on the evaluation of long-distance trips in the entire study area as well as on commuter journeys to and from the city of Brunswick. An agent-based demand model in conjunction with a traffic flow model was used to simulate four scenarios with different penetration rates of fully automated vehicles. The results show a major shift in the mode share, an increasing of the daily mileage, and reduced travel time of the motorized individual transport, as well as minor changes in travel distance and total traffic volume.

Full text (open access): https://doi.org/10.1016/j.procs.2022.03.028

Germany / United Kingdom

Title: Comparing implicit communication via longitudinal driving dynamics: A cross-cultural study in Germany and the UK

Source: Transportation Research Part F: Traffic Psychology and Behaviour (vol. 102; April 2024)

Abstract: …The perception of three means of communication in connection with the presence of a labelling as an automated vehicle (eHMI) was examined in two samples in Germany and England. 27

participants drove from a slip road onto the motorway and interacted with another vehicle. After a stretch on the motorway, they passed a second slip road on which there was a vehicle merging onto the participants lane. This was repeated six times to test all variables. After each situation, the perceived cooperativity and criticality was recorded, as well as the time headway (THW) to the other vehicle. This paper presents the findings from the UK sample and compares them with the German results, which were previously published. Results show, that when the cooperating vehicles are on the slip road, participants from both countries prefer this vehicle to decelerate. However, when participants themselves are on the slip road, expectations for vehicles on the target lane are ambiguous in the UK sample. Except for one aspect (perceived cooperativity of decelerating vehicles on the slip road), the perception of automated vehicles is similar to those of manual drivers. Also, UK participants do not maintain a different safety distance from these vehicles, while this is the case in the German sample. This paper contributes valuable insights into the cross-cultural evaluation of driving dynamics, shedding light on implications for the development and acceptance of automated vehicles.

Full text available via U of M: https://doi.org/10.1016/j.trf.2024.03.008

Norway

Title: **Automated Shuttle Services in Public Transport. Lessons Learned From the SmartFeeder Research Project in Norway**

Source: European Transport Conference 2020

Abstract: …The SmartFeeder research project (2017-2020) has studied the introduction of automated shuttle buses in Norway. The purpose is to use the early pilot experiences to build knowledge on how automated mobility services should be implemented in the future transport system. The project was initiated by the National Railway Directorate, in order to gain knowledge on how automated first- and last mile services can improve the railway and other modes of public transport, and thereby contribute to a green shift in passenger transport. The aim of the project has been twofold; 1) to enhance public mobility solutions for the future transport system and 2) to build a comprehensive knowledge basis for future development and policies on automated transport in collaboration between public authorities, private actors and scientists. The project will be concluded during spring 2020.

Full text: https://aetransport.org/past-etc-papers/conference-papers-2020?abstractId=7052&state=b

Title: **"Game over" for autonomous shuttles in mixed traffic? Results from field surveys among pedestrians and cyclists on how they interact with autonomous shuttles in real-life traffic in Norway**

Source: Transportation Research Interdisciplinary Perspectives (vol. 18; March 2023)

Abstract: This article describes the use of a game theoretic basis for studying interaction between autonomous shuttles and ordinary road users in mixed traffic. The authors report results from field surveys about real-life interactions with autonomous vehicle (AV) shuttles among pedestrians and bicyclists in two Norwegian pilot studies, in Oslo and Kongsberg, where AV shuttles have been introduced in mixed traffic. Pedestrians and cyclists are considerate and tend to yield to the AV shuttle at both sites. Cyclists in Oslo are less considerate towards the AV shuttle over time.

Full text (open access): https://doi.org/10.1016/j.trip.2023.100781

Title: **Lessons learned from the trial operation of an autonomous urban passenger ferry**

Source: Transportation Research Interdisciplinary Perspectives (vol. 26; July 2024)

Abstract: Since 2016, a university-led effort to develop autonomous urban passenger ferry prototypes has been underway in Trondheim, Norway. The work culminated in what is considered the world's first trial operations of an autonomous urban passenger ferry open to the public, where the ferry milliAmpere2, over three weeks, completed almost 500 trips and transported more than 1500 passengers over a 100-meter crossing. During the trial period in September and October 2022, several quantitative and qualitative data samples were collected to understand passengers' and safety operators' perceptions of trust and safety onboard autonomous ferries. This article briefly presents the autonomous ferry and its autonomy system and provides details about the trial operation, the area of operation, and the data samples collected.

Full text (open access): https://doi.org/10.1016/j.trip.2024.101142

Sweden

Title: **Autonomous shuttles contribution to independent mobility for children – a qualitative pilot study**

Source: Journal of Urban Mobility (vol. 4; December 2023)

Abstract: The purpose of this study is to investigate if and in what way autonomous buses can contribute to children's independent mobility and, using children's experiences, provide insights into this before the introduction of autonomous buses in cities and public transport systems. To do so, the two research questions "How can autonomous buses in the transport system contribute to children's independent mobility?" and "What prerequisites are necessary for autonomous buses to contribute to children's independent mobility?" are answered. The survey is based on a case of introduction of autonomous buses in urban environments in Sweden. Children from the school in the residential area were recruited to try out the shuttles and share their view on the useability of the service. Three focus groups with students in a primary school were conducted with the aim of gaining the participants' experiences. The results indicate that the introduction of autonomous buses in an urban area can contribute to children's independent mobility in several ways and that the buses have certain characteristics that enable them to be adapted to children's conditions. The low speed of the shuttles, which is often seen as an obstacle when it comes to time efficiency, has a positive effect on perceived safety in this case. The mobility solution is also child-friendly in that it is accessible in terms of trip planning and payment.

Full text (open access): https://doi.org/10.1016/j.urbmob.2023.100058

United Kingdom

Added August 15, 2024

In May 2024, the Automated Vehicles (AV) Act became law in the UK. This article summarizes the legislation and anticipates self-driving vehicles could be on UK roads in 2026:

https://www.gov.uk/government/news/self-driving-vehicles-set-to-be-on-roads-by-2026-as-automated-vehicles-act-becomes-law

Appendix A2: Definition of "Safe" – Draft definition prepared by Safe Testing of CAV Innovation Alliance Committee

Definition of Safe – A w*orking document prepared by Safe Testing of CAV Innovation Alliance Committee*

Safe operation of a motorized vehicle on public roads involves a combination of adherence to traffic laws, practicing defensive driving, maintaining the vehicle properly, and being aware of and responsive to road conditions and other road users.

Safety can be defined as acts that preserve life, health and the bodily integrity of all individuals.

Here are the key aspects:

1. **Adherence to Traffic Laws**:
   - **Speed Limits**: Always observe and adhere to posted speed limits and adjust speed according to road conditions.
   - **Traffic Signals and Signs**: Obey all traffic signals, stop signs, yield signs, and other road signs.
   - **Right of Way**: Understand and follow right-of-way rules to avoid collisions at intersections and other situations where paths cross.
   - **Lane Discipline**: Stay in the appropriate lane and use signals when changing lanes or turning.
   - Adherence to "**3-second rule**" for following distance, as recommended by the National Safety Council

2. **Defensive Driving**:
   - **Awareness**: Always be aware of your surroundings, including other vehicles, pedestrians, cyclists, and potential hazards.
   - **Anticipation**: Anticipate potential hazards and prepare for sudden changes in traffic conditions.
   - **Safe Distance**: Maintain a safe following distance from the vehicle ahead to allow for sudden stops.
   - **Avoid Distractions**: Minimize distractions such as mobile phones, eating, or other activities that take attention away from driving.
   - **Adjusting to Conditions**: Adapt driving to weather, road conditions, and visibility. Slow down in rain, snow, fog, or heavy traffic.

3. **Vehicle Maintenance**:

- **Regular Inspections**: Conduct regular vehicle inspections and maintenance, including brakes, tires, lights, and fluid levels.

- **Functionality**: Ensure all vehicle systems, including wipers, defrosters, and mirrors, are functioning properly.

- **Safety Features**: Ensure that safety features such as seat belts, airbags, and anti-lock brakes are in good working order.

4. **Driver Responsibility**:

- **Sober Driving**: Never drive under the influence of alcohol, drugs, or any substances that impair your ability to operate a vehicle safely.

- **Rest and Alertness**: Avoid driving when fatigued. Take breaks on long trips to stay alert.

- **Use of Seat Belts**: Always wear a seat belt and ensure all passengers are buckled up.

- **Child Safety**: Use appropriate child safety seats and restraints for younger passengers.

5. **Interaction with Other Road Users**:

- **Pedestrian Right of Way**: Yield to pedestrians at crosswalks and be vigilant in areas with high foot traffic.

- **Cyclists**: Share the road with cyclists, give them adequate space, and be aware of bike lanes.

- **Motorcycles**: Be aware of motorcycles, which can be harder to see, and give them plenty of space.

- **Emergency Vehicles**: Yield to emergency vehicles by pulling over to the side of the road when they approach with lights and sirens.

6. **Road Awareness**:

- **Work Zones**: Slow down and be prepared for sudden changes in traffic flow in construction zones.

- **School Zones**: Observe lower speed limits and heightened caution in school zones and near buses.

- **Railroad Crossings**: Approach railroad crossings with caution, look both ways, and obey crossing signals.

7. **Handling Emergencies**:

- **Breakdowns**: If your vehicle breaks down, pull off the road safely, use hazard lights, and seek assistance.

- **Accidents**: In the event of an accident, move to a safe location if possible, check for injuries, call emergency services, and exchange information with other parties involved.

By adhering to these principles, drivers can significantly reduce the risk of accidents and ensure a safer driving environment for themselves and others on public roads.

Safe testing for Autonomous and Connected Vehicles (CAVs) involves rigorous and systematic evaluation methods to ensure the safety, reliability, and efficiency of these vehicles before they are deployed on public roads. This testing framework includes a combination of virtual simulations, controlled environments, and real-world testing under various conditions.

Key aspects of safe testing for CAVs include:

1. **Virtual Simulation**:

   - **Scenario Testing**: Use detailed simulations to test CAVs under a wide range of scenarios, including rare and dangerous situations that would be difficult or unsafe to replicate in the real world.

   - **Software-in-the-Loop (SiL) and Hardware-in-the-Loop (HiL)**: Integrate the vehicle's software and hardware components into the simulation environment to test their interactions and responses in real-time.

2. **Closed-Track Testing**:

   - **Controlled Environment**: Conduct initial tests in a secure, closed environment such as a test track to evaluate the vehicle's performance in a safe, controlled setting.

   - **Repeatability**: Perform repeatable tests to gather consistent data and refine the vehicle's algorithms and systems.

3. **Safety Protocols**:

   - **Fail-Safe Mechanisms**: Ensure that CAVs are equipped with robust fail-safe mechanisms to handle system failures and ensure the safety of passengers and other road users.

   - **Redundancy**: Implement redundant systems for critical components to provide backups in case of a primary system failure.

4. **Real-World Testing**:

   - **Pilot Programs**: Deploy CAVs in limited, real-world settings under close supervision to gather data on their performance in everyday traffic conditions.

   - **Progressive Complexity**: Gradually increase the complexity of the test environments, starting with less congested areas and moving to more complex urban settings.

5. **Regulatory Compliance**:

   - **Adherence to Standards**: Ensure that CAVs comply with national and international safety standards and regulations.

   - **Collaboration with Authorities**: Work closely with regulatory bodies to ensure that all testing procedures meet legal and safety requirements.

6. **Data Collection and Analysis**:

   - **Comprehensive Monitoring**: Collect extensive data on vehicle performance, including sensor inputs, decision-making processes, and outcomes.

   - **Continuous Improvement**: Use the data to continually refine and improve the vehicle's algorithms and systems.

7. **Human Factors and User Experience**:

   - **Human-Machine Interface (HMI)**: Test and refine the interfaces through which humans interact with the vehicle to ensure ease of use and safety.

   - **Driver and Passenger Behavior**: Study how drivers and passengers interact with the vehicle to identify and mitigate potential safety issues.

8. **Cybersecurity**:

   - **Vulnerability Testing**: Conduct thorough testing to identify and mitigate potential cybersecurity vulnerabilities.

   - **Data Protection**: Ensure that all data transmitted between connected vehicles and infrastructure is secure and protected against unauthorized access.

9. **Collaboration and Transparency**:

   - **Industry Collaboration**: Collaborate with other industry players to share knowledge and best practices.

   - **Public Transparency**: Maintain transparency with the public regarding testing processes and results to build trust and acceptance.

By combining these methods, manufacturers and researchers can ensure that autonomous and connected vehicles are thoroughly tested and validated for safety before they become a common sight on public roads.

Appendix B: 2024 MN CAV Summit Summary

Governor's Advisory Council on Connected and Automated Vehicles 2024 MN CAV Summit Summary

Background

In April 2019, Governor Walz issued an executive order appointing a [Connected and Automated Vehicle Advisory Council](#) to study, assess and prepare for the opportunities and challenges associated with the widespread adoption of CAV and other transportation technologies. After a brief pause in 2023, a new Advisory Council was appointed and began work in January 2024. To build on the learnings and work of the past year, a summit was held to bring together Council members, ex-officio members, and Innovation Alliance Committee members. This one and a half day event combined stakeholder panels, facilitated discussions, and committee work time focused on how to best prepare Minnesota for CAV and other transportation technologies.

Day One Summary - Panel Sessions

Throughout day one, three panel sessions were hosted to bring in key stakeholders to share their perspectives. All panelists were asked about their excitement and concerns about connected and automated technologies. Questions, tailored to each group, aimed to identify areas of focus for the Council and state of Minnesota as CAV technology develops.

Minnesota State Elected Officials Panel

Senator Jim Carlson (District 52), Senator John Jasinski (District 19), Representative Erin Koegel (District 39A), Representative John Petersburg (District 19B)

Moderator: Heidi St. Clair, Director of Supply Chain Analytics, Automation and Innovation, CHS Inc.

During this panel, the legislators shared their own interests in transportation technologies, perspectives on the concerns and attitudes of their constituents, and areas of opportunity for the state of Minnesota. They agreed that transportation is a non-partisan issue, and that technology solutions will need to work across urban and rural areas. Panelists recognized technology's role in improving safety, logistics, and addressing climate change, emphasizing the need to adapt solutions to Minnesota's unique needs.

Transportation Challenges and Priorities
The panel emphasized the diverse transportation needs across Minnesota and the imperative that adoption of these technologies must solve the challenges of our weather conditions. Rural areas face challenges related to basic infrastructure and affordability, while the metro areas may focus on last-mile solutions and integrating advanced technologies into their network. This topic is not top of mind with their constituents, but they acknowledged the potential that connected and automated vehicles (CAVs) could offer in solving the transportation challenges they face.

Potential of Automated and Connected Vehicles (CAVs)

CAVs were recognized for their potential ability to enhance safety, mobility, and independence, particularly for the disabled and elderly. However, concerns remain regarding affordability, safety, and public acceptance. Panelists noted that Minnesota's climate and infrastructure complexities make it an ideal testing ground for these technologies, offering opportunities to refine their application in diverse environments.

Role of Government and Policy

Legislators acknowledged the need for clear policies to encourage industry partnerships while safeguarding public interests. While government plays a vital role in adapting legislation to facilitate innovation, panelists urged caution in overregulating or favoring specific technologies. Balancing innovation with safety and data privacy concerns was seen as critical to building public trust.

Public Engagement and Education

To increase public confidence in CAVs, the panel advocated for more demonstrations and hands-on experiences, such as showcasing technology at public events like the state fair. Educating the public about the benefits and limitations of CAVs was seen as essential for fostering acceptance and dispelling fears about automation and data security.

Future Opportunities and Risks

Minnesota was encouraged to focus on improving and adapting existing technologies rather than leading in developing new ones. Panelists highlighted risks such as cybersecurity threats, overreliance on technology, and challenges in balancing innovation with individual freedoms. They stressed the importance of collaboration between public and private sectors to ensure transportation advancements benefit all Minnesotans equitably.

Local Government Representative Panel

Dillon Dombrovski, City Engineer, City of Rochester, Wayne Sandberg, Public Works Director and County Engineer, Washington County

Moderator: Jay Hietpas, Assistant Commissioner, Operations Division, MnDOT

The panelists identified safety and efficiency on local roads as the overall priorities for their organizations; and, they acknowledged the potential for CAV and other technologies to help address them. They stressed the importance of coordination and collaboration with the state in order to avoid a patchwork of regulations and requirements among different jurisdictions. The panelists also emphasized their interest in understanding how infrastructure investments that support CAVs would be paid for and prioritized, given constraints on funding at the local level. Finally, the need for ongoing education and information sharing with local elected officials and the public was identified as a key action as CAV initiatives advance in Minnesota.

Safety and Efficiency in Roadways

Improving safety and efficiency on roadways emerged as a major theme, with the potential for leveraging technology to reduce collisions, optimize traffic flow, and decrease emissions. Panelists emphasized the importance of data collection and analysis, including pedestrian and vehicle collision data, to inform decisions and improve roadway safety. Accessibility and congestion were also key concerns, with the potential for CAV technologies to address these challenges while benefiting

vulnerable populations like the elderly and those with mobility issues. Environmental benefits such as reduced emissions through technologies like Google's Project Green Light, were mentioned.

Local Control vs. State Regulation

Panelists highlighted the balance needed between local and state control in managing policies and regulations. They contrasted the lack of clarity in Minnesota's laws to California's well-defined regulatory framework, underscoring the importance of collaboration among city, county, and state officials to ensure consistency. They also emphasized that one size doesn't fit all when looking at the challenges across different urban, suburban, and rural jurisdictions. For example, in metro areas with multiple jurisdictions, consistent rules are critical to avoid confusion. Finally, feedback from manufacturers on infrastructure requirements was emphasized as a means to create supportive and uniform regulations.

Accessibility and Aging in Place

Transportation technologies were seen as vital for addressing the needs of elderly individuals who want to age in their homes. Future technologies could provide greater flexibility and reliability, enabling independence and access to essential services. The broader implications of autonomous vehicles, such as changes in land use and zoning, were also discussed, including reduced reliance on personal garages and repurposing parking spaces for community benefits.

Education and Budgeting for Local Governments

Education and adequate funding were also identified as critical factors for local governments in adopting new transportation technologies. Engagement with mayors, city council members, and county commissioners is critical in order to advance efforts at the local level. Panelists emphasized the need for clear standards to guide implementation and budgeting for technology upgrades, particularly in winter climates. Adapting technologies for harsh weather conditions was highlighted as a priority for manufacturers who want to test and deploy in Minnesota.

Community Engagement and Education

Grassroots education and community engagement were seen as essential for building public confidence in new technologies. Local events, social media platforms, and educational content like YouTube videos were recommended as tools to reach diverse audiences. Direct engagement with communities was emphasized in order to address concerns and foster understanding about the potential benefits of these technologies. People need to have a chance to ask questions, share concerns, and ideally, experience how the technology works firsthand. It was suggested the Council could play a stronger role in education and engagement as part of its work.

Communities Experiencing Transportation Barriers Panel

Jillian Nelson, Community Resource and Policy Advocate, Autism Society of Minnesota, Maureen Schneider, Chair, Minnesota Board on Aging

Moderator: Kyle Shelton, Director, Center for Transportation Studies, University of Minnesota

Panelists at the CAV Summit discussed the challenges faced by elderly individuals and people with disabilities in today's transportation systems, highlighting the potential benefits of emerging technologies for these communities. They highlighted the importance of collaborative efforts with key providers of services, including state agencies like the Department of Human Services (DHS) and providers of health care. Ultimately, they stressed that planning for the most vulnerable and underserved populations creates solutions that benefit everyone.

Engagement and Outreach

Contrary to popular belief, elders are not afraid of technology; they are well-prepared, eager to understand, and willing to adopt innovations if they enhance their quality of life. Similarly, people with disabilities are comfortable with technology, but their diverse transportation needs, including mobility aids and sensory challenges, require tailored solutions. Panelists encouraged Summit attendees to be intentional about their outreach now so that their needs and ideas can be incorporated as the CAV efforts advance. They also stressed the need to develop initiatives that will help familiarize these communities now with new types of transportation, including model rides and fare-free experiences, to increase confidence and adoption.

Partnerships and Collaborations

The panelists emphasized the importance of early involvement with DHS as it oversees programs that provide critical funding support for transportation solutions. They should be at the table as new types of services are designed in order to ensure that elders and peoples with disabilities will be eligible to use them and will have financial support, if needed, to access them.

Managed health care organizations, also have a vested interest in ensuring individuals can access medical appointments, as missed appointments cost the healthcare system an estimated $150 billion annually.

In addition, there are already existing technology platforms supported by the state that could be valuable resources in reaching the elder and disability communities, including MinnesotaHelp.Info, the Senior Linkage Line, and Disability Hub MN. Minnesota is recognized as a leader in elder service delivery and perhaps the adoption of CAV technologies can strengthen that leadership in the future.

Future Vision of Transportation

Panelists shared their visions for transportation, focusing on community-wide systems that serve individuals across the lifespan, from birth to end of life. They emphasized inclusivity in transportation design, recognizing that anyone can join the disability community at any point and that everyone is aging. They advocated for designing automated vehicles and transportation systems that are accessible to all types of mobility needs. Consistent, accessible transportation solutions are critical to improving health, well-being, and quality of life for the elderly and disability communities. And, if a transportation technology solution works for them, it will work for, and benefit, everyone using transportation.

Guest Speaker: Nathan Gargiulo, State of California Department of Motor Vehicles

Nathan Gargiulo from the California DMV's Autonomous Vehicles Branch provided a comprehensive overview of the state's approach to autonomous vehicle (AV) testing, deployment, and regulation. California currently authorizes 32 manufacturers to test AVs with a safety driver, six for driverless testing, and three for public deployment. The DMV's policy and operations units work collaboratively to oversee permitting and ensure compliance with strict safety and operational standards. Companies must report collisions within ten days and provide annual data on mileage and disengagements, enabling effective tracking and accountability.

California's regulatory framework includes detailed requirements for testing with and without safety drivers. These cover vehicle standards, test driver qualifications, collision reporting, and operational protocols, such as remote operator communication and law enforcement interaction plans. Deployment permits require companies to define operational design domains (ODD), adhere to safety standards, and provide consumer protections. Since 2014, California has issued 13 suspensions and three revocations of deployment permits for non-compliance, ensuring public safety remains a priority.

Gargiulo highlighted diverse AV applications, including rideshare services, shuttle pilots, and food delivery. Urban areas like San Francisco and Los Angeles are central to testing and deployment, while rural areas remain less explored due to infrastructure and operational challenges. The DMV collaborates with law enforcement to develop training programs for handling AVs, including removing vehicles from roadways and addressing incidents.

Public education and engagement are essential to building confidence in AV technologies. California uses feedback mechanisms, like a direct AV feedback form, to address safety concerns and improve public trust. Consumer privacy and transparency around data usage are evolving priorities, with ongoing efforts to educate users about the implications of interacting with autonomous systems.

The regulatory framework is continuously updated to reflect technological advancements and stakeholder input. The DMV works with manufacturers, insurers, and other stakeholders to address challenges such as insurance coverage, accessibility for people with disabilities, and adapting AVs to meet diverse mobility needs. Public perception remains a critical factor, with efforts focused on increasing awareness, addressing cost transparency, and fostering confidence in AV technologies across different communities.

Mr. Gargiulo outlined the requirements for a permit to test with a safety driver, test in driverless mode, and for public-use deployment. Key components to these requirements include collision reporting, annual disengagement reporting, and law enforcement interaction plans. The presentation provided useful examples of regulatory options for a permitting process, which could provide clarity for OEMs looking for paths to deployment. While testing is occurring on a variety of roadways, the California environment is limited to a mostly urban environment. Audience members were interested in learning more about the types of operational data required by the State of California, insurance implications of deployment, and protections on consumer data being acquired by these vehicles.

Themes & Key Takeaways from the Discussions and Presentation:

- Reducing traffic crashes and fatalities as well as improving traffic flow, increasing access to transportation options, and reducing emissions are viewed as potential benefits that CAVs could provide in the future.

- In order to achieve the potential benefits, public confidence and trust in the technologies needs to greatly increase. People who have ridden in AVs deployed as robotaxis or transit vehicles report a greater comfort level with the technology.

- More engagement is needed with legislators and local elected officials through information sharing and experiential opportunities with CAVs. Elected officials want to be prepared to answer questions from their constituents and to be able to speak about what is happening in MN regarding CAVs.

- Focus on use cases and how CAVs will address existing transportation challenges and lack of access to transportation. Technologies that address the needs of people experiencing transportation barriers will address the needs of everyone. And, technologies that work in Minnesota's weather conditions will work everywhere.

- Consistency and collaboration is needed among state and local agencies on safe testing policies and regulations to provide clear guidance for researching and deploying CAV technologies in Minnesota.

- Continued engagement between the public and private sectors is needed to build understanding about each sector's priorities and concerns; and to move toward mutually beneficial solutions.

World Café Activity

The final session of the day featured a world café-style activity that provided participants with the opportunity to offer feedback and ideas that would inform the final results of each Innovation Alliance Committee's work in 2024. Table discussions were organized around the Innovation Alliance Committees' topics: Safe Testing of CAVs, Infrastructure, Traffic Regulations and Safety, and Cyber Security, Data Privacy, and Data Governance. Participants rotated through each of the tables and addressed these questions for each of the topics:

1. How does MN be bold in this area?

2. What information do we still need to move this goal forward?

3. Based on the conversations we've had during the summit and over the past year, what is the one big goal this committee should focus on in 2025?

A couple of highlights from each discussion are listed below. A more comprehensive summary for each question is included in Appendix B1.

Safe Testing of CAVs

- Draft a framework and policy recommendations for driverless deployment in Minnesota
- Catalog and promote use cases and assets for testing in Minnesota

<u>Infrastructure</u>

- Define infrastructure and vehicle connectivity requirements for the successful operation of CAVs
- Revisions to Minnesota's MUTCD standards are needed to account for CAV technologies

<u>Traffic Regulations and Safety</u>

- Define operational and crash data from CAVs that could lead to improved safety interventions
- More clarity is needed around regulatory considerations like liability and crash accountability and CAV adherence to speed limits

<u>Cyber Security, Data Privacy, Data Governance</u>

- Federal leadership required to guide discussions on cybersecurity and data issues
- Public sector needs to define and communicate the scope and purpose for requesting data collected from CAVs

Day Two Summary

Day two began with a group review of highlights from the previous day of presentations and learning. The next portion of the agenda focused on Innovation Alliance Committee work time. Attendees broke into small groups matching the four committee focus areas and, utilizing lessons from the summit and previous work, began focusing on next steps to further the work in that topic area. Documentation from Day Two's committee discussions will be captured in the Council's Annual Report. To wrap up the event, Council members and Ex-officio members debriefed from committee discussions and offered an opportunity to identify themes and areas of overlap.

Council Next Steps

To conclude 2024, the Council will convene one final time in early December. Each Innovation Alliance Committee will meet once prior to that gathering and finalize recommendations for next steps. These recommendations could include actions for the Governor's Advisory Council on CAV, the committee, the state of Minnesota, local agencies, industry, and other major stakeholders to the development and deployment of CAV. Themes from the year will be outlined in detail through an end of the year Council report.

Appendix B1: World Café Discussion Summary

Summary of World Café Discussions

1. How does Minnesota be bold in this area?

<u>Safe Testing of CAVs</u>

- **Incentives:** Test CAV with diverse users, including those with disabilities. Explore incentives like a "test here" grant and regulatory testing compliance.

- **Safety Outcomes:** Implement A/B testing using simulations with human and machine testers to compare safety outcomes.

- **Research Corridor:** Create a CAV testing corridor as a research playground.

- **Adverse Weather:** Accept greater risks for snow/ice testing and learn from other states' policies.

- **Legislative Action:** Enact legislation prioritizing public good over individual complaints.

- **Predictability:** Define a clear, safe path for CAV testing and deployment.

- **Commercial Vehicles:** Shift focus from consumer applications to industrial use cases.

<u>Infrastructure</u>

- **WCAG 2.1 Accessibility**: Ensure car systems and infotainment meet accessibility guidelines.

- **Redundancy**: Prioritize information redundancy and multi-sensing capabilities.

- **Freight Corridors**: Invest in corridors equipped with CAV-friendly technologies and policies.

- **Private Funding for Infrastructure**: Secure private-sector contributions for updates like signing and striping.

- **Edge Cases First**: Focus designs on disabilities and less-maintained county roads.

- **Corridor Features**:

  o   Smart and safety-focused highways.

  o   Adherence to MUTCD Part 5 standards.

- **Expand Accessibility with goMARTI**: Deploy more accessible CAV projects in communities.

- **Dynamic Message Signs (DMS)**: Use DMS for real-time info on conditions, speeds, and vehicle communication.

- **V2X Funding Gap**: Address financial shortfalls to meet federal Vehicle-to-Everything (V2X) goals.

Traffic Regulations and Safety

- **Enhanced Safety Measures:**

  - Driver background checks for vulnerable populations.

  - Tax OEMs based on fatal crashes to incentivize safety.

- **Informed Driving:** Alerts for pedestrians, traffic disruptions, and vehicle-to-everything (V2X) communication.

- **Zoning for Autonomous Vehicles (AVs):** Explore "no drive zones" based on type (human drivers, CAVs, or both).

- **Smart Infrastructure:**

  - Intelligent intersections tracking vulnerable road users.

  - Signal priority and dedicated signals for CAVs.

  - Permitting ADA-compliant transit deployments.

- **Technological Integration:**

  - Connected devices (e.g., wheelchairs, motorcycles).

  - Clear regulations to foster innovation in crash reporting and operations.

- **CAV Optimization:** Permit platooning and ensure transit deployments align with accessibility standards.

Cyber Security, Data Privacy, and Data Governance

- **Incentives:** Limited liability could encourage participation.

- **Privacy:** Emphasize privacy for connected and autonomous vehicles (CAV), potentially pioneering national standards, and examine effects on OEMs.

- **State Data Needs:** Define the scope and purpose of data collection.

- **NIST CSF for CAV:** Suggest adopting a cybersecurity framework for CAV systems.

- **Safety Data:** Highlight that safety-related data is the key priority for public use, focusing on engineers and safety professionals.

2. What information do we still need to move this goal forward?

Safe Testing of CAVs

- **Examples:** Frameworks from other states.

- **Public Acceptance:** Public perception of CAVs.

- **Safety Outcomes:** CAV technology addressing top causes of fatal crashes.

- **Policy Guidance:** Legislative uncertainties and safe testing criteria.

- **Coordination:** Relationships with legislators and agencies.

Infrastructure

- **Connectivity**: Assess infrastructure and vehicle connectivity requirements.

- **Power Needs**: Define power needs for vehicles, infrastructure, and communication systems.

- **Neighboring States**: Understand collaboration opportunities with neighboring states (ND, SD, WI, IA) in corridor development.

- **Precision GPS Alignment**: Ensure high-precision GPS compatibility in Minnesota.

- **Modalities**: Explore the cost and practicality of vision-based systems versus hardware-based sensors.

- **Industry Status**: Examine the state of CAV trucking technologies.

- **Speed Limit Data**: Update mapping for speed limiter integration.

- **Driver Information**: Identify where drivers need information most.

Traffic Regulation and Safety

- **Data Mining**

  - Analysis of crash data for proactive safety measures.

  - Identification of high-risk areas and tension points (e.g., CAVs vs. pedestrians).

- **Regulatory considerations:**

  - Speed limits for CAVs.

  - Liability and crash accountability.

- **Guidance:** Data requirements for OEM deployment approval.

Cyber Security, Data Privacy, and Data Governance

- **Stakeholder Catalog:** Comprehensive listing of OEMs, vendors, infrastructure, and data brokers.
- **Traffic Analytics:** Explore traffic control, management, and operations improvements.
- **Data Transparency:** Develop a data access framework, leveraging European rules and existing metadata catalogs.
- **National Discussion:** Engage federal audiences and initiate broader discussions on data and security education.
- **Cybersecurity:** Improve analysis of low-tech cyber and AV attack risks, including those involving teleoperators.

3. Based on the conversations we've had during the summit and over the past year, what is the one big goal this committee should focus on in 2025?

Safe Testing of CAVs

- Draft policy recommendations for future driverless deployment.

- Define a go-to-market strategy.

- Invest in CAV maintenance training and certification.

- Promote Minnesota's unique testing resources (e.g., MnRoad).

- Enable new use cases, especially for cold weather/rural testing.

- Align goals with safe testing and educate stakeholders/public.

- Emphasize bipartisan collaboration on AV testing.

- Highlight successful CAV testing projects and partner internationally for policy insights.

Infrastructure

- Learn from international CAV infrastructure and data practices.

- Revise Minnesota's standards for CAV technologies through an update of the MnMUTCD.

- Establish V2X compatibility standards for 2024, 2032, and beyond.

- Catalog existing infrastructure initiatives and interventions.

- **Community Engagement**: Increase public interaction and community engagement with CAV technologies to build acceptance.

- Seek federal funds for long-term CAV needs and quantify national V2X deployment costs.

Traffic regulations and safety

- Build education and public trust in autonomous vehicles (CAVs).
- Clarify and define "driver" as human, machine, or hybrid.
- Increase funding for public transit and focus on first/last-mile solutions.
- Create a legislative framework to define AV right-of-way corridors and establish statutes for CAV ownership, use, and fault determination.

Cyber Security, Data Privacy, and Data Governance

This group's notes did not prioritize specific actions or goals for 2025, but instead suggested that progress should be made on each of the bullet points highlighted in the first two questions.