The following Implementation Plan is supplemental to *NCHRP Web-Only Document 395: Impacts of Connected, Automated Vehicle Technologies on Traffic Incident Management Response* [NCHRP Project 20-102(16)].

NCHRP 20-102 (16): INTEGRATING TIM AND CAV IMPLEMENTATION PLAN

Introduction

As vehicle technology advances to include more connected and automated driving features, emergency responders to traffic incidents face unprecedented circumstances and challenges engaging with these vehicles. Responders need information and new procedures to support and understand how to safely interface with these new vehicle technologies. Uncertainty in response is further complicated by the limited and often disjointed communications, standards, and information exchange between the connected, automated vehicle (CAV) developers, and traffic incident management (TIM) communities. To ensure responders can effectively and safely respond to incidents, it is important that the developers and manufacturers of CAV technologies understand the needs and processes of the responders who will engage with their vehicles during incidents.

A shared understanding of the impact of CAV technologies on TIM and emergency response is critical to the safe adoption of CAVs on the transportation networks. Responders need and deserve clear, actionable, and continuously updated information about CAVs, and developers will benefit from the real-world incident experience of responders.

NCHRP 20-102 (16) looked at the challenges facing responders in responding to incidents that involve advanced technology vehicles, including connected vehicles and vehicles with advanced driving systems. The project considered opportunities to advance communication and coordination between CAV developers and manufacturers and incident responders and support the safety and preparedness of responders through information sharing and training. The project deliverables include a guide for communicating and connecting TIM communities and CAV developers and manufacturers. The project also developed recommendations for information-sharing products, including one-page flyers, online repositories to share good practices, an online communication interface for responders and CAV original equipment manufacturers (OEM), and training materials to support emergency responders.

This document provides an overview of the project findings and outlines actions to support the implementation of the findings and recommendations.

Research Results

The project included literature reviews, research, and interviews conducted by the research team to capture how CAVs may impact TIM activities, including risks and benefits, and how responders are currently engaging with these technologies. The research utilized active engagement with emergency responders, as well as interviews with CAV, industry, and policy leaders. The data collected was used to identify the enablers and barriers to integrating TIM perspectives within the CAV industry and explore specific strategies to remove barriers and improve connection and participation. Based on feedback from

stakeholders and from the research, the team recommended products to be used within and between CAV and TIM communities.

Challenges identified through the research and interview included the need to:

- *Standardize operating procedures* that integrate CAVs in TIM response.
- *Standardize data and technology and share data* related to vehicle operations and incident response.
- *Expand training* to support incident responders' ability to identify and respond to CAVs involved in an incident.
- *Modify incident reports* to capture data on CAV-involved incidents.
- *Address related CAV challenges* such as vehicle stabilization, disengaging advanced driving systems, towing CAV, directing CAV around incident scenes, and extinguishing electric vehicle fires.

The research also identified key considerations for engaging emergency responders in the development of CAVs, including:

- Conducting pilot programs, demonstrations, and vehicle testing that engage TIM responders.
- *Sharing information* on vehicles and emerging technologies with responders.
- Conducting multidisciplinary responder training.
- *Integrating CAV information* into existing responder training modules.

From the OEM perspective, the research identified opportunities to align responders needs with CAV development, including:

- Establishing *centralized points of contact* within OEMs to connect with responders.
- Supporting national legislation, practices, and frameworks for CAV development that *support national standards*.
- Enhance and streamline communication between OEMs and responders.

These findings provided the basis for the projects' recommended products and activities. The four recommendations were to develop four products:

- Single-page flyer
- Online standard operating procedures (SOP) repository
- Input form for responders to connect with OEMs
- CAV-relevant content for responder training

The following section discusses implementation strategies for developing and promoting each of these products.

Implementation Strategy

NCHRP 20-02 (16) focused on opportunities to integrate CAV technologies and TIM practices to enhance safety for responders and the traveling public. The project recommended the development of four products to inform and prepare responders for traffic incidents involving CAVs, and to enhance communication and cooperation between responders and CAV OEMs to support emergency response

through CAV design, deployment, and training. The four recommended products are focused on different audiences, incident responders, CAV OEMs, or both, and need to be developed in coordination and consultation with both groups.

The following lays out an implementation strategy for developing the products, a communication plan for promoting and sharing the products, and considerations for addressing potential challenges to implementation.

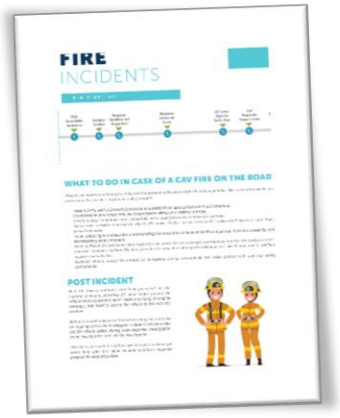
Building the Products

The recommended products include information and training materials for incident responders, an online source for standard operation procedures (SOP) to support response agencies' updates to SOPs to address CAV-involved incidents, an online input form to facilitate communication between responders and OEMs, and CAV-related training material for responders. Table 1 provides a summary of the recommended products.

Table 1 Recommended Products

Product	Audience	Purpose
Single-page flyers	Responders	To provide discipline-specific information for responders to prepare them to respond to CAV-involved incidents.
Online SOP repository	Response agencies	To provide an online source for agencies developing or modifying SOPs to include response protocols or procedures for CAV-involved incidents.
Input form for responders to connect with OEMs	Responders and OEMs	To facilitate information sharing between responders and OEMs to address response concerns with CAVs.
CAV-relevant content for responder training	Responders	To provide accessible, digestible content on CAV-involved incidents.

Single-Page Flyer



Single-page flyers targeting each incident responder discipline would provide focused information in a concise, easily accessible form. Flyers would be developed for each of the following responder groups:

- Law enforcement
- Fire/rescue
- Emergency medical services (EMS)
- TMC operators
- Towing and recovery

The flyers would be available electronically in a print-ready format for easy access and sharing. They would provide information on current CAV technology and discipline-specific need-to-know information on responding to CAV-involved incidents. To maintain relevancy in a quickly changing CAV environment, it is recommended that the flyers be reviewed quarterly and updated as needed.

Format

The format of the flyers would be limited to a single-page handout containing critical, bite-size information on responding to a CAV-involved incident. The format should be standardized for national distribution and color-coded by discipline for easy recognition by target audiences. They would be distributed electronically to organizations and agencies and could be printed as handouts in trainings and briefings, posted on notice boards, enlarged as training posters, and shared on agency websites. Regular review and update of content would provide incident responders with up-to-date information about CAV technology and recommended procedures for interacting with CAVs.

Content

The content of each flyer will be discipline-specific and reflect the most current CAV technology and responder practices. This may include information needed to interact with CAVs en route, on scene, and post-incident. For example, what does law enforcement need to know about interacting with a moving CAV in terms of traffic stops; what safety considerations should fire and EMS be aware of when approaching or interacting with a CAV on scene; and what critical information does towing and recovery need to safely remove a CAV from an incident scene.

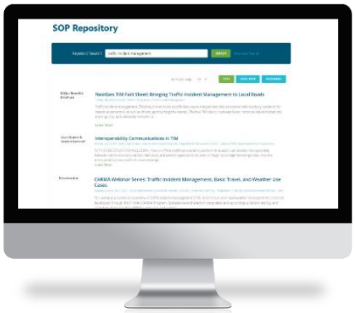
Approach

Each discipline-specific flyer should be developed in coordination with CAV OEMs and response organizations to ensure they meet the needs of responders and reflect accurate and current CAV technologies. The development of each flyer should be closely coordinated with representative organizations of the target discipline and representatives of the CAV community to ensure that the information is current, accurate, and actionable.

Leadership of flyer development could come from a variety of sources, including TRB and FHWA. Their role would be to convene the appropriate representatives to identify critical need-to-know information specific to each discipline, confirm current CAV technology information, and identify recommended procedures to address CAV-specific challenges or variations to traditional SOPs. A process for final review by CAV and discipline-specific organizations should be established for accuracy and usefulness.

Online Standard Operating Procedures (SOP) Repository

An online repository for SOPs would provide a resource to response organizations interested in developing model SOPs for their members and for response agencies developing or updating their SOPs to address the evolving challenges and needs of CAV technology. By compiling examples of SOPs that address CAV technologies, agencies can share their knowledge and practices easily and cost-effectively. Consistent CAV-related SOPs across agencies would support responder safety and effective response to incidents involving CAV. SOPs can provide the basis for responder training and the evolution of agency practice.

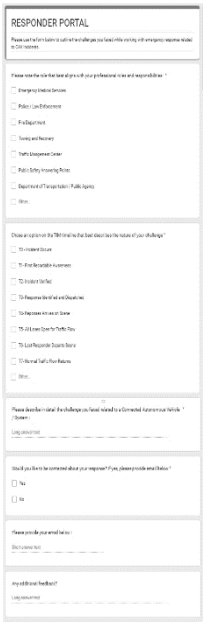


Approach

The main audience for the SOP repository is the responder community with input and support from the CAV community. The online repository could be similar to other websites developed by the U.S. DOT Intelligent Transportation Systems Joint Project Office (ITS JPO) or the National Operations Center of Excellence (NOCoE) and provide a searchable database of SOPs developed by response agencies and OEMs. The repository could be added to an existing website or developed as a standalone resource. It would be populated with available, known SOPs related to responder interactions with CAV, and allow users to search on SOPs by agency and discipline. This would include agency SOPs, industry SOPs developed for response to CAV incidents (e.g., Waymo), and model SOPs or templates. The site would also allow users to upload SOPs as they are developed and would need to be moderated to ensure that uploads meet site content standards.

The development of the site could be led by TRB, U.S. DOT, or NOCoE, in cooperation with existing, compatible websites. Coordination with responder organizations and CAV OEMs is essential to the design and population of a useful website.

Online: Input Form for Responders to Connect with OEMs



One of the most common concerns expressed by the incident response community about how to prepare, train, and respond to CAV-involved incidents is the lack of communication between responders and CAV developers. Responders are often frustrated by not being able to provide input and perspective to CAV developers that could enhance public and responder safety. An online portal or input form would allow incident responders to share information and experiences interacting with CAV, and to offer suggestions on changes to operations or functions to improve those interactions.

The responder input form would collect issues and suggestions in near real-time and share these with OEMs and CAV technology developers. The input form would include drop-down menus for ease of categorizing concerns and text boxes to allow responders to describe the issue or situation. The information collected would be shared with appropriate OEMs for their consideration and response. Concerns and responses would be summarized and reported back to incident responders on the same site.

Approach

The development of the input form and response reports could be facilitated by U.S. DOT, TRB, or NOCoE in coordination with incident responders and OEMs to ensure the usefulness of the portal. A working group of incident response organizations and CAV OEMs would allow collaborative exploration of the most effective format and structure to facilitate communication. The portal itself would need to be moderated to review and direct input to the appropriate OEMs and organizations. This would require identifying OEM liaisons or contacts to direct input to and to facilitate responses from the OEMs. The form could be developed to automate some of this review, based on challenge type, incident type, CAV manufacturer/brand, responder type, and description keywords.

CAV-Relevant Content for Responder Training

The fourth product recommended in the NCHRP 20-102 (16) research was the development of key information about CAV-involved incidents to support responder training. This would include CAV-relevant content that could be included in existing training curricula and briefings, rather than stand-alone CAV training materials. The approach recommended is to develop CAV-related information in bite-sized form that can be incorporated into existing training modules. This approach makes the information more relevant to current practices and does not create a burden on training programs to add new topics or training modules. For example, critical information about disengaging automated driving systems would be integrated into fire/rescue training on vehicle stabilization and extrication. Information on how to

report driver information on crash reports when the vehicle is fully automated would be included in law enforcement training on crash reporting.

In addition to developing critical training nuggets for use in existing curricula, expanding and updating information in TIM and responder training to include challenges and recommendations for interacting with CAV would provide additional resources to responders. This could be integrated into training offered online on sites like ResponderSafety.org, included in the annual Responder Day activities, or added to the FHWA National TIM Responder Training.

Approach

A working group of responder training personnel and OEM representatives should be formed to develop critical training information, recommend a range of delivery options (integration in existing training programs, online briefings or training, inclusion in single-page flyers by discipline, etc.), and establish an update process to ensure information remains current and relevant in an evolving CAV environment. The working group could be part of a larger coalition of response organizations and OEMs convened to develop the products recommended by this project.

Communication Plan

Building the products is an important first step to sharing information between incident responders and CAV developers. The next critical step is to distribute and promote the use of these products. This requires a structured approach to exploring opportunities to communicate the findings of this project, distribute products, and engage stakeholders in sharing information.

This section outlines activities to share the products across CAV/TIM stakeholders and expand their use.

Cross-Reference Products

To support a coordinated rollout of the recommended products, cross-referencing products would enhance the visibility and awareness of the other products. For example, including links or QR codes to the online form or SOP repository on the single-page flyers would increase awareness of these products. Including information on the products in training materials would also raise awareness. Opportunities for cross-referencing and promoting other products should be considered in the development of each product.

Webinar

One way to bring awareness of the products to target audiences is to offer webinars that specifically target the responder community as the audience. Webinars can be offered in partnership with existing providers, such as the National Responder Safety Institute, Partners for Automated Vehicle Education (PAVE), NOCoE, ITS-JPO, and specific responder discipline organizations. These webinars should be short, focused, and recorded to allow viewing on demand. They should also provide an open forum for questions and discussions to engage participants.

Distribution of products

As products are developed, they should be announced to a broad group of incident response organizations for distribution and use by their constituent agencies. Table 2 provides a suggested list of organizations to include and engage for outreach and the communications formats they offer to their constituents.

Table 2 Compiled Organizations List by Category and Communications Format

Category	Organization	Mailers	Social Media	Live Events	Online Events	Print Media	Videos
Academic and Research	California Center for Innovative Transportation	X					
	Emergency Responder Safety Institute		X	X	X	X	X
	National Police Foundation	X	X	X	X		
	Transportation Research Board	X	X	X	X	X	
	University Transportation Centers	X	X				
Emergency Communications	Association of Public-Safety Communications Officials International	X	X	X	X		
	FirstNet	X	X	X	X		X
	National 911 Program	X			X		X

Category	Organization	Mailers	Social Media	Live Events	Online Events	Print Media	Videos
Emergency Communications	National Association of State 911 Administrators	X			X		X
	National Emergency Number Association		X	X	X		X
	National Public Safety Telecommunications Council	X	X	X	X		
Emergency Management	International Association of Emergency Managers	X	X	X	X		X
	National Emergency Management Association	X	X	X	X		X
Emergency Medical Services	American College of Emergency Physicians		X	X	X		X
	Committee on Trauma – American College of Surgeons		X			X	
Emergency Medical Services	National Association of Emergency Medical Technicians	X	X	X	X	X	X
	National Association of EMS Physicians	X	X				
	National Association of State EMS Officials		X	X	X		X
	National EMS Management Association	X	X	X	X		X
Fire and Rescue	International Association of Fire Chiefs	X	X	X	X		

Category	Organization	Mailers	Social Media	Live Events	Online Events	Print Media	Videos
Fire and Rescue	International Association of Fire Fighters	X	X	X	X	X	X
	National Volunteer Fire Council	X	X	X	X		
Law Enforcement	International Association of Chiefs of Police	X	X	X	X		
	Major Cities Chiefs Association	X	X				
	Major County Sheriffs of America	X	X				
	National Sheriffs' Association	X	X	X	X		X
Technology & Telematics	American Transportation Research Institute	X	X				
	American Trucking Associations	X	X				
	Association for the Advancement of Automotive Medicine	X	X	X	X		X
	Intelligent Transportation Society of America	X	X	X	X		X
	National Association of State Chief Information Officers	X	X	X	X		X
	National Association of State Technology Directors	X	X	X	X		X
	Public Technology Institute	X	X	X	X		X

Category	Organization	Mailers	Social Media	Live Events	Online Events	Print Media	Videos
Technology & Telematics	Society of Automotive Engineers International	X	X	X	X		X
Transportation Operations	American Association of State Highway and Transportation Officials	X	X	X	X		X
	American Public Works Association	X	X	X	X		X
	Association of Transportation Safety Information Professionals	X	X	X	X		X
	Automobile Association of America	X	X	X	X		X
	Governors' Highway Safety Association	X	X	X	X		X
	Institute of Transportation Engineers	X	X	X	X		X
	International Municipal Signal Association		X	X	X		X
	National Association of City Transportation Officials		X	X	X	X	X
	National Association of County Engineers		X	X	X		
	National Operations Center of Excellence		X	X	X	X	X

Category	Organization	Mailers	Social Media	Live Events	Online Events	Print Media	Videos
Towing and Recovery	Towing and Recovery Association of America	X		X		X	
	Emergency Road Service Coalition of America	X	X	X		X	
	State Towing Associations	*(varies by state)*					
	Wreck Master	X	X	X	X	X	
Connected and Automated Vehicles	PAVE (Partners for Automated Vehicle Education) Campaign	X		X		X	
	Autonomous Vehicle Industry Association	X	X				
	Cooperative Automated Transportation Coalition	X	X	X	X		
	Coalition for Future Mobility	X	X			X	X
	Center for Transportation and the Environment	X	X			X	

Presentations

Working with TIM/CAV stakeholders, it is recommended that opportunities for presentations on available products be given at a variety of venues and events, ranging from national conferences to more local events such as TIM team meetings or State responder trainings. Presentation materials should be developed that could be used and adapted for different audiences and events and made available to stakeholder organizations to share on their websites and with their members.

The following associations have been identified as key partners for presentations. Each identified partner is listed with conferences and event opportunities for coordination.

- **National Emergency Number Association (NENA)**: The next NENA Annual Conference is scheduled for June 28-July 2, 2024, and will take place in Kissimmee, FL. Additional details are available on the NENA Conference website.
- **National Association of State EMS Officials (NASEMSO)**: NASEMSO's Annual Meeting is scheduled for May 12-16, 2024, in Pittsburgh, Pennsylvania. Information is available on the NASEMSO website.
- **International Association of Fire Chiefs (IAFC)**: IAFC holds its Annual Meeting in August each year. It also offers workshops and meetings throughout the year. Information is available on the IAFC Events page.
- **International Association of Chiefs of Police (IACP)**: IACP's Annual Conference is held in October. The 2023 conference will be held October 14-17 in San Diego, the 2024 conference is scheduled October 19-22 in Boston. Information on upcoming conferences is available on the IACP website.
- **National Sheriffs' Association**: The National Sheriffs' Association hosts two conferences annually, a winter conference in February in Washington, DC, and an Annual Meeting in June. The 2024 Annual Meeting will be held June 24-27 in Oklahoma City. More information on conferences is available on the National Sheriffs' Association website.
- **Governors' Highway Safety Association (GHSA)**: GHSA's 2024 Annual Meeting is scheduled for September 7-11 in Indianapolis. Information on future meetings is available on the GHSA website.
- **Towing and Recovery**: Several towing events are held annually that could provide a forum for CAV/TIM outreach. These include the American Towman Exposition to be held in Baltimore in 2024, and TowXpo to be held in San Antonio in 2024. Tow Times maintains a list of shows and expos for the current year that includes more local and regional events as well.

Articles/Publications

Announcements of developed product availability and associated updates should be included in organization newsletters and publications to promote the research and products that readers might be interested in. As part of the outreach and communication efforts, individual articles in industry, research, or other publications would provide information to the CAV and TIM communities to let them know about new products and updates. Compiling a list of organizational points of contact for the partners in Table 2

will provide a way to quickly disseminate information and updates or to share links to relevant research and products.

Discipline-agnostic articles or templates could be provided to each responder organization as the basis for discipline-specific articles in their outreach materials (newsletters, websites, blogs, etc.) In addition to discipline-specific publications, information announcements and articles in more general responder publications such as Emergency Management and Response – Information Sharing and Analysis Center's (EMR-ISAC) InfoGram bulletin.

Responder OEM Conference/Workshop

An effective way to promote the products and facilitate communication among incident responders and CAV developers would be to hold a CAV/TIM workshop or partner with existing events to include a multidisciplinary session. Such activities can set the stage for expanded communication and coordination between responders and OEMS. These could include presentations, demonstrations, and hands-on training or scenarios.

The following are examples of approaches to offering a CAV/TIM-focused event. The first looks at coordinating a workshop with professional meetings or conferences. The second considers a nationally sponsored standalone workshop.

1. A CAV/TIM demonstration coupled with an existing event. This could include a workshop or demonstration at a conference, TIM meeting, or an emergency response-specific planning or coordination event.
    a. **A demonstration could be paired with any of the annual meetings of partner organizations listed in Table 2.**
    b. **Demonstrations could include how to disable an automated vehicle, work with connected vehicle data, or integrate automatic crash notification data in emergency communications and dispatching.**
    c. **Activities could include live demonstrations and hands-on exploration of different automated vehicles or tabletop exercises.**
    d. **These demonstrations should engage both CAV manufacturers and emergency responders to facilitate and encourage information sharing.**
2. A standalone event focused on CAV/TIM issues and considerations.
    a. **U.S. DOT or another national-level organization could convene a CAV/TIM-focused workshop or conference to support information sharing and educational opportunities between vehicle and technology developers and TIM responders.**
    b. **This event could be designed as a national forum or as a regional or local event offered around the country or even virtually. It should engage responders in leadership and initial response levels of organizations to build awareness and enhance responder skills related to CAV incidents.**

Addressing Implementation Challenges

There are several critical challenges to developing and promoting the recommended products. It is essential that all key stakeholders from the TIM and CAV communities are actively engaged and represented in developing and rolling out the products to their members and ensuring that the products are useful and meet their members' needs. Connecting with key stakeholders, building meaningful coalitions with active representation from all TIM and CAV interests and disciplines, and maintaining product relevance and usefulness are essential to implementing the recommended products.

Connect with Key Stakeholders

It is essential that product development and roll-out engage a broad representation of incident responders and CAV developers to ensure usefulness and validity. Clearly defined objectives for involvement and broad outreach to all potentially affected stakeholders and partners are critical to the success of the products. This should include all TIM response disciplines and targeted outreach to OEMs for technical guidelines. It is important to identify and engage the best contacts in each discipline for each product.

Build Meaningful Coalitions

To provide ongoing, cross-disciplinary oversight to the development, roll-out, and ongoing maintenance of the recommended products and other initiatives to support response and interaction with CAVs, a coalition of TIM responders and CAV developers should be brought together to facilitate dialogue and exploration. If a more formal group is formed to facilitate collaboration between incident responders and CAV developers and OEMs, it should be sponsored by an agency or organization that can provide staffing and resources to support and facilitate the group. It could be an ad hoc group, a working group of another committee (such as the TIM Executive Leadership Group), or a more formal standing committee focused specifically on integrating TIM and CAV. It is essential that any successful coalition have strong leadership and direction, and that all members be engaged in ongoing activities.

Regularly Update Information and Products

The CAV environment and technologies are evolving rapidly. To address these rapid changes, it is important to develop a product content update process to ensure information is current and useful. This process should be built into the development of each of the products and include content review, update steps, and recommendations on monitoring and updating responsibilities.

Recommendations for Additional Research

Based on the interviews and literature review undertaken for the project, a number of additional research needs were identified. Each of the following research needs would continue to support coordination between incident responders and CAV OEMs and developers.

Activities to Support TIM Responder and OEM Coordination

There is a need to develop and provide training and other materials to help responders identify CAVs and CAV-specific conditions (e.g., level of engagement, how to approach the vehicle, safety-critical features, and design elements). This could be similar to the work the National Fire Protection Agency (NFPA) has done on responding to hybrid and electrical vehicle fires, providing training materials and an emergency response field guide to identify different makes and models of electrical vehicles. (See information on this effort at https://www.nfpa.org/EV)

Responder Engagement in Pilot/Testing Deployments

Pilot programs, demonstrations, and vehicle testing can enhance coordination and information sharing between responders and OEMs. These and other activities should be explored as opportunities to engage OEMS and first responders prior to vehicle and technology deployment to understand the needs and concerns of responders and to share knowledge through hands-on scenarios. The planning for these events should engage responders and local leaders with OEMs and identify specific details about what they do (or do not) want from these activities.

Legislative/Regulatory Updates

This project identified a need to involve responders more in legislative and regulatory conversations about CAVs and their implications. Increased engagement of incident responders in national, policy-level discussions on issues such as standardization of data and vehicle design would enhance the conversations and support more robust results. Participation or representation in research, working groups, and development of briefing documents, among other policy-level activities would advance the needs and interests of responders, enhancing safety for the responders and the traveling public. For example, standardizing vehicle design (taken at the industry level or mandated) ensures responders know where safety-critical components are located and how to disengage driving systems when needed.

An important first step is to monitor and share legislation and policies under consideration or enacted. The National Conference of State Legislation (NCSL) provides an example of a repository that could be developed for CAV-relevant policies, tracking existing, proposed, and failed legislation that involves CAVs. This initiative could be expanded to add a search filter for TIM or incident response in the NCSL database. Additional research would allow responders and OEMs to stay up to date on discussions about relevant policies, such as data standardization, which support better integration of CAV and TIM. Sharing briefing documents or updates of relevant regulations or policy changes to the incident response communities is critical to helping them prepare and train for changing CAV technologies.

Including CAV Considerations in SOPs

In addition to the SOP repository product recommended by this project, research and coordination between responders and CAV developers to develop model SOPs or recommended practices for interacting with and responding to CAV would enhance safety and support consistent response to CAV-involved incidents. A multidisciplinary responder-CAV coalition to explore practices related to approaching or interacting with CAVs in a variety of incident scenarios would significantly enhance responders' understanding of CAV operations and how to interact with them, and OEMs' understanding of how various CAV design features may positively or negatively affect incident response and responders. This coalition could be charged with developing a national model CAV incident response SOP.