



# Peer Exchange Report

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## Maintenance Work Zones Peer Exchange

# Overview

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The National Operations Center of Excellence (NOCoE) hosted the Maintenance Work Zones Virtual Peer Exchange to share information between a cross section of agency managers in the transportation operations and maintenance function of their jurisdictions. Their experience in developing and managing temporary work zone plans, programs, technology, strategies, and policies in their organizations provided the basis for an exchange of ideas about current leading practices.

The goal of the peer exchange was to share successful real-world experience from agencies working on the safety and efficiency of temporary and maintenance work zones by using TSMO strategies. The *Transportation Operations Manual* states that "the phrase, 'speed kills' is perhaps more applicable in work zones than any other area. The combination of speed, reduced clearances, changes in roadway geometry... combine to heighten the risks associated with work zone crashes, especially to workers."

There was an emphasis on sharing successful approaches such as work force training and development, Smart Work Zone technologies, work zone data exchanges (WZDx), and traffic safety cameras, as well as traveler information and messaging that can be adapted and applied to other peer organizations. The discussion in each segment shared challenges, successes, and lessons learned with various applications. Agency staff are working to create new opportunities to improve maintenance work zones through collaborative problem-solving, but some aspects are still a work-in-progress in some regards.

The participants were encouraged to actively take part by sharing their questions, comments, and current practices among each other. An introductory segment conducted polling of participants to gauge where their agencies are with respect to the different topics on the agenda. Key issues not touched on or where additional engagement is needed are noted in Next Steps at the end of this report. Attendees were asked to consider the actions their agency may need to take to align desired goals and objectives to provide safe maintenance work zones, incorporate new data sources and technologies, share public information, keep their staff up to date in their training and development to resolve the current and future challenges.

Participants are able to reach out to presenters for further information or assistance, and were asked how the NOCoE, its partner associations, and FHWA can provide resources to assist them in their implementation of maintenance work zones.

# Discussion Topics

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<b>SUMMARY</b>	<b>1</b>
<b><i>Session 1 – Participants’ Perspectives on Agenda Topics</i></b>	<b>1</b>
<ul style="list-style-type: none"><li>• Understanding Perspectives</li><li>• Discussion</li></ul>	
<b><i>Session 2 – Safety: Balancing Worker Needs with Traveler Behavior</i></b>	<b>5</b>
<ul style="list-style-type: none"><li>• Introduction to the Conversation</li><li>• Perspective from Massachusetts DOT</li><li>• Perspective from North Dakota DOT</li><li>• Discussion</li></ul>	
<b><i>Session 3 – Regional Work Zone Data Sharing</i></b>	<b>9</b>
<ul style="list-style-type: none"><li>• Perspective from Maricopa County DOT</li><li>• Discussion</li></ul>	
<b><i>Session 4 – Data Exchanges, Data Dictionaries, and Data Sharing</i></b>	<b>12</b>
<ul style="list-style-type: none"><li>• Introduction to the Conversation</li><li>• Perspective from Iowa DOT</li><li>• Perspective from Colorado DOT</li><li>• Discussion</li></ul>	
<b><i>Session 5 – Positive Protection Policy and Speed Safety Cameras</i></b>	<b>17</b>
<ul style="list-style-type: none"><li>• Introduction to the Conversation</li><li>• Perspective from Maryland DOT, CHART</li><li>• Discussion</li></ul>	
<b><i>Session 6 – Work Force Training and Development</i></b>	<b>20</b>
<ul style="list-style-type: none"><li>• Introduction to the Conversation</li><li>• Perspective from Virginia DOT</li><li>• Perspective from ATSSA</li><li>• Discussion</li></ul>	
<b>NEXT STEPS</b>	<b>24</b>
<b><i>Key Issues</i></b>	
<b><i>Conclusions</i></b>	
<b>RESOURCES</b>	<b>28</b>

# Summary

## Session 1 – Participants’ Perspectives on Agenda Topics

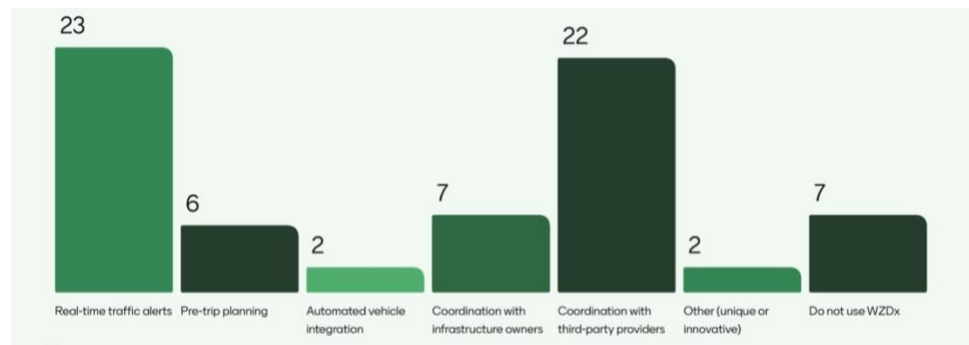
### Understanding Perspectives

The session was introduced by the facilitators and then moved into a series of poll questions touching on the topics of the subsequent sessions of the agenda to understand the characteristics of participating agencies’ programs related to maintenance work zones. The questions were related to the overarching TSMO-related challenges and opportunities of various types for maintenance work zones and Intelligent Transportation Systems (ITS) technology applications.

#### Q: Which Smart Work Zone (ITS) capabilities does your agency use?

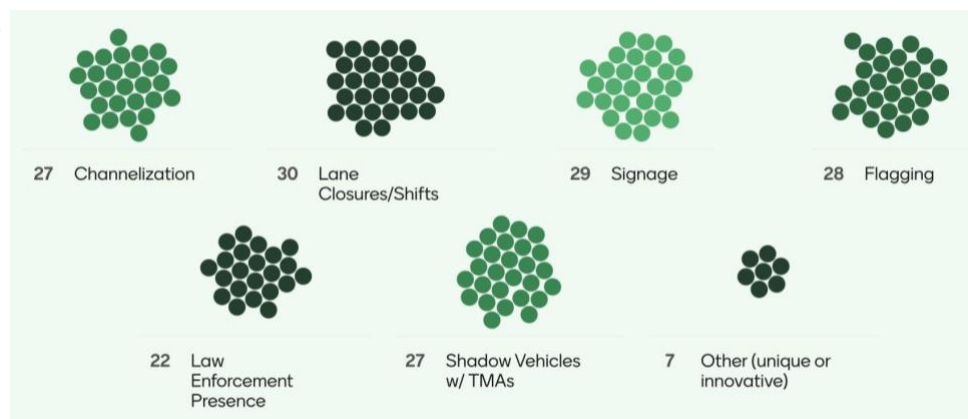
Other unique or innovative capabilities shared include:

- Dynamic merge systems
- Connected contractor equipment (see Discussion section regarding Advanced Digital Construction Management Systems)

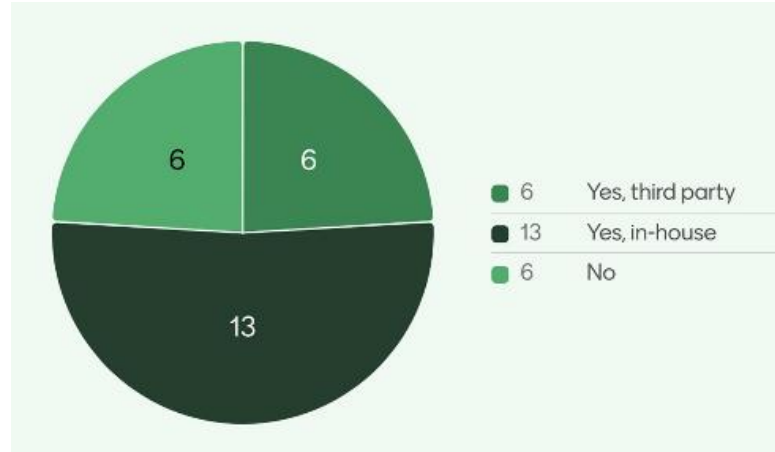


#### Q: What Work Zone Data Exchange (WZDx) use does your agency employ?

#### Q: Which physical traffic control elements does your agency use for maintenance work zones?



*Q: Is there a certification program for work zone implementation in your agency?*



*Q: What training does your workforce receive for physical and smart work zones? Does it differ by personnel classification?*

A cross section of responses included:

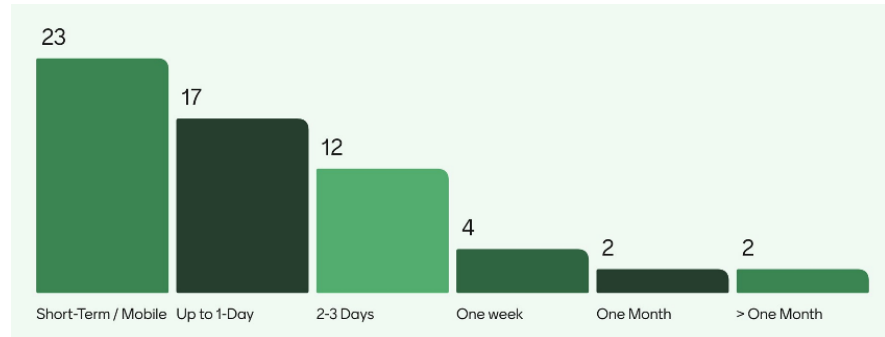
- Formal annual one-week traffic control work zone courses, some agencies with refresher courses, typically in wintertime.
- Subject Matter Experts provide various trainings in the fundamental areas of traffic engineering and State specific trainings. Field staff and technicians attend a two-day formal class.
- Train the trainer approach for data. Physical work zones training is determined by shop supervisors.
- Use of certification programs.
- Currently building our work zone training based on new FHWA rules.
- There is an annual meeting to discuss best practices. Some shops have training areas dedicated.
- Construction personnel get project specific training when Smart Work Zones are used. Just getting to the introduction of Connected Work Zones and training will be project specific.
- Very little training. Working to develop a work zone activity data program that should come with better training.
- Smart work zones are covered in general work zone training.
- Little on smart work zones or minimal direct training offered.

*Q: How does your agency coordinate and harmonize standards with other jurisdictions for maintenance work zones?*

- *Manual on Uniform Traffic Control Devices*, 11<sup>th</sup> edition (MUTCD) and State standards and specifications (including supporting drawings).
- Divisions/Districts correspond with each other on standards/.
- Agency does not but county data is merged on state 511.
- State handbooks, e.g., *Oregon Temporary Traffic Control Handbook* or *Virginia Work Area Protection Manual*.
- Agency develops highway standards in line with requirements in the MUTCD and encourages other agencies in the State to follow our guidance.

*Q: Which duration best describes your agency's maintenance work zone activities?*

Most agencies define two to three days or less as maintenance work zones. Virginia defines mobile, short duration, short duration stationary, intermediate term stationary, long-term stationary and night-time activities.



*Q: How does your agency's work zone implementation vary by activity duration and complexity?*

- Variation in activities are consistent with State standards and specifications as well as associated drawings.
- Quite varied in construction. In maintenance there are some repetitive standards used.
- There are various work zone control plans based on duration and complexity.
- Type of roadway or closure.
- Roadway traffic volume.
- Roadway speed.
- Types of activity or operation within work zones, e.g., crack sealing, mowing, guiderail repair, etc.
- In program management we assign a path to our project if competitively bid. The path determines the amount of plan reviews. Non-let projects are context specific.

*Q: What requirements does your agency place on third-party contractors for short duration activities?*

- Permitted work to follow MUTCD (multiple responses) either with or without state standards, specifications, or drawings.
- Supplemented by reporting closures to the engineer's office.
- Third party contractors are required to follow contract documents that include either standards and specifications, or reference internal manuals and guidance.
- Advance warning signage.
- State handbooks, e.g., *Oregon Temporary Traffic Control Handbook* or *Virginia Work Area Protection Manual*.

*Q: What are your agency's references for standards and procedures for maintenance work zones? (Beyond MUTCD or state standards & specs)*

Agencies that they use:

- On-line information, e.g., Iowa DOT *Electronic Reference Library* [Standard Road Plans – TC Series](#) or New York State DOT [standard sheets for work zone traffic control](#).
- Formal training program documents.
- On-line Traffic Control Manual to access standards sheets.
- Engineering Policy Guide.
- Region specific preference within the state. Possibly road/route specific for events/holidays.
- Contract specifications.
- No other references.

## **Discussion**

Matthew Miller, Director of New and Emerging Transportation Technologies with the Iowa DOT, shared insights into the Advanced Digital Construction Management Systems (ADCMS) project, [a collaborative effort with the Delaware DOT](#) supported by an FHWA grant. The initiative focuses on leveraging existing contractor equipment to enhance road safety and project documentation. By integrating with an e-ticketing vendor (HaulHub) and using the ISO 15143 equipment specification, the project tracks location and fuel usage to provide real-time "worker presence" notifications via Waze. While the GPS accuracy isn't precise enough to identify specific lane closures, it successfully alerts drivers to slow down by confirming that active work is occurring on the road.

Beyond safety notifications, the technology is being used to create digital as-built plans, collecting critical data such as pavement widths and profiles directly from the machinery. This approach is a shift away from mounting external cameras or hardware, instead opting to collect data already generated by the equipment's internal systems, such as the John Deere Operations Portal. Miller noted that while some contractors were initially hesitant about transparency, many have embraced the system once they realized the goal was safety and efficiency rather than surveillance. The success of the program is evident in its scale, with hundreds of pieces of equipment now connected and contractors voluntarily maintaining the connection across multiple projects.

## **Session 2 – Safety: Balancing Worker Needs with Traveler Behavior**

### **Introduction to the Conversation**

The session covered various approaches employed by agencies focused on safety balanced between workers' needs and driver behavior. Speakers and the discussion touched on smart work zone deployment, movable barrier systems, planning considerations such as flagging operations, time of day, etc. as well as other elements like variable speed limits, temporary signals, and traffic enforcement.

### **Perspective from Massachusetts DOT**

Neil Boudreau, Assistant Administrator of Traffic and Safety for the Massachusetts Department of Transportation (MassDOT) detailed the state's comprehensive strategies to reduce operating speeds and improve safety in construction and maintenance work zones. Historically, Massachusetts has been a "police detail state" which traditionally relied on on-site officers to manage traffic. However, recent legislative changes and technology advancements are shifting the focus toward more dynamic, data-driven solutions. A major milestone occurred in 2021 when the state granted MassDOT the authority to implement variable speed limits, allowing for enforceable regulatory speed reductions specifically when workers are present.

To maximize the effectiveness of these speed limits, MassDOT has categorized them into static and dynamic applications. Static limits are reserved for areas with inherent geometric hazards, such as narrowed lanes or shifts in alignment, and remain in place 24/7. In contrast, dynamic speed limits are reduced only during active work periods and restored to normal limits when the roadway is clear. Boudreau emphasized that this approach builds credibility with the public, as drivers are more likely to comply with reduced speeds when they can clearly see that a hazard—active workers—exists. To support this, the state is integrating radar speed feedback displays and "connected" work zone devices, such as smart arrow boards and location markers, which validates worker presence in real-time.

Looking forward, MassDOT is focusing on the Connected Work Zone standard to broadcast accurate, live data to third-party mapping apps and vehicle manufacturers. The state began testing specifications in 2025 that push validated work zone data—including lane closures and reduced speed limits—directly into vehicle dashboards and GPS systems. In addition to these digital efforts, the state continues to use physical tools like temporary portable rumble strips to alert distracted drivers and partners with State Police for aggressive enforcement campaigns. During the 2024 and 2025 National Work Zone Awareness Weeks alone, these efforts resulted in hundreds of citations, underscoring the state's multi-layered commitment to protect both road users and highway workers.

Following the formal presentation, the subsequent discussion explored the practical challenges and successes of MassDOT's work zone safety initiatives, specifically regarding performance metrics, the physical behavior of rumble strips, and the legal weight of digital speed limits. Boudreau clarified that while MassDOT is currently developing performance benchmarks to comply with federal safety and mobility rules by late 2026, they are still refining the data capture methods needed to produce consistent metrics.

Boudreau reported an average speed reduction of 6 to 7 mph by using temporary portable rumble strips, noting that workers felt safer because the noise alerted them to approaching vehicles. However, Kenneth Thornewell of the North Carolina DOT shared a contrasting experience, noting that on high-speed interstates, rumble strips caused "shockwave" braking where traffic would suddenly drop from freeway speeds to 5 mph, forcing them to abandon the technology. Boudreau acknowledged these deployment challenges, explaining that MassDOT now leaves their use to the discretion of on-site engineers rather than requiring them in every instance. The Temporary Rumble Strips are required on all projects aside from when the surface is milled and the pavement friction does not allow the strips to stay in place. The

Resident Engineer may choose to not deploy the temporary rumble strips if the setup is going to be short duration and not a traditional 8-10 hour shift.

The variable speed limits displayed on portable variable message signs are regulatory supported by legal authority and fully enforceable. Boudreau shared that unlike traditional speed zones that require a lengthy speed study, these limits are established during the design process and stamped by an engineer. The digital infrastructure provides a specific timestamp of exactly when the reduced limit was active, providing unambiguous evidence for law enforcement and resolving a common hurdle faced by other states.

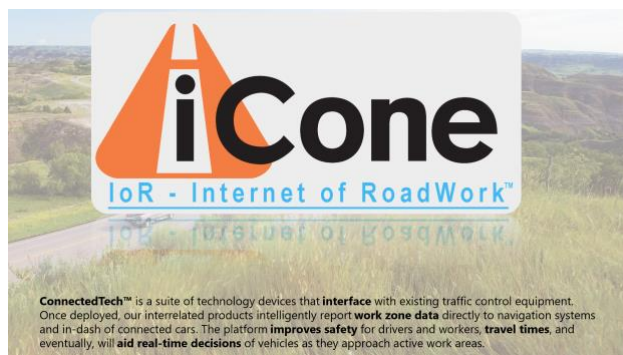
The discussion touched on the integration of digital mapping with platforms like HaulHub. While Delaware DOT uses geofencing to detect when equipment like pavers enter a work area, Massachusetts is moving toward using physical "start and end" marker devices to pinpoint active work. This allows for more granular data than a simple geofence, helping to eliminate "ghost" work zone notifications and providing drivers with specific instructions—such as exactly which lane is closed—well before they reach the bottleneck. Boudreau expressed an expectation that this level of precision will eventually lead to better driver decision-making and fewer last-minute lane changes.

### **Perspective from North Dakota DOT**

Following a string of traumatic safety incidents, including a fatal tractor mowing accident and a severe collision that pinned a worker against a cable guardrail, the North Dakota Department of Transportation (NDDOT) urgently shifted toward automated work zone awareness. Mike Kisse, Program Manager - Maintenance Division shared that the department realized that their manual process for updating travel maps was failing; busy field crews often lacked the time to log work zone locations, leaving the public unaware of active maintenance. To bridge this gap, NDDOT integrated iCONE and iPin technology to automate the presence of maintenance crews on their public-facing travel maps.

### ***Integration and Compatibility***

The core of this strategy involves equipping maintenance vehicles, such as those with truck-mounted attenuators (TMAs) and pickup-mounted message boards, with connected devices that activate automatically. Functionality and hardware compatibility were critical components of the iCone rollout. The Arrow Board Kit is designed to integrate seamlessly with existing arrow boards,<sup>1</sup> while the iPin device provides a solar-powered solution specifically used to mark the beginning and end of work zones. When a crew member turns on an arrow board displaying a left or right chevron for a lane closure the iCONE device immediately broadcasts that data. This not only populates the NDDOT travel map with a specific "M" icon for maintenance but also pushes alerts to third-party apps like Waze and in-vehicle HAAS Alert systems. This automation ensures that worker presence notifications are accurate and real-time, removing the burden of manual entry from the workers on the ground.



Kisse highlighted the versatility of the iPin devices, which are small, portable units that can be tossed into the cab of a tractor during roadside mowing operations. By simply turning the device on, a moving mower's location is digitally mapped, providing a road hazard warning to approaching motorists. The

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<sup>1</sup> Agencies should note a specific compatibility limitation: existing full matrix arrow boards are not compatible with the current iCone lineup. However, for those requiring full matrix functionality, the LiteSys Arrow Board is specifically noted as being compatible with iCone integration.

NDDOT is currently scaling this initiative, with plans to equip over 70 new pickup-mounted message boards with these connected devices to ensure statewide coverage.

The goal for NDDOT is to achieve high data integrity to satisfy the requirements of the Work Zone Data Exchange (WZDx) and the Situation Data Exchange (SDX). Kisse acknowledged that while their data is currently reaching third-party providers, the agency is working to refine the format to ensure it is more widely and reliably used by navigation companies and Original Equipment Manufacturers (OEMs). By focusing on accuracy and automation, North Dakota aims to transform its work zones from invisible hazards into digitally "visible" areas, specifically targeting high-risk activities like winter operations and roadside maintenance.

### *Procurement Guidelines*

For the 2025-27 biennium, the procurement process for these devices has been formalized to ensure regulatory compliance and accurate record-keeping. While individual districts are responsible for making purchases, any procurement reaching the \$100,000 threshold requires a formal process involving three separate quotes. To maintain oversight, all purchase requests must be routed through the Maintenance Division, which is responsible for tracking these acquisitions and ensuring that all departmental procurement rules are strictly followed. Each of three primary iCone hardware solutions (the Work Truck Beacon Kit, the Arrow Board Kit, and the iPin device) operates under a tiered pricing structure, where per-unit costs decrease significantly with higher order volumes ranging from approximately \$750 to \$970 per unit depending on the quantity with the advantage of having no associated annual fees.

### **Discussion**

The post-presentation discussion focused on the technical, behavioral, and jurisdictional hurdles of implementing connected work zone technology. The conversation was divided into several key thematic threads:

#### *Data Accuracy and the Phantom Work Zone*

A major point of discussion was the reliability of automated data from connected arrow boards. Kelly Wells and Kenneth Thornewell (North Carolina DOT) shared a discovery regarding contractor behavior: instead of turning arrow boards off after a shift, crews often simply turn them parallel to the road. Because the device remains powered on, it continues to broadcast a lane closure to traveler information apps like Waze.

This creates a phantom work zone that leads to a negative feedback loop: motorists give the alert a "thumbs down" in the app, causing Waze to stop broadcasting that device's data. Consequently, when the board is turned back toward traffic the next day, the alert remains suppressed. Participants agreed that while technology is meant to reduce human error, the lack of awareness among field crews, who often don't realize the boards are smart, creates new data integrity issues.

#### *The Challenge of Mapping and Integration*

Matthew Miller (Iowa DOT) highlighted the complexity of associating raw device data with specific road events. He noted that a connected arrow board provides a pinpoint, but a Traffic Management Center (TMC) still often must manually snap that point to a map polyline or an existing work zone event to make the data actionable.

Miller also questioned whether the complexity of the current WZDx specifications can be confusing and technically difficult for OEMs to render. He made the case that instead of trying to map highly specific details like "Lane 1" or "Lane 2," agencies should focus on a simpler approach: broadcasting what the sign actually says in relation to the road's geometry. This would allow vehicle manufacturers to use their own algorithms to determine how and when to warn a driver.

### *Variable Speed Limits and Vehicle Interference*

The group discussed the unintended consequences of variable speed limits on modern vehicle safety features. Dave Huff (South Dakota DOT) reported that motorists with adaptive cruise control found their cars automatically slowing from 80 mph to 55 mph when approaching electronic signs, regardless of what the sign actually displayed. Others noted that some manufacturers, specifically Honda, have indicated that vehicle camera sensors struggle to read digital or LED-based speed signs accurately. This led to a discussion on the necessity of providing OEMs with direct data sets rather than relying on optical recognition by car cameras. The consensus was that while V variable speed limits are a win for enforcement, they require a digital data feed to ensure smart vehicles don't respond erratically to the physical signs.

### *Enforcement and Safety Outcomes*

Juan Pava (Illinois DOT) shared information from their enforcement program. In 2025, Illinois allocated \$7.2 million for police details in work zones, resulting in over 16,000 citations and 6,200 motorist assists. He emphasized that the presence of speed safety cameras alone reduced operating speeds by 8 to 17 mph, bringing most drivers into compliance with the 55 mph limit. Similarly, Iowa DOT credited a combination of hands-free laws and extra work zone enforcement for a 28 percent reduction in fatalities over the previous year.

### *Jurisdictional Gaps and Regional Coordination*

A closing point addressed the large gap in coordination between state, city, and county agencies. The group recounted instances where state traffic was detoured directly into an unmapped municipal project because the two jurisdictions were not sharing data. While the WZDx standard is a move toward a universal "blueprint" for decentralized states, the group admitted that real-time coordination across jurisdictional lines remains one of the most difficult tactical elements to solve.

## Session 3 –Regional Work Zone Data Sharing

### Perspective from Maricopa County DOT

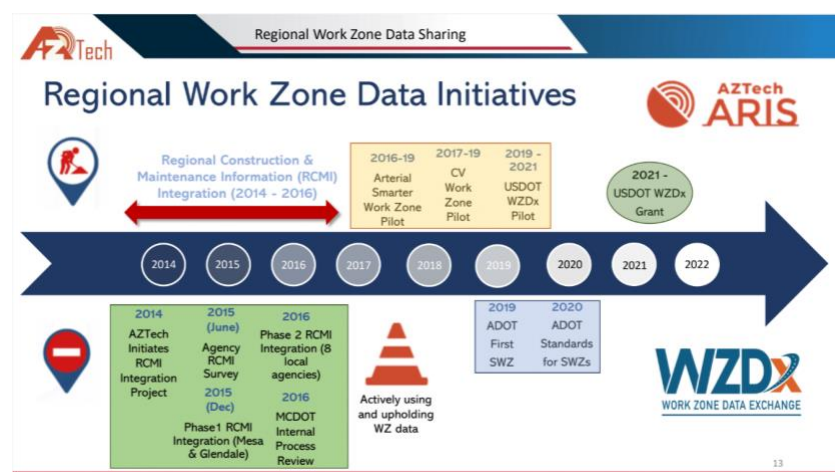
Alexander Lemka, a data systems engineer at the Maricopa County Department of Transportation (MCDOT), presented an overview of the Phoenix metro area’s robust regional data-sharing infrastructure and associated work zone data initiatives. At the heart of these efforts is AZTech, a long-standing regional traffic management partnership led by MCDOT and the Arizona DOT (ADOT). This partnership facilitates collaboration among 24 transportation and public safety organizations including local cities, towns, and universities, allowing them to share resources like fiber networks and camera feeds—giving MCDOT access to thousands of cameras and high-resolution data from over 4,100 signalized intersections across the region.

### *Core Technical Infrastructure*

A principal component of this collaborative framework is the Regional Archive Data System (RADS) and the broader Aztec Regional Information System (ARIS). RADS functions as the centralized engine for processing and aggregating real-time transportation data across local agencies. Building upon this, ARIS serves as the comprehensive regional portal, providing performance measures, event notification systems, and data services. By transitioning from siloed, agency-specific systems to a centralized, cloud-hybrid infrastructure, MCDOT has enabled seamless data exchange, allowing agencies to monitor signals, track performance, and coordinate incident responses through standardized APIs. These systems aggregate vast amounts of transportation data in real-time, ranging from emergency CAD feeds to signal performance metrics. Lemka highlighted that work zone data is a critical element of this integration, sourced from traffic control plans and permitting systems. By centralizing this information, MCDOT provides a "tactical view" for partner agencies, complete with speed charts and live CCTV snapshots to monitor the actual impact of construction and maintenance on traffic flow.

### *Work Zone Data Exchange (WZDx)*

A critical challenge is the historical lack of standardization in how work zone data is shared. Previously, vendors had to build custom interfaces for every single agency, a process that was costly, inefficient, and prone to error. To resolve this, MCDOT has adopted the WZDx specification. The agency serves as a regional "middleman," taking disparate data formats from various local jurisdictions and translating them into a unified, human-readable JSON



format. This standardization is vital for third-party consumers like Waze or Google Maps, as it eliminates data conflation and provides a common language for infrastructure operators. The project recently upgraded to WZDx version 4.2, specifically to better handle directional data challenges and ensure the feed remains compliant with national standards.

### *Advancing Safety Through "Smart" Work Zones*

A persistent issue in traffic management is the false alert—when navigation apps warn drivers of construction or lane closures that are no longer active, which erodes driver trust and leads to dangerous outcomes. Beyond data standardization the importance of data accuracy needed to be addressed. To

combat issue, MCDOT is piloting various Smart Work Zone technologies which use field-verified data from:

- **Smart Arrow Boards:** Utilizing GPS and cellular links to report active/inactive status.
- **Worker Wearables:** Confirming the physical presence of personnel on-site.
- **Smart Cones/Drums:** Using sensors to define real-time zone boundaries.
- **Portable DMS:** Feeding data directly into the WZDx stream.

#### *Future Outlook: Connected Vehicles*

The final component of this strategy involves the transition toward integration of Connected Vehicle (CV) applications. While current reporting relies on permits which may not perfectly reflect when a contractor is actually on the road, MCDOT is launching projects to deploy smart cones, arrow boards, and intrusion alerts. These devices will provide high-confidence, real-time verification of worker presence. By disseminating work zone data not just through traditional navigation apps, but directly to connected vehicles and mobile applications, MCDOT aims to provide real-time alerts about lane closures, speed restrictions, and worker presence directly to drivers. Through the CVAZ project, the region is installing roadside units (RSUs) at 750 intersections and equipping 400 vehicles with onboard units (OBUs) to facilitate real-time safety warnings and signal priority. Supported by federal grants, these initiatives represent a significant leap toward a connected, automated roadway environment where improved data quality and device interoperability directly translate to reduced worker exposure and increased public safety.

The goal of these initiatives is to create a seamless information flow that enhances both safety and mobility. By leveraging the Connected Work Zone standard, MCDOT aims to deliver real-time warnings directly to drivers' smartphones or connected dashboards, even in work zones. Lemka concluded by emphasizing that while manual processes still play a role in associating smart devices with permitted events, the continued expansion of the regional data hub will eventually provide a standardized, off-the-shelf solution for large-scale connected vehicle adoption across Maricopa County.

#### **Discussion**

The post-presentation discussion focused on the technical difficulties of merging static project plans with real-time sensor data, as well as the unique governance model for data sharing in the Phoenix region. The conversation was primarily structured around two thematic threads:

#### *Data Association and Device Logic*

A central theme was how to technically link a specific set of smart devices to a specific Traffic Control Plan. This association remains a work in progress in Maricopa County while the agency has piloted small-scale implementations, they are currently collaborating with ADOT to build a Smart Work Zone data lake platform to serve as the bridge that matches a physical device's ID to an active event in the database.

The challenge is further complicated by directionality where it was noted that a single bidirectional road restriction is often represented as two separate events in a WZDx feed. Determining which event a smart device belongs to requires high-precision GPS; if the coordinates are slightly off, the system struggles to know if a smart cone is protecting the northbound or southbound lane. To address this, MCDOT is developing standardized contract language to require smart device data from contractors on larger upcoming projects, which will allow for more rigorous testing of intrusion alerts and emergency vehicle warnings.

#### *Standards, Governance, and Partner Relationships*

The discussion also touched on the unique relationship Maricopa County maintains with its regional partners and whether previous efforts to standardize data were informing current work zone initiatives. Lemka explained that the transition to WZDx was relatively smooth because MCDOT acted as a translator. Instead of forcing every small municipality to overhaul each of their databases, MCDOT took

the partners' existing data—even if it included non-standard text entries instead of cardinal directions (“northwest” vs. “NW”)—and formatted it to meet national specifications.

Much of this regional collaboration operates on a surprisingly informal basis. Aside from CCTV camera sharing, which requires formal Intergovernmental Data Agreements, most other data sharing is performed at the “will of the partner agency.” This voluntary ecosystem is sustained by the mutual benefits of the ARIS platform; local agencies provide their data because they find the resulting regional applications and traveler information services valuable enough to justify the participation.

## Session 4 – Data Exchanges, Data Dictionaries, and Data Sharing

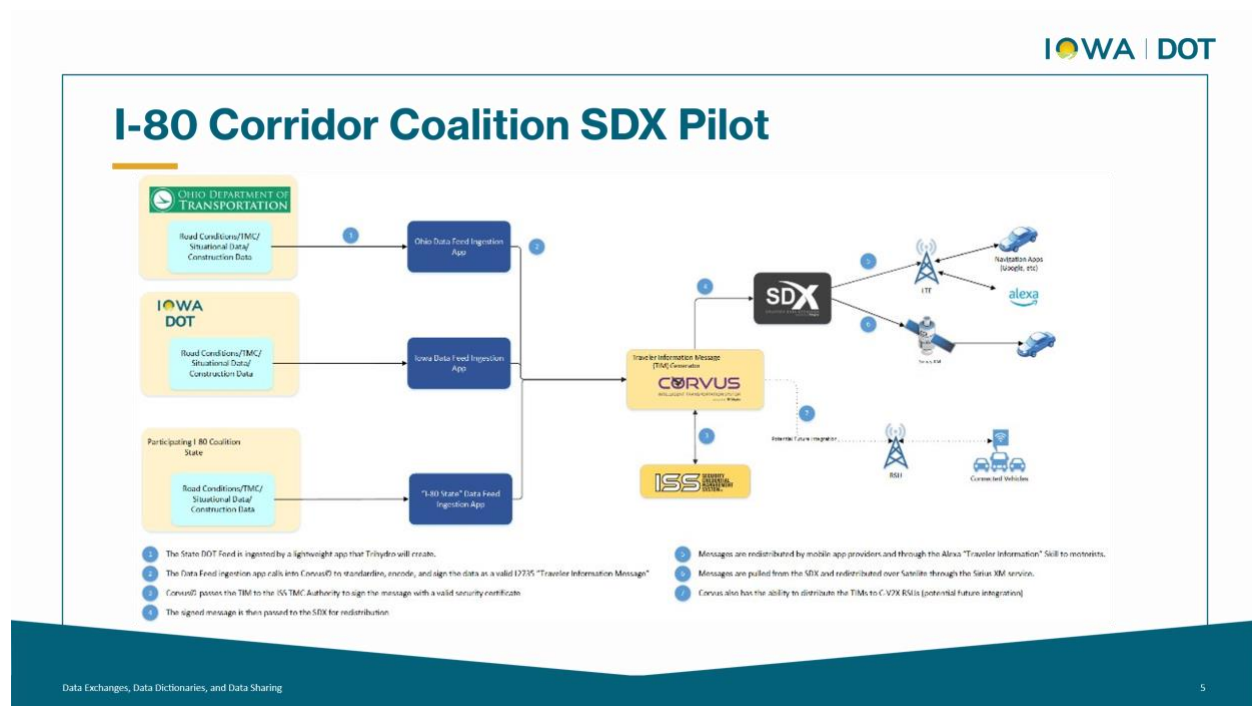
### Introduction to the Conversation

This session revolves around practical needs and considerations for data exchanges, data dictionaries, and data sharing. Representatives from Iowa DOT and Colorado DOT shared their experiences prior to a round robin discussion.

### Perspective from Iowa DOT

Matthew Miller (Iowa DOT) provided a candid assessment of what is currently hindering national progress in work zone safety and automated vehicle integration. Drawing from his experience with the I-80 and I-35 corridor coalitions, he highlighted a major bottleneck: the lack of standardized data structures across state lines. The operational and strategic framework for developing "Connected Corridors," emphasizes the urgent need to bridge data silos across state and municipal boundaries.

The primary motivation for this initiative is the current fragmentation of data; an inventory of the I-80 corridor revealed significant inconsistencies, with 162 unique event data fields across eight states and a lack of standardization in areas like truck parking, which currently utilizes 48 distinct fields across only three states. To address this, the I-80 Corridor Coalition initiated a six-month Situation Data Exchange (SDX) pilot, which focused on connecting 11 states and aligning their event data with standardized formats, specifically SAE J-2735 and J-2740.



The operational success of this framework relies on several key functional pillars that transform how infrastructure data is captured and utilized. The presentation highlights three specific applications:

- **Maintenance Operations:** Field staff utilize smart devices (iPads) to digitally log work zones and lane closures, integrating with RAMS systems and Linear Reference Systems for real-time tracking, with plans to expand this to construction zones.
- **Permit Integration:** The system creates a direct pipeline between WZDx and existing utility permitting software (such as AMANDA), triggering data flows the moment a permit is issued. One blind spot in utility permitting, for example in Austin, Texas, is that automated systems can start

a work zone event based on a permit but often fail to clear the event once work is finished, leading to stale data. This lack of ground truth is a major deterrent for mapping companies and autonomous vehicle manufacturers who require high-confidence, real-time verification before routing users or vehicles through a restricted area.

- **Data Aggregation:** The architecture acts as a centralized hub, pulling real-time API data from State DOTs to provide standardized, compliant commercial-grade feeds. It also incorporates external data from commercial providers, using provenance tracking and confidence scoring to ensure the integrity of the data based on its adherence to standards and timeliness.

From an architectural perspective, the presentation underscores that ITS architecture is the fundamental backbone required to automate corridor communications and responses. As asset management becomes increasingly sophisticated, the industry is transitioning from traditional GIS-based data to more complex 3D BIM (Building Information Modeling) data which can include vertical and horizontal detail rather than simply pins. By standardizing metadata and agreeing on data definitions, agencies can achieve true interoperability.

The presentation concluded by identifying both the current progress and the remaining hurdles for achieving a fully mature connected corridor. While efforts are underway to categorize data quality through the Managing Disruptions Operations Data Exchange (MDODE) and defining rigorous scoring rubrics, significant gaps remain. These include the need for bidirectional data exchange where AI tools can prioritize truthful versus stale data, the acquisition of ground-truth sampling, and the necessity of high-quality historical data to train the artificial intelligence systems. This will allow automated triggers that activate cross-border detour signs and provide reliable information to the traveling public to support managing corridor traffic flows.

The post-presentation discussion centered on the subjective nature of data quality across state lines and the specific needs of private-sector mapping giants.

#### *Data Quality and the "Tomato-Meter" Concept*

A recurring theme was the lack of confidence state agencies have in their own data. Miller noted a general sentiment among states participating in the SDX... while they are highly confident in reporting total road closures, they are significantly less certain about the accuracy of lane closure data. To address this, Miller proposed a public facing "Rotten Tomatoes" score for state data, a grade that would rank the quality and standards-adherence of a state's data feed.

Miller acknowledged that such a ranking could be a sensitive topic for state employees, noting that even his own agency was initially annoyed when he graded their feed as a "C." However, he believes that this transparency is essential for bringing "equilibrium" to a corridor. By seeing where they fall short in relation to their neighbors, states can identify which data fields are being left blank or where their standards are slipping, allowing them to reach out to higher-performing states or specific vendors for help.

#### *Private Sector Needs and Regulatory Gaps*

When asked about private sector involvement, Miller highlighted a surprising disconnect between what states report and what mapping companies like Google actually need. In direct conversations, Google representatives emphasized that their highest priority is regulatory sign data, specifically speed limits. Currently, many mapping companies rely on manual drive-bys or image recognition from crowdsourced photos to update speed limits because agencies are not consistently reporting them in their digital feeds.

Miller pointed out the irony that while agencies are focused on reporting the physical nature of a work zone (e.g., "right lane closed"), they often fail to report the one piece of information that has legal consequences for the driver: the reduced speed limit. He suggested that for a data feed to be truly valuable to an OEM or a mapping provider, it must include the regulatory information that motorists are held accountable for, rather than just a description of the construction activity.

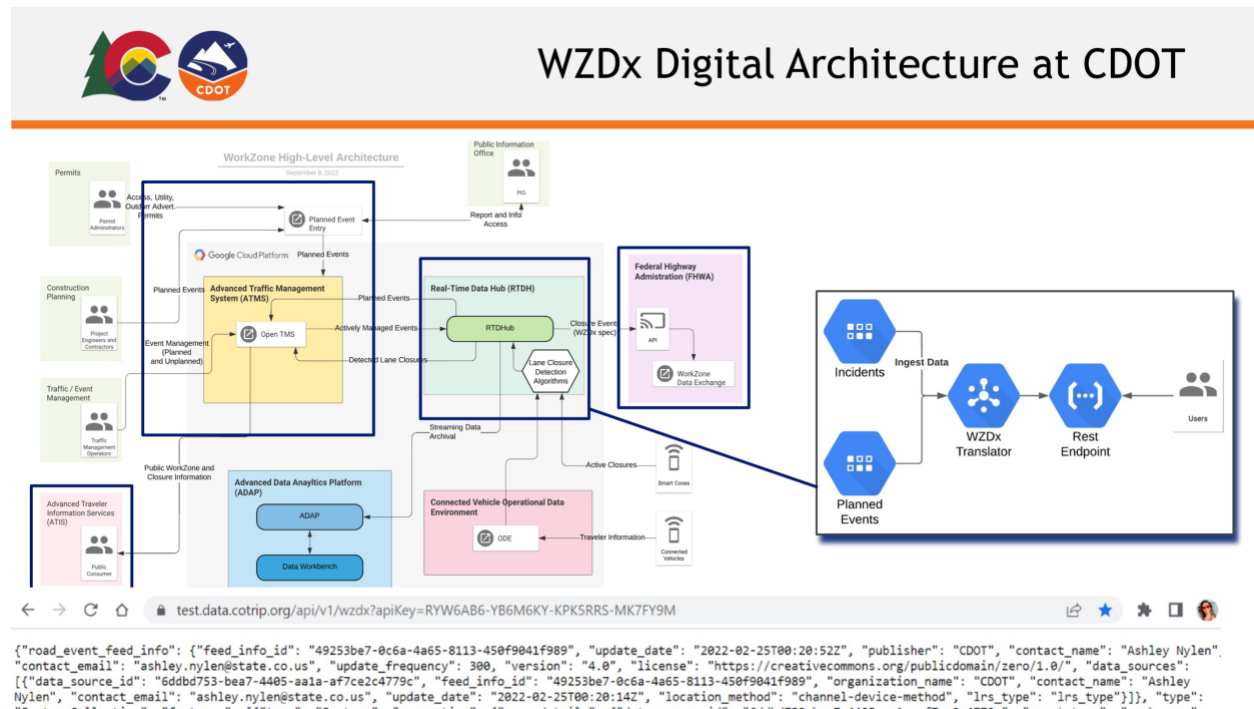
## The Role of Aggregators in Standardization

It is impractical for every individual state DOT to meet with every car manufacturer to agree on a data format. Instead, he advocated for using groups like the SDX as a centralized hub to be efficient in data sharing. These aggregators already have established relationships with Google, Apple, TomTom, and various OEMs, making them the most effective vehicle for pushing standardized state data into the dashboards of the traveling public.

## Colorado DOT Work Zone Data Exchange Program

Heather Pickering-Hilgers, Assistant Director of Mobility Technology with the Colorado Department of Transportation (CDOT) outlined the agency's strategic shift from manual reporting to a highly automated, real-time WZDx ecosystem. Using a 2021 federal grant, CDOT integrated its data architecture into the Google Cloud Platform, housing its Advanced Traffic Management System (ATMS) and real-time data hub. While most data is still sourced from planned events entered manually by contractors into the LaneAware system, CDOT is maintaining both a standard feed and an experimental real-time feed that captures dynamic roadway changes. The merging of planned and real-time work information is intended to more accurately communicate the real-time, dynamic nature of the agency's work zones.

The hallmark of Colorado's innovation is the marriage of WZDx with Autonomous Truck Mounted Attenuators (ATMAs). In traditional systems, a traveler using the COtrip app might see a static six-mile work zone for a mobile operation like paint striping, even though the actual work occupies a tiny, moving fraction of that space. CDOT's experimental feed uses the ATMA's real-time GPS data to broadcast the exact location of the work vehicle, creating a dynamic truck plus buffer zone. This allows for far more granular updates, effectively replacing wide-net warnings with precision alerts for motorists.



Despite these advancements, CDOT faces common industry hurdles, specifically regarding data accuracy and ground truth of information. While the WZDx feed often proved more geographically accurate than the COtrip app which sometimes incorrectly places data to the wrong roads, manual human intervention

is still required to bridge gaps. Using an interdisciplinary approach between software developers, ITS, security, operations, traffic engineering, and maintenance staff within the agency, CDOT has on-going quality improvement effort for the work zone data lifecycle. The objectives are to understand the issues with directionality, road events, mismatching data (appears in COtrip, but not in WZDx and vice versa), and data error messages. For example, smart cones (iCONEs) provide live data, but if they aren't explicitly linked to a planned project in the system, the architecture has to use geofencing to effectively guess which closure the data belongs to. Furthermore, long-term construction projects that span months or years are often harder to track accurately than short-term maintenance, especially with regard to long-term lane shifts.

Looking forward, CDOT is refining its Smart Work Zone device specifications through five active pilots and working to expand the role of traveler information messages. This will include future WZDx improvements such as:

- Incorporating other data types (iCones, 568, AVL data from CDOT vehicles)
- Building a visual map display for WZDx messaging
- Queryable Rest Endpoint to make WZDx an analytics ready database.
- Refining and enhancing COtrip data for the traveling public to engage and plan trips.
- Developing and encouraging adoption of LaneAware business processes to make CDOT a leader in work zone data collection, distribution, and analysis

A significant upcoming milestone involves a cross-border partnership with Utah to share work zone data along the I-70 corridor, ensuring that major closures or disruptions are broadcast seamlessly between state lines. By the summer of 2026, CDOT expects to have a fully operational system that coordinates inputs from traffic operations, maintenance staff, and automated hardware, providing a unified and reliable safety net for both human drivers and future automated vehicle systems.

## **Discussion**

Following the CDOT presentation the session moved into a discussion centered on the logistical and technical reality of achieving data accuracy in work zones, moving from high-level standards to the practicalities of data collection and state-to-state coordination.

### *Real-Time Tracking and Private Sector Integration*

Matthew Miller (Iowa DOT) and Heather Pickering-Hilgers (CDOT) discussed the mechanics of real-time vehicle tracking. CDOT uses Geotab to provide updates every few seconds, which are then pushed to their WZDx feed every 30 seconds. A major hurdle remains getting this high-frequency data into mainstream apps like Google and Apple Maps. While Waze has begun picking up this data through the Situation Data Exchange (SDX), other providers have been less responsive.

Miller noted that the SDX acts as a vital single API for the private sector. Currently, a commercial entity like Trucker Path would theoretically have to pull from approximately 180 different APIs to get a nationwide view of work zone events. By centralizing this through the SDX, agencies provide a much more attractive, low-barrier resource for developers who are wary of managing 50 different state-specific data structures.

### *The Equipment Footprint and Hardware Realities*

The conversation shifted to what the on the ground elements are to generate this data. Mike Kisse (North Dakota DOT) inquired about the physical requirements for accurate reporting. Pickering-Hilgers explained that while CDOT has over 500 Roadside Units (RSUs), the lack of On-Board Units (OBUs) in private vehicles remains a significant gap.

The group debated whether agencies should prioritize digital Traffic Control Plans (TCPs) or physical device data (e.g., smart arrow boards). One position was that ground truth must always win; while a TCP

represents the plan, factors like sun glare, wind-tipped signs, or site-specific adjustments mean the physical reality often differs. There is a strong desire to see more standardized smart device requirements in contractor RFPs to ensure that when a lane is closed, a digital signal is automatically generated, regardless of whether a human operator manually enters the event.

#### *Data Hierarchy and Sufficient Information*

A question regarding data hierarchy was raised, what is the minimum amount of information required to be useful without being unsafe because it is not sufficient? The participants agreed on ten core fields—including location, timestamp, and route, but noted that even these are inconsistent across borders (e.g., PennDOT using three-digit codes for interstates).

The discussion highlighted several high-priority data gaps:

- **End Roadwork Marker:** Miller noted that many crews neglect to place or digitally mark the end of a work zone. For an autonomous vehicle, missing the end sign could lead to the car driving at 55 mph indefinitely, or conversely, accelerating to 80 mph through a work zone because it failed to acquire the data for a tipped-over speed sign.
- **Level of Impact Information:** Beyond knowing a hazard exists, drivers and logistics companies need to know the scale of the impact. The discussion moved into the concept of a "sleep or drive" decision-making process; knowing if a closure will last two hours versus 24 hours is more valuable to a motorist than a simple "road closed" alert.
- **Map Polygons:** A persistent technical struggle is that state linear reference systems often don't align with proprietary maps like Google's. This leads to snapping errors where an event appears in the middle of a split highway rather than on a specific lane.

#### *Data as Digital Infrastructure*

The session concluded with discussion of the concept that data itself must be viewed as Digital Infrastructure. Just as physical roads require maintenance and standard parts, digital feeds require high data provenance and regular quality scoring. The participants emphasized that while they cannot fix every data point overnight, moving toward a standardized corridor approach, where states share the same digital language and ground-truth verification is the only way to prepare the nation's highways for both human safety and the eventual deployment of autonomous vehicles.

## Session 5 – Positive Protection Policy and Speed Safety Cameras

### Introduction to Conversation

The rubric of the Safety System Approach takes multiple perspectives leading to actionable approaches to address the systemic safety of the transportation system. Two approaches are enforcement methods to modify driver behavior and positive protection providing time and space separation for workers in the roadway.

### Perspective from Maryland DOT

Following a tragic 2023 crash on the I-695 Baltimore Beltway that claimed the lives of six workers, the Maryland Department of Transportation (MDOT) and the State Highway Administration (SHA) significantly overhauled their work zone safety protocols. Sung Yoon Park, Chief of the Traffic Development and Support Division at MDOT, outlined these changes which were driven by recommendations from a gubernatorial workgroup and the subsequent passage of the Maryland Road Worker Protection Act. A cornerstone of this legislative shift was the modernization of the automated speed enforcement program, which saw the civil penalty for work zone speed violations double from \$40 to \$80 starting in June 2024.

The state's strategy now emphasizes a tiered fine structure and increased enforcement flexibility. To better protect workers, fines are doubled when personnel are physically present in a work zone, and the law now allows for unmanned speed control systems and the deployment of multiple enforcement units within a single zone. To support these mandates, MDOT developed *Worker Present* trailers, which use activated flashing lights to warn motorists of active work and the potential for higher fines. Additionally, the state has revised its partnership with State Police, allowing for more active enforcement where one officer can remain stationary while another actively pursues and cites speeding drivers.

Beyond enforcement, MDOT has introduced comprehensive safety guidelines focusing on positive protection and driver education. This policy is rooted in federal regulations (23 CFR Part 630, subpart K), existing State Highway Administration (SHA) standards for Temporary Traffic Barrier use, and specific Maryland state law (Transportation Code § 8-613.2). Maryland now mandates the use of positive protection devices such as temporary traffic barriers or protection vehicles that contain and redirect vehicles, thereby reducing the risk of motorized traffic crashing into workers or workspaces. The policy includes a supplemental assessment framework for high-risk areas and establishes a formal exception process that must be supported by a detailed engineering study. The agency has also refined its lane closure guidelines to balance safety with traffic flow, generally discouraging closures that result in delays exceeding 30 minutes or queues longer than four miles, unless deemed necessary for safety.

The criteria for deploying these devices are strictly defined by speed and roadway conditions. For all highways with a speed limit of 45 mph or greater, positive protection is mandatory if workers lack a safe escape route, if the work is within 15 feet of an open travel lane, or if roadside hazards like drop-offs or unfinished bridge decks are left unprotected during non-working hours. Furthermore, if a project is expected to remain stationary for at

### Positive Protection Devices in Work Zones

#### 2. Expressway/Freeway (Speed Limit ≥ 45 mph)

**In addition to a) and b),** when work is expected to last **at least two (2) weeks** (as consecutive days), and the work space limits remain unchanged for that duration, the following applies:

**a. If work is in the travel lane:**

- **Full closure** should be considered first.
- If full closure is not feasible, **temporary traffic barriers** shall be used as positive protection.

**b. If work is on the shoulder or within 15 feet of an open travel lane:**

- **Temporary traffic barriers** shall be used as positive protection



least two consecutive weeks, the use of a temporary traffic barrier becomes a requirement to ensure long-term stability and protection.

## Positive Protection Devices in Work Zones

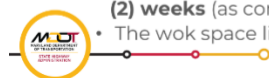
### 1. Highways (Speed Limit $\geq$ 45 mph)

a. Positive protection devices are required for any work duration when any of the following conditions apply:

- Workers do **not** have a safe escape route from traffic.
- Work occurs **on the roadway, on the shoulder, or within 15 feet of an open travel lane.**
- **Unprotected roadside hazards** (e.g., drop-offs, unfinished bridge decks) remain in the clear zone during non-working hours.

b. Temporary traffic barrier shall be used when:

- Work on the roadway or shoulder is expected to last **at least two (2) weeks** (as consecutive days), **and**
- The work space limits remain unchanged for that duration.



Specific and more stringent protocols apply to expressways and freeways where speeds are 45 mph or higher. For long-term projects lasting at least two weeks, the policy dictates a hierarchy of safety measures: a full roadway closure must be considered the first and most preferred option. If a full closure is not feasible, temporary traffic barriers must be used for any work occurring in the travel lanes, on the shoulders, or within the 15-foot buffer zone. This reflects a commitment to separating high-speed traffic from active work zones through physical infrastructure whenever possible.

Finally, the presentation highlighted several critical items currently under revision to further bolster field safety. A major update includes lowering the mandatory speed threshold for Protection Vehicles (PVs) from 55 mph to 45 mph, ensuring that shadow vehicles are utilized on a wider range of roadways. The revisions also encourage the deployment of additional PVs based on specific safety concerns and seek to update formal specifications regarding their use. While the policy provides blanket exceptions for short-duration projects, it reinforces the role of protection vehicles as a primary safety measure when permanent barriers are not practical.

To foster a statewide "culture of safety," Maryland has expanded its annual Work Zone Safety Summits and established the *Unity Ride*, a high-visibility event featuring construction equipment to raise public awareness. Internally, the department has implemented constructability reviews at the initial stages of project development to identify safety risks before work begins. Ongoing efforts include streamlining technical standards to ensure consistency across all safety manuals and continuing media outreach to educate the traveling public on the life-saving importance of obeying work zone regulations.

## Discussion

The post-presentation discussion highlighted the evolving landscape of automated speed enforcement (ASE) across several Mid-Atlantic and Northeastern states, focusing on legislative authority, operational hurdles, and the debate over how to define success.

### State-Specific Progress and Policy

Representatives from several states shared the current status of their ASE programs, revealing a mix of established systems and emerging pilots.

- **Delaware and Virginia:** Delaware currently utilizes speed enforcement cameras in work zones on a full-time basis, rather than limiting use to periods of worker presence. Conversely, Virginia is preparing to launch a statewide program on I-81. Virginia's law currently mandates that workers be present for enforcement to occur, though officials noted that the 2026 General Assembly is actively considering legislative changes that could alter these requirements.
- **New York and Maryland:** These states manage the most robust programs mentioned. New York operates 30 mobile units that generated nearly 200,000 citations in an 11-month span. Maryland reported even higher volume, with roughly 367,000 citations issued last year. Despite these high

numbers, Maryland officials noted a 17 percent reduction in total citations over the past year, suggesting a potential shift in driver behavior.

- **Massachusetts and Missouri:** Massachusetts is currently seeking legislative authority for a pilot program to demonstrate the severity of the speeding issue to lawmakers. Missouri is pursuing a "semi-automated" model (similar to Arkansas) to navigate current legal restrictions while pushing for broader authority.

#### *Operational Challenges and Work Zone Geometry*

A recurring theme was the logistical difficulty of deploying camera systems safely. Craig D'Allaird (New York State DOT) emphasized that camera trailers cannot simply be dropped into a site; they require specific protection, typically behind concrete barriers, and cannot be placed in safety buffers or roll-ahead areas. This often leads to no deployments if the work zone isn't designed to accommodate the equipment. Additionally, the group discussed the importance of signage hygiene, noting that citations cannot be issued if speed reduction signs are missing from entrance ramps, as drivers must have a fair warning of the lower limit.

#### *Coordinating Multi-Agency Enforcement*

The discussion touched on the friction between automated systems and traditional law enforcement. In New York, state police and camera vendors coordinate to prevent double ticketing. Interestingly, some camera vendors have reportedly asked state police to avoid work sites where cameras are active to simplify operations, though participants generally agreed that a uniformed officer remains the single most effective deterrent for speeding.

#### *Defining and Measuring Success*

The most significant debate centered on whether average speed is a valid performance metric.

- **Case Against Speed Metrics:** Some participants argued that because violations are often issued to less than 2 percent of total traffic, the average speed of the remaining 98 percent remains largely unchanged, making it a poor indicator of safety. They suggested that a decrease in the *number of violations* over the life of a project is a more accurate measure of whether the program is successfully "training" drivers to slow down.
- **Case For Speed Metrics:** Others maintained that speed remains the most objective and easily measurable data point. By using probe data and monitoring "reckless" thresholds (e.g., 15 mph over the limit), agencies can identify if they are successfully curbing the most dangerous drivers, even if the halo effect of the cameras vanishes once a driver passes the unit. Maryland mentioned on-going collaboration with the University of Maryland to develop more sophisticated evaluation tools to settle this debate.

## Session 6 – Work Force Training and Development

### Introduction to Conversation

This session included presentations from a Virginia Department of Transportation (VDOT) and the American Traffic Safety Services Association (ATSSA), a professional association that provides work zone safety training and certificates for public and private transportation organizations.

### Perspective from Virginia DOT

Jeff Legg, Work Zone Safety Supervisor with VDOT detailed several key initiatives aimed at improving safety for maintenance crews, specifically focusing on training, short-duration operations, and equipment requirements. In February 2026, the Virginia Department of Transportation (VDOT) introduced key updates to its maintenance operations and work zone safety protocols. VDOT has launched the 11th edition of the *Virginia Work Area Protection Manual*, which serves as a specialized, easier-to-use version of the Virginia MUTCD Part 6 published separately for ease of field use. VDOT emphasizes that the manual provides the essential standards, guidance, and support for all temporary traffic control (TTC) devices.

### Certification

To support these standards, VDOT maintains a robust three-tier certification program (Technician, Supervisor, and Designer) that processes thousands of students annually through in-person and virtual classes. The department overhauled its flagger certification after an audit revealed inconsistencies, now requiring all stand-alone flagger training to be managed through ATSSA. VDOT generally accepts ATSSA national equivalents for these certifications, and all flaggers must hold a valid, recognized flagging certification card.

Virginia's training program was noted for its intensity, requiring an 80% score to pass with only one retake allowed within a 24-hour period. VDOT treats the curriculum as a "living document," updating it whenever crash data indicates a new trend or when the *Work Area Protection Manual* is revised. Other states, including Illinois and Massachusetts, noted that while they may not reach Virginia's volume, they are moving toward hybrid models combining virtual modules with hands-on field training to ensure practices are understood in a real-world context rather than just a classroom.

### Very Short Duration Operations (VSDO)

Addressing feedback from maintenance crews, VDOT introduced a formal definition and safety protocol for Very Short Duration Operations to improve worker safety. These are defined as activities taking 5 to 15 minutes to complete at a specific location. Common applications include minor debris or animal removal, emergency patching, or sign maintenance. Recognizing that the time spent setting up and removing a traditional work zone often exceeds the time needed for the work itself, VDOT designed these procedures with the goal of minimizing worker exposure.

### WZ Training Certification |

- **Three levels**
  - Technician/Basic (8 hours)
  - Supervisor/Intermediate (16 hours)
  - Designer/Advanced (16 hours)
- **Approx. 65 classes per month**
- **3,000 Basic and 4,000 Intermediate students per year**
- **200+ Instructors (VDOT staff, contractor trainers, etc.)**
- **All classes include in-person or virtual instruction, handouts, and multiple-choice test (80% passing required for both in person and virtual training)**

Job duty	Requirement
Flagger	ALL flaggers must be certified (see next slide)
Technician/Basic (anyone who installs, maintains, or removes TTC devices)	VWZ Technician or Supervisor certification - at least one person on each crew responsible for installing/maintaining/removing TTC devices
Supervisors/Intermediate, Safety Managers, and Inspectors	VWZ Supervisor certification - At least one person on site whenever work is active
Designers/Advanced	VWZ Designer required for engineers that developing and sign/seal MOT plans

Under these procedures, the work vehicle is equipped with amber rotating lights and is positioned in advance of the work area to serve as a shield and "Caution: Frequent Stops" signage positioned 80 to 120 feet in advance of the activity. On high-volume roadways, a TTC spotter is required to maintain safety. Other states commented on the definition with one highlighting a common challenge where crews try to circumvent the process by attempting to treat a series of potholes as separate 15-minute setups to avoid the labor of a full lane closure. To counter this, the agency implemented a spatial limit, defining the duration as 15 minutes within 1,000 feet. This was acknowledged by the group as a useful point to consider for agencies who use or plan to use this approach.

### *Enhancing Safety through Technology*

Safety for flagging operations has also been bolstered by the 2022 mandate requiring portable temporary rumble strips for stationary operations with daytime flagging operations on two-lane roads under specific conditions (e.g., duration greater than 3 hours, speeds of 35 mph or greater, and 500+ ADT). These strips have proven effective in reducing approaching vehicle speeds by 7 to 8 mph while providing an audible warning to workers and motorists. VDOT closed a loophole where crews would take breaks to reset the three-hour clock by clarifying that the mandate applies to the total duration of the work.

VDOT is actively promoting the use of Automated Flagging Assistance Devices (AFADs) for maintenance tasks such as bridge work, guardrail repair, and pavement patching. By replacing manual flagging with these automated systems, VDOT aims to remove the "human element" from high-risk zones, significantly enhancing safety for crew members.

### *Operational Adjustments*

Recent operational changes have streamlined requirements for mobile operations and reduced worker risk by focusing on high-impact safety measures:

- **PPE:** High-visibility Type E trousers or leg gaiters are now required for all flaggers and workers involved in installing/removing TTC devices during daylight hours. Nighttime operations require Type E trousers and illuminated stations.
- **TMA Signage:** Previously, drivers had to stop their vehicles with TMAs on dangerous high-speed roads to manually switch "Right" or "Left" lane plaques. VDOT's research from a pilot program in Southampton County determined that motorists react primarily to the arrow board and the orange background rather than the specific text. As a result, VDOT now allows the removal of these designations and has introduced a simplified universal sign, significantly reducing the frequency with which workers must exit their vehicles to adjust signage in live traffic.

### **Perspective from ATSSA**

Eric Perry, Director of Innovation and Technical Services at ATSSA, provided a comprehensive overview of the organization's mission to advance roadway safety through standardized training. ATSSA is a non-profit trade association with 28 chapters nationwide with over 1,500 member companies and an expansive network of chapters and committees. He highlighted the importance of the 11th edition of the MUTCD as the foundation for their curriculum workers in the roadway, with the intent to create a uniform experience for drivers across the U.S. to ensure predictable and safe responses to work zones. Perry emphasized that the primary obstacle to roadway safety remains unsafe driver behavior, specifically driver distraction and speeding. To combat these challenges, ATSSA advocates for a proactive approach built on standardized training, consistent deployment of traffic control devices, and clear communication among crews.

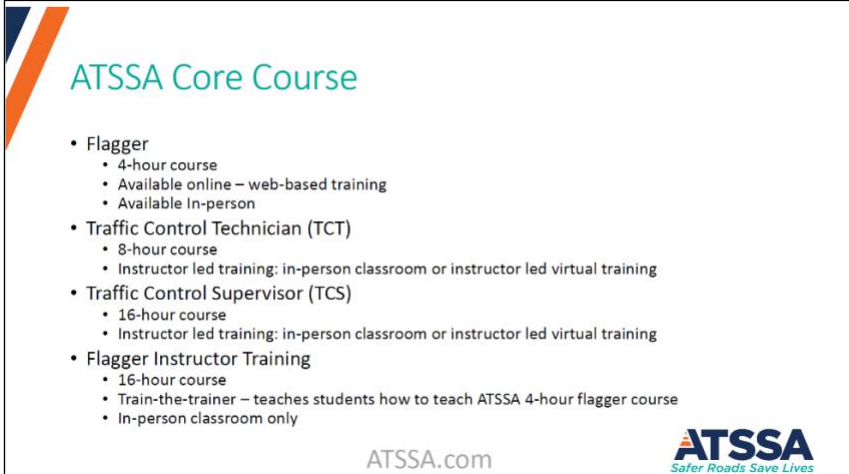
### *ATSSA Training and Certification Framework*

A significant portion of the presentation focused on the role of comprehensive, standardized training as the bedrock of work zone safety. ATSSA offers a robust curriculum designed to ensure that all personnel, from flaggers to supervisors, possess the necessary skills to manage real-world conditions effectively. Additionally, ATSSA offers a "train-the-trainer" instructor course to maintain a high level of professional

flagging instruction. Perry noted that while they do offer state-specific courses, ATSSA strongly advocates for national standardization to assist contractors who operate across state lines.

Key training programs include:


- **Flagger Training:** A 4-hour course (available online or in-person) focused on standardized flagging procedures, signals, and protective practices.
- **Traffic Control Technician (TCT):** An 8-hour, instructor-led course providing a foundational understanding of the MUTCD and hands-on techniques for device installation.



The graphic is titled "ATSSA Core Course" and lists the following training programs:

- **Flagger**
  - 4-hour course
  - Available online – web-based training
  - Available In-person
- **Traffic Control Technician (TCT)**
  - 8-hour course
  - Instructor led training: in-person classroom or instructor led virtual training
- **Traffic Control Supervisor (TCS)**
  - 16-hour course
  - Instructor led training: in-person classroom or instructor led virtual training
- **Flagger Instructor Training**
  - 16-hour course
  - Train-the-trainer – teaches students how to teach ATSSA 4-hour flagger course
  - In-person classroom only

ATSSA.com



- **Traffic Control Supervisor (TCS):** A 16-hour advanced course designed for those overseeing the implementation of traffic control plans, featuring workshops and comprehensive exams.
- **Flagger Instructor Training:** A 16-hour "train-the-trainer" course for those instructing the flagger curriculum.
- **Maintenance and Short Duration Activities (MSDA):** An 8-hour course tailored for utility and moving operations, emphasizing worker protection and simplified control procedures.

The ATSSA training methodology focuses on practical, real-world applications rather than a "cookie-cutter" slide-based approach. The courses are held at agency locations or virtually and incorporate interactive workshops and small group discussions to engage participants. Courses are capped at 40 students, and open to both individuals and groups. For flaggers whom Perry described as the "boots on the ground" and the first line of communication with the public, the training includes a mandatory demonstration piece to ensure they can safely manage traffic in both routine and emergency situations.

#### *Innovation and Future Directions*

The presentation shared some of the current innovations in roadway safety incorporating a focus on integrating advanced technology—including AI-powered platforms, smart work zone devices, and enhanced visibility solutions—to solve specific, field-identified problems.

In closing, a number of specialized trainings aimed at maintenance and short-duration operations, where the risk-to-setup ratio is often high are available through the FHWA *Work Zone Safety Grant*. ATSSA offers free training to public agencies under the grant program that focuses on simplified control procedures, rapid deployment, and worker protection. ATSSA provides resources like the Worker Protection Toolkit and specific guidance for Automated Flagger Assistance Device (AFAD) operators, the goal is to build a pervasive "culture of safety" where the efficiency of a setup directly reduces the time workers are exposed to hazardous traffic conditions.

## **Discussion**

### *Hardware Mounting and Public Education on AFADs*

Technical questions arose regarding the physical mounting of signage on shadow and TMA vehicles.

- **Sign Mounting:** VDOT clarified that while shadow vehicles often use magnetic signs or those bolted to tailgates, TMA vehicles have dedicated metal uprights located directly beneath the arrow boards to hold Road Work Ahead signage.
- **AFAD Navigation Issues:** North Dakota shared a safety concern regarding AFADs, noting that some motorists, confused by the gate arms, would simply drive around them into oncoming traffic. To mitigate this, the agency found it necessary to place cones along the center line to physically guide vehicles. While Virginia does not yet have a public service announcement to educate the public on AFADs, they confirmed that they also require center-line cones to prevent these dangerous head-to-head incursions.

Massachusetts highlighted a strategic interest in AFADs as a "middle ground" solution. Because the state faces significant restrictions on the use of civilian flaggers, they hope that adopting automated technology will allow them to maintain safety while reducing their heavy reliance on police details for standard maintenance tasks. This prompted a commitment among several states to share their internal guidance and pilot results as they transition away from human-centric flagging.

### *Emerging Technology and Gap-filling Courses*

The conversation turned toward how work zones will intersect with connected and autonomous vehicles. While ATSSA has not yet fully integrated these into their standard training curriculum, Perry noted that the association is actively focusing on work zone ITS and data sharing.

VDOT's Marc Lipschultz raised a common gap in current training models. He suggested that engineers performing routine tasks like guardrail inspections do not necessarily need a 16-hour supervisor course but do require a 1-to-4-hour safety orientation. Perry confirmed that ATSSA is developing a "New Employee" course to address this specific need for brief, high-impact safety awareness.

### *Collaborative Models, Micro-Credentialing, and Free Resources*

State representatives shared various strategies for scaling their training efforts:

- **Academic Partnerships:** New York State DOT is piloting a "micro-credentialing" program with the state college system. By providing grants to colleges to develop training, the DOT secures a permanent curriculum for its staff while allowing the colleges to certify outside entities for state and federal work. New York officials admitted to modeling this approach after Virginia's successful partnership with the University of Virginia.
- **FHWA and the National Highway Institute:** Jawad Paracha reminded the group that the National Highway Institute (NHI) offers several free, virtual work zone courses, including specialized tracks for law enforcement and traffic analysis.
- **National Work Zone Safety Information Clearinghouse:** Martha Kapitanov highlighted that the Clearinghouse remains a primary repository for free, grant-developed training modules accessible to any agency that creates an account.

### *Policy and Updates*

The session concluded with an emphasis on the concept of signage hygiene and the update to the MUTCD with the release of the 11<sup>th</sup> edition. All of the participating organizations are currently in a cycle of updating training materials to reflect the new MUTCD. Participants were also encouraged to utilize the AASHTO Transportation Operations Manual to help standardize their internal safety policies and job duty training requirements.

# Next Steps

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## **Key Issues**

The closing discussion of the peer exchange identified major issues associated with maintenance work zones with the implementation of new ITS technology. Participants shared perspectives on the difference between theoretical technology deployment and the practical realities, the gap between agency expectations and the actual performance of third-party navigation apps, as well as the logistical hurdles of training a transient inspection workforce. The focus was on what hasn't been discussed or where there are gaps that the NOCoE and its partner organizations could address through various products.

## **Discussion**

### **Static Standards vs. Dynamic Data**

Douglas Noble (ITE) observed that there was a disconnect between the high-tech solutions discussed and the current primary resources agencies rely on such as the MUTCD and State DOT standards, specifications, and drawings. These are inherently static documents focused on the physical assets of a traffic control plan, like sign placement and barrier types, but they offer little guidance on the digital communication protocols required for systems like WZDx, especially in maintenance work zones.

Matthew Miller (Iowa DOT) highlighted the consequences of this gap, contrasting the visual consistency of stop signs across the country with the total lack of consistency in digital messaging. He noted that while the MUTCD ensures a sign looks the same in every state, the actual content of digital messages on boards or 511 systems can vary significantly, where one state might provide actionable instructions while another provides technical descriptions like "alternating lane closures" that offer little value to a driver trying to navigate a specific lane.

### **Actionable Intelligence for the Driver**

Miller and Noble commented on the current state of messaging in the context of end-user experience, observing that data shouldn't just be about reporting an event, but about providing actionable information. Miller pointed out that drivers don't necessarily care about the administrative details of a permit (e.g., "Monday through Friday, 8:00 a.m. to 5:00 p.m."); they need to know which lane to be in at the time they receive the message.

### **Data Integrity and the "Information Trust" Gap**

Agencies communicating work zone data to third-party providers like Waze, Google, and Apple generated from WZDX or SIFS feeds expressed frustration that they have little control over how or when that data appears in a driver's navigation app.

- **The Expectation Gap:** States like South Dakota noted that purchasing smart devices often comes with the expectation of universal communication, only to find that data might only reach a single platform (e.g., Waze), which may have low local adoption.
- **Quality over Quantity:** North Carolina found that third-party trucking apps were pulling outdated or planned work zone data from 511 systems and presenting it as active, real-time information. Agencies with similar issues now focus on validation by using connected arrow boards to provide a checkmark that confirms a work zone is physically active.
- **The SIFS/Waze Success:** Minnesota reported an increased data acceptance rate in the Waze Partner Hub from 50 percent to 99 percent by switching to a SIFS feed.

### **The Search for a Living Standard**

The participants discussed the limitations of using the MUTCD for technology, noting that it is a requirement for devices, not communication protocols. Neil Boudreau pointed to Traffic Management Data Dictionary (TMDD) and the Connected Work Zone specifications as the digital standards. However, a major challenge remains the communicating of these standards to local municipalities and counties, many of whom are not yet aware of these protocols.

Nick Ramfos and Boudreau suggested that instead of waiting for the slow update cycles of the MUTCD, agencies should look toward the *Transportation Operations Manual* (TOM). The goal is to treat the TOM as a living document that can evolve alongside technology. By housing communication protocols and operational strategies in a more dynamic format, or pushing them into the ITS Standards Program, the industry can create a framework that changes as quickly as the technology.

### **Workforce Training and Inspection Hurdles**

North Carolina and ATSSA noted that while certification exists for installers and supervisors, there is a lack of specific training for inspectors, particularly third-party consultants, who must verify that smart technology is functioning.

- **Prioritization Conflicts:** Inspectors are often heavily involved in the primary requirements of the job (e.g., monitoring paving depths). In the evening checking if a sign is transmitting to Waze is often a low priority compared to the immediate safety of the milling operation.
- **Information Distribution:** Even when agencies issue technical bulletins about new specifications, the amount of information is so high (over 400 bulletins in some cases) that field staff may miss critical updates.
- **The Micro-Credentialing Solution:** To address this, agencies are looking toward shorter, targeted training modules that focus on the specific technical requirements of connected work zones rather than broad 16-hour certification courses.

### **Balancing High-Tech with Practical Field Success**

The discussion underscored that while Smart Work Zones are the goal, simple, low-tech changes often provide the most immediate safety benefits for maintenance crews.

- **Pilot Operations vs. Mobile Work:** North Dakota found that field crews felt significantly safer using pilot car operations instead of traditional mobile setups or lane closures. This shift in operational policy has reduced worker exposure without requiring complex digital infrastructure.
- **Speed Feedback Signs:** One of the most effective tools identified was the integration of radar speed displays with speed limit signs on mobile message boards. Crews reported that drivers respond to these displays surprisingly quickly, providing a high-impact, low-cost deterrent to speeding.
- **Funding and Capability:** Participants emphasized that not every agency is at the same stage of technological maturity. Success is increasingly defined by an agency's ability to fund and evaluate equipment that bridges the gap between basic maintenance and advanced ITS.

## Gaps and Future Actions

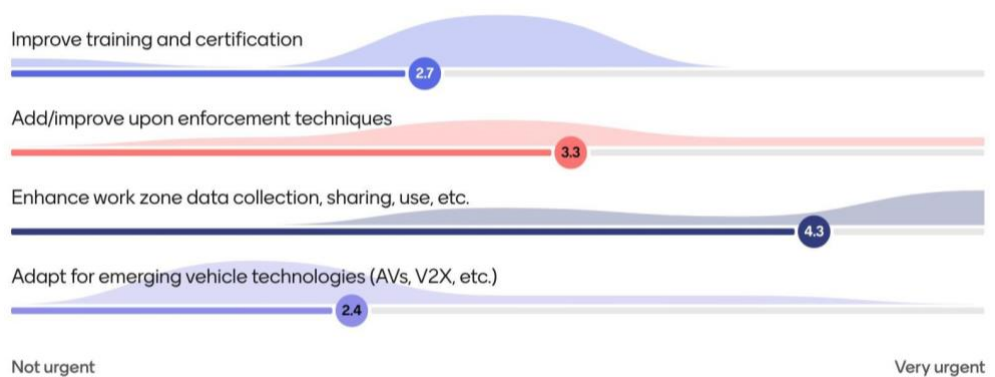
Participants were asked a number of closing questions to help understand key takeaways from the peer exchange as well as identifying gaps in knowledge to support future actions by the NOCoE and its partners.

### Participant Feedback

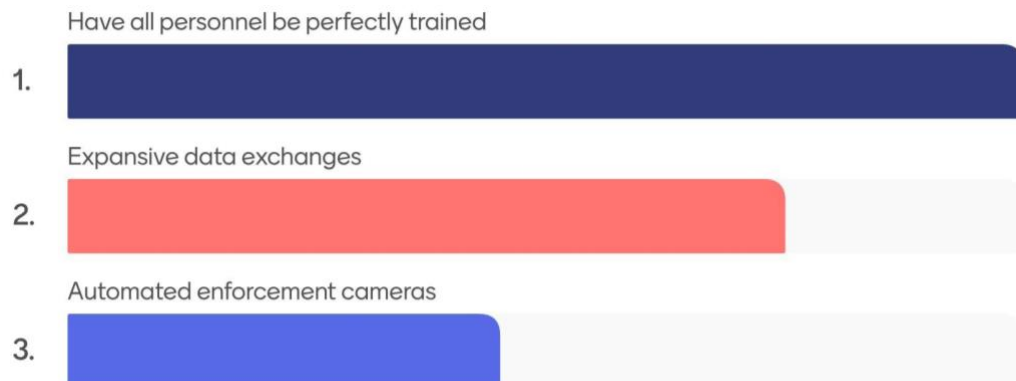
*Q: What is your biggest learning item from the last two days that you will take back with you?*

- Technology possibilities in both maintenance and construction work zones.
- Connected work zones.
- Vehicle communication technology
- Where states are on connected work zones.
- Workforce development and training.
- Work zone cameras and work zone speed enforcement.
- Picked up bits and pieces from everybody’s presentations for items, procedures, and policies we can incorporate into our traffic control plans.

*Q: Rate the following in terms of urgency in improving temporary work zones*



*Q: If you could do one thing tomorrow to improve safety of temporary work zones it would be:*



### **Key Gaps and Implementation Needs**

<b><u>Topic Thread</u></b>	<b><u>Identified Gap</u></b>	<b><u>Proposed Need/Action</u></b>
<b>Data Synchronization</b>	Lack of real-time "ground truth" in third-party apps.	Mandate connected arrow boards to confirm active status.
<b>Inspection Capacity</b>	Inspectors lack the tools/training to verify tech functions.	Develop specific "Inspection Certification" modules.
<b>Legislative Strength</b>	Automated enforcement exists but lacks penalties (points/fines).	Pilot programs to demonstrate effectiveness to leadership.
<b>Siloed Operations</b>	Maintenance tech is advancing faster than construction tech.	Transfer proven maintenance technologies roadmaps to contractors.

The consensus was that while the digital infrastructure (WZDX/SDX) is critical for the future, the immediate focus must remain on data quality, workforce competence, and simplified field operations to protect the employees in the work zone. Digital infrastructure is moving beyond static drawings and toward a unified roadway environment that supports maintenance and construction workers, human drivers and the emerging needs of connected and automated vehicles.

Topics for consideration of future resource development:

- Case study or best practice product(s) regarding data quality for connected infrastructure in work zones with specific interest in procedures to implement and confirm active status of arrow and message boards.
- Development of boilerplate training module(s) for inspectors and other workers installing, maintaining, or inspecting smart work zone technologies.
- Case study or best practice product(s) regarding automated enforcement technologies of work zones, with special focus on products for agency decision-makers and elected officials.
- Case study or best practice product(s) to support transfer of knowledge regarding smart work zone technologies to third party contractors. This may need to involve other organizations like ARBTA, etc.
- Case study or best practice product(s) on speed feedback signs in work zones
- Case study or best practice product(s) variable speed limits in work zones (this has separately brought up in the context of visibility and congestion management)
- Peer-to-peer discussion opportunity or forum to connect organizations facing similar challenges and support a valued interaction of the new network of contacts in this topic space.

NOCoe will meet the AASHTO, ITE, ITS America, and FHWA representatives along with ATSSA to review the peer exchange findings and work on next steps as well as potential products.

# Resources

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## AASHTO

Transportation Operations Manual,  
Chapter 20: Event Management Tactics | 20.4 Work Zone Traffic Management.

## NOCoE

- [Heavy Equipment Based Connected Work Zone](#), DelDOT, NOCoE Case Study 29 May 2025.
- [Emerging Data and Work Zone Safety Applications](#), NOCoE Webinar, 19 March 2025.
- [AZTech Smarter Work Zone – Regional Work Zone Innovations](#), video/FHWA workshop (2021)

## Federal Highway Administration

Work Zone Management Program [web page](#), select resources:

- [Work Zone Data Exchange \(WZDx\)](#)
- [Noteworthy Practices](#)
- [Design and Construction Strategies](#)
- [ITS & Technology](#)
- [Performance Measurement](#)
- [Programmatic Reviews](#)
- [Public Information and Outreach Strategies](#)
- [Work Zone Safety and Mobility Rule \(Subpart J\) and Temporary Traffic Control Devices Rule \(Subpart K\)](#)
- [Work Zone Traffic Management](#)
- [Worker Safety](#)
- [Peer-to-Peer Program for Work Zones](#)
- [Publications](#)
- National Highway Institute catalogue; Course 1341091 - Maintenance Training Series: Basics of Work Zone Traffic Control

## National Cooperative Research Program

- Synthesis 587: Use of Smart Work Zone Technologies for Improving Work Zone Safety (2022)
- Synthesis 533: Very Short Duration Work Zone Safety for Maintenance and Other Activities (2019)
- Research Report 1051: Preparing Transportation Agencies for Connected and Automated Vehicles in Work Zones (2023)
- [Research Report 945: Strategies for Work Zone Transportation Management Plans](#) (2020)

## US DOT Smart Grants

- *Smarter and Safer Work Zone Through Multimodal Intrusion Detection*, Indiana DOT (FY2024)
- *Real-time Work Zone Speed Management with Multi-Source Data*, Maryland SHA (FY 2023)
- *Autonomous Truck Mounted Attenuator for Work Zone Safety*, Colorado DOT (FY2022)
- *Integrating Work Zone Data Exchanges in Illinois for a Safer Highway System*, Illinois DOT (FY2022)

- Extending the Wisconsin Work Zone Data Exchange (WZDx) to Local Roads Using Smart Work Zone ITS, Wisconsin DOT (FY2022) in Madison, WI area

### **National Work Zone Safety Information Clearinghouse**

National Work Zone Safety Information Clearinghouse web page, select resources:

- Database search on [Temporary Traffic Control](#)
- Database search on [Smart Work Zone](#)
- Database search on [WZDx](#)

### **ATSSA**

- [State Training and Certification Requirements](#)
- [ATSSA Training Catalog and Learning Management System Access](#)

### **Delaware DOT**

[Accelerating Digital Inspection Practices with Connected Machinery](#), Delaware DOT (FY2022-23) [Advanced Digital Construction Management Systems](#) (ADCMS) FHWA grant,

### **Massachusetts DOT**

- [Standard Details and Drawings for the Development of Temporary Traffic Control Plans](#)
- [Smart Work Zone Control and Performance Evaluation Based on Trajectory Data](#) (2024)

### **Iowa DOT**

[Electronic Reference Library \(ERL\) | Standard Road Plans - TC Series](#)

### **Colorado DOT**

Safety | Work Zones [web page](#) including links to Flagger Program, Lane Closure Strategies, Safety and Mobility Program, and Work Zone Traffic Operations Strategies

### **Maryland State Highway Administration**

- Work Zone Safety and Mobility [web page](#)
- [Work Zone Safety Toolbox](#)
- [SafeZones Automated Speed Enforcement Program](#)

### **North Dakota DOT**

- [Traffic Control Requirements for NDDOT Operations on Highways and Streets](#) (2025)
- [NDDOT Innovation iCone](#)

### **Oregon DOT**

Work Zone Traffic Control [web page](#) including the [Oregon Temporary Traffic Control Handbook \(OTTCH\)](#)

### **Virginia DOT**

Work Zone Safety and Operations [web page](#) including the [Virginia Work Area Protection Manual \(VWAPM\) version 11.0](#) and work zone traffic control training requirements.