

# OPERATIONS AND MAINTENANCE PEER EXCHANGE REPORT

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**NOCoE**  
National Operations Center of Excellence

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# NOCOE OPERATIONS AND MAINTENANCE PEER EXCHANGE PROCEEDINGS

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## Overview

On June 11-12th, 2019, the National Operations Center of Excellence (NOCoe) held an Operations and Maintenance Peer Exchange in Montgomery, Alabama. Hosted by the Alabama Department of Transportation, the purpose of the peer exchange was to facilitate knowledge transfer between the state department of transportation (DOT) operations and maintenance practitioners around the country.

The overall theme for this event was the important synergy that has begun taking place among operations and maintenance divisions in state departments of transportation and the positive impact this is having on their respective missions and goals. The peer exchange covered the following topics with state DOT presentations in each topic area ([See agenda](#)):

**Topic 1:** Increasing Lane Capacity within Existing Right of Way ([WSDOT](#), [MDOT](#))

**Topic 2:** Incident Management/Incident Response ([MDOT SHA](#), [TDOT](#), [MnDOT](#))

**Topic 3:** Work Zone Construction and Maintenance Needs ([MDOT](#), [ALDOT](#))

**Topic 4:** Limitations and Restrictions for Maintenance in Today's World (General Discussion)

**Topic 5:** Workforce Development: TSMO and Maintenance ([NOCoe Presentation](#) / Discussion)

This report includes a section on each of the topic areas above. The first three sections include a high-level summary of the topics followed by a detailed summary of the presentation and discussion highlights spearheaded by two or more state DOT presentations. The fourth section offers insights from the wide-ranging discussion among participants on the limitations and restrictions they confront in their day to day maintenance efforts. The final section of the report includes NOCoE's presentation on TSMO Workforce initiatives and the general discussion on workforce development in the areas of maintenance and operations by peer exchange participants.

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## **TOPIC 1: INCREASING LANE CAPACITY WITHIN EXISTING RIGHT OF WAY**

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The first topic of discussion in the peer exchange was Increasing Lane Capacity within Existing Right of Way. Although constructing new roads can reduce congestion, building a new highway or adding new lanes on an existing one is an expensive proposition. It has been shown instead that Active Traffic Management (ATM) can help with dynamic management of recurrent and non-recurrent congestion by focusing on the trip reliability. ATM stresses the automation of dynamic deployments to optimize performance quickly to avoid delay of manual deployment of operational strategies. ATM strategies including dynamic lane use control, dynamic merge control, dynamic shoulder lanes, dynamic speed limits, and queue warning can lead to significant savings of both time and cost.

Adam Hill, the editor of ITS International, noted in an article ([Traffic Monitoring and Hard Shoulder Running](#)), that with hard shoulder running, congestion decreases and incidents either remain the same or in fact decrease. He interviewed Beverly Kuhn of the Texas Transportation Institute who stated that “the various agencies in the US that have monitored safety after the implementation of shoulder running have not found a significant increase in crashes. The general consensus is that the use of the shoulder as a travel lane has helped ease congestion by increasing capacity, and thereby helps offset the loss of the shoulder.”

The effectiveness of an approach like hard shoulder running depends upon a strong partnership between the operations and maintenance arms of a department of transportation. Maintaining shoulder lanes, barriers, signs, and the additional technologies employed to make this enhanced road capacity work calls for methodical and preventive maintenance, as shown in the following two examples.

### **Presentation/Discussion Highlights for Topic 1**

#### **Washington State DOT Learnings—Shoulder Use for Transit to Increase Travel Time Reliability**

The Washington State Department of Transportation (WSDOT) highlighted its use of shoulders with the goal of improving transit travel times for C-TRAN buses. The goal was to improve transit travel times on SR-14 by allowing C-TRAN buses to by-pass traffic by using shoulders when the highway is backed up (based on time of day and travel demand). This approach did create maintenance issues, including how best to perform shoulder brushing and guard rail maintenance. The optimal solution for WSDOT was to conduct night maintenance. To effectively implement this solution, the state established policies to oversee its hard shoulder running. The policies stated that the buses may only use the shoulder when mainline speeds are less than 35 mph, and may only travel 15 mph over mainline speeds to a maximum of 35 mph. Alongside these modifications, an increase in incident response was introduced — more tow trucks and push trucks were positioned in an on-call mode. The use of hard shoulders for buses has resulted in improved travel times and reliability.

The successful implementation of the Washington State DOT's hard shoulder running was a direct result of the partnership with the maintenance division.

### **Michigan DOT Learnings—US 23 Flex Route to Overcome Nonrecurring Congestion**

Michigan DOT has implemented the US 23 Flex Route strategy to address the significant recurring directional peak hour congestion on US 23 from the Ohio border to Flint (major north/south route). With the goal of 97% system reliability, the department's operations and maintenance divisions worked together to incorporate preventative maintenance plans and intelligent transportation systems (ITS) maintenance efficiencies to improve response times. Arrangements were made to operate within allowable work hours (including off-peak) that brought costs down compared to working only at night. A Microwave Vehicle Detection System (MVDS) was installed to ensure accurate queue detection. Compared to the conventional inductive loop detectors, MVDS are easy to maintain without interruption of traffic. However, in order to continue obtaining high quality data, MVDS sensors need routine maintenance and management including checking setup position, on-site calibration, data communication, and data management. Use of MVDS helped meet the goal of 97 percent system reliability which was a priority for the project.

Among the modifications made were those to Lane Control Signs (LCS) where the controllers were removed from the signs and put into cabinets, and cabinet size itself was increased to accommodate additional controllers. Also, copper was used for all the wiring installation material (aluminum bends easily under pressure).

Initial estimates suggested a high budget for maintenance (assuming night only maintenance), but with a new contracting method (the force account method), costs were reduced. In force account method, the work is billed for the cost of labor, materials, and equipment, plus an agreed percentage for overhead and profit (without prior agreement as to lump sum or unit price cost). The new budget terms allowed off-peak maintenance work during the day which helped reduce the costs. In the initial phases of the project, the equipment upgrades budget and the engineering budget for installation were relatively high. The expectation is that the majority of the costs will shift to maintenance and operations later in the project since the processes will be well-established by then.

The work included a number of maintenance efficiencies including the installation of boot (power strip) bars in each cabinet to remotely reboot equipment to decrease maintenance response times. Also, environmentally controlled laptops were incorporated at the two nodes to reduce response times for maintenance. Additionally, winter maintenance protocols have also been reviewed and enhanced including protocols to reduce speed, categories to post on LCS when difficult to determine speeds or road conditions, and signage cleaning protocols.

Among the operational considerations for the Flex Route are:

- The part-time shoulder use was preferred over High Occupancy Vehicle lanes. Drivers can be cited for improper lane use (e.g. disobeying a traffic sign if running in red-cross). Overall, the public listens and obeys the lane use law.
- Trucks are not allowed in the left lane (narrow shoulder for roadside). Enforcing the variable speed limit compliance has been more challenging compared to the lane restriction.
- Michigan DOT has worked with FHWA closely to make sure that the design and operational parameters are accepted for hard shoulder use.
- The queue warning system includes gantries with an MVDS system that collects speed and lane occupation information that posts information for drivers.

The bottom line, benefit-cost analysis (FHWA TOPS tool) shows a \$7 million net positive result for the project. The travel patterns have been improved overall, however, one of the challenges that still exists is the congestion and incident increase just outside the flex route limits. To address this issue, the sequencing of traffic from the project limits, to outside project limits, needed some fine-tuning.

Following Michigan DOT's presentation, Minnesota DOT (MnDOT) attendees commented that they used hard shoulder running in 2009 for interchange construction in metropolitan Minneapolis. It led to an increase in crashes, however, the crashes would have been worse if the approach was not used. MDOT actually got help from MnDOT when setting up their US 23 Flex Route.

## TOPIC 2: INCIDENT MANAGEMENT AND INCIDENT RESPONSE

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The second topic of discussion in the peer exchange was Traffic Incident Management (TIM) and Incident Response. The Federal Highway Administration (FHWA) defines incident management and response as a planned and coordinated multi-disciplinary process to detect, respond to, and clear traffic incidents so that traffic flow may be restored as safely and quickly as possible. With that in mind, there are many first responders for DOTs to partner with including police, firefighters, DOT towing, medical personnel, and others who have responsibility for the roadway during an incident. However, those broader partnerships will not work, if a DOT's operational and maintenance arms do not work hand-in-hand.

### Presentation/Discussion Highlights for Topic 1

#### Maryland DOT Learnings: TSMO 2.0, Maintenance, and TIM

The Maryland Department of Transportation's State Highway Administration (MDOT SHA) began its presentation with the view that the intent of TSMO is to effectively manage and operate existing facilities and systems to maximize their full-service potential. TSMO strategies aim to optimize capacity that is limited by recurring and non-recurring congestion. Among the agency's strategies and solutions is its commitment to TIM. MDOT SHA applies the following strategies and approaches related to TIM/maintenance:

- **Role of maintenance in effective operations** - TSMO and maintenance have evolved together in the face of 21<sup>st</sup> century transportation. The important role of maintenance in improving mobility is undeniable. Maintenance supports shoulder repair, guardrail repair, mowing operations, line striping, Raised Pavement Marker (RPM) replacements, and emergency operations. Maintenance work may now have to take place in a smaller window of time because of the extended rush hour (e.g. begin at 10:30 a.m. instead of 9:00 a.m.).
- **Equipment use** - MDOT SHA uses its own shop equipment if major incidents occur. In Maryland, winter maintenance vehicle use is transparent to the public as much as possible (inspired by Michigan DOT's [MiDrive](#)). Maintenance equipment is more technology-advanced than ever. DOTs need to be more informed in asking the vendors about their required inside-the-vehicle equipment and technologies.
- **Outreach and education** - Outreach and education are conducted to address the gap between senior level officials and lower level boots on the ground staff. Highway maintenance seminars are held for internal coordination. TIM staff are asked to come one hour earlier to the coordination meetings to review maintenance needs. This education/outreach is especially important where TSMO/maintenance intersect in achieving goals. For instance, well-maintained line striping and pavement markings are crucial in a connected and autonomous vehicle (CAV) future.
- **Data and winter operations** - Maintenance and operations may be asked to support MDOT SHA's TSMO performance management activities through the provision of data and performance

tracking (e.g. “Regain Time”). Continuous weather data can be collected through mobile devices attached to the maintenance car, extending the role and contribution of maintenance. Using collected data, the ability to calculate salt usage lb/lane miles/inch snow via technology sharpens the provision of this service. Another data-driven strategy that MDOT SHA uses is that all patrol routing is determined based on the research and analysis that was done by the University of Maryland’s Center for Advanced Transportation Technology Laboratory (CATT Lab) and Morgan State University using historical data.

Given that the TSMO strategies are reducing the impact of crashes and traveler delay on Maryland roadways, it has become essential that TSMO coordinate with maintenance shops. This coordination helps with the efficient allocation of resources at maintenance shops and supports Freeway Incident Traffic Management detours.

### **Tennessee DOT Learnings: The Convergence of Operations/Maintenance/Incident Management**

In working a mostly rural state, the Tennessee Department of Transportation (TDOT) has always been committed to strong and effective incident response. That said, an especially severe crash involving a potato truck crash on Interstate 40 that led to a significant traffic delay, encouraged TDOT to up its game. The lessons from the potato truck crash spoke to the need for a memorandum of understanding between TDOT and the safety community that established a unified command structure to deal with highway incidents. The memo authored a range of proactive, consistent protocols to facilitate safe, quick incident clearance, and committed sufficient resources (depending on the time/availability of the resources for recovery). For instance, previously, there were 24 distinct versions of lane clearance guidelines around the state districts. This was changed, with best practices gleaned from the range of approaches, and a standard process was created.

As new provisions were developed for incident response, it also became clear to TDOT that a number of secondary issues were created by what had been standard operations. One was the need to balance the timeline for repairs that have to be completed in the incident phase compared to what can be scheduled or triaged later. An all hands on deck approach toward incidents led to a clarification of “maintenance” employee roles in rural incidents, in particular, ensuring there was a capacity to respond and act. Additionally, the Standard Operating Guideline (SOG) helped formalize TDOT’s role to include detailed responsibilities during the time of the accident, initial reporting, incident response, through the final recovery stage. These SOGs helped address a number of matters. Among the specific improvements were:

- **Scene management improvements** - Helping to empower the staff at the scene to make the decision is important. It is helpful to assessing and addressing the matter of fiscal responsibility for secondary damage when removing vehicles comprehensively in DOT processes. Also, for more efficiency, improvements in equipment allocation and management were made. In rural areas, there is a challenging dynamic between managing the incident and completing tasks.



- **Quick clearance of the roads** - Separating the roles on the scene is important. One person worries only about implementation and clearance. The delegate cares about TMC communications. The incident commander wears a different color hard hat to distinguish himself/herself. It is important to work with the fire truck responders to make sure they work as fast as they can to clear the scene. If it takes a lot of time for the towing company to get on-scene, TDOT uses in house equipment. It is a big deal to clear the road as soon as possible. The DOT can and should use any equipment/resources available if it will reduce the overall clearance time for an incident. With few exceptions, lanes should not be blocked for the off-loading of cargo. If the wreckage is clear of the roadway, the rest of the recovery work should be scheduled at night or during off-peak hours.
- **Efficient Processes** - An example of efficient processes for quick clearance was TN DOT's scene investigation protocols. The scene investigation is completed by an independent third party, usually FHWA. When a major incident happened in Tennessee during the nationwide shutdown of federal agencies in January 2019, TDOT had a backup plan in place and was able to get assistance from the Nashville trooper helicopter.
- **Hands-on TIM Training** - TDOT also provided Hands-on Training (HOT) for not just leadership but for district maintenance staff. This interdisciplinary TIM Training was developed through the Regional TIM committees with involvement from District Maintenance staff.

Among the takeaways, solutions and lessons learned from these new approaches are: 1) TIM implementation is now more robust, comprehensive, and effective; 2) practical, easy to carry out solutions can work (e.g., using dump trucks as screens to cover active accident scene in remote setting, allowing traffic to resume flowing earlier than otherwise might have been possible); and 3) relationships are a priority, as enhanced partnerships are more important to long term success than a single incident outcome.

Overall, good working relationships with maintenance staff, effective policy and processes, and effective equipment utilization and coordination have led to positive performance and good outcomes for TDOT.

### **Minnesota DOT Learnings: Building a TIM Program with TSMO and Maintenance in Mind**

In Minnesota, TSMO goals interface closely with TIM program operational goals. The Traffic Incident Management program addresses mobility and safety goals. MnDOT's TIM program strategy has followed directly from these goals. The TIM strategies in the TSMO plan are focused on developing regional TIM programs and TIM programs for work zones. Within each of these strategies are sub-strategies. The full list can be found in MnDOT's slides on the NOCoE website.

This strategy has led to a number of changes in policies, processes, and performance goals:

- "Open Roads" – A statewide policy between MnDOT and the Minnesota State Patrol (MSP) to make re-opening roads and lanes a priority.

- “Quick Clearance” – A change in state law 169.041, applies to the Metro district only, gives MSP and MnDOT additional legal force to clear obstructions promptly.
- The goal for Metro: an average incident clearance time of 35 minutes.
- Goal statewide: clear incidents from the roadway in 90 minutes.

With these changes have come several takeaways and lessons learned. MnDOT had success in reaching an agreement with its partners along with initial TIM training rollout. MnDOT continues to address challenges to train new staff and familiarize them with the open roads policy. Also, MnDOT is looking into methods to collect data for performance measures and to maintain current success. There is a need for continuous training and collaboration.

The maintenance crew supports TIM operations by providing equipment, materials, and manpower to clear incidents in the metro district, the greater Minnesota districts, and statewide. While these actions have a positive impact on reducing clearance time, they also have caused unforeseen implications for maintenance. The implication for maintenance crews is that they need to postpone regular maintenance duties for incidents which may cause the overall health of the infrastructure to deteriorate in the long term.

## **TOPIC 3: WORK ZONE CONSTRUCTION AND MAINTENANCE NEEDS**

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The third topic of discussion in the peer exchange was Work Zone Construction and Maintenance Needs. As cited by the FHWA in its Work Zone Management Program, managing traffic during construction is necessary to minimize traffic delays, maintain motorist and worker safety, complete roadwork in a timely manner, and maintain access for businesses and residents. Effective work zone traffic management includes assessing work zone impacts and documenting strategies for mitigating the impacts in a Transportation Management Plan (TMP). The role of a DOT's maintenance division is central to ensuring a win-win situation for the DOT and the public: successfully completed work in the work zone (on time and within budget), and effective traffic flow that ensures the safety of the traveling public and workers alike. The highlights below include some of the lessons learned from the Michigan and Alabama DOTs in addition to a summary of maintenance-related issues that were raised in the recent NOCoE Smart Work Zones Peer Exchange.

### **Presentation/Discussion Highlights for Topic 3**

#### **NOCoE Learnings: Smart Work Zones Peer Exchange**

As a preview to the discussion on work zones and maintenance, Niloo Parvinashtiani of NOCoE, reviewed the outcomes from the recently held Work Zone Peer Exchange. She noted that the peer exchange covered three major topics: traveler information in work zones, lane closure management, and technology in work zones.

There were a number of key maintenance-related takeaways that came out of these discussions:

- It is important to have an inventory of accessible spare parts for smart work zone equipment.
- There is a learning curve for smart work zone equipment set up and maintenance in work zones.
- Equipment maintenance is key to the success/failure of managed work zones.
- There are inevitable challenges in choosing between outsourcing and in-house execution of tasks. These considerations include time limitations/resource limitations, extracting data from equipment, and QA/QC.
- Work zone gaps/issues by Capability Maturity Model (CMM) categories are worth assessing. Gaps in business processes include different schedules for project cycles and maintenance cycles. Gaps in culture include engaging diverse stakeholders from different levels/jurisdictions of maintenance staff.

For more information, view the [Smart Work Zone Peer Exchange proceeding](#) on the NOCoE Website.

#### **Michigan DOT Learnings: Bay Region—Work Zones and Maintenance**

The Michigan DOT's (MDOT) Bay Region (one of seven regions in the state) consists of 15 counties with a budget of approximately \$37 million (out of a state-wide \$300 million budget). Its work zone approach

focuses on planning, coordination, and the use of smart technology to ensure the best possible outcomes for safety and mobility. The following is among the early learnings in its region-wide approach:

- **Planning coordination** - To avoid conflicts, MDOT holds bi-weekly calls (March - December) with region operations engineers/groups and the bridge program manager. On these calls, the team goes through a master spreadsheet and updates it as needed, to make sure that when maintenance is out there, people know about it.
- **Stakeholder coordination for work zones** - Due to an increase in work zone worker fatalities, an industry task force has begun looking at preventive measures. Part of the work zone coordination is ensuring that the dispatch and emergency responders know about any planned work zone and maintenance work. Also, there was a case of a split merge where fire trucks could not pass. A lesson learned was to ensure that the larger emergency vehicles can pass whenever there is a lane closure.
- **Smart work zones** - Staging for winter operations is an important part of the operations readiness. Smart work zones are usually not used for maintenance because they are short term. One technology that has worked really well for MDOT's work zones is the moveable concrete barrier wall. The moveable barrier wall or the "zipper wall" was also used in pavement projects in Kent County, Michigan. In that project, the zipper wall was moved twice daily, allowing contractors to maintain two lanes of travel during peak volumes. The addition of the moveable barrier allowed construction to be completed within one season as opposed to two seasons, resulting in cost savings over the original estimate. In addition, safety was improved by separating construction traffic from the traveling public.
- **Scheduling maintenance** - MDOT schedules maintenance work as much as possible but a lot of unexpected things come up, so it is important for the maintenance staff to be flexible. Additionally, the DOT focuses on scheduling maintenance and work zone projects for a single location at the same time to take advantage of the road closure. Often, the project limits are separate, so there is no conflict between the limit of work between the two contractors. Scheduling maintenance/ops simultaneously is more common in urban areas. MDOT has a lot of tourist traffic weekends like the 4th of July – so the DOT avoids scheduling road work/maintenance during holiday weekends at all costs.

### **Alabama DOT Learnings: The Importance of Culture in Managing Work Zones**

Alabama DOT (ALDOT) has begun assessing how best to create and maintain smart work zones. These learnings on how to address the challenge of work zone traffic management have equal implications for the state's event management, and they have successfully implemented a primary example. In the fall, the college football schedule creates a comparable set of traffic management problems for which the following range of approaches can be applied: real time traveler information; queue warning; dynamic lane merge; incident management; variable speed limits; automated enforcement; entering/exiting construction vehicle notification; and performance measurement.

An intangible element plays an equally strong role in effective work zone management—the shared culture of commitment and partnership among operations, maintenance, and law enforcement personnel to tackle these traffic challenges. The value of this collaboration has helped find practical solutions to a number of work zone sites. For instance, the ALDOT tried dynamic lane merge during a maintenance project, but it did not work well because there was not enough volume passing through the project site. In some cases, it was found that using multiple dynamic message signs was not necessary and potentially a distraction to drivers; using static signing would be sufficient in those cases.

## General Discussion

- **Internal and external coordination of lane closures**
  - At TDOT, each district handles lane closures a little differently. A single person is a clearinghouse for coordinating lane closure for 24 counties. All lane closures are documented and a PDF is placed on the TDOT website each week.
  - Most DOTs divide their approach toward safety training for maintenance staff. Usually, the DOT trains the internal staff and the contractor is responsible for their own staff.
  - WSDOT has important MUTCD safety training material available for workers, providing traffic control guidance for common work operations. This document can be found in the “supporting documents and resources” section of this document.
  
- **Transportation management plans** - Several operational considerations for Transportation Management Plans addressing detours were discussed. The TMP manual usually does not address operations per se. At MDOT, operations and incident engineers in the region or the central office review them for operations considerations. The traffic control plan gets stamped but the individual TMP does not get stamped. TMPs are usually a living document. It takes three to four weeks to get approval from an engineer if there's a change in the plan, that is why people are hesitant to make it more dynamic/live.

## TOPIC 4: LIMITATIONS AND RESTRICTIONS FOR MAINTENANCE IN TODAY'S WORLD

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The last Peer Exchange Topic on Day 1 was a general discussion on limitations and restrictions for maintenance in today's world. Participants engaged in a wide-ranging discussion and shared the following considerations.

### Discussion Highlights for Topic 4

#### Public Expectations

- **The expectation of being a customer service-oriented agency** - The public sometimes expects unrealistic customer service from the DOT. People expect the DOT to know more than just operations and be able to coordinate everything. (e.g. early school closures, schedule of all events, etc.), which is not realistic. This call to have transformed services to be on a par with technology companies such as Amazon with extensive development, innovation, and education requires an increased expenditure from the public funding which is unacceptable in the public's eyes. Sometimes these expectations contradict themselves. For example, we all want the roads to be cleared of snow but do not want to go through the delay of driving behind a snowplow. The public does not understand what the DOT needs to do to make things happen. The public also may assume the worst of a DOT if anything goes wrong. A contractor may make a bad impression that reflects on DOT. The default assumption becomes that the DOT is corrupt, lazy, etc. Engineers are not good at educating the public. Having focus groups on marketing and training on how to do outreach would be helpful to enhance engineers' public outreach capabilities.
- **Public's and legislators' attention** - Often, artificial issues get the public's and legislators' attention. In wintertime, snow vehicles and salt usage are often discussed, even though, the public might not understand all the ins and outs of how winter salt treatment works. This discussion moves to the topic of potholes in the springtime. One state DOT conducted a survey experiment by sending out a survey monkey form to volunteer commuters. The program did not continue because the state did not receive much constructive feedback. Through the legislator feedback, a lesson learned for a state DOT was to avoid DMS signs that are blank or have general safety messages.
- **Everything is in the public's eye** - With the increased use of social media and smartphones, any issue or incident is widely communicated by the commuters when the videos and photos are shared in social media platforms. People pay extra attention to a state's operations during emergency management situations and in winter. Agency capabilities are limited when addressing winter weather because of funding limitations, but the public expects more, ignoring these realities. Unless a rural road is a pass-through between metropolitan areas, the roads will get less attention and face longer response times when incidents happen.

## 24/7/365 Service

- **Budgeting for increased hours of operation** - In some states, TSMO funding comes from maintenance. In that case, going to 24/7/365 operations means a tradeoff between TSMO and other fixed maintenance expenses. Usually, 24/7 operations do not come with their own resources and require tradeoffs.
- **Workforce needs for increased hours of operations** - Workforce recruitment/retention is a challenge in normal circumstances, but with an increase in the workforce need, it will be an even bigger challenge. A big consideration is addressing fatigue issues related to employee nighttime work and excessively long/consecutive shifts. For example, if a TMC operator's schedule requires that person to do day shift a few days a week, and night shift other days of the week, that imposes an irregular sleep schedule causing fatigue and safety issues. A potential solution could be shifting towards having regular nighttime work crews with a fixed schedule. Additionally, currently, there is no established mechanism in place to limit hours of fieldwork in special conditions like winter/maintenance. It would be ideal to define procedures that limit the fieldwork hours to no more than 16 hours. More thought needs to be given to the consequences of the fatigue when sending drivers into high risk conditions. One state hires temporary staff for winter operations. Electricians may help support/back up snowplow drivers who are fatigued/finished with hours of service.
- **Increase in demand and system use** - The other topic of discussion was the implications and challenges of the increase in demand and system use. The public expects traffic to be smooth at all times, therefore, night work is common. Consistency between regions in a state is also another demand from the public. It was mentioned that budget limitations result in deferred maintenance causing the DOT to be in a reactive mode rather than looking at the system holistically. More advanced monitoring systems help the DOT to anticipate the problems via an early warning system. Also, device failure happens, but what matters most is the handling of the recovery.

## **TOPIC 5: WORKFORCE DEVELOPMENT FOR TSMO AND MAINTENANCE**

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NOCoE's longstanding Workforce Development (WFD) initiative was highlighted on Day 2 of the Peer Exchange with the purpose of determining how best NOCoE's continuing WFD efforts might interface with and support a department's maintenance workforce needs.

### **NOCoE Learnings—NCHRP 20-7 TSMO Workforce Guidebook**

Funded by NCHRP 20-7, the TSMO Workforce Guidebook offers the TSMO community a tool to understand how to develop a strong TSMO workforce and a Strategic Management Framework for identifying new positions, recruiting, and retaining TSMO staff. The [Workforce Guidebook](#) is available on the NOCoE website.

NOCoE Managing Director Patrick Son previewed the workbook as a way of considering whether its approach might be a useful model for DOT maintenance jobs. He also shared another initiative NOCoE is executing—case studies on a number of university/DOT collaborations on workforce development. The MDOT SHA, ALDOT, and TDOT agencies are participating in this case study effort.

In addition to NOCoE's efforts, attention was drawn to the National Network for Transportation Workforce (NNTW)--Transportation Career Pathways initiative which is looking at transportation workforce challenges and opportunities as a whole.

The question was posed to attendees: How inclusive should the TSMO workforce be of the maintenance needs? The state DOTs believed that it is important that the maintenance positions be incorporated in a number of ways, given the natural linkages across department portfolios. The ensuing discussion led into a detailed discussion toward needs, current practices, and future opportunities.

### **Discussion Highlights for Topic 5**

#### **Position Descriptions and Knowledge, Skills, and Abilities for Maintenance**

At WSDOT, general maintenance position types by responsibility include snow removal, pavement patching, guard rail repairs, vegetation removal, welding, and sign repairs. Specialty classes include incident response, signal maintenance, and restriping. For WSDOT, it is hard to find people with the required skills or with similar skills who can get trained easily (e.g. electrician jobs). Since traditional electricians do not have familiarity with signals and do not meet the skill requirement, it is extremely hard to fill these positions (similar issues exist in MI). This position is usually underpaid, so the only motivation might be the quality of life depending on DOT's retirement and benefit plans.

At MDOT, the Transportation Maintenance Worker Guidance Handbook provides a method for classifying employees according to the employee's knowledge, skills and abilities, and work elements that each employee can effectively perform. The in-person training might be different for the central office versus



regional offices based on each region's needs. MDOT requires a Commercial Driving License (CDL) for most positions. As a result, it is easier to move employees from maintenance to operations if needed. In Minnesota, the workforce is interchangeable between crews but some roles need special certifications. Another consideration is that construction workers usually have more education/math skills and do not necessarily like to do snow plowing type jobs. The Colorado Department of Transportation (CDOT) has developed a college degree for maintenance (School of Mines).

At the North Dakota Department of Transportation (NDDOT), the Design Division has some of the needed specialty work, and the electrician positions are contracted out. The maintenance positions include Transportation Technician I, II, III, Transportation Services Supervisor I, II, Highway Traffic Control Specialist I, II, Transportation Engineer III-ITS (Fargo District), and Highway Traffic Control Supervisor. All of these positions report to the districts. The Highway Maintenance Coordinator and Superintendent report to District Administration. The position description for all these roles can be found in the "Supporting documents and resources" section of this report. One of the challenges that the NDDOT faces is that the state is one of 7 State agencies going through Statewide IT unification. As a result, ITS maintenance is now operating within the IT department, so workers will need to report to another state agency.

At the Georgia Department of Transportation (GDOT), there is a distinction between the ITS electrician position and the maintenance electrician position. GDOT has restructured the shops to have a few people with CDL in each shop. Some skill needs are contracted out depending on where DOT is positioned with internal skills.

### **Recruiting Challenges in the Maintenance Area**

In general, the pipeline for recruitment is dry in all areas including maintenance. Ideal employees are those who are the "Jack and Jill" of all trades. Prospective employees need a clean record with good social skills. An organization can train skills but teaching work ethic or attitude is very hard (hire for attitude, train for aptitude). At ALDOT, recruiting interns has proven to be a good tactic for hiring. The challenge is that the commute to different district offices is sometimes challenging for the interns. Many times, DOTs are actively involved with workforce development by attending career days in high schools, volunteering and speaking at schools, providing support for "bring your kid to work" days, holding bridge-building competitions, and career shadowing events. Usually, each employee has dedicated volunteer hours each year that can be used for these events. The thing to keep in mind is that engineers have a bias toward encouraging students to be professionals even though there are gaps and needs in non-professional jobs.

DOTs are employing a psychology lens to test applicants. A prerequisite for hiring is that the person needs to be flexible and know how to deal with ambiguity. One of the participating DOTs mentioned that they have a pre-interview process to assess candidates. They look for someone who can handle routine change and has good anger management skills (maintenance schedules can be very unpredictable). They also look

at how people deal with unpredictability and frustration. Honesty in filling the applications is another important factor.

## **DOT Core Competencies**

A DOT, as an organization, needs to have core competencies to be able to function efficiently. The core competencies define major responsibilities that need to be done by DOT staff in-house. It is important for each DOT to thoroughly think about defining these core competencies based on its needs. Over time, the required knowledge, skills, and abilities will change and morph. Thus, these definitions need to be dynamic with things changing constantly in the transportation industry.

DOTs are starting to take on roles and lead programs that have not been traditionally part of their business models (e.g. data management). The agency constantly needs to assess each new/modified service to see if it fits the current business model, or if the DOT needs to change the business model to accommodate the need, or if the need should be addressed outside of the DOT by using outsourcing methods. When using outsourcing methods, holding the contractor accountable becomes crucial. If the majority of tasks are contracted out, DOT loses its ability to manage, inspect, and direct the contractor. The contract model needs to incorporate/retain oversight of what is contracted. The DOT's goal is to be a good steward of the public's money and not a money pass-through to the contractors. Background and exposure are important for procurement and contract finance, so many DOTs develop their own staff because these roles are very delicate and state-specific. Many times, traditional engineers do procurement/complicated contracts because it is overwhelming for procurement staff.

Outsourcing has long term consequences, so it is wise to never 100% outsource core competencies. Wrong attitudes include departments and staff who want to hand over anything difficult to contractors. DOT is in great need of people who can make sure they know what the DOT wants and that the work is done efficiently. This is more important in the operations world.

When the DOT sources out tasks through contracting, it loses the ability to see how things are done and loses the knowledge of how to do it. An example of a core competency that is not relevant anymore today is "paving roads." The paving crews used to be DOT staff for decades but this responsibility is completely outsourced today. An example of a core competency that remains relevant to this day is the ability to write Request for Proposals (RFPs). Finally, data management is a good example of a service that will be done best through a partnership with the private sector (P3).

## **ITS In-House vs. Contract**

The benefit of contracting ITS maintenance is that payment is used as a major performance incentive. For instance, if the lights/signals are not working, the contractor is not getting paid. That is a mechanism that can be used with contractors, but not with internal staff.

When asked, a number of DOTs commented on the use of in-house maintenance staff versus contracted. MDOT has taken a hybrid approach; ITS maintenance is contracted and some other tasks are done in house. ALDOT shared that its maintenance work is contracted, and at MDOT SHA, it is 60% state/40% contract. The Virginia Department of Transportation (VDOT) outsources maintenance for interstates. MnDOT is an exception in this area since it does all of its ITS maintenance in house. With 12 staff providing service to a big system, they have had challenges with replacing equipment and asset management (solution: MnDOT uses year-end funds for the purchase and installation of equipment).

It is important to note that for maintenance crews employed internally, there is a large pay difference between ITS and non-ITS jobs. Maintenance is a multifaceted area where having an employee who has a variety of specialty skills is considered a luxury. While there are many jobs handled by the same person, in some cases there are crews focused in certain areas (e.g. ITS maintenance). We need to be more inclusive of general maintenance in TSMO and accept that these two cannot be separated out in some areas.

## **Workforce Retention**

It was commented that sometimes people are really good at technical work but they are not necessarily good at managing people when moving up in positions. It is important for the DOT to find a good method to reward these individuals for their technical capabilities. The example of the Idaho Transportation Department (ITD) was brought up where the workers can move horizontally across divisions/crews.

Good retirement plans used to be a good motivation for DOT recruitment, however, we can see that more and more, DOTs are moving towards retirement plans with fewer benefits, which makes hiring difficult. An example of a change in long term benefits is the ability to withdraw retirement money only after the employee is 62. This used to be after 25 years of employment, no matter what age. The changes are not just a challenge for retention but also getting the employees attracted to consider the job in the first place.

Also, DOTs need to be more creative when thinking about pension programs. If a DOT is in the 401k game, that is a different world than the pension world. The DOT has to choose which world it is in and provide a respectable package. The peer exchange attendees all agreed that the changes in compensation and benefits are one of the major contributors to workforce recruitment/retention issues. The notion of public service has also suffered in recent years and hurt recruitment. Marketing the message as “serving society for the greater good” tends not to work. In general, there is a need for an overall strategy to engage states to create a better environment to recruit/retain a public workforce.

Another incentive for recruitment is getting support from the DOT for education. GDOT helps its employees get GEDs. TDOT reimburses GED costs as long as the person stays and works in Tennessee. TDOT’s program collaborates with the adult education office to support post-secondary degree education; with reconnect courses and life experience, the employees can earn up to 60 credits and start from the fourth semester in college. The ALDOT state personnel board has instituted a policy for retention. The

policy includes special merit raises and retention bonuses. The retention bonus is in response to someone with a job offer with a higher compensation offer, \$5,000 is offered to that person under the condition that they stay with DOT for two years. This offer is more meaningful for those at a lesser pay scale.

### **The Challenge of Data**

When collecting and sharing data, there are unintended consequences for transportation agencies. An example that was mentioned was that when several datasets including the MPOs datasets were combined by a private modeling company, certain predictions were made. For instance, the datasets were used to predict the characteristics of anyone who passes a billboard. It is worth contemplating the MPO's/DOT's responsibility when they share data with others. Another example was where VDOT hired the Virginia Commonwealth University (VCU) to collect data for them. When the university was trying to deliver the data, VDOT was asked how they will be using the data. VCU has an ethics board who goes over these situations. If a DOT has an ethicist, the role can be shared by all divisions in addition to TSMO. Regardless of the method we use for workforce support, it is very crucial for the DOT to be ready and prepared for a data-oriented future.

### **Role of Inspection in TSMO and Maintenance**

There is a gap in Tennessee for ITS inspections support. To address this, TDOT is developing in-house training on how to do ITS inspections for CEI (Construction Engineering Inspection) and MEI (Maintenance Engineering Inspection).

MDOT has defined separate roles for ITS inspection to cover all of its system needs. The role of the Construction Engineering Inspector is separate from the ITS Design Manager. The CEI is responsible for brick and mortar individual devices/projects and each region has an inspector. The system manager is responsible for overseeing the big picture ITS implementations. The system manager usually comes from an engineering background (electric, computer, civil, etc.).

### **Final Words on Workforce**

The Peer Exchange concluded with states voicing consensus on the value of NOCoE helping to bridge operations and maintenance gaps:

- NDDOT stated they have a great need in this area and having workforce discussion with TSMO experts in the room was very helpful.
- ALDOT stated that the workforce discussion in the AASHTO Maintenance Committee was more structured, but that this issue is ubiquitous and a defined group would be counterproductive. Being more pervasively distributed helps people think more comprehensively. That said, they concluded that external resources would be helpful to support the distributed model.

- TDOT stated that they are thinking about the line between TSMO/maintenance and where that lies.

## SUPPORTING DOCUMENTS AND RESOURCES

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1. [Agenda and Participants List](#)
2. [Merged PDF with All Peer Exchange Slide Presentations](#)
3. [AL: ALDOT Statewide TSMO Program Plan with Appendix](#)
4. [AL: ALDOT Statewide TSMO Strategic Plan](#)
5. [AL: ALDOT Statewide TSMO Master Plan PowerPoint Slides](#)
6. [AL: Non-professional Maintenance Job Descriptions \(Folder\)](#)
7. [MD: MD CAV 101 Flyer](#)
8. [MD: MD TSMO Program](#)
9. [MD: MD TSMO Infographic](#)
10. [MI: MI Maintenance Program Overview](#)
11. [MI: MI TSMO Program Overview](#)
12. [MI: MI Wiki - Contract Administration and Oversight Guidelines for ITS Projects](#)
13. [MI: MI Service Prequalification Classifications and Descriptions](#)
14. [MI: MI Maintenance Training/Position Description/Support Materials \(Folder\)](#)
15. [MI: MI Accomplishments Report \(2011-2018\)](#)
16. [MI: MI Special Provision for Movable Concrete Traffic Barrier](#)
17. [MN: MN TSMO Fact Sheet](#)
18. [ND: NDDOT - Operations & Maintenance Overview](#)
19. [ND: ND Maintenance Position Description \(Folder\)](#)
20. [NOCoe: TMSO Workforce Guidebook](#)
21. [WSDOT Work Zone Traffic Control Guidelines for Maintenance Operations](#)