ROAD WEATHER MANAGEMENT PEER EXCHANGE REPORT

JUNE 25-26, 2019

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PEER EXCHANGE OVERVIEW

On June 25th – 26th, 2019, the National Operations Center of Excellence (NOCoE) hosted the Road Weather Management (RWM) peer exchange in Salt Lake City, Utah. The peer exchange was planned and organized in collaboration with the AASHTO Committee on Transportation Systems Operations (CTSO) Community of Practice (CoP) for Road Weather Management.

The peer exchange was organized around four road weather management strategies, chosen by a CoP survey conducted in early 2019. The four topics and the associated DOT presentations were:

- Topic 1: Integrating mobile observations about road weather conditions for decision-making
- Topic 2: Variable speed limits driven by road weather
- Topic 3: Active real-time motorist warning systems for road weather hazards (road ice, wind, fog, flooding, blowing dust, etc.)
- Topic 4: Predictive traffic condition models integrating traffic models and road weather forecasts

The purpose of the peer exchange was to facilitate the knowledge transfer between operations, maintenance, and weather practitioners and to identify key actions for organizers and participants to execute in order to advance the practice around four specific road weather management strategies.

PEER EXCHANGE PROCESS, GOALS, AND REPORT OVERVIEW

This peer exchange was part of a year-long process to advance the practice of road weather management. The process, led by the AASHTO CoP on Road Weather Management, aimed to not only capture the best practices around road weather management, but to identify key actions that might drive the adoption of these practices going forward.

Foundations

On January 29, 2019, NOCoE hosted a webinar, planned by the CoP, with the goal of gaining preliminary data on the sources of road weather data utilized during TSMO operations and the types of road weather management applications and strategies the participants believed would yield high payoff potential during weather events. A poll held during this webinar showed that RWM Data sources utilized by the participants were dominated by fixed Road Weather Management System (RWIS), National Weather Service (NWS) forecasts and products, and network images (e.g. traffic cameras and other sources of images).

As a follow-up to this webinar, a survey of the operations and maintenance community was issued to identify the top 4-5 road weather management strategies that have the highest pay-off for agencies. The four topics identified, outlined in the previous section, were confirmed by the CoP to be areas where a large impact could be made to both advance the practice and to increase adoption.

Unique Peer Exchange Structure

The CoP and NOCoE then set out to organized a peer exchange to not only share the valuable practices of agencies leading the way in road weather management, but to utilize the collective knowledge and insights of these agency representatives to identify top road weather management priorities for the next 1- 3 years.

Twenty-six road weather management subject matter experts gathered for this peer exchange, held over two days. After introductions on activities from the CoP, the AASHTO Committee on Transportation Systems and Operations (CTSO), and the Federal Highway Administration (FHWA), the peer exchange continued with four working sessions, each around the four road weather management topics areas identified previously.

Each working sessions began with presentations from agencies who've led the way around a particular topic area and then attendees broke into four groups to conduct table-top exercises to determine priority action items to advance the practice of the given focus area:

- Two teams followed a Capability Maturity Model (CMM) process to determine actions across the 6-CMM dimensions.
- Two teams aligned actions to the AASHTO CTSO 8-Working Groups.

CTSO Analysis for Topic Area Tabletop Exercise

Tabletop Exercise		
Committee on Transportation System Operations (CTSO) Analysis		
Directions: Identify 1 to 2 actions to advance Road Weather Management across the 8 CTSO groups. This exercise is open to interpretation based on the experiences of your agencies! You are welcome to skip any groups that you feel are not priorities.		
CTSO Groups	**Action 1**	**Action 2**
Working Group on Operations Strategies TSMO and operations planning, emerging operations strategies, operations workforce development, operations guidebook, operations research, operations performance management		
Working Group on Operations Implementations (Former TIM group) Initial focus on work zones, collaboration between AASHTO and other organizations, related research initiatives, performance management and data needs		
Working Group on Freight Operations Permitting harmonization, Federal mandates, truck parking, CAVs (platooning), pilot car safety, freight operations research, freight operations performance management needs		
Working Group on ITS ITS equipment and data, ITS lifecycle asset management, sunsetting ITS technologies, ITS standards and guidelines, ITS data, ITS vendors, ITS research, outreach, and performance mgt.		
Working Group on Communications Technology DSRC licensing and deployment, communications infrastructure (including private, i.e. cellular, etc.), ITS communications support, emergency management communications, FCC policy		
Working Group on CAV CAV deployment support, Signal Phase and Timing (SPaT), CAV education and outreach, CAV-related asset management, CAV research, CAV data, CAV performance management		
Subcommittee on Performance Management and Data Engage CTSO subcommittees and working groups to understand data needs, assist with MAP-21 compliance, liaise with and leverage other national groups (AASHTO, NOCoE, ITE, ITSA, etc.)		
Research Development and Implementation Coordinators Coordinate with CTSO groups, TRB, other AASHTO, NOCoE, and USDOT on TSMO research efforts and needs; provide online database for gathering TSMO research needs (with NOCoE)		

CMM Analysis for Topic Area Tabletop Exercise

Tabletop Exercise		
Capability Maturity Model (CMM) Analysis		
Directions: Identify 1 to 2 actions to advance Road Weather Management across the 6 dimensions of the CMM. This exercise is open to interpretation based on the experiences of your agencies! You are welcome to skip any dimensions that you feel are not priorities or are not the best fit for the scope of this workshop.		
CMM Dimensions	**Action 1**	**Action 2**
Business Processes Formal scoping planning, programming, budgeting		
Systems and Technology Systems architecture, standards, interoperability, standardization and documentation		
Performance Measurement Measures definition, data acquisition, analysis, utilization		
Culture Technical understanding, leadership, policy commitment, outreach, program authority		
Organization and Staffing Organizational structure, staff capacity, development, retention		
Collaboration Relationships with public safety agencies, local governments, MPOs, and the private sector		

In the afternoon of the second day, participants came back together to determine two priority action items for each of the four focus areas. Commonalities between actions from the various teams were consolidated and an overall assessment was made for commonalities across focus areas. The result was the adoption of key actions to be taken by the CoP over the next 1-3 years, which is outlined in the table at the end of this report.

An Overview of This Report

While the process to identify key actions during the peer exchange was intricate, this report will cover the key findings from the presentations, discussion, and the final actions that resulted from the two-day discussion.

For each section based on the four road weather management topics, we will provide a brief overview and key points of the two presentations, but we encourage you to review the presentations in full via the links at the end of this report. We'll also provide the final actions related to each topic area, even though these actions were finalized much later in the peer exchange.

Additionally, we provide a table of road weather data collection and usage by participating agency, gathered throughout the peer exchange. While not comprehensive, this table can serve as a reference of activities occurring around the country.

The report concludes with the table of actions the CoP is working on as a result of this peer exchange, a brief discussion on the workforce development issues related to road weather management, and a glossary of all the presentations given during the peer exchange.

To get up to date information on the activities of the Community of Practice on Road Weather Management, including the status of these actions, visit their website or contact the CoP Chair, Steve Cook of Michigan DOT.

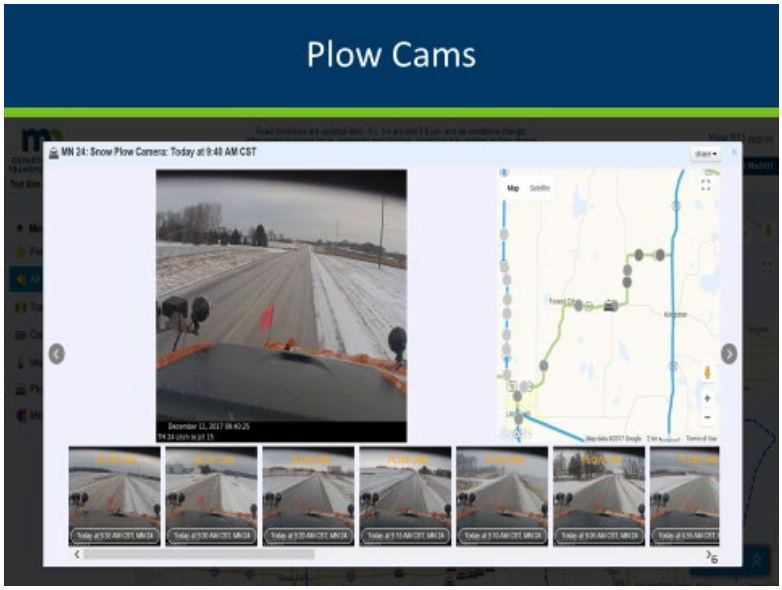
TOPIC 1: INTEGRATING MOBILE OBSERVATIONS ABOUT ROAD WEATHER CONDITIONS FOR DECISION-MAKING

Presentation Highlights for Topic 1

Minnesota DOT

Joe Nathan of Minnesota DOT, presented on Minnesota's Integrating Mobile Observations program. Key facts about the program, include:

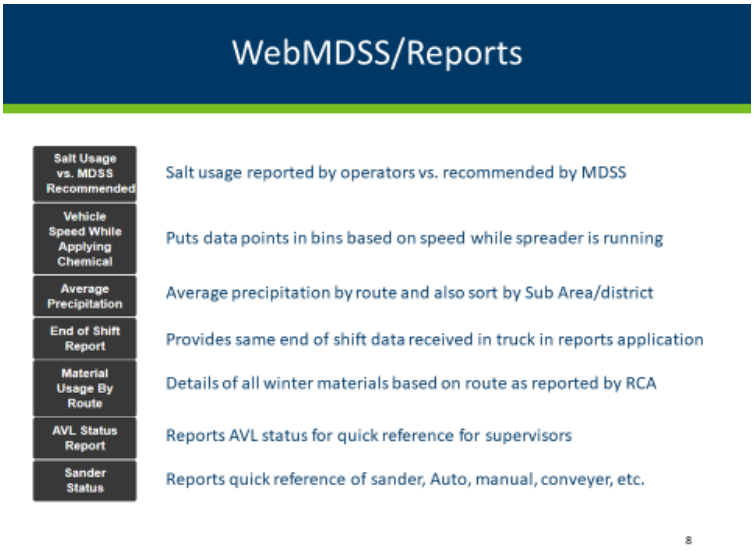
- MnDOT has 750+ plow trucks, 25 light duty vehicles and 35 mower tractors deployed with AVL systems
- Mobile data collected:
    - Air Temperature
    - Surface Temperature/Surface condition/Friction
    - Spreader controller information
    - CAN BUS data
    - Camera Images



The goal of the program is to provide:

- A robust system with built in interfaces providing real time mobile data to enhance MnDOT Operations
- Fleet Management/Vehicle Maintenance information
- Traveler Information Systems (511)
- Web MDSS
- Managers/Supervisors (MDSS Reports Interface)
- Internal reporting system (RCA) Through TAMS (not developed)

A key highlight of the program is the maintenance decision support system (WebMDSS) that provides a number of useful tools and reports related to road weather and performance management. Details are in the slide below:

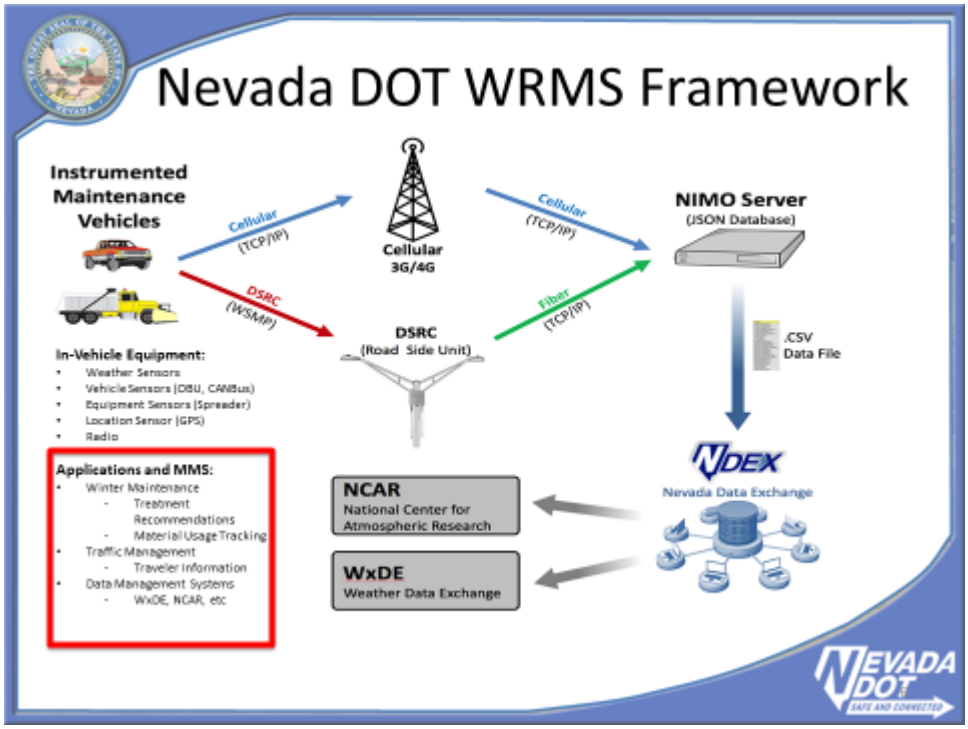


The salt sustainability program is a unique program underway in Minnesota. The goal is to reduce or mitigate chloride use based on calculated levels from the MDSS, driven by winter weather data. By having accurate weather information, operators are able to set target goals for chloride usage to both meet the need to keep the roadway safe and to ensure that there's no overuse of the chemical on the roadway.

Nevada DOT

Rod Schilling presented on Nevada's DOT Integrated Mobile Observations (IMO) and decision making program. Nevada utilizes instrumented maintenance vehicles, road side DSRC units, and weather data to support a comprehensive decision support system. The applications available involve:

- Winter Maintenance
  - Treatment recommendations
  - Material usage tracking
- Traffic Management
  - Travel information, via alert systems to Waze
- Data Management Systems
  - WxDE, NCAR, etc



Nevada is working on a common platform to include plow information, road locations, load improvements and event storm water systems.

Top Actions Identified by Working Groups

1. **Illustrate benefits of Integrating Mobile Observations through case studies and best practices analysis.**

- Short term efforts (underway or anticipated) from FHWA, CTSO RWM CoP, existing IMO practitioners

2. **Set de facto data standards (fixed and mobile environmental sensor stations (ESS)) and develop strategies for IMO implementation and integration.**
    - Advancement dependent on Clear Roads initiative
    - Steve Cook will work with AASHTO CTSO ITS Working Group and CoP

TOPIC 2: VARIABLE SPEED LIMITS DRIVEN BY ROAD WEATHER

Presentation Highlights for Topic 2

Oregon DOT

Galen McGill reported on Oregon DOTs variable speed limit program on OR-217, a 7.5 mile highway connecting I-5 and US-26. This is a 2-3 lane freeway where signs provide travel time, weather warning, and advisory speed limits.

On OR-217, 11% of speed reductions were due to weather, where the data found that drivers were more likely to comply with the warning systems compared to congestion based warnings.

OR-217 VSL Driver Compliance

- There are 6 advisory speed limit options for congestion response and 2 for weather response in accordance with OAR 734-020-0019
- The difference between measured and posted advisory speeds are lower for weather based speed reductions

Activation Source	Advisory Speed	Obs. Speed, Avg	Difference between Observed & Advisory Speed, mph	Difference, %	Overall difference by system, mph	Number of Obs.
Congestion	25	25.0	0.0	0%	1.5	1,304,666
Congestion	30	34.2	4.2	14%		424,447
Congestion	35	43.5	8.5	24%		804,813
Congestion	40	43.8	3.8	9%		473,935
Congestion	45	48.7	3.7	8%		702,660
Congestion	50	45.4	-4.6	-9%		1,244,624
Weather	35	36.4	1.4	4%	-2.5	20,915
Weather	45	42.4	-2.6	-6%		522,539

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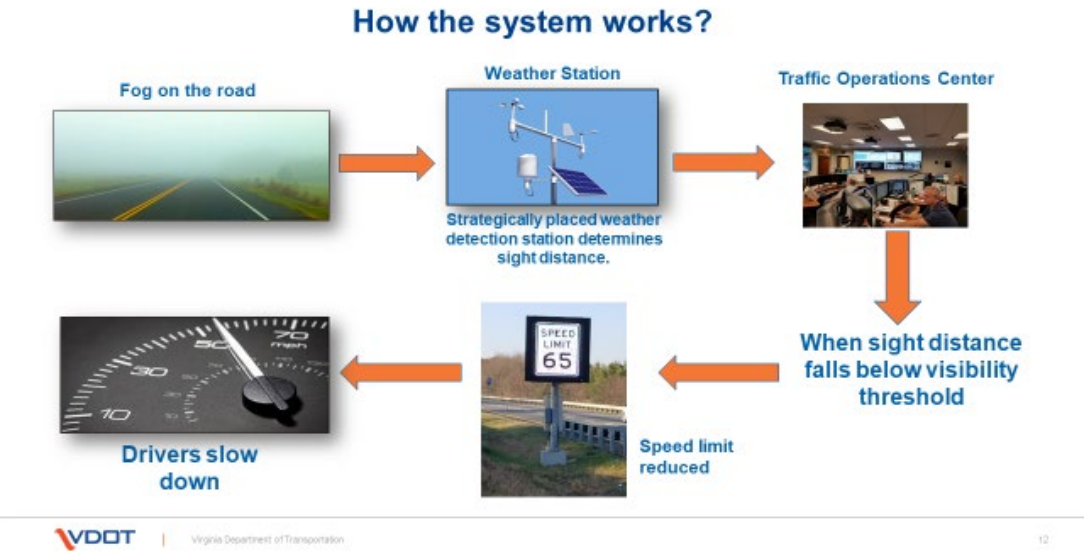
The discussion on the Baker Valley VSL system, included an illuminating photograph on the VSL system hardware:

The presentation concludes with information on how Oregon's DSS works, the law enforcement portal guiding enforcement efforts, and how system overrides are designed.

Virginia DOT

Mike McPherson of Virginia DOT presented on the state's system on Interstate 77 in Virginia at Fancy Gap Mountain. This stretch of road is consistently beset by dense fog, limiting visibility to less the 200 feet. Over 16 years, this stretch of roadway saw 9 significant crashes, with at least 482 vehicles, 7 fatalities and more than 100 injuries. The VSL system was designed to prevent these types of crashes, with the state goal of having zero fatalities and to have no more crashes with a massive number of cars.

A total of 69 signs of various types (static, VMS, etc. are in place in support of the traffic safety system. The system is deployed via the set-up in the figure below:



Preliminary results demonstrate a reduction in both rear end crashes and the overall number of crashes, as well as a reduction in crash severity. Some key findings are that driver responsiveness is still an issue. And while Virginia is an enforcement state for VSL, enforcement in thick fog is incredibly difficult.

Top Actions Identified by Working Groups

1. **Develop and document system engineering criteria (scoping, design specs, life cycle costs) for VSL for road weather.**
    a. In the short term determine current materials available
    b. Develop and describe materials on new and innovative strategies/systems/ algorithms/methodologies for using VSL for road weather and potential inputs to ConOp documents
    c. Will need the support and engagement of AASHTO CTSO
2. **Develop a research statement for the benefits of VSL for road weather (overall and drill into regulatory versus advisory).**
    a. CTSO members to draft materials for the Research in Operations Database
    b. CoP leadership in coordination with Tennessee DOT representative

TOPIC 3: ACTIVE REAL-TIME MOTORIST WARNING SYSTEMS FOR ROAD WEATHER HAZARDS

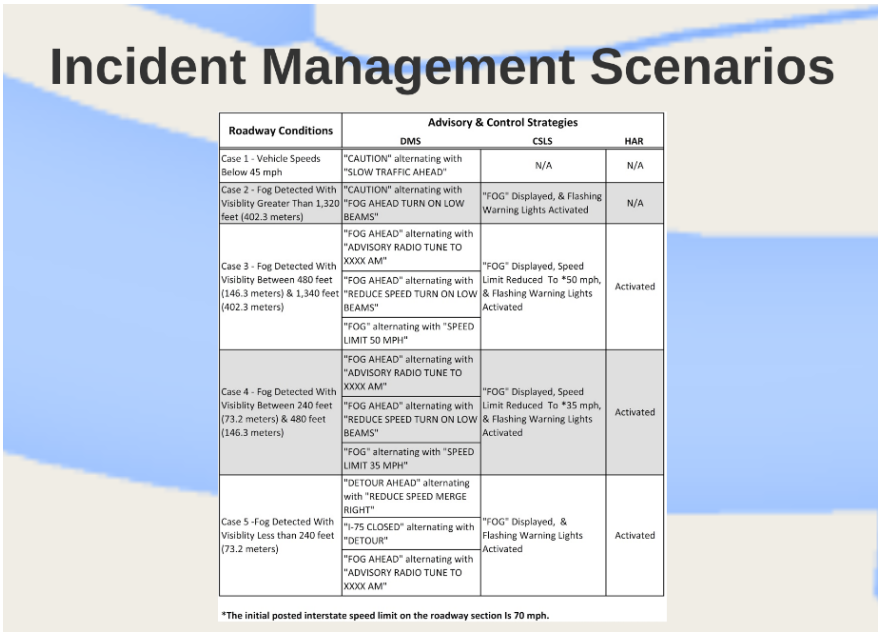
Presentation Highlights for Topic 3

Tennessee DOT

Said El Said presented on Tennessee DOTs real-time motorist warning system on I-75 outside of Calhoun, TN. The system was built in the aftermath of a terrible fog related incident that included 99 vehicles, with 50 injuries and 15 fatalities. The system includes:

- 8 visibility sensors
- 10 dynamic message signs
- 10 changeable speed limit signs
- 6 swing gates at entry ramps within the fog zone

The system was designed with 5 incident management scenarios:



Roadway Conditions	Advisory & Control Strategies		
	DMS	CSLS	HAR
Case 1 - Vehicle Speeds Below 45 mph	"CAUTION" alternating with "SLOW TRAFFIC AHEAD"	N/A	N/A
Case 2 - Fog Detected With Visiblity Greater Than 1,320 feet (402.3 meters)	"CAUTION" alternating with "FOG AHEAD TURN ON LOW BEAMS"	"FOG" Displayed, & Flashing Warning Lights Activated	N/A
Case 3 - Fog Detected With Visiblity Between 480 feet (146.3 meters) & 1,340 feet (402.3 meters)	"FOG AHEAD" alternating with "ADVISORY RADIO TUNE TO XXXX AM"	"FOG" Displayed, Speed Limit Reduced To *50 mph, & Flashing Warning Lights Activated	Activated
	"FOG AHEAD" alternating with "REDUCE SPEED TURN ON LOW BEAMS"		
	"FOG" alternating with "SPEED LIMIT 50 MPH"		
Case 4 - Fog Detected With Visiblity Between 240 feet (73.2 meters) & 480 feet (146.3 meters)	"FOG AHEAD" alternating with "ADVISORY RADIO TUNE TO XXXX AM"	"FOG" Displayed, Speed Limit Reduced To *35 mph, & Flashing Warning Lights Activated	Activated
	"FOG AHEAD" alternating with "REDUCE SPEED TURN ON LOW BEAMS"		
	"FOG" alternating with "SPEED LIMIT 35 MPH"		
Case 5 -Fog Detected With Visiblity Less than 240 feet (73.2 meters)	"DETOUR AHEAD" alternating with "REDUCE SPEED MERGE RIGHT"	"FOG" Displayed, & Flashing Warning Lights Activated	Activated
	"I-75 CLOSED" alternating with "DETOUR"		
	"FOG AHEAD" alternating with "ADVISORY RADIO TUNE TO XXXX AM"		

*The initial posted interstate speed limit on the roadway section Is 70 mph.

The system has been upgraded several times, including CCTV cameras, and has been expanded to other sections of the state.

We recommend you view the full Prezi presentation here.

Maricopa County DOT

Nicolaas Swart presented on Maricopa County's road hazard motorist warning systems:

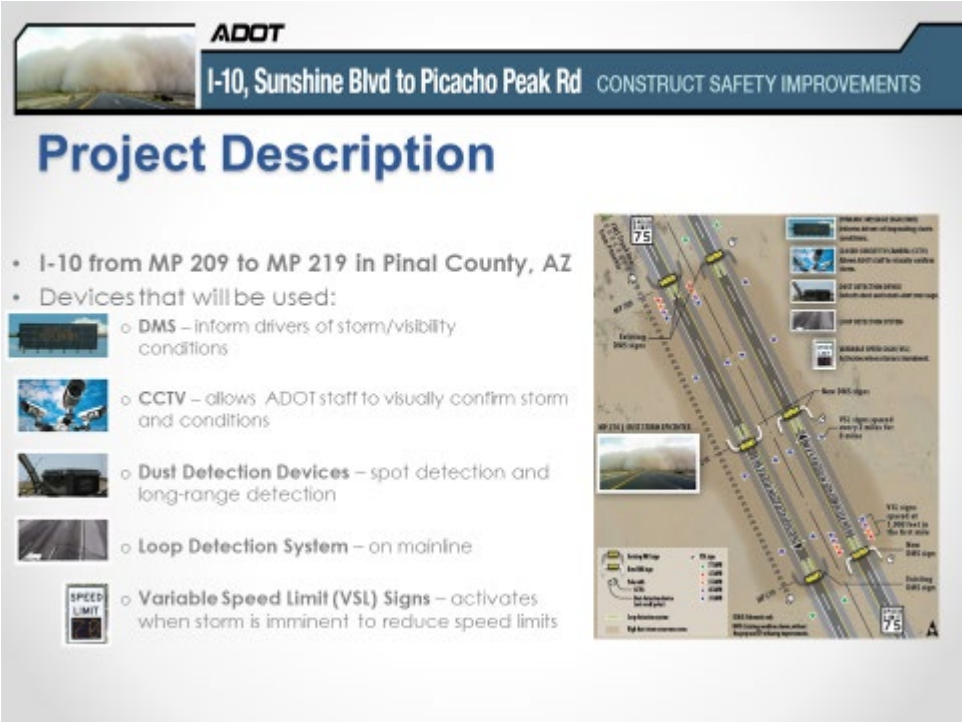
- Automated Flood Roadway Warning
- Dust Detection and Warning

The automated flood roadway warning system:

- Independently monitors the existing flashing beacons

- Notifies designated agency representatives (MCDOT and/or Flood Control) via e-mail when the Existing Flashing Beacons activate
- Provides always-on snapshot camera images of each flashing beacon and the low point in the roadway
- Operates continuously without access to utility power or landline communications
- Provides diagnostics to monitor the health of the equipment

The construction of the dust detection and warning system is currently in program. It will address the ongoing safety issue of dust storms which, since 2000, have contributed to 1,207 collisions, 40 fatalities, and 1,136 injuries.



The infrastructure deployed for this project includes some existing and some new infrastructure. Existing dynamic message signs will be used and supplemented by some new signs, which will be used to post information about impending dust conditions or current conditions in or near the corridor. These DMS will also be used for regular DMS functions when there is no dust activity in the area. CCTVs that have communication back to the TOC will be installed to allow the TOC to have a visual feed of the corridor and allow them to confirm the conditions that are being detected.

Two types of dust detection devices:

- Spot detection, which will detect visibility within the corridor and be programmed to realize certain visibility thresholds that will activate a system response.

- Long-range dust detectors, which will help detect dust conditions that are on the horizon but outside of the project corridor.

This will allow Arizona DOT to warn drivers about conditions they are approaching or will be hitting the corridor soon. Finally, a series of variable speed limit signs will be installed that will allow Arizona DOT to incrementally step-down the speed limit along the corridor in response to low visibility conditions.

Top Actions Identified by Working Groups

1. **Conduct systems engineering analysis for real-time warnings for road weather which includes technologies, common core specs, best practices, compliance requirements.**
    a. Medium term efforts to develop model systems engineering document for real-time warnings for road weather led by Zachary Clark (NCDOT) and Michigan DOT.
2. **Study best practices/use cases in real-time warning systems to identify effective applications.**
    a. Engage CTSO to support the development of an NCHRP problem statement to advance industry understanding on human factors and behavioral aspects of effective messaging for real time warning systems.
    b. Short to medium term timeline with leads of Maryland DOT SHA and FHWA.

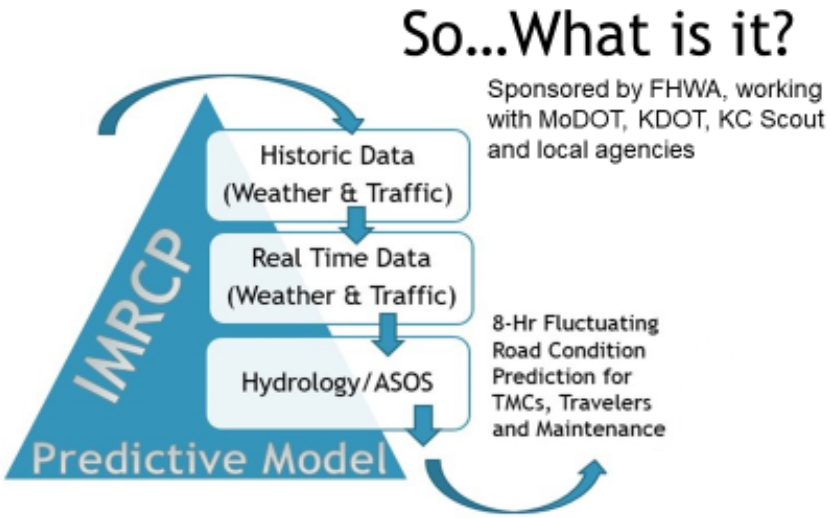
TOPIC 4: PREDICTIVE TRAFFIC CONDITION MODELS INTEGRATING TRAFFIC MODELS AND ROAD WEATHER FORECASTS

Presentation Highlights for Topic 4

KC Scout

Nancy Powell presented on KC Scout's Integrated Modeling for Road Condition Prediction (IMRCP). According to the presentation:

> "the objectives of the IMRCP system includes developing an integrated predictive system that incorporates real-time and 10 plus years of archived data and results from an ensemble of forecast and probabilistic models. This includes atmospheric and road weather, hydrology, traffic, work zones and winter maintenance operations, incidents, special events and demand models. The IMRCP combines all of these data and models in order to predict the current and future overall road and travel conditions. The IMRCP can be used by travelers, transportation operators, and maintenance providers."



The IMRCP provides operator awareness from current to likely, future traffic and road conditions and risks. Management strategies can then be more accurately deployed and communicated to travelers, allowing both operators and travelers to make better informed decisions:

- Enacting controls (e.g., VSL, ramp metering, gates)
- Deploying maintenance and traveler assistance
- Changing (delaying, re-routing) travel plans

The IMRCP user interface is impressive and it's worth reviewing the presentation to see the multi-layered map and dashboard system.

Having been deployed just before this peer exchange, KC Scout is looking to evaluate its effects throughout 2019-2020.

Wyoming DOT

Vince Garcia presented on traffic and weather prediction models on the I-80 corridor, via the Connected Vehicle Pilot Deployment in Wyoming. The CV pilot incorporated a number of road weather management strategies, utilizing analysis, modeling, and simulation tools with the broad number of DSRC units deployed on the roadside and in vehicles.

The AMS tools for weather-responsive management strategies (WRMS) will use mobile and CV road weather data to both alert variable speed limit and traveler information systems. It will also guide plow routing and anti-icing strategies. The challenge appears to be how to integrate CV data with WRMS AMS tool.

Mr. Garcia concluded the peer exchange's final presentation with a strong reminder of the disastrous effects weather can have on vehicles and the people traveling the roadways:

Top Actions Identified by Working Groups

1. **Understand and communicate predictive traffic models (PTM) for advancing road weather state of the practice and pilot projects.**
    a. Disseminate information on state of the practice
    b. A short-term timeline with efforts led by KCScout and NOCoE
2. **Define PTM needs and goals with the help of diverse group of stakeholders.**
    a. In the short term, engage diverse group of stakeholders and develop engagement plans.
    b. Share results with the AASHTO CTSO CoP
        - PennDOT and NOCoE will lead this action

ROAD WEATHER DATA COLLECTIONS AND USE BY PARTICIPATING STATE

Throughout the peer exchange, states shared how they collect road weather data and discussed how it is used. The following table captures anecdotally described data sources and usage and *is not intended to be a comprehensive overview of road weather data usage by state*. However, it may serve as a reference or the beginning of an attempt to map out road weather data usage across the country.

State	What do you collect?	What do you do with it?
Nevada	• ESS based wind warning/prohibition • Waycare platform (+ weather)	• Posts messages between Reno/Carson City (BUT . . prolonged storms and wind created issues this winter) • Predictive crash modeling
Michigan	• ESS data	• Performance measures on system to target areas to implement projects • Pull from presentation
Pennsylvania	• General weather data • 3rd party from INRIX • Waze • Historical crash data	• Evaluating congestion pie chart • Weather restrictions for freight • Trends from past used to forecast potential events
Tennessee	• 36 RWIS turned off in 2011 • Mobile sensors on trucks become the go to • Low visibility system around eastern part of the state	• Rather than dealing with the risk of RWIS, focus on event by event. • Fog and low visibility warnings, signs, road closures
Oregon	• ESS Data • Maintenance reported data on conditions • Snow plow data • Video from remote cameras	• Signage • Variable speed limits • Data warehouse integrates all data • Traveler information (w/NWS data)
Maryland	• Marwis (Lufft) 54 currently – learning how to attach sensors to the appropriate types of vehicles • 127 RWIS • 1500 Snow plows (800 large scale) • Looking to combine with ViewMondo system, MDSS, etc.	• 511 and public information systems • Operational decision making in the TMC
Georgia DOT	• Wind sensors adjacent to bridges • Water sensors for flooding • NWS	• Message closures • Forecasting data comparisons

State	What do you collect?	What do you do with it?
ND DOT	• Marwise data • AVL (30 trucks)	• Data goes into MDSS system • ATMS software
Utah	• Soil moisture • Crash data for weather • Vehicle information	• Planning purposes • Active warnings. • Truck rollover project – real-time suggested speed based on road conditions.
Wyoming	• Everything (including control dispatch data, phone calls, radio calls, etc.) AVL, RWIS, equipment, speed sensing, DMS. Mobile app images	• Connected vehicle information on i-80 • Mobile app
Nevada (rod)	• ESS (evasive and non-evasive)	• Transportation management asset plan
NCDOT	• No RWIS or in road detection goes into TMCs automatically • Inputs come from SSP, law enforcement or deliberate action via wind alert • Adding flood gauges after 1/3 state cut off during Florence (also adding CCTV coverage) • Adding Waycare • Drones via aviation and SHP	• Hurricane/flooding evacuation
Alaska DOT	• RWIS network • Each region looks at the MDSS system	
WashDOT	• RWIS network • Wind speed data	• TMCs use to decide on messaging • Freight closures (deciding whether

State	What do you collect?	What do you do with it?
DelDOT	• High Sierra • Mobile weather (umondo) • Dash cameras • Social media and crowdsourcing • Snow plow tracker • Pathfinder • AI software tool to read everything • Hydrology sites • Extensive drone program	• Google cloud with all the data
MCDOT	• Flood warning system: sensors to detect the flow in the washes, plus cameras	• Flood warning system, automated by sensors
Iowa DOT	• 73 RWIS sites • 900 plows with AVL and cameras plus mobile pavement temp system	• Dashboard for RWIS in TMC • Weather messaging • DMS signs
MN DOT	• RWIS sites for MDSS • AVL data • Pathfinder	• MDSS • Snow plow
Arizona DOT	• 17 RWIS (been upgrading and adding 3 – 10 more) • AVL – air and road temp, relative humidity and dew point • 27 plow cameras	• Pre-storm treatment decisions, timing for plow trucks • Road condition forecasting for travelers
Aurora/Iowa DOT	• Non-invasive sensors	• Understanding how to use legacy data
Virginia DOT	• Vehicle, wind, crash • RWIS Network in ASTM system	• Dealing with wind solutions • Messages to DSL signs
MoDOT/KS DOT	• NWS integrated into ATMS • Integrated modeling for road prediction • IDIS code input on each crash • TrafficVision (video analytics)	• Emergency management program gets data • Learn about slide off decisions in real-time

FINAL ACTIONS

As discussed a previous section, a key goal of this event was to identify and prioritize key actions to advance the practice and adoption of the four road weather management strategies covered in the peer exchange. After working groups met following each topic area discussion, they developed potential action items around both the ability to work with other AASHTO groups and how the action fit within advancing the CMM. After synthesizing the actions, the group prioritized eight actions, covered in the table below.

Action Table

Priority Actions	Steps to Address Action	Timeline
Illustrate benefits of IMO through case studies and best practices analysis	FHWA efforts scope check	Short
	Document unique case studies. Include crash reduction (when possible), actual deployment (granular) and maintenance costs, cost/benefit analysis, performance measures,	Short term for existing and medium for additional implementations
	Identify resources needed for planning, implementation, and operations such as IT, equipment, and maintenance.	Short term for existing and medium for additional implementations
Set de facto data standards (fixed and mobile ESS) and develop strategies for IMO implementation and integration	See if we can adopt fixed standards for mobile	Short
	Review Clear Roads plug n' play protocol for peripherals, mobile technologies for integration of IMO	Short (dependent on Clear Roads initiative)
	Create de facto standards (connection with maintenance and management reporting)	Medium to Long
Develop and document system engineering criteria (scoping, design specs, life cycle costs) for VSL for road weather	Review FHWA ATM Implementation Operations Guide and pull applicable criteria for VSL for road weather.	Short
	Gather existing ConOps and systems engineering documents from states who've deployed VSL for road weather	Short

Priority Actions	Steps to Address Action	Timeline
	Develop and describe new and innovative strategies/systems/algorithms/methodologies for using VSL for road weather and potential ConOps	Medium to Long
Develop a research statement for the benefits of VSL for road weather (overall and drill into regulatory versus advisory)	Develop one paragraph for Research in Operations Database	Short (July 1, 2019)
	Track progress through ROPS	Short (August 26, 2019)
	If chosen, develop the problem the statement	Short (October 2019)
Conduct systems engineering analysis for real-time warnings for road weather which includes technologies, common core, specs, best practices, compliance requirements	Develop model systems engineering document for real-time warnings for road weather	Medium
Study best practices/use cases in real-time warnings to identify effective applications	Synthesize all real-time warning applications for road weather (and review WTI report for Western U.S.)	Short to Medium
	Develop NCHRP(?) problem statement for human factors/behavior analysis of effective messaging for real-time warning systems for road weather	After synthesis (short)
Understand and communicate predictive traffic models (PTM) for	Disseminate information on practices, examples, demos	Short

Priority Actions	Steps to Address Action	Timeline
road weather state of the practice and pilot projects	Maintain a living document on the definition, components, and capabilities of predictive traffic models for road weather	Short
	Publish results of pilots	Short
Define PTM needs and goals with the help of diverse group of stakeholders	Identify diverse group of stakeholders	Short
	Develop engagement plan and tactics	Short
	Share results of engagement	Medium

WORKFORCE AND ROAD WEATHER MANAGEMENT

In the fall of 2019, NOCoE released its TSMO Workforce Resources to help organizations with recruiting and retaining TSMO practitioners, assist with potential human resources materials, to deliver a comprehensive database of TSMO trainings, and to provide potential position descriptions for TSMO related jobs new to many organizations.

As the road weather management peer exchange illuminated, much of the work around these topics is being executed by operations and maintenance personnel who aren't always able to coordinate or share information in the most efficient manner possible to manage the transportation system. While the actions identified during the peer exchange will advance the state of the practice for road weather management, a complementary effort around workforce development will ensure agencies have the necessary workforce to execute these key road weather management strategies.

Position Descriptions

An NCHRP Project on TSMO Workforce developed a series of 19 model position descriptions for professional level TSMO-related positions to assist practitioners in recruiting qualified personnel. The scope of the work was limited to positions that require a 4-year college degree and above.

The position descriptions compiled by the team include: 1) jobs that are currently being filled by organizations in varying degrees as they shift towards more comprehensive TSMO throughout the organization; and 2) jobs that will be required in the next 5 to 10 years depending on how rapidly

emerging technology makes its way into the transportation industry. While many of the position descriptions build on more specialized civil engineering skills, others recognize the need to broadly expand and diversify the training and education needed for future positions. All 19 position descriptions can be found here.

Surface Weather Specialist

Surface Weather Specialist was identified as one of the nineteen positions. The full position description can be found below.

Job Title:	Surface Weather Specialist		
Minimum Years of Experience/Position Level:	5-10 Years/Mid-Level	**Job Category:**	☐Management ☐Engineering ☒Specialist ☐Systems and Data Management
Applicable to:	☒DOT ☒County ☒City		☐MPO ☒Private ☒Toll Agency
General Summary of Position / Purpose of Position			
This position is a specialist that provides advanced transportation systems management and operations (TSMO) as it relates to weather applications.			
Roles and Responsibilities			
1.0 Managerial			**% of Time**
1. Direct and supervise staff. 2. Meet regularly with employees to assign work, establish work objective and timelines to ensure working objectives are met. 3. Evaluate employees' performance, during established time frames, throughout the year and at formal review periods. 4. Motivate and train and/or ensure required training is available for staff. 5. Communicate regularly with direct reports, both individually and in staff meetings. 6. Ensure that all the paperwork required for processing pay documents and human resource matters, including performance appraisals, disciplinary actions, filing vacant positions and separations, are completed accurately and processed in a timely manner.			10%
2.0 Strategic Planning			**% of Time**
1. Develop and implement TSMO business and related plans to guide resource allocation and achieve unit performance targets. 2. Collaborate with others in plan development, reporting plan results, linking performance targets to specific, measurable, achievable, relevant, time-bound, (SMART) objectives in staff expectations, identifying and making resource recommendations. 3. Ensure funding and resources are utilized in the most cost effective and beneficial manner. 4. Ensure the most current program elements, performance measures and functions are being implemented.			10%

3.0 Customer Service	**% of Time**
1. Participate in meetings, on committees, task teams and other groups with internal and external customers to represent TSMO interests. 2. Maintain professional contact with elected officials, private companies, public, government agencies, and officials doing business with the State. 3. Promote good public relations with the persons contacted while adhering internal policies. 4. Provide accurate and timely responses to the public, contractors, and other department personnel. 5. Promote the resolution of outstanding technical and contractual issues. 6. Communicate effectively (strong written and verbal communication skills) and work well with team members from diverse technical backgrounds.	10%
4.0 Project Management	**% of Time**
1. Develop and manage consultant contracts and other types of agreements that support TSMO functions and/or relate to performance targets. 2. Develop documentation for contract funding, request for proposal (RFP) and related documents, participation on technical review committees (TRC), evaluation of contract work products, consultant evaluation and invoice processing approval.	20%
5.0 Technical	**% of Time**
1. Incorporate detailed weather information in the operational decision-making processes. 2. Collect and take advantage of advanced technology, such as connected vehicle data and information transmissions, to increase situational awareness, improve roadway levels of service, and optimize use of resources and materials. 3. Use innovative applications and systems to inform decisions as well as increase the ability to respond quickly and appropriately to adverse weather and roadway surface conditions to reduce or eliminate weather-related crashes and delays. 4. Assess the nature and magnitude of storms, determine staffing needs, plan road treatment strategies and timing, and activate pre/posttreatment systems. 5. Generate improved plans and recommendations to maintenance personnel, providing expanded data acquisition from fixed and remote sensors as well as from mobile sources. 6. Apply advanced systems such as Variable Speed Limits for Weather-Responsive Traffic Management (WRTM), Signalized Intersection for WRTM, Road Weather Information (RWINFO) for Maintenance and Fleet Management Systems, Road Weather Information (RWINFO) for Freight Carriers, Road Weather Information (RWINFO) and Routing Support for Emergency Responders, etc. 7. Assess the potential for connected vehicle data to enhance and transform road weather performance measurement and management processes in traffic management and maintenance operations.	45%
6.0 Other	**% of Time**
1. Perform other duties as required.	5%
Education	
☐High School Degree	

☐Technical Degree/Associate Degree ☒Bachelor's Degree in Related Field ☐Bachelor's Degree in Engineering; or ☐Bachelor's Degree in Computer Science ☐Bachelor's Degree in Business ☒Bachelor's Degree in Environmental Science ☐Bachelor's Degree in Science, Economics, Statistics, or another Quantitative Field ☐Master's Degree in Engineering ☐Master's Degree in Engineering (preferred but not required) ☐Master's Degree in Quantitative Field (preferred but not required) ☐PhD in Civil Engineering, Transportation Engineering, Electrical or Computer Engineering, Computer Science, or related field (preferred but not required)
Certificates, Licenses, Registrations
☐Registered Engineer in Training ☐Registered Professional Engineer ☐Professional Traffic Operations Engineer ☐Certified Information Systems Security Professional

SUPPORTING DOCUMENTS AND RESOURCES

1. NOCoE RWM Peer Exchange - Attendees
2. NOCoE Peer Exchange on Road Weather Management - Agenda
3. NOCoE RWM Peer Exchange - Opening Michigan DOT
4. SICOP Update
5. Utah DOT Weather Program
6. FHWA Weather Program
7. Nevada IMO
8. Minnesota IMO
9. Virginia VSL
10. Oregon VSL
11. MCDOT Real-time warning systems
12. Tennessee Real-time warning systems
13. KCScout Predictive Traffic Modeling.pdf (1.39 MB)
14. Wyoming Predictive Traffic Modeling.pdf (1.01 MB)