ORGANIZING FOR TSMO

2020 Peer Exchange Report

November 2020

U.S. Department of Transportation
Federal Highway Administration

FOREWORD

Transportation Systems Management and Operations (TSMO) applications and strategies are programs, projects, or services designed to get the safest and most efficient use out of existing and planned infrastructure. Organizing for operations involves mainstreaming TSMO by making it a central part of an agency's mission and institutional structure. This is accomplished by advancing TSMO programs and projects within the agency and typically involves actions to improve the TSMO culture, workforce, collaboration, business processes, and approach to managing systems and technology in agencies. This Peer Exchange brought together 20 TSMO leaders from across the United States and the Federal Highway Administration (FHWA) staff to share valuable information about their agencies' experiences with advancing and implementing TSMO and to engage in learning from the experiences of other peers and agencies.

Cover images source: Getty Images

Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
FHWA-HOP-20-046		

4. Title and Subtitle	5. Report Date
Organizing for TSMO – 2020 Peer Exchange Report	November 2020
	6. Performing Organization Code

7. Author(s)	8. Performing Organization Report No.
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9. Performing Organization Name and Address	10. Work Unit No. (TRAIS)
Cambridge Systematics, Inc. 3 Bethesda Metro Center, Suite 1200 Bethesda, MD 20814	11. Contract or Grant No. DTFH61-16-D-00051

12. Sponsoring Agency Name and Address	13. Type of Report and Period Covered
U.S. Department of Transportation Federal Highway Administration Office of Operations 1200 New Jersey Avenue, SE Washington, DC 20590	Final Report
	14. Sponsoring Agency Code HOP

15. Supplementary Notes

FHWA Task Order Contracting Officer's Representative (TOCOR) for this project: Joseph Gregory.

16. Abstract

Transportation Systems Management and Operations (TSMO) applications and strategies are programs, projects, or services designed to get the safest and most efficient use out of existing and planned infrastructure. Organizing for operations involves mainstreaming TSMO by making it a central part of an agency's mission and institutional structure. This is accomplished by advancing TSMO programs and projects within the agency and typically involves actions to improve the TSMO culture, workforce, collaboration, business processes, and approach to managing systems and technology in agencies. This report summarizes discussions and findings of a February 2020 Peer Exchange. The peer exchange brought together 20 TSMO leaders from across the United States and FHWA staff to share valuable information about their agencies' experiences with advancing and implementing TSMO and to engage in learning from the experiences of other peers and agencies.

17. Key Words	18. Distribution Statement
Transportation Systems Management and Operations, capability maturity model, advancing operations, implementation, data, collaboration, organization, partners, business case, planners	No restrictions.

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	56	N/A

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EXECUTIVE SUMMARY

The Federal Highway Administration (FHWA) hosted a group of Transportation Systems Management and Operations (TSMO) leaders to share their agencies' experiences in advancing TSMO programs. This report gives an overview of the discussions and the important takeaways of the "Organizing for TSMO Peer Exchange" held on February 26 and 27, 2020.

Agencies have taken important steps to advance TSMO programs and planning while implementing action plans to advance TSMO objectives. This peer exchange brought together a diverse set of State and local peers to share valuable information about their agencies' experiences with advancing and implementing TSMO and to learn from their peers. The event included a roundtable discussion at the beginning and then four focused sessions:

- Session 1 (Organizational improvements to support advancing TSMO) focused on organizational improvements to support advancing TSMO and opened with two peer presentations on how agencies organize around TSMO. The participants then broke into two groups for a facilitated exercise on organizational structure.
- Session 2 (Collaboration/Partnerships that advance TSMO) addressed collaboration and partnerships that advance TSMO and began with two peer presentations on the types of collaborative efforts agencies are implementing and insights on partnerships needed to advance

TSMO. After the peers made their presentations, the participants took part in a facilitated discussion to further explore the various approaches in collaboration to advance TSMO.

- Session 3 (Communicating TSMO: Making the business case and branding) dealt with communicating TSMO, including making the business case and branding, and opened with two peer presentations on how agencies communicate TSMO ideals. After the peers made their presentations, the participants broke into two groups for a facilitated exercise on communicating TSMO.
- Session 4 (Priority Issues Session) asked participants to brainstorm a list of priority topics that are worth further exploration in the peer exchange environment. The group prioritized and narrowed down the full list, and the facilitators and FHWA highlighted four topics. Participants divided into four small groups and discussed each topic in greater detail.

Representatives from 15 organizations participated in the peer exchange, including from: 12 State departments of transportation (DOTs), two metropolitan planning organizations (MPOs), and one regional transportation commission. In addition, representatives from FHWA were in attendance.

Key Takeaways

The TSMO community of practice has matured in the past decade. From the beginning of the National Academy of Sciences Second Strategic Highway Research Program (SHRP2) to the current rollout of research completed under that program, DOT leaders have supported integrating research outputs into agencies across the nation. This peer exchange provided a valuable opportunity for a group of TSMO leaders to share experiences and have conversations about how TSMO programs are succeeding across the nation and across the wide diversity of TSMO program approaches—generally unique to each agency. Throughout the two-day exchange, participants highlighted many important aspects of advancing operations, including the following key takeaways.

Institutionalizing TSMO

- Agencies exhibit a wide spectrum of "organizational approaches" to TSMO. Participants acknowledged there is no "right answer" or "one-size-fits-all" structure, and that successful models depend on individual context. While some agencies have benefited from a substantial reorganization around TSMO, others have found success from building on legacy roles and structure to add a TSMO focus.

- DOTs and other entities have built many successful partnerships around TSMO. Collaboration has allowed DOTs to mainstream and institutionalize TSMO beyond agency-centric approaches. Participants recognized the unique and important role that MPOs have in advancing TSMO regionally, and State DOTs recognized the importance of engaging MPOs as key stakeholders. While MPOs do not operate the roadway network, they often are integral in policy, planning, and funding functions of programs.

- Making the case for TSMO operations and maintenance (O&M) funding involves collecting and analyzing historical cost data at the unit level, developing specific system plans that consider O&M needs (e.g., telecommunications), and demonstrating the consequence of reduced level of service by affected TSMO strategy.

- To monetize TSMO benefits—which can help build program support and demonstrate effectiveness—agencies can develop a common understanding among practitioners on how to use available data, take advantage of available modeling tools, employ storytelling to leverage qualitative outcomes, and consider the effectiveness of the delivery medium, especially one that is digestible and relatable.

- Participants strongly felt that changes in leadership remain one of the most critical issues to address when institutionalizing TSMO and executing a TSMO plan. Even among well-established programs and programs where the agency's head is a TSMO "champion," there is always a risk that the program will regress (or even be eliminated) after a change in leadership.

- Agencies have an ongoing need to build and maintain the business case for TSMO, regardless of program status, so that the program is understood to be invaluable and irreplaceable over the long term.

TSMO Readiness

- Participants anticipate that TSMO mainstreaming will continue. Agencies indicated that they will continue to formalize TSMO as a prominent, frequently top-tier program by deploying a "TSMO first" stance to tackle mobility, accessibility, and system reliability issues across multiple modes, with increased collaboration among public- and private-sector partners and further leveraging of advanced technologies.

- If participants had one additional employee to support their TSMO program needs, the most frequently mentioned uses would be further mainstreaming TSMO by striking the right balance with targeted capacity improvement projects, furthering agency inreach and outreach to advance a TSMO mindset and build program understanding, gaining further data analytics capacity, and deploying programmatic or leadership capacity to focus on agency-wide coordination and consistency.

- When communicating TSMO messages, agencies need the messages to be deliberate, consistent, and proactive in tone. Agencies can tailor messages that communicate the need for TSMO and its outcomes to a variety of internal and external stakeholder groups to build program awareness, buy-in, and effective contribution to its implementation.

- Successful TSMO workforce practices include working with universities or trade schools to incorporate TSMO into engineering curricula; leveraging existing certification programs to build information technology (IT) and data management skills; promoting Science, Technology, Engineering, and Math programs in high schools and community colleges; and building internal awareness through new-hire orientation programs, cross-training, and rotational programs.

- The TSMO community of practice has matured in the past decade with many more States implementing TSMO plans and advancing TSMO planning. In general, the landscape where TSMO topics are discussed has expanded further throughout agencies, beyond just those staff involved in intelligent transportation systems (ITS), traffic engineering, and other day-to-day operational activities.

TSMO Implementation

- Agencies shared that they could address the challenges of harnessing the growing availability and volumes of data, developing actionable performance measures, and communicating outcomes tailored to different audiences by constructing simple, standardized dashboards for TSMO. An existing example is the National Bridge Inventory for bridge inspection reporting.

- Big data, crowdsourced data, and connected vehicle and infrastructure data will continue to fuel demand for TSMO professionals, data scientists, and others versed in complex performance analysis. Some participants see the benefits of increased internal capacity within the State DOT or an IT department to manage and analyze the increased data streams.

- Striking the right balance between applying TSMO solutions and traditional capacity improvements to system demands was a top concern among some participants; they noted that there is always a need for strategic capacity additions, or at least system reconstruction activities. Acknowledging this need while also considering TSMO a comparable tool to address mobility and safety issues allows agencies to achieve better program success.

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PEER EXCHANGE SESSIONS

Introduction

The Federal Highway Administration (FHWA) hosted a group of Transportation Systems Management and Operations (TSMO) leaders to share their agencies' experiences in advancing TSMO programs. This report gives an overview of the discussions and the important takeaways of the "Organizing for TSMO Peer Exchange" held on February 26 and 27, 2020. This report focuses on key points and themes from the peer exchange, summarizing the two-day event.

Participation in the peer exchange included a wide variety of agencies, from States with major urban areas to those that are predominantly rural. Agencies from the east and west coast, as well as northern and southern States, gave the exchange geographic diversity. In the spirit of exchanging information on the status of TSMO programs across the nation, the first morning included a good deal of time allowing each participant to provide information on their role in the agency and the status of their TSMO program. The event included focused sessions on organizational structure, making the business case and branding for TSMO, and collaboration with partners. Importantly, the two-day event provided unstructured time for the group to discuss near-term and future possibilities for advancing operations and steps to be taken. The event included a roundtable discussion at the beginning and then four sessions:

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The National TSMO Context

TSMO leads from FHWA Office of Operations and the Resource Center welcomed the group to the peer exchange, and participants made a quick round of introductions. The FHWA representatives explained the purpose of the peer exchange and provided a national overview. The peer exchange offered an opportunity for participants to learn from each other about the challenges, opportunities, and effective practices agencies have employed to improve their capabilities and institutionalize TSMO. From FHWA's perspective, it was important to hear from TSMO leaders about future needs for organizing for operations, and how FHWA might assist in advancing the community of practice. Each of the FHWA participants provided their perspective on key FHWA efforts and the national TSMO context.

The workshop discussions built on the past decade of planning and organizing for operations activities and the impact of the capability maturity model's (CMM) six dimensions, and implementation plans to advance agencies' maturity level, both institutionally and at the program level.

The FHWA Office of Operations team supports State departments of transportation (DOT) and regional agencies to advance TSMO programs. In addition, the American Association of State Highway and Transportation Officials (AASHTO), the National Operations Center of Excellence (NOCoE), and Transportation Research Board (TRB) partner with FHWA to advance TSMO and cultivate support for TSMO.

Expanding TSMO Planning

- In 2014, there were fewer than five documented TSMO plans, and now nearly 25 TSMO plans are active.
- NOCoE has seen increasing State DOT engagement.
- Dedicated funding now exists for TSMO in some States.
- State DOTs are putting in place committees and positions for TSMO.
- A "TSMO-First" approach is gaining traction.

As discussed during the FHWA presentation, FHWA research indicates an increased commitment to advancing TSMO, particularly through the more than 20 State DOT TSMO program plans being developed. These plans, along with FHWA experience in working with agencies across the nation, show that no two agencies are exactly alike. Elements that contribute to unique trajectories of TSMO program structures include:

- Unique agency institutional policies and cultures.
- Different organizational structures and reporting relationships.
- Range and varied TSMO maturity of partners and stakeholder agencies.
- Disparate levels of institutional readiness and leadership supporting TSMO advancement.

FHWA provides several capability maturity frameworks available to assist agencies with implementing TSMO programs, including tools for Road Weather Management, Traffic Incident/Emergency Management, Work Zone Management, Special Events Management, Arterial (Traffic Signal Systems) Management, and Traffic Management. In addition, there are

important resources and outreach materials on the FHWA TSMO website (ops.fhwa.dot.gov/tsmo). Outreach materials include TSMO case studies, fact sheets, and guidebooks. Recent materials include resources on linking traffic management and travel demand management, expanding traveler choice using incentives, integrating travel time reliability into transportation system management, and artificial intelligence for TSMO.

In-progress FHWA projects that advance TSMO include:

- Examining the interface between TSMO and other disciplines, such as coordination between safety and operations or design and operations.
- Assessing organizational arrangements, structures, and relationships within an agency to determine how agencies can increase their effectiveness for implementing TSMO and increase the priority for TSMO where there are challenges with a lack of momentum and/or advancing TSMO efforts.
- Mainstreaming TSMO by identifying and fostering key elements, such as integrating TSMO into agency policies, procedures, and information and decision support systems; building a business case for TSMO; and establishing a culture that values TSMO.
- TSMO Outreach Materials including a brief overview suitable for the chief executive officer (CEO) level.
- Online training for making the business case for institutional, organizational, and procedural changes to support more effective TSMO.

Participant Perspective on TSMO

In establishing a baseline for the exchange of peer experiences, each participant prepared a short summary introducing themselves and a few key elements of their agency's TSMO programs, including:

- Progress with TSMO and TSMO program planning.
- Biggest TSMO success.
- Largest challenge in advancing your TSMO program.

- Actions taken to advance TSMO.
- Needs/requirements to advance TSMO.
- Next steps to take with the TSMO program.

The following are summaries of each participant's remarks on the agency's baseline.

Freeway and Arterial System of Transportation at Regional Transportation Commission of Southern Nevada

The Director of Freeway and Arterial System of Transportation (FAST) at Regional Transportation Commission (RTC) of Southern Nevada updated the participants on the history of TSMO in the region. The participant explained that RTC began these initiatives in the 1990s, and the agency is co-located with the Nevada Department of Transportation, Department of Public Safety, and Highway Patrol. He described recent and current TSMO initiatives at RTC, including high-occupancy vehicle (HOV) lane expansions and gantry deployment along the entire system and across all lanes of traffic to allow lane closures.

The participant from RTC also described some of the challenges going forward with TSMO at RTC. The group faces the challenge of building an evidence-based case for TSMO and communicating it to their partners. He explained that RTC is data-rich but information-poor; they have an abundance of data about their day-to-day operations and discrete metrics, but they need to aggregate data and produce summary metrics. This would allow RTC to directly attribute strategies to their results, which would encourage buy-in from partners, expanded resources, and improve traveler perceptions.

South Dakota Department of Transportation

The Research and TSMO Program Manager at the South Dakota DOT shared his experience with implementing TSMO in a rural State. Since congestion is not a major issue in the State, the agency orients TSMO activities around weather, freight, and incident management. The agency focuses on organizational capability over specific projects, partnering with the Department of Public Safety and metropolitan planning organizations (MPO) for traffic incident management.

The participant explained that the small department faces several challenges. The primary challenge is hiring and maintaining staff; existing staff have various roles, making it difficult to

allocate responsibilities and develop TSMO training. The agency faces challenges applying existing Financial Management and Information System (FMIS) categories to certain TSMO projects. Dave suggested that the agency needs to define the business case for TSMO and improve stakeholder and leadership knowledge on the benefits of TSMO, which should lead to greater acceptance and resources for their TSMO initiatives.

Michigan Department of Transportation

The Statewide Traffic Signals Manager for the Michigan DOT shared how her agency used intelligent transportation systems (ITS) strategies to develop a TSMO template and a signals safety plan. The agency emphasized TSMO language in their recent long-range plan, and they are developing a TSMO statewide plan as well. The agency prioritizes connected and automated vehicle (CAV) planning, so the staff are working to develop a CAV statewide plan to stay at the forefront of this emerging technology.

One of the challenges facing TSMO implementation in Michigan is budget allocation. Michigan DOT is historically infrastructure driven, which is often one major investment, while TSMO projects have ongoing operations and management costs that need to be accounted for in the long term. The Michigan DOT team developed a website that outlines five business cases for TSMO to demonstrate the financial benefits of implementation, and they use data to justify funding for operations projects at the agency.

Arkansas Department of Transportation

The Assistant Division Engineer, Transportation Planning and Policy and the State ITS Engineer from the Arkansas DOT described their efforts to implement TSMO at the agency. Like South Dakota DOT, Arkansas does not have a central traffic division, so the agency integrates TSMO responsibilities into the operations, design, and planning branches. The assistant division engineer works in the planning division, who have integrated TSMO into their performance measures and management and long range and strategic plans.

One of the main challenges facing Arkansas DOT is determining future priorities based on limited funding and staff; should they invest in new technology or focus on maintaining existing systems? The agency formed various committees to address this uncertainty, including a traffic incident management committee to train responders and a TSMO committee to promote and

support TSMO within the agency. The participants report that the committee pushed to procure consultant services for their first TSMO Program Plan, which should begin soon.

MetroPlan Orlando

The TSMO Director at MetroPlan Orlando shared his experience implementing TSMO in the last 10 years. The initial challenge for implementing TSMO in the organization was overcoming a lack of knowledge among staff and answering the question: "what is TSMO?" The agency developed an "elevator speech" that addressed this initial response and focused on "low hanging fruit" strategies that quickly and clearly demonstrated positive outcomes to leadership.

This strategy proved successful, and the agency has integrated TSMO into their policy and culture. The agency developed a successful traffic incident management (TIM) program that includes traffic management centers (TMC), public outreach, and emergency services; completed a signal retiming initiative that showed results; and formed a TSMO committee that participates in a district-wide TSMO consortium and sits at board meetings. The agency developed a strong working relationship with other MPOs and the DOT District Office, where they partnered for a $12 million grant.

Utah Department of Transportation

The ITS Program Manager for Utah DOT shared how the agency uses technology to implement TSMO practices, reporting that Utah is a smaller DOT that is progressive with technology, which allows for quicker decisions and implementation than larger agencies. The agency successfully implemented variable speed limits between Salt Lake City and Park City on I-80, doubled incident management operations, and developed an ITS master plan with regional involvement.

There are still challenges that come with a smaller agency. The participant explained that Utah DOT is decentralized across four regions in the State, which spreads out responsibility to implement TSMO and handle project funding. Because TSMO is not widely known outside of the DOT, it can be difficult to promote with other agencies. Utah DOT seeks to get MPOs more involved in TSMO conversations and training.

Missouri Department of Transportation

The Traffic Study Specialist and TSMO Sub-team Liaison for Missouri DOT outlined the agency's focus areas for TSMO advancement: work zones, TMCs, and advancing technologies.

The agency has had success using data to update the DOT's practices, developing action matrices, performance data, and data sharing sites for third parties with dedicated fees; the agency used this to promote smart work zones, zipper merge, and predictive analytics.

The participant reports many of the same challenges faced by other organizations, citing lack of resources and general knowledge of TSMO as a barrier for starting the implementation process. The agency receives support from State leadership for broad participation in TSMO to integrate it within the organization and hopes to include consultants for future implementation.

Georgia Department of Transportation

The Assistant State Traffic Engineer at Georgia DOT explained how TSMO helped the State through significant events. The TSMO system launched during the 1996 Olympics to manage vehicle and pedestrian capacity, and its implementation helped the State successfully manage traffic through national sporting events and respond effectively to a bridge fire on a major interstate. The agency receives sustained federal funding and the State prioritizes TSMO funding when needed.

The participant from Georgia DOT described the challenges of operating and maintaining large capital projects: it can be difficult to ensure that cost considerations are part of project development and strategies are consistent across regions. The agency is working to advance industry and technology deployment strategies to communicate goals and objectives across the region. The agency's next major project is developing an infrastructure for a baseline CAV ecosystem.

Maricopa Association of Governments

The TSMO Program Manager for Maricopa Association of Governments (MAG) in Arizona, explained that the association, which represents about 70 percent of the State's population, successfully completed a two-year system management and operations plan. The association has had strong institutional collaboration through AZTech, a partnership among public agencies focusing on regional operations and data sharing, which has led to their success in the region.

The participant related that confusion among their regional partners has created challenges for MAG; MPOs struggled to understand their role in the process, the TSMO name change created uncertainty, and jurisdiction confusion caused further issues. Going forward, MAG prioritizes

reauthorizing funding increases based on the next regional transportation plan, which will feature many TSMO components.

Texas Department of Transportation

The Section Director for the Traffic Safety Division of the Texas DOT shared the agency's recent success implementing a TSMO dashboard that provides travel time reliability, signal information, and clearance times, backed by performance metrics that encourage accountability. The participant indicated that Texas DOT leadership supports new initiatives and funding, empowering the agency to be proactive statewide.

The participant from Texas DOT explained that Texas' size has led to challenges in TSMO implementation. The variance in population density means that rural districts have less funding, and it can be difficult to define priorities statewide. To address this, the agency plans to identify a hands-on "champion" with a traffic background and belief in the project and an executive in the area who supports the program. The agency also plans to expand its TSMO training for first responders and traffic signal technicians, partner with third parties for traffic and weather data, and connect all signals across the State to better prepare for CAVs.

Maryland Department of Transportation

The TSMO Program Manager for Maryland DOT shared some of the takeaways from the agency's implementation of its 2018 TSMO strategic plan. The agency established a TSMO executive committee to break down silos within the organization, with representatives from different offices collaborating to implement strategies and cultivate buy-in from different districts. The participant attributed the success of TSMO to Maryland DOT's leadership team who were responsive to the initiative and focused on how to implement TSMO policies.

Though there is substantial buy-in from the agency, the participant from Maryland DOT reports that getting engineers to prioritize TSMO has been a challenge. Going forward, the agency seeks sustained funding to progress initiatives and explore multimodal opportunities in the Baltimore-Washington region.

Figure 1. Photo. Participants provide TSMO perspectives.

(Source: Federal Highway Administration.)

Minnesota Department of Transportation

Minnesota DOT's State TSMO Director and Metro District Traffic Engineer detailed their experience with TSMO implementation at the agency. While the DOT has been successfully applying TSMO strategies for many years, it recently completed TSMO strategic, business, and implementation plans in 2019 to better organize and execute its program.

Minnesota DOT recently upgraded traffic signals and controllers and improved signal timing and central communications. While the TSMO updates helped with traffic, the process gained a reputation as a traffic product, leading to challenges convincing planners and politicians to fund TSMO over traditional projects like road construction. To convince skeptics, participants plan to leverage the recently completed TSMO plans to expand data collection, chose new projects with solid return on investment, and develop performance measures to justify additional funding and staff throughout the State.

Pennsylvania Department of Transportation

The Chief of the Highway Safety and Traffic Operations Division at Pennsylvania Department of Transportation (PennDOT), described the recent reorganization of four groups within the agency to focus on TSMO. The participant outlined how the division successfully coordinated with Information Technology to develop TSMO strategies at the State level, securing PennDOT leadership commitment to provide a fiber backbone across the State to support ITS and TSMO activities.

The agency has had some success with TSMO training, like a boot camp for TMC staff and a TSMO performance program, but they plan to expand training to include project decision-makers and develop TSMO guidebooks, ensuring that staff have the knowledge to lead programs and initiatives. The agency also looks to expand their data collection practices to address updated Federal needs.

Session 1 Organizational Improvements to Support Advancing TSMO

Session 1 opened with two peer presentations on how agencies organize around TSMO. The Minnesota DOT (MnDOT) recently completed a TSMO program plan and made organizational adjustments to execute the plan, including creating a new statewide TSMO director. Arkansas DOT (ArDOT) is about to embark on developing a TSMO plan, and while the agency was not formally organized around TSMO, several collaborative working relationships provide evidence of progress and growing interest in delivering and advancing TSMO.

Minnesota Department of Transportation Peer Presentation

MnDOT has had an extended, successful history with TSMO, even without a defined "TSMO Program." Organizationally, TSMO piggy-backed on separate organizational elements such as traffic signals and lighting maintenance, previously performed separately by a specific Metro District traffic signals unit for the Minneapolis-St. Paul region and within Central Office Traffic Engineering for the rest of the State (Greater Minnesota). To resolve several inefficiencies with this arrangement, MnDOT created a separate Electrical Services Section (electrical maintenance) within the statewide Division of Operations, combining the Metro and Greater Minnesota traffic signal and lighting maintenance functions. MnDOT also created a new Asset Management Program Office.

With a specific focus on TSMO, the department completed a TSMO Program Plan in June 2019 comprising strategic, tactical, and programmatic components. The plan substantially advances the department's focus on TSMO and further elevates the program to the mainstream. The plan formalizes many of the activities the department was already performing and seeks to make consideration and execution of TSMO more deliberate (selecting the highest-value and most cost-effective solutions to transportation challenges), consistent (applying solutions appropriately across the State and not just when time or funding is available), and proactive (anticipating issues and planning ahead of time).

Organizationally, the plan calls for designating and funding a State TSMO coordinator (now termed TSMO director), creating additional staff positions to support TSMO strategies (e.g.,

statewide TIM coordinator), and further defining the roles of two TSMO-focused collaborative groups—a TSMO Leadership Team and TSMO Working Group. The State TSMO Director:

- Reports to the Operations Division.
- Supports implementation of TSMO strategies.
- Helps find funding for TSMO Implementation Plan strategies.
- Chairs the TSMO Leadership Team and Working Group.
- Works with Districts, Central Office specialty offices (e.g., traffic engineering, maintenance, freight, etc.), management groups (e.g., planning, pre-construction, operations, etc.), and external organizations (e.g., State Patrol, Cities, and Counties) to promote and implement TSMO strategies.

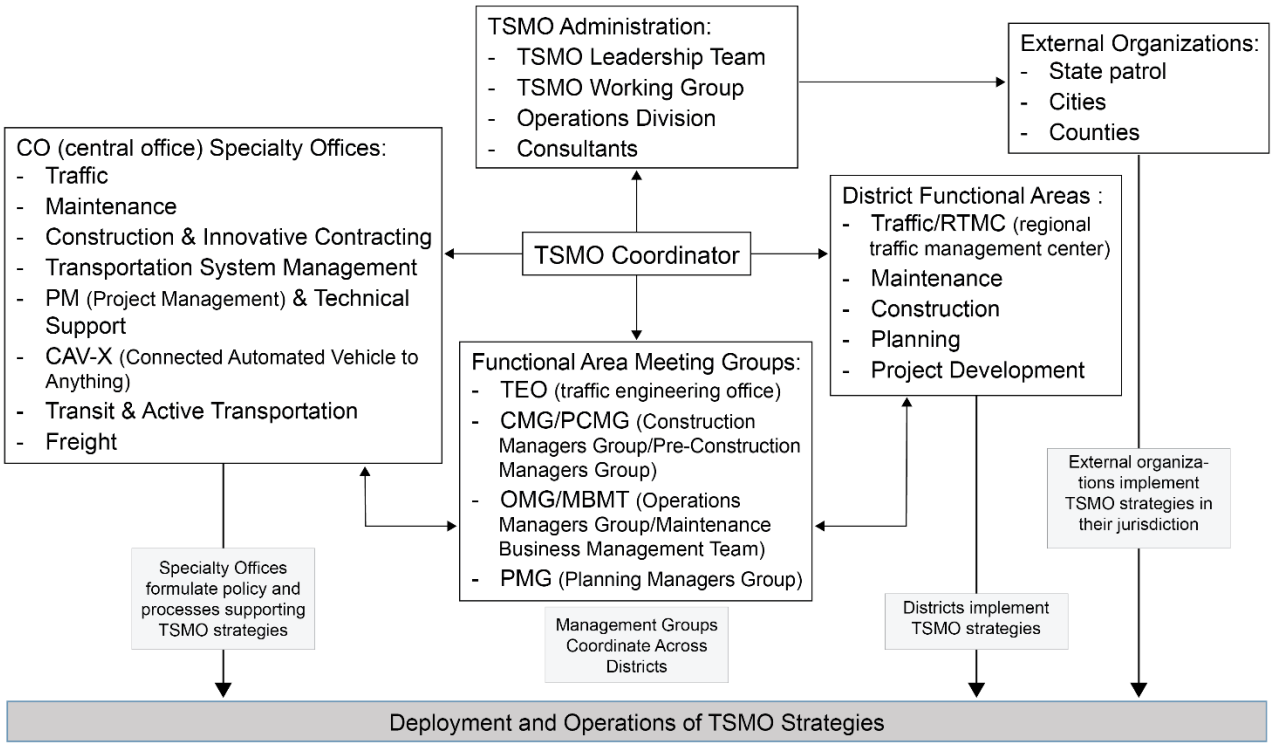

Figure 2. Diagram. Minnesota Department of Transportation proposed organizational model for TSMO.

(Source: Minnesota Department of Transportation.)

At a broader level, the plan also proposes a "TSMO organizational model" that institutionalizes and integrates TSMO into the department structure to support the execution of TSMO strategies and achieve TSMO strategic objectives. This step would articulate who is responsible and accountable for executing elements of the TSMO program. This is an ongoing activity as the department applies the TSMO director's role and considers expanding the membership and refining the roles of the TSMO Leadership Team and Working Group, potentially adding additional TSMO-specific staff and making other organizational adjustments on a temporary or permanent basis. As MnDOT continues to develop an organizational approach, it may look to organizational models applied for other department services and organizational initiatives that addressed previous needs. The department cited the following examples: building a new section within an office, as it did with traffic safety within the Office of Traffic Engineering and traffic signal operations within the new Electrical Services Section, creating a shared services group like ITS or right-of-way, deploying regional or district coordinators, as it did for its Toward Zero Deaths initiative, and potentially reintegrating the new function into the traditional structure over time.

Arkansas Department of Transportation Peer Presentation

TSMO activities and a supportive organizational structure are dispersed and loosely defined at ArDOT. The department is beginning to develop a TSMO plan that may result in recommendations to formally organize the department for TSMO. As of early 2020, ArDOT does not have a separate traffic division, having previously dissolved one and distributed its responsibilities across the planning, design, and operations branches. An examination of its current organization chart reveals the operation of its TMC and ITS under Maintenance, which also manages TIM, while drawing from Transportation Planning & Policy, Highway Police, and the State's 10 districts. Other cross-disciplinary responsibility for TSMO includes work zone management by Roadway Design and the districts, and traveler information by Public Information and the districts. The ITS Management Section, itself, oversees ITS, mobile and backhaul radio, signal operations, TMC, radio dispatch, and roadway lighting.

Management committees bring together various disciplines to carry out TSMO strategies. A Traffic Incident Management Committee has seen particular success with significant increases in first responder training, passage of quick clearance legislation, and use of performance management to improve program outcomes. Other committees include work zone management, Motorist Assistance Patrol Program, and TSMO generally.

TSMO "champions" can be found throughout the department and among external partners. ArDOT sees a critical mass of champions teaming up to advance TSMO. Two organizational successes include growth within the ITS Management Section across electrical engineering, systems engineering, and civil engineering and collaborations around TSMO between the Maintenance branch and ITS Section and the Planning branch and Transportation Planning & Policy Section—as demonstrated by their attendance together at the peer exchange. On the planning side, the section aligns performance measures, performance management, and long range/strategic plans with TSMO.

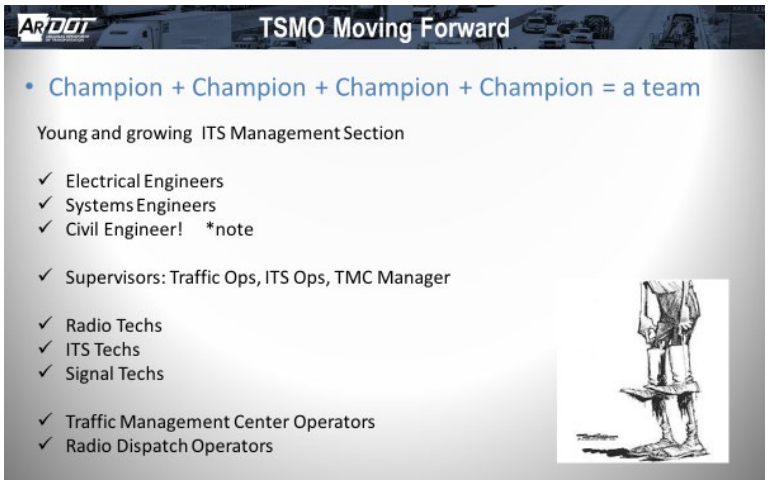

Figure 3. Presentation slide. Arkansas Department of Transportation TSMO Champions.

(Source: Arkansas Department of Transportation.)

Breakout Exercise and Report Out

After the peers made their presentations, participants broke into two groups for a facilitated exercise on organizational structure. Each group discussed various pros and cons of organizational approaches supporting TSMO and the characteristics of each. The groups gave additional thought to notable successes and areas for improvement among the differing approaches.

While not every instance was represented by the agencies in attendance, participants understood that there is a wide spectrum of "organizational approaches" to TSMO—because of a legacy organizational structure or following recent adjustments or reorganization, often as part of a TSMO planning process. For those agencies that self-identify as having a formalized approach to TSMO or consider it a mature activity within the agency, organizational approaches range from a fully centralized, top-level division to a distributed organizational approach with TSMO responsibilities resting among multiple functional groups, as well as a central office/headquarters and districts/regions. Alternatively, TSMO may lie among a few specialized functional groups, with TSMO consideration and responsibilities otherwise a part of most other staff's job duties to some degree—effectively embodied by a TSMO culture that permeates the agency. Among agencies otherwise at the lower end of the TSMO capability maturity scale, their organizational approaches may be considered ad hoc, informal, or relatively undefined.

Peer Exchange Discussion on Organization to Advance TSMO

- No "one size fits all" or "right answer"
- Wide range of successful organizational approaches
- Substantial reorganization not necessary
- "Organizational approaches" include building on legacy roles and structure to add a TSMO focus
- Approach should align with agency culture, mission and goals
- An incremental approach avoids substantial disruption
- Achieving department-wide consistency can be achieved through targeted champions

Across the organizational approach spectrum, participants acknowledged there is no "right answer" or "one-size-fits-all" structure. A successful model depends on context. The essential consideration is determining the organizational approach that best fulfills achieving the agency's objectives. Participants suggested that a successful organizational approach should allow for TSMO to integrate with or extend the existing culture and successful practices of the agency rather than redefining them and "carving TSMO out as special." For many agencies, this approach may not point to significant reorganization that creates a TSMO-specific division, while other agencies may find that option feasible and preferable for their needs. One example benefit of a consolidated TSMO organization is the improved ability of external partners to better understand with whom to interact on TSMO.

Implementing a new organizational approach may be done incrementally to avoid highly disruptive changes or to incorporate feedback and observation on how the approach should ultimately work best. MnDOT's organizational actions reflect this tactic, as it contemplates the ultimate role of the new State TSMO Director, whether additional TSMO-specific staff will augment that role, and whether new roles and responsibilities will eventually reintegrate into the department's traditional structure or remain as a standalone section. MnDOT's approach, along with that of many other agencies, shows the importance of developing a TSMO plan prior to implementing changes, especially those involving new resources such as adding new staff positions.

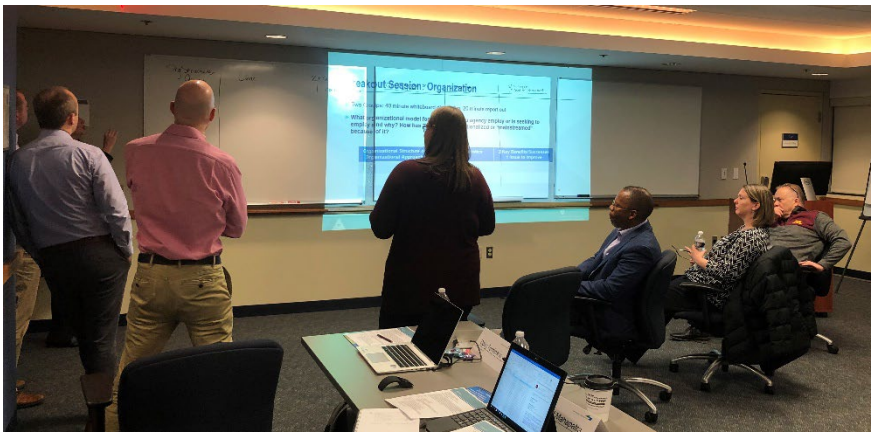

Figure 4. Photo. Participants discuss organizational approaches.

(Source: Federal Highway Administration.)

At a more granular level, the discussion illustrated that identifying or cultivating champions in less urbanized districts/regions, particularly for decentralized DOTs, is becoming more critical. Some agencies have made progress mainstreaming TSMO but still recognize the need to make TSMO approaches more consistent statewide—typically outside regions with significant urban areas, which tend to have been readily employing and advancing TSMO strategies and therefore have a supportive organizational structure or approach. In general, participants have found it beneficial to be clear how TSMO fits into individuals' day-to-day jobs and their (potentially formalized) responsibilities, particularly when an explicit TSMO division or section is not present—and even then, other staff outside a TSMO-specific group will necessarily play a role in TSMO. Cross-functional or multidisciplinary management groups focused on TSMO can be part of the organizational approach to provide forums for collaboration, guidance, and decision making. Overall, participants stressed the need for an organizational approach to strike the right balance between providing a sufficiently strong centralized role managing TSMO and accommodating the varied needs and inputs of technical disciplines or programs as well as districts/regions across the agency.

Session 2 Collaboration/Partnerships that Advance TSMO

Session 2 began with two peer presentations on the types of collaborative efforts agencies are implementing and insights on partnerships needed to advance TSMO. This session highlighted the metropolitan planning organization's role in urban areas with a participant from the Maricopa Association of Governments (MAG) providing a regional experience in advancing TSMO in Phoenix, Arizona. A participant from Texas DOT (TxDOT) then presented on how Texas, a very large State, is implementing TSMO planning efforts at a district level with each of the 25 districts in the agency.

Maricopa Association of Governments Peer Presentation

The participant from MAG began his presentation by providing a bit of history on how the Phoenix metropolitan area advanced technology and roadway network management through a collaborative structure between MAG, AZTech (led by Maricopa County), and Arizona DOT (ADOT). MAG leads a System Management and Operations Plan that includes integrated corridor management (ICM), regional priority arterials, local priority corridors, and regional operations. It is also involved with an emerging technologies pilot, for which it has received Federal funds. Local sales tax revenue also goes toward some transportation investments.

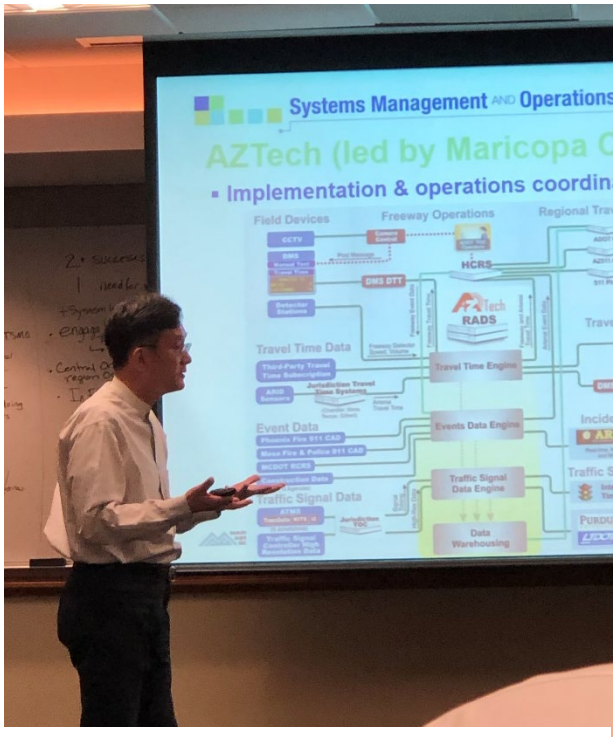

Figure 5. Photo. Presentation on Maricopa Association of Governments TSMO collaboration.

(Source: Federal Highway Administration.)

MAG partners with AZTech on the implementation and operations of a network of roadway systems. They also work closely with ADOT on freeway management system and

traffic incident management programs. Jeff highlighted a grant application to implement ICM along 31 miles of the Loop 101 corridor around the Phoenix metropolitan area. MAG collaborated with the Department of Safety, ADOT, Maricopa County fire and police, and the University of Arizona in this application.

Texas Department of Transportation Peer Presentation

TxDOT completed a statewide TSMO Program Plan in 2018. Part of this statewide effort recommended having TSMO program plans developed in each of the 25 districts. Currently, each district is moving forward with a program planning effort that tailors advancing TSMO to its needs. Some districts realized a need to first develop or update an ITS planning effort before or in parallel to developing TSMO program efforts.

The presenter stepped through how this major undertaking of 25 planning efforts in a five-year program will occur. The process closely follows the FHWA's CMM guidance and aligns with 14 TSMO operations strategies. The rollout of district level TSMO plans will engage a large array of stakeholders in each of the districts and contain significant outreach and awareness building components.

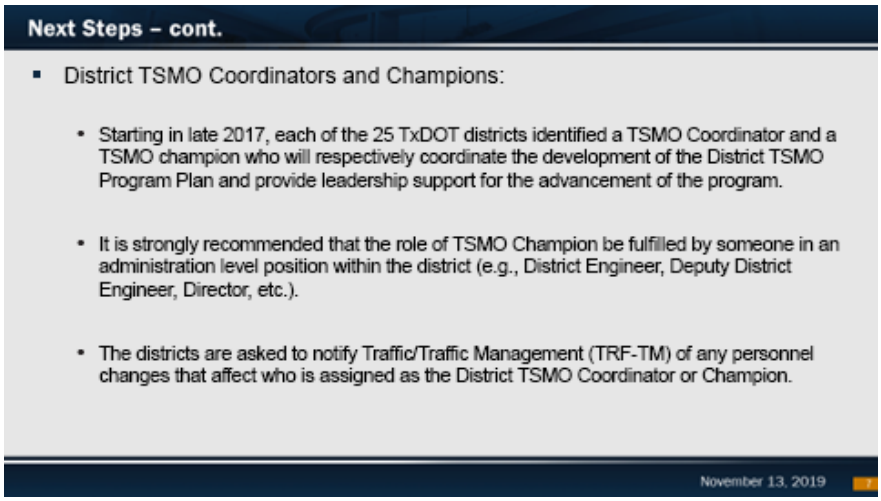

Figure 6. Presentation slide. Texas Department of Transportation district coordination for TSMO program plans.

(Source: Texas Department of Transportation.)

Facilitated Discussion

After the peers made their presentations, the participants took part in a facilitated discussion to further explore the various approaches in collaboration to advance TSMO. The entire group

discussed examples of how MPOs and DOTs collaborate to advance TSMO and how DOTs mainstream and institutionalize TSMO outside of centralized and headquarter type approaches. Additional discussions explored how best to collaborate with other stakeholder segments such as law enforcement, emergency management, and universities.

Collaboration between regional stakeholders in Integrated Corridor Management programs established successful partnerships that go beyond the ICM projects and impact broader transportation operations.

The discussion began around how regional TSMO planning is being linked to statewide efforts and mainstreamed into established DOT processes. Georgia DOT showcased a prime example of how TSMO collaborations had helped to establish relationships that were invaluable when a massive fire in March 2017 collapsed a bridge on I-85. The Georgia DOT had important existing relationships that helped achieve quick actions and resolution to the incident with demand management strategies and detour routing. Maryland State Highway Administration added that TSMO outreach with local partners helped to identify opportunities to partner and where State funding could be accessed.

RTC of Southern Nevada noted that more recently non-traditional partners such as mobility as a service (MAAS) providers have become important partners. New private-sector stakeholders are also becoming important partners. As one example, the Resort Corridor Mobility Association has approached RTC with new construction concepts and strategies to manage traffic near Allegiant Stadium south of Las Vegas.

MetroPlan Orlando noted that there were times when some partner agencies did not see the role for MPOs in the TSMO discussion. This is not the case in Orlando where the MPO is fully engaged with various partners in Central Florida to implement the actions identified in CMM self-assessments performed in 2014 and 2017 to track progress in planning for operations. The region fully sees how collaborative efforts between the DOT and MPOs have advanced operations and maintenance activities. The discussion noted that efforts easily falter without strong collaboration.

In recent Concept of Operations (ConOps) grant submissions for ICM along I-4 (from Tampa to Orlando) regional entities supporting the grant included three FDOT districts and two MPOs, illustrating both FDOT's strong investment in TSMO and engagement of MPOs. Other peers brought forward examples of similar collaboration around ICM activities or corridor initiatives,

including I-15 in Las Vegas and I-29 in South Dakota. There was a consensus that collaboration across agencies is necessary to advance corridor programs. The "corridor" focus helps to bolster support for operational strategies and often requires and thereby creates a champion to advance the project.

In Florida, ConOps documents and the systems engineering process has moved from a few projects here and there to acceptance on a statewide basis.

> ***"It was incredibly beneficial to hear from other agencies, especially the MPOs, for their input on how TSMO is working for them and their partners."***
>
> – Peer Participant

MoDOT explained how the KC Scout program is an example of collaboration in the Midwest. The program brings together MoDOT and the Kansas DOT (KDOT) and includes joint TMC activities for the Kansas City metropolitan area. Sharing snowplow resources was an example of one of the many benefits to the KC Scout collaboration. The TMC also houses Operation Greenlight, a cooperative effort to improve traffic signal coordination and incident response on major routes throughout the bistate Kansas City area, led by the Mid-America Regional Council (the MPO for the region).

Finally, the group cited the national TIM training programs as beneficial to advance collaboration efforts and TSMO across the nation. Nearly all participants in the peer exchange gave unanimous nods of approval.

Session 3 Communicating TSMO: Making the Business Case and Branding

Session 3 opened day two of the peer exchange with two presentations on how agencies communicate TSMO ideals by making the business case for efforts and branding TSMO messaging. Utah DOT (UDOT) recently completed a TSMO business case document and remains focused on internal messaging of TSMO. The group then heard from Michigan DOT (MDOT) on how the agency has advanced TSMO over the last four years.

Utah Department of Transportation Peer Presentation

The participant from UDOT presented the agency's approach to advancing TSMO. Phase 1 of their effort focused on building internal awareness of TSMO at the agency, beginning with the development of a TSMO business case, which focused on achieving senior leader buy-in for advancing TSMO. The effort recognized that TSMO was something the agency had been doing for decades and that finding every agency position's connection with TSMO should be explored and documented. Phase 2 of the effort began with department-wide outreach to raise the awareness of TSMO, anchored by workshops focused on explaining TSMO and how it relates to everyone's role.

To integrate a TSMO mindset into project planning, UDOT developed a TSMO Operations Review to assess ways to include TSMO at the concept phase of project development. UDOT Region 3 piloted the review process, and the department is expanding it statewide. UDOT is also developing one-page summaries and checklists that focus on the various divisions and programs to expose possible advancement of TSMO concepts tailored to each group. Each one-page summary provides a checklist with specific steps that the division can consider advancing TSMO. Once complete, the group will visit each of the UDOT regions with a workshop to further advance the awareness of the planning effort and opportunities to advance TSMO.

Michigan Department of Transportation Peer Presentation

Michigan DOT hosted a CMM workshop in 2013 and have had many accomplishments since. MDOT began formal planning for TSMO in 2015 when they were able to include specific TSMO language in the Michigan State Transportation Improvement Program (STIP) and State Long Range Plan. The early work developed five business case documents tailored to distinct audiences: DOT leadership, DOT staff, MPOs and partner agencies, legislators, and the traveling public.

Figure 7. Presentation slide. Michigan Department of Transportation TSMO Business Case for the traveling public.

(Source: Michigan Department of Transportation.)

Michigan DOT has hosted several FHWA workshops to advance TSMO, including TSMO benefit/cost analysis (TOPS-BC Tool Training), Active Traffic Management/Advanced Transportation Demand Management, and ramp metering.

In 2016 MDOT held an internal workshop that provided baseline material for their TSMO Strategic Plan. The workshop conducted a gap analysis on 10 TSMO business areas and established priority actions to advance TSMO in the agency. Over 70 staff engaged in this process. The effort defined common gaps across the business areas to identify broader strategic actions called commonality areas:

- Improve IT processes.
- Focus on data issues.
- Assess integration of TSMO functions.
- Investigate TSMO funding integration.
- Increase awareness and outreach efforts.

MDOT issued the resulting Strategic Plan in 2018 and updated it in early 2020.

The agency identified early actions to explore how TSMO funding fit into traditional funding streams, called templates in Michigan. MDOT held a working session to pinpoint where TSMO fit into existing agency processes. This work session mapped existing funding processes for Safety Programs, Signals, and ITS; identified gaps and alignment needs; and developed the need for freeway and non-freeway operations funding. This work session resulted in meaningful progress to mainstream funding for TSMO.

Breakout Exercise and Report Out

After the peers made their presentations, the participants broke into two groups for a facilitated exercise on communicating TSMO. For each of the following three items, participants thought about the various groups of stakeholders and the nuance required for messaging around TSMO to capture the stakeholder's interest.

- Making the business case—why, content, format, audiences, use cases/how agencies use it, and any outcomes.
- How TSMO connects and works with other parts of the agency.
- How to best communicate TSMO (messaging) to other internal departments/disciplines (planning, design, construction, maintenance, and safety) and partner agencies.

Peer Exchange Discussion of How to Formulate TSMO Messages by Audience

- Leadership—Link TSMO to agency goals and priorities
- Planning Staff—Demonstrate how to integrate TSMO into systems planning
- Maintenance Staff—Illustrate how TSMO facilitates more effective maintenance outcomes
- Law Enforcement—Relate TSMO to safety and quicker incident clearance
- Private Sector—Show TSMO's potential to save time and money
- Public—Highlight TSMO's improvements to the travel experience, from safety to reliability

Group One

Group One began by categorizing various types of stakeholders and how messaging should be targeted to each type. Regardless of the targeted stakeholder, the messages should be deliberate, consistent, and proactive in tone. For each stakeholder type, the group discussed the nuance needed for messaging TSMO.

Group One's discussion by stakeholder type included the following:

- **CEO/Director.** The group noted that at the CEO level, communicating TSMO should link the priorities of the agency and the customers the agency serves. Messages that showcase the benefits of operations, such as "TSMO is cheaper and faster" and that TSMO "addresses congestion without building more lanes" are important core selling points. At the same time, technology deployments have unique long-term maintenance costs that differ from traditional capital projects and should not be ignored.

- **Maintenance Staff.** For maintenance staff, the TSMO message should include information on how technology allows the job to be done more effectively. TSMO strategies often provide data to enhance system operations generally, allowing, for example, maintenance departments to optimize maintenance windows effectively. Information collected from TSMO applications can help design safer work zones, keeping maintenance staff and travelers safe.

- **Law Enforcement.** The ideal TSMO message for law enforcement relates to how TSMO can support quicker incident clearance by enabling early detection and response, resulting in safer conditions for responders and the traveling public.

- **Private-Sector Customers (e.g., freight sector and economic development entities).** Participants noted that there may be negative perceptions of advancing TSMO among certain stakeholders, such as a tow company thinking it may lose business if traditional rotational programs change to a model where the fastest or nearest got the business. An effective approach is redirecting the negative view with messages that highlight TSMO benefits, such as when the agency collects incident information quickly, tow companies can arrive on scene more quickly, which is good for business.

> ***"What really resonated with me was how important the recognition of TSMO by top management can be for program success."***
>
> – Peer Participant

Group Two

Group Two discussed the topic in four segments: the audience, the TSMO message, the nuance, and what stakeholders hear. Four groups of stakeholders were then highlighted as the Group Two discussion found:

- **Agency Leadership.** Successful messages for agency leadership should be tied to agency goals. The nuance in the message should connect to solid concepts (not the abstract), it should be personal and relatable, and clearly show leadership how the agency is advancing TSMO. Leadership may hear that TSMO requires additional resources and therefore they must buy into the program. Peer experiences on advancing operations help support agency leadership understanding.

- **The Public.** Public messaging should explain how TSMO improves the safety and reliability of the system and makes a positive impact on their travel experience. For the public, the message should show results and provide information about the system's services. The public should understand how travel delay costs money for everyone and that TSMO investments are not nearly as expensive as larger infrastructure programs. Messaging to the public should garner support for DOT programs that improve customer satisfaction.

- **Private Sector.** This group also expanded consideration of private-sector partners to include businesses, the freight sector, contractors, telecom providers, and the health industry, showing how messages around improved operations might be brought to each of them. Business entities (contractors, freight, etc.) will understand messages about how traffic congestion impacts their bottom line. Opportunities to leverage media coverage can help expand the messaging itself, which, in turn, can prompt support, satisfaction, and trust from these stakeholders, further reinforcing program legitimacy.

- **Planners.** Communicating TSMO to planners should involve how TSMO consideration can integrate into systems planning. Messaging can incorporate basic TSMO education that provides information on the complete TSMO-toolbox and aspects agencies should consider before investing in large capacity projects. Messaging for planners should include TSMO awareness building to advance operations starting at the planning phase of programs and plans. The nuance with planners should include performance measures for outcomes of TSMO programs. Having planners that support and consider TSMO at the earliest planning stages is key to advancing TSMO in an agency.

Session 4 Priority Topics

Session 4 asked participants to brainstorm a list of priority topics that are worth further exploration in the peer exchange environment. The group prioritized and narrowed down the full list (provided below), and the facilitators and FHWA highlighted four suggested topics.

Participants divided into four small groups and circulated among whiteboard/flipchart "stations" for about 15 minutes each. Each board posed a basic set of questions about one of the four priority topics. At each station, the small groups discussed the topic, documented their concerns or potential challenges, offered an example solution or best practice (either from their agencies or from other peer agencies they knew of), or otherwise identified resources that would help address the challenge. Suggested topics included:

- Conducting life-cycle assessments and asset management for ITS and TSMO.
- Funding for TSMO—sources and mechanisms.
- Operations and Maintenance (O&M) of ITS equipment or TSMO-related equipment—how to handle increased demand with a static budget.
- O&M—how to account for or understand TSMO O&M costs as part of the project development process, how to make the case for the funding, and how to secure the funding.
- Strategies to understand what to do with data to make it useful, develop meaningful performance measures, and dashboards.
- "TSMO first" policies—ways to establish the mindset or requirement to think or plan/develop operationally before pursuing traditional capital projects.
- Workforce issues—having the right staff and training to sustain a TSMO program or implement advanced strategies.
- Agency "Director of Innovation" role or similar becoming more widespread, but how does it relate to TSMO?
- Pedestrian/bicycle and transit users/systems—how do they relate to TSMO (safety and mobility)? Where are "Offices of Mobility" focusing on all modes found?

- Promotion of transportation demand management (TDM), including gamification.
- Freight planning and TSMO.
- TSMO outreach to the public and decision makers.
- Connected and automated vehicle planning, both corridors and statewide.

Figure 8. Photo. Participants discuss priority issues.
(Source: Federal Highway Administration.)

- Benefit/cost analysis and monetizing TSMO benefits, both internal (to the agency) and external (to society), particularly the need for examples and data for advanced strategies like ICM.
- Freeway operations and arterial operations integration—Who is in charge? What are the applied technologies and policies?

The participants selected the following four priority topics:

1. **Workforce Issues:** Staffing, training, and innovation-oriented staff.
2. **TSMO O&M:** How do agencies manage ongoing operations and maintenance costs of a TSMO program and secure TSMO-specific funds?
3. **TSMO Benefits:** In the context of making the TSMO business case, how do agencies monetize benefits (especially when there is a lack of data) and capture benefits/costs, both internal (agency) and external (society)?
4. **Data and Performance Measures:** In the context of day-to-day operations, how do agencies harness data, performance measures, and dashboards to advance TSMO program objectives?

Priority Issue No. 1—Workforce Issues

Participants identified a host of workforce issues that have been challenging agencies for some time as they advance their TSMO programs. These concerns have frequently been raised during CMM workshop self-assessments: recruitment, retention, career paths and degree/license requirements, position descriptions, and training.

Participants focused on the issue of attracting and retaining TSMO professionals, particularly those with IT or data management experience, such as data scientists, electrical engineers, and specialized field technicians. Participants questioned whether to maintain or attempt to eliminate the requirement of holding a civil engineering degree or professional engineer's license as a requirement for hiring into the DOT and charting an upward career path.

Examples of successful practices that can foster a TSMO workforce included working with universities or trade schools to incorporate TSMO into engineering curricula and leveraging existing certification programs (e.g., Cisco) to build IT and data management skills. Agencies looking to generate interest and new hires for TSMO could promote Science, Technology, Engineering, and Math (STEM) programs in high schools and community colleges, highlighting how the DOT is applying advanced and emerging technology applications. New hire orientation programs, cross-training, and rotational programs can build awareness and interest in TSMO program activities among new and existing staff.

Successful TSMO Workforce Practices Identified by Participants

- Work with universities or trade schools to incorporate TSMO into engineering curricula.
- Leverage existing certification programs to build IT and data management skills.
- Promote STEM programs in high schools and community colleges.
- Build internal awareness through new-hire orientation programs, cross-training, and rotational programs.
- Capitalize on national resources and training opportunities (e.g., Operations Academy™ and NOCoE).

Participants also recognized several national resources and training opportunities such as the University of Maryland-hosted Operations Academy™ and the NOCoE's recent initiative that focuses on workforce, including development of an online database of TSMO training courses. Participants suggested that the NOCoE database could be advanced further by organizing its

contents into coherent curricula, such as standardized "courses" by knowledge level that an agency could easily use to develop a TSMO training program.

Participants identified the role of "innovation directors" (or similar) as a new workforce consideration. Participants observed that this relatively new position or title, which is becoming increasingly popular among public agencies, includes the following challenges: creating or understanding this person's role, particularly its linkage or relationship to TSMO and research, retaining such a person, since because they are often lured away by other "innovation" opportunities (especially in the private sector), and tapping into this person's availability, as they are often spread thin or highly in demand (especially if they are effective at the job), juggling multiple duties and commitments. Participants acknowledged the valuable work of several agencies' innovation directors, who have introduced leading-edge technology applications, promoted new business processes, and helped to cross-fertilize "good ideas."

Priority Issue No. 2—TSMO Operations and Maintenance (O&M)

Participants recognized that the rapidly growing number of ITS devices and other capital deployments to support TSMO strategies places a strain on O&M budgets. The participants observed that two challenges exist with this trend, where the second is an extension of the first: 1) having enough resources to conduct a growing volume of maintenance activities in the face of often static budgets, and 2) the need to better understand specific maintenance activity costs to make the case for appropriate resource levels. Related challenges include conducting a comprehensive needs assessment for O&M, decommissioning and disposing of outdated technologies, and directing federal or State-defined funding sources appropriately toward maintenance activities.

Participants suggested that overcoming the challenge of ITS and TSMO maintenance needs is largely a matter of using the right communication methods and tools. Much like the findings of the session on communicating TSMO and making the business case, agencies must effectively demonstrate the

Participant Ideas to Support TSMO O&M Funding

- Collect and analyze historical cost data at the unit level.
- Develop specific system plans that consider O&M needs, like for telecommunications.
- Demonstrate the consequence of reduced level of service by affected TSMO strategy.

need—through asset management planning, performance data, life-cycle cost analysis, and even persuasive anecdotal or qualitative arguments to managers, key decision-makers, and other staff that can help support the case. Specific good practices participants noted include:

- Collecting and analyzing historical cost data at the unit level.
- Developing specific system plans that consider O&M needs (e.g., a telecom plan for communications).
- Demonstrating the consequence of reduced level of service (with service defined differently depending on the intended outcome of the TSMO strategy).

On the funding and O&M delivery side, participants suggested the following solutions:

- Creative use of funding categories to direct money toward maintenance activities.
- Placing O&M "projects" on the STIP and supporting them with federal funding.
- Generating new sources of revenue for maintenance by monetizing services related to the devices or equipment in question (e.g., data, fiber, or right-of-way).
- Gaining efficiencies through outsourcing, P3s, and performance-based contracting.

Priority Issue No. 3—TSMO Benefits (to Make the Business Case)

Monetizing TSMO benefits remains a perennial challenge, requiring agencies to obtain the "right" data at a reasonable cost of collection and applying analytical techniques that properly capture benefits that resonate with intended audiences, particularly secondary benefits like job access, economic development, and improved equity. Participants observed that estimating the cost of future technologies hampers clear communication on why investing in them makes sense. Similar challenges exist with a lack of data to estimate non-recurring costs.

Helpful solutions offered by the group include:

- Developing a common understanding among practitioners on how to use the data to monetize and communicate the benefits.

- Taking advantage of available modeling tools to calculate costs and benefits—for example, FREE VAL from (Texas Transportation Institute) TTI has been used to analyze the impacts of incidents and work zones.
- Employing good storytelling and highlighting the qualitative aspects of strategies and outcomes as a substitute or augmentation to quantitative analysis. When lacking hard numbers, participants have found that it helps to make an agency's case through real-world experience, like maintaining a positive user experience and operational brand and leveraging positive media coverage to create a level of comfort among the public, which can help justify further investment in the system's TSMO strategies.
- Considering the effectiveness of the delivery medium; for example, infographics and info-videos successfully communicate benefits, being both easily digestible and relatable. Among many good examples mentioned, these techniques have been applied to illustrate the benefits of ICM in San Diego, ramp metering in Minneapolis, Maryland's TSMO Program, fiber and communication expansion in Utah, and collaborative TSMO efforts in the Orlando metro region.

Participants' Recommendations on Monetizing TSMO Benefits

- Develop a common understanding among practitioners on how to use available data.
- Take advantage of available modeling tools.
- Employ storytelling to leverage qualitative outcomes.
- Consider the effectiveness of the delivery medium, especially one that is digestible and relatable.

Priority Issue No. 4—Data and Performance Measures (for Day-to-Day Operations)

Members of the group discussed a range of challenges from harnessing the growing availability and volumes of data, developing actionable performance measures, and communicating outcomes tailored to different audiences. At times, participants noted, the granularity and sheer volume of potential data overwhelms an agency's capacity to manage and understand how to use it to operate the system on a day-to-day basis (e.g., high-volume signalized intersections and highly instrumented freeway corridors). Participants remarked about a lack of public trust

toward “big data.” They also discussed a disconnect between broad-scope performance measures, often applied on a statewide basis, that indicate how well transportation-related objectives are met, and those that relate to specific TSMO activities. Finally, the group remarked that making comparisons across different technologies or data sources intended to measure the same outcome is like “comparing apples and oranges” because of differing definitions and standards.

As with several other challenges discussed throughout the peer exchange, addressing concerns with data and performance measures often comes down to communication. Participants offered many dashboard-type application examples that help operationalize and communicate data in meaningful ways that resonate with audiences (e.g., agency staff practitioners, upper management, and the public). One participant’s recommendation entailed constructing simple, standardized dashboards for TSMO, like how agencies use data in the National Bridge Inventory for bridge inspection reporting. Other examples from States in attendance include:

- Texas DOT: “At-a-glance” dashboards customized to different audiences.
- Utah DOT: Snow and ice performance metrics app and Automated Traffic Signal Performance Measures applications.
- Maryland DOT: STORM app showing where snowplows and maintenance staff are working.
- RTC of Southern Nevada (Las Vegas region): In-house operational dashboard that provides CSV file download capabilities.
- Georgia DOT: Dashboards that aggregate disparate data sources that provide analytics to focus resource allocation.

Organizing for Operations and the Future of TSMO

In the final session, the full group contemplated the future of TSMO programs at their agencies. Participants discussed:

- Where will TSMO and TSMO programs be in five years?
- How would you use one additional employee?
- What are some issues with institutionalizing TSMO program planning and "making it stick"?
- What are proposed activities for advancement?

Where will TSMO and TSMO programs be in five years?

Participants anticipate that the further mainstreaming of TSMO will continue. Agencies will continue to formalize TSMO as a prominent top-tier program, deploying a "TSMO first" stance to tackle mobility, accessibility, and system reliability issues across multiple modes, with increased collaboration among public and private sector partners and further leveraging advanced technologies. Evidence of a "wave" of TSMO awareness and practice can be seen by the "friendly competition" among some States' districts/regions to adopt practices or implement strategies and technology faster that permeates TSMO beyond typical urban areas or simple initiatives driven at the headquarters or central office level. Participants anticipate that partnerships will continue to grow in number and importance—partnerships with MPOs and freight organizations are two examples cited.

Big data, crowdsourced data, and connected vehicle and infrastructure data will continue to fuel demand for data scientists and others versed in complex performance analysis. Participants agree that some internal capacity within the DOT or IT department would be beneficial. Contracting out to consultants or universities can be costly. Transforming large volumes of TSMO data into "actionable insights" was a significant need expressed among participants (drawing a frequent response to what an additional TSMO staff person would add to an agency, summarized below). They expect this trend will grow over the next five years.

How would you use one additional employee?

Participants indicated how they would use one additional staff full-time equivalent (FTE) to support their immediate TSMO program needs.

- Multiple responses related to marketing efforts or inreach/outreach to spread the "TSMO message," build program understanding, and further engrain the TSMO mindset among staff. One participant stated this role would require administrative and graphic design skills to prepare and deliver high-quality marketing materials.
- More than one response sought to deploy an extra resource in an analytical capacity—to transform data into actionable insights, to quantify mid- to long-range O&M costs, to track deployments from a regional perspective, and assess their data to monetize data and further build the business case for TSMO.
- Other responses incorporated a programmatic or leadership element—someone to oversee and implement a TSMO plan, a TSMO "czar" internal to the agency, a person to coordinate meetings with stakeholders and "tie together moving pieces," or staff to provide programmatic support for TSMO across the State, ensuring consistency among different internal groups.

What are issues with institutionalizing TSMO program planning and "making it stick"?

Striking the right balance between applying TSMO solutions or traditional capacity improvements to system demands was a priority among some participants. Many recognized that TSMO does not apply to all cases (it is not a "silver bullet") and should be used where applicable. This understanding can help build TSMO as a mainstreamed program by generating buy-in and avoiding backlash.

Participants strongly felt that changes in leadership remain one of the most critical issues to address when institutionalizing TSMO and executing a TSMO plan. Even among well-established programs and programs where the agency's head itself is a TSMO "champion," there is always a risk that the program will regress (or worse, no longer exist) after a change in leadership. As one participant put it, "TSMO is one administrator away from dying." This concern further emphasizes the consistent need to build and maintain the business case for TSMO—strengthening the program and its understanding to make it invaluable or irreplaceable ("like the fire department"). Tracking performance and justifying all investments as a matter of course helps maintain this level of awareness and program indispensability.

There is a consistent need to build and maintain the business case for TSMO regardless of program status. The program must be understood to be invaluable or irreplaceable, "like the fire department."

On the positive side, several newly elevated leaders have come from TSMO backgrounds, demonstrating the growing importance of TSMO itself and that a leadership career path can have a TSMO focus, further legitimizing its status as a top-tier agency program.

What are proposed activities for advancement?

Participants offered suggestions on how FHWA could help address the challenges and concerns raised throughout the peer exchange.

- Potential resources or initiatives mentioned by participants include:
  - A national level resource linking a reduction in incidents from TSMO relative to reductions from traditional roadway redesign practices.
  - Providing a national-level clearinghouse of TSMO solutions that compiles and standardizes their impacts.
  - Developing national criteria to build benefit/cost metrics for TSMO strategies, since Moving Ahead for Progress in the 21st Century (MAP-21) performance measures do not lend themselves well to granular decisionmaking.

  - » Facilitating a TSMO peer exchange designed for MPOs to further drive TSMO capacity-building among that cohort of critical decision makers.
  - » Coordinating other initiatives at the national level to elevate best practices and eliminate "everyone doing their own thing," such as data science methods and standards.
- Participants stated that FHWA could develop clearer national guidance in some instances:
  - » One example is clearer and more relevant guidance on dynamic message sign message content.
  - » A success story participants described as worth emulating is the Memo for ITS Construction issued in September 2019 that helped clarify nontraditional procurement procedures.
- Suggestions for FHWA included:
  - » Modifying the MPO transportation plan certification process to emphasize incorporating TSMO into long range plans and transportation improvement programs. This would build on how Division Offices have been increasingly proactive at including operations specialists in MPO certifications.
  - » Continuing to communicate the degree of funding flexibility in federal aid for TSMO.
  - » Supporting TSMO awareness training.

Participants' Top Priorities Going Forward

- Further mainstreaming TSMO by striking the right balance with targeted capacity improvement projects.
- Further agency inreach and outreach to advance a TSMO mindset and build program understanding.
- Gaining further data analytics capacity.
- Deploying programmatic or leadership capacity to focus on agency-wide coordination and consistency.

Source: Getty Images

SUMMARY OBSERVATIONS ON TSMO READINESS

The TSMO community of practice has matured in the past decade. From the beginning of the National Academy of Sciences Second Strategic Highway Research Program (SHRP2) to the current rollout of research completed in that program, State DOT leaders have supported integrating research outputs into agencies across the nation. The SHRP2 research put definition to organizing for operations and created a framework State DOTs could use to measure their maturity for operations and implement plans to advance awareness and understanding of how TSMO fits into organizations, whether they are State DOTs or regional collaborations.

This peer exchange provided a valuable opportunity for a group of TSMO leaders to share experiences and have conversations about how TSMO programs are succeeding across the nation given the wide diversity of how TSMO programs have been approached—generally unique to each agency. The participants' observations about the advancements made in the TSMO community over the past two years since the previous peer exchange were insightful. Drawing on the report from the 2018 peer exchange, participants and organizers saw advancements in the TSMO community.

For instance, organizers noted from the beginning of planning this event that:

- Many more States are implementing TSMO plans or currently planning TSMO programs.
- While topics from past years are similar (the need to message TSMO and how to collaborate with stakeholders, for example), the landscape where these topics are discussed has

expanded. For example, while the messages that promote TSMO may be familiar ("TSMO addresses congestion without building more lanes"), the messaging's reach now extends further throughout agencies, beyond just those staff involved in ITS, traffic engineering, and other day-to-day operational activities. Planning offices, design staff, and district/region staff in more rural areas are several key examples of where TSMO awareness and efforts to mainstream have gained focus.

- States that were not able to participate two years ago have evolved to placing greater emphasis on advancing TSMO and participating in these types of exchanges. This interest aligns with States just now embarking in preparing a TSMO program plan.
- Several States have designated key statewide TSMO staff positions that did not exist two years ago (Maryland, Minnesota), and some States have added TSMO coordinators within their regions/districts. TSMO champions exist in more disciplines and organizational roles throughout agencies and not just among staff with strong operational backgrounds within headquarters/central office.
- The conversation around performance measures has evolved from a need to simply measure or communicate performance, to accessing capabilities for more advanced data analytics that develop "actionable insights" to better manage a TSMO program across the board and in finely targeted ways. The explosion in the quantity of data and the improved quality of data, drives this trend.
- States are starting to take advantage of new resources and ways to tackle perennial workforce development challenges, including capitalizing on the work of NOCoE, which offers numerous resources and has made workforce a marquee outreach topic.

> ***"This was one of the best peer exchanges I've attended. It was a great balance of roundtable discussion, presentations, and break out exercises."***
>
> – Peer Participant

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November 2020

FHWA-HOP-20-046

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