Using Capability Maturity Frameworks for Transportation System Management and Operations (TSMO) Program Advancement

RWM TSS WZM TM TIM

Case Studies and Lessons Learned

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16. Abstract Growing from research in the Strategic Highway Research Program 2 and subsequent support within the Federal Highway Administration Office of Operations, Transportation System Management and Operations (TSMO) capability maturity models and frameworks have been widely promoted to State departments of transportation. With over five years of application, a body of knowledge is now available on how best to advance capability maturity. Different program areas under TSMO have particular needs. These differences have led to varying approaches to promote the concept of capability maturity. There have also been challenges in advancing capability maturity, from explaining the value, gathering interest, supporting follow-up activities, and linking capability maturity to broader TSMO initiatives. This report presents six case studies of agencies that have used TSMO capability maturity models to advance their programs.			
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LIST OF ACRONYMS

Acronym	Definition
AASHTO	Association of State Highway and Transportation Officials
ADOT	Arizona Department of Transportation
ATSPM	Automated Traffic Signal Performance Measures
CMF	Capability Maturity Framework
CMM	Capability Maturity Model
CMSA	Capability Maturity Self-Assessment
DMS	Dynamic Message Sign
DOT	Departments of Transportation
FHWA	Federal Highway Administration
GBS	Good Basic Service
GDOT	Georgia Department of Transportation
IT	Information Technology
KDOT	Kansas Department of Transportation
NWS	National Weather Service
ODOT	Oregon Department of Transportation
OKI	Ohio-Kentucky-Indiana
PSE	Planned Special Event
RTOP	Regional Traffic Operations Program
RWIS	Road Weather Information System
RWM	Road Weather Management
TIM	Traffic Incident Management
TM	Traffic Management
TMC	Transportation Management Center
TOC	Traffic Operations Center
TSMO	Transportation System Management and Operations
TSS	Traffic Signal System
SHRP2	Strategic Highway Research Program 2
WYDOT	Wyoming Department of Transportation
WZM	Work Zone Management

CHAPTER 1. INTRODUCTION

This report is intended for transportation professionals who work at State and local agencies and provides evidence on how capability maturity assessments can help accelerate the evolution of Transportation Systems Management and Operations (TSMO) programs. Through the real-world examples that are provided, agencies will gain confidence in the utility of these frameworks to help meet their local program needs.

State and local departments of transportation (DOTs) are slowly moving toward a greater emphasis on managing their transportation systems to support travel mobility and reliability. These agencies, often under the umbrella of the TSMO program, seek to maximize the efficiency of their transportation systems by using an integrated suite of strategies that work together to preserve the roadway capacity and improve safety, security, and travel reliability.

Over the last two decades, TSMO deployment has advanced significantly. TSMO now encompasses a diverse set of activities that include approaches to manage both recurring and non-recurring sources of congestion. Today, these include activities such as traffic incident management, work zone management, traffic signal management, traveler information, road weather management, and corridor management. More importantly, applications and strategies under the TSMO umbrella are steadily taking advantage of developments in traffic technology, connectivity, and understanding of travel behavior.

While the growth of TSMO has been impressive, it has not been without growing pains. Largely champion-led, TSMO implementations in agencies have lacked a programmatic focus, often ending up as a collection of diverse but unrelated activities. This lack of focus has created continuing challenges in funding TSMO activities, building support from decision makers, sustaining improvements in programs, addressing staff turnover, managing change, and leveraging successes.

Federal, State, and local stakeholders involved in TSMO have recognized the critical need to enable more institutionally robust programs within agencies. Agencies are increasingly seeing the value of looking at ***TSMO as a way of doing business at a DOT*** rather than a discrete set of activities. However, the evolution toward a TSMO-centric organization requires an agency to take a hard look at its current institutional capabilities to support TSMO.

CAPABILITY MATURITY MODELS FOR TSMO provide a structured approach to navigate through complex institutional challenges. The use of TSMO CMMs has enabled agencies to identify opportunities for improvement and develop a programmatic focus for TSMO.

Capability Maturity Concepts for TSMO

To support the evolution, the Strategic Highway Research Program 2 (SHRP2) brought forth the concept of capability maturity models (CMMs) to TSMO. Adapted from the software world, the CMM has provided an effective structure for agencies to see where they stand in terms of institutional capability for TSMO.

What Is Included in Capability Maturity Models for TSMO?

Capability maturity brings together an approach to review common barriers to adoption and success of TSMO. The frameworks allow for a rigorous common understanding and improvement of institutional issues that an agency faces on a continual and consistent basis. By understanding and using a capability maturity framework, agencies can:

- Develop consensus around needed agency improvements.
- Identify their immediate priorities for improvements.
- Identify concrete actions to continuously improve capabilities to plan, design, and carry out TSMO.

The six dimensions of capability include:

1. Business processes, including formal scoping, planning, programming, and budgeting.
2. Systems and technology, including the use of systems engineering, systems architecture standards, interoperability, and standardization.
3. Performance measurement, including measures definition, data acquisition, and data use.
4. Culture, including technical understanding, leadership, outreach, and program legal authority.
5. Organization and workforce, including programmatic status, organizational structure, staff development, and recruitment and retention.
6. Collaboration, including relationships with public safety agencies, local governments, metropolitan planning organizations, and the private sector.

For each of the dimensions, four levels of capability are used in the framework:

- Level 1—Activities and relationships that are largely ad hoc, informal and champion-driven, and substantially outside the mainstream of other DOT activities.
- Level 2—Basic strategy applications understood; key processes that support requirements identified and key technology and core abilities under development; but limited internal accountability and uneven alignment with external partners.
- Level 3—Standardized strategy applications carried out in priority contexts and managed for performance; technical and business processes developed, documented, and integrated into DOT; and partnerships aligned.
- Level 4—Full, sustainable core DOT program priority, established on the basis of continuous improvement with top-level management status and formal partnerships.

By following a structured process, agencies can self-identify their current and desired levels of capability for each dimension and develop a plan for improvement.

Continued support from the Federal Highway Administration (FHWA) and American Association of State Highway and Transportation Officials (AASHTO) has led to several State DOTs using the TSMO CMM to advance their programs. Results from the CMM have helped State DOTs advance TSMO program plans, providing clear direction on the following:

- Business processes for TSMO.
- System and technology needs.
- Performance measurement.
- Perception and culture improvement for TSMO.
- Organizational and workforce processes for TSMO.
- Collaboration approaches for TSMO.

Using the TSMO CMM has directly led to agency advancements in planning for TSMO, as shown by the States (Figure 1) that are currently undertaking or have completed TSMO program plans. Each of these States has used the results of the CMM assessments to identify priorities and adapt its organizational practices and processes to mainstream TSMO.

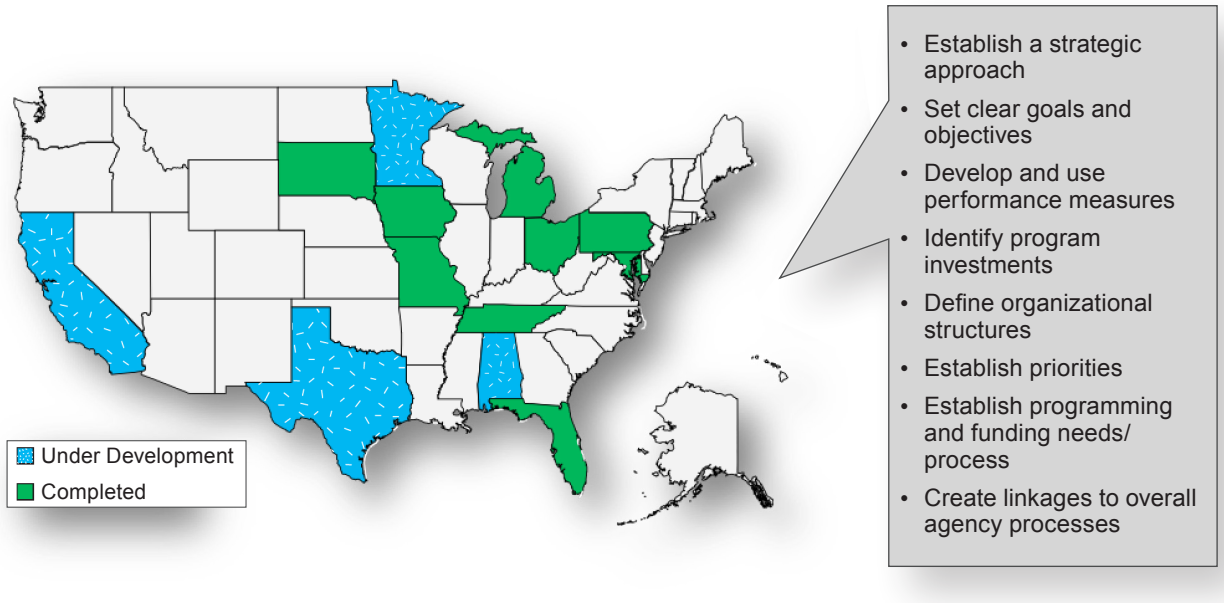

Figure 1. Diagram. State DOT TSMO program planning activities have relied on TSMO CMM for improvement priorities (Source: FHWA).

While the TSMO CMM provides the big picture assessment, agencies have found a need for continuous improvement of specific areas that are often included in TSMO programs. Taking a bottom-up view, FHWA supported the development[1] of six CMFs that provide guidance for transportation agencies to assess and improve their current institutional capabilities for dealing with six TSMO program areas (Figure 2).

Program area CMFs are available online[2] and provide a complimentary set of tools to the TSMO CMM. Each CMF allows an agency to assess and benchmark its existing capabilities in the particular TSMO program area and, upon completion, provides an action plan with tangible actions for the agency. Following is a brief description of each CMF and its overall goal:

- The Road Weather Management Framework assesses the institutional ability of an agency or a region to respond to adverse weather conditions from both a maintenance and operations perspective.
- The Traffic Management Capability Maturity Framework assesses the capability to manage the movement of traffic on streets and highways and includes corridor management approaches.
- The Traffic Incident Management Capability Maturity Self-Assessment allows an agency to assess its capabilities to plan and coordinate multi-disciplinary process to detect, respond to, and clear traffic incidents so that traffic flow may be restored as safety and quickly as possible.

Figure 2. Diagram. FHWA's elaboration of CMM concepts for TSMO led to the development of program-level capability maturity frameworks (Source: FHWA).

- The Work Zone Management Capability Maturity Framework evaluates the capability of assessing work zone impacts and implementing strategies for mitigating the impacts.
- The Traffic Signal System Capability Maturity Framework assesses capabilities for improving the design, operations, and maintenance of traffic signal systems.
- The Planned Special Event Capability Maturity Framework assesses the agency's capability to manage concerts, festivals, and conventions at permanent multi-use venues as well as less frequent public events at temporary venues.

[1] FHWA's development of the CMF was based on the AASHTO CMM, which has roots in the software development industry.

[2] Tools can be accessed at https://ops.fhwa.dot.gov/tsmoframeworktool/available_frameworks/index.htm.

Use of Capability Maturity Frameworks for TSMO Program Area Improvements

Between February 2014 and August 2018, 27 State DOTs used CMFs to assess program capabilities (Figure 3). Typically, the use of the CMFs was through facilitated workshops. The workshops were a means to facilitate the use of the CMFs by bringing together relevant stakeholders who may have otherwise struggled to create a structured meeting. FHWA continues to support the use of these frameworks through ongoing delivery of the CMF workshops.

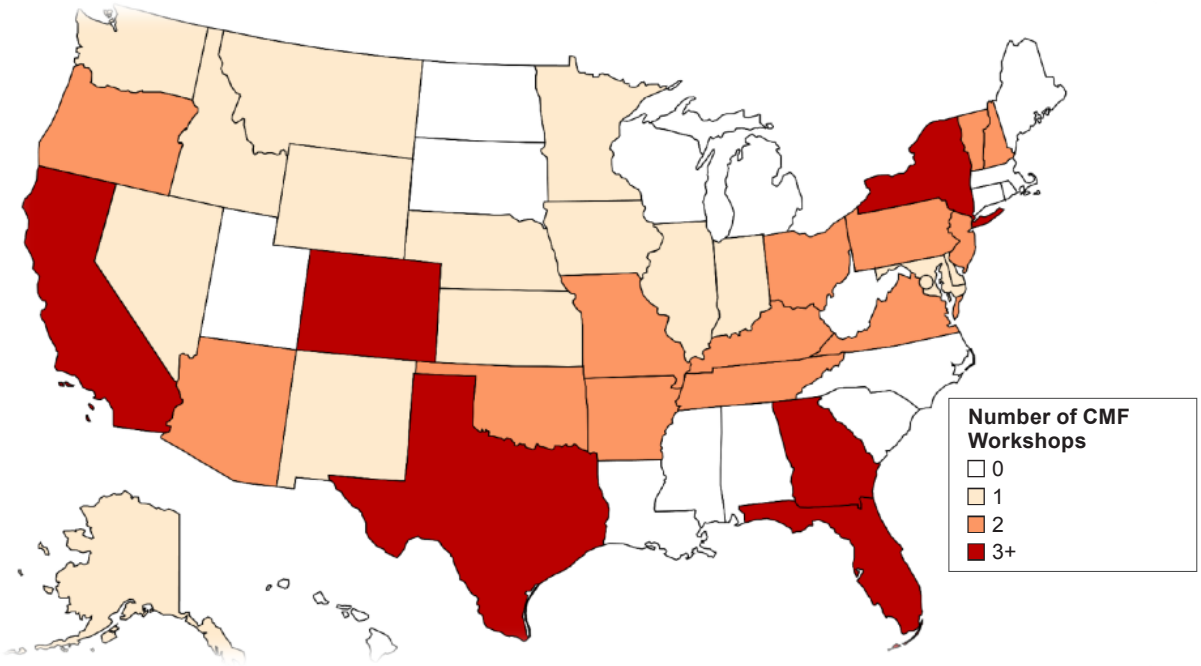

Figure 3. Map. Use of CMFs by State DOTs across program areas as of August 2018 (Source: FHWA).

Purpose of the Document

With over five years of experience in capability assessment, a body of knowledge is now available on how best to advance capability maturity for TSMO and program areas under TSMO. Different program areas under TSMO have particular needs. These differences have led to varying approaches to promote the CMFs. There have also been challenges in advancing capability maturity, from explaining the value, gathering interest, supporting follow-up activities, and linking capability maturity to broader TSMO initiatives. Meanwhile, there is a continued need to identify the benefits of advancing TSMO capabilities and the role of capability maturity concepts to other agencies that may be in the beginning stages of TSMO adoption.

This report highlights six noteworthy case studies involving the use of CMFs. These case studies span five of the six TSMO program area CMFs. The case studies highlight how consideration of capability maturity concepts have helped advance the program areas within the agency. The case studies also highlight challenges in following through on some of the recommendations from the assessments. Agencies selected for inclusion in this report as case studies are:

- Wyoming DOT—Road Weather Management.
- Arizona DOT—Road Weather Management.
- Georgia DOT—Traffic Signal Management.
- Oregon DOT—Traffic Incident Management.
- Kansas DOT—Work Zone Management.
- Ohio-Kentucky-Indiana Council of Governments—Traffic Management.

This report is intended for transportation professionals who work at State and local agencies and provides evidence on how capability maturity assessments can help accelerate the evolution of TSMO programs. Through these real-world examples, agencies will gain confidence in the utility of these frameworks to help assist with their specific program needs.

CHAPTER 2. ROAD WEATHER MANAGEMENT CAPABILITY MATURITY FRAMEWORK

Framework Overview

The Road Weather Management (RWM) CMF assesses the institutional ability of an agency or a region to respond to adverse weather conditions from both a maintenance and operations perspective.

Sample Actions from the Framework

The RWM CMF identifies over 75 actions across all the dimensions of capability. Below are some sample actions:

- Define operational procedures to allow transportation management center (TMC) operators to provide coordinated response across jurisdictional boundaries.
- Conduct a multiagency tabletop exercise annually to practice a multiagency response to large regionally significant adverse weather events and identify process gaps and institutional issues.
- Establish a protocol for securing and moving maintenance resources (materials, labor, equipment) from other parts of the State or from other agencies or private contracts when the existing resources in one region are not adequate.
- Provide funding for a multifunctional quick response team within an agency that is available to respond to maintenance and operations issues during events on priority corridors and locations.
- Initiate a joint response between the TMC, emergency operations center, and weather community on significant weather-related events.
- Establish memoranda of understanding for interagency management or response plans, including sharing of resources and responsibilities.
- Create an operational plan for multiagency priority corridors for operations and maintenance, taking into account adjacent jurisdictions, local needs, and multimodal travel considerations.

Use of the Framework

The CMF is particularly useful for agencies or regions that are:

- Implementing new weather-responsive traffic management practices.
- Updating maintenance practices or implementing new approaches to winter maintenance, such as deploying the Maintenance Decision Support System.
- Updating or creating new program plans for RWM.
- Undergoing organizational realignments for TSMO.

Link to the CMF

https://ops.fhwa.dot.gov/tsmoframeworktool/available_frameworks/road_weather.htm

Level of Deployment

To date, 14 State DOTs have used the CMF process and have involved close to 300 personnel involved in RWM activities. While there is no requirement to use the framework, State DOTs' interest in the framework stems from an agency-wide need to evaluate and improve existing road weather management capabilities.

CASE STUDY 1: WYOMING DEPARTMENT OF TRANSPORTATION

Wyoming Department of Transportation (WYDOT) staff and their on-site contractor participated in the RWM CMF assessment in Cheyenne, Wyoming. WYDOT has some of the more advanced road weather management capabilities in the United States. WYDOT has a robust road weather program across the State and manages a 24/7/365 operations center largely focused on weather. WYDOT's interest in the CMF process was dictated by the emerging need for the agency to take advantage of its investments in road weather technology.

Snapshot of RWM CMF Use at WYDOT

Timeframe: September-October 2015.

Sponsoring agency: WYDOT.

Motivation: Use the RWM CMF to accelerate adoption of advanced technology and system automation for weather responsive traffic management.

Feedback on CMF: Simply bringing maintenance-focused staff and TMC staff into the same room for an in-depth analysis of operations was probably its greatest contribution since the day-to-day business in both groups typically prevents them from setting time aside for this kind of long-term thinking and analysis.

Message for other agencies: The CMF can be a foundational tool to assess readiness to implement new technology for RWM.

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Figure 4. Image. Wyoming's interest in RWM CMF was to accelerate deployment of RWM technologies seen in the picture (Source: WYDOT).

Key Outcomes

WYDOT's assessment revealed high levels of capability in most areas but also showed the need for clearer performance measures and streamlined culture. WYDOT identified a series of recommended actions to close these gaps and to improve technology adoption and agency collaboration with outside stakeholders. With only a few exceptions, within three years, WYDOT was able to advance the actions named in the CMF assessment, leading to a meaningful improvement to its RWM program. Following are the details of these actions:

- WYDOT followed through with its action to conduct multiagency tabletop exercises, holding them with maintenance crews, the Department of Health, and the Department of Homeland Security to improve preparedness for significant events. Extensive tabletop planning was done in advance of the 2017 solar eclipse, which drew unprecedented crowds to large areas of the State.
- WYDOT added the Pikalert Decision Support System into the TMC. The system allows for the fusion of multiple weather sources into a streamlined set of inferences on conditions, a specific action recommended by the CMF assessment.
- WYDOT has begun creating pre-event video messages as a product of its Pathfinder capabilities with the National Weather Service (NWS). WYDOT is also constantly working with the NWS on Pathfinder, a collaborative effort between the NWS, State DOTs, and State DOT support contractors who provide road weather information to share and translate weather forecasts into consistent transportation impact statements for the public.
- WYDOT's proposed actions also included culture-focused actions such as developing agreed-upon internal maintenance and traffic management goals and developing online dashboards that provide summary statistics for weather response. These actions are still in progress within the agency, but WYDOT created a visual dashboard that allows the WYDOT chief engineer to see current and planned road closures, thereby offering a maintenance forecast. WYDOT's goal is to ultimately transition this dashboard, which is currently only for internal use, into a public information source.
- WYDOT has also taken ownership in creating snow-related performance measures and is working with local governments to create a snow index that accounts for local factors as well as time of day to create a normalized score across different regions of the State. The process of completing this and other performance measures is still underway.
- WYDOT set a goal to set up "process triggers" to notify TMCs and maintenance staff when specific sensors are either failing or reporting extreme weather. This goal is being completed in two phases: the first involved creating an algorithm for showing when and where sensors were malfunctioning, and it is already finished. The second phase, which is ongoing, involves creating the system for providing the information in an actionable manner to TMC operators.
- Several of these actions have helped WYDOT advance road weather management efforts, including the Wyoming CV Pilot.

Challenges

Instances where identified actions stalled with respect to capability maturity, could typically be traced back to inability to assign clear ownership of the project or initiative to a staff member.

CASE STUDY 2: ARIZONA DEPARTMENT OF TRANSPORTATION

Arizona Department of Transportation (ADOT) staff, contractors, and external partners met for the RWM CMF assessment in Phoenix, Arizona. ADOT's primary challenge was to create a program that would fit the diverse and complex road weather needs across the State—from the snowier mountain parts to the dry southern parts, each faced with different weather challenges. Entering the assessment, ADOT's approach to road weather management was ad hoc, with strong capabilities in some regions of the State but not others. Arizona's interest in RWM CMF was to address the complex microclimates and diversity of weather conditions in the State. In the following image (Figure 5), the top picture is only 4 miles away from the bottom picture, yet the images depict vastly different driving conditions.

Snapshot of RWM CMF Use at ADOT

Timeframe: May–June 2017.

Sponsoring agency: ADOT.

Motivation: Use the RWM CMF to develop a coordinated statewide program that addresses the diverse weather conditions in the State. The program can help formalize practices and procedures for perfecting data collection and performance measurement.

Feedback on CMF: ADOT considers the RWM CMF workshop a valuable means for raising institutional awareness of RWM. Since the workshop, a full-time position for an RWM director was appointed, and the workshop is credited as being critical to the development of a formalized RWM program.

Message for other agencies: The CMF can enable support for statewide coordination of RWM efforts.

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Figure 5. Image. ADOT's interest in RWM CMF is driven by the need to address the diverse weather conditions in the State (Source: Mark Trennepohl).

Key Outcomes

ADOT made significant advancements based on the recommendations from the assessment. They were able to finalize a standard dynamic message sign (DMS) message library, upgrade its Road Weather Information System (RWIS) network, get more involved in using fleet vehicle data as part of the Integrating Mobile Observations initiative, and begin the process of codifying its advanced social media sharing practices into written documentation and established procedures. Details of these actions are as follows:

- A key action identified in the RWM CMF is proactive engagement with the public. One of the State's new most notable practices is its commitment to sharing live videos of real-time road conditions via social media. These videos are generated by ADOT staff and have been picked up by the local media.
- By late 2018, ADOT will have installed grip sensors in four contiguous RWIS stations along a 50-mile segment of I-40 (through the Flagstaff area). Two years ago, many of the 17 RWIS stations were in disrepair, and most operators simply relied on pictures. Since the RWM CMF workshop, there has been a push to enhance RWIS system performance in terms of sensors and data integrity. ADOT has set up plans to begin a snowplow dash-cam pilot in the Flagstaff area on I-40 and I-17 in the winter of 2018–2019. Sixteen plow trucks are being fitted with network-connected cameras that will allow drivers to share real-time road condition images and plow truck locations on the AZ511 website.
- Advancements in developing ADOT's workforce, considering the actions identified, focused on capacity building. For example, after the workshop, ADOT held a training session on how to use the Vaisala Navigator Decision Support System, which taught employees how to use the pavement forecasting capability to make proactive maintenance and operations decisions. ADOT considers pavement forecasting to be one of its most valuable tools because it allows maintenance crew members to position themselves in the most strategic points in the lead-up to a major storm.
- ADOT also has route classification, prioritization, and expected levels of service written into its winter operations manual. A challenge, however, is that it has been hard for ADOT to convince the public that certain routes need to be prioritized.
- ADOT's DMS systems have also improved since the CMF workshop. Initially, the Traffic Operations Center (TOC) had never focused on storm operations, and it would display more generic messages such as "Winter Operations: Use Caution" across the whole State and would often leave messages that were not consistent with conditions. Now, there is a greater emphasis on posting and removing messages related to weather on time.
- Once the RWM program matured because of the workshop, ADOT maintenance crew members started to have direct input into the process by contacting TOCs via radio and telling operators to put up more precise messages in specific areas, depending on the live conditions encountered in the field. While this tactic was originally met with resistance by TOC staff, it has led to positive change regarding more exact, proactive use of DMSs. ADOT is beginning to standardize the DMS winter message libraries in its TOCs.

Challenges

Challenges occurred in instances where action items are longer-term efforts that ultimately require more robust infrastructure. Instances where ADOT was unable to advance its RWM CMF action items were primarily due to insufficient time to advance the technology systems and infrastructure. For example, ADOT is defining event start/stop times for winter events; however, as ADOT continues to upgrade its existing RWIS network, defining events may be based on data coming from the RWIS stations.

CHAPTER 3. TRAFFIC SIGNAL SYSTEM CAPABILITY MATURITY FRAMEWORK

Framework Overview

Traffic signal programs should strive to achieve delivery of good basic service (GBS), which is defined as doing what is most important in the context of limited resources. GBS requires strategically aligning design, operations, and maintenance strategies to make sure that the agency can effectively design, begin, and use the traffic signals it constructs. Traffic signal management involves the planning, design, integration, maintenance, and proactive operation of traffic signal systems to achieve policy-based goals to improve the efficiency, safety, and reliability of signalized intersections.

The Traffic Signal System (TSS) CMF incorporates the concepts presented in the FHWA guidance document *Traffic Signal Management Plans: An Objectives and Performance-Based Approach for Improving the Design Operations and Maintenance of Traffic Signal Systems*.

Use of the Framework

The CMF is particularly useful for agencies or regions that are considering development or updating of documents that direct the daily maintenance, design, operation, and management or strategic implementation plans for traffic signal systems.

Link to the CMF

https://ops.fhwa.dot.gov/tsmoframeworktool/available_frameworks/traffic_signal.htm

Level of Deployment

To date, seven DOTs have used the CMF process and have involved close to 100 personnel involved in traffic signal activities. While there is no requirement to use the framework, FHWA is working with the Institute of Transportation Engineers to include the CMF process in the 2018 national traffic signal benchmarking activity.

Sample of Actions from the Framework

The TSS CMF identifies over 100 actions across all the dimensions of capability. Below are some sample actions:

- Develop a traffic signal management plan, also knowns as a traffic signal program plan, to align design, operations, and maintenance activities with program objectives.
- Link design, operations, and maintenance business practices to maximize use of capital resources to ensure the reliability of field infrastructure.
- Develop a long-range financial needs assessment to plan for the obsolescence of local controllers, and central traffic management systems.
- Implement an on-demand engineering service contract for traffic signal operations support.
- Design and maintain a regional communications architecture/plan.
- Provide funding and encourage key operations and maintenance personnel to periodically attend technical training programs and professional conferences to keep abreast of the latest equipment and procedures associated with traffic signal operations and maintenance.

CASE STUDY 3: GEORGIA DEPARTMENT OF TRANSPORTATION

Representatives from the Georgia Department of Transportation (GDOT) and key contractors with the Regional Traffic Operations Program (RTOP) met for the TSS CMF assessment in Atlanta, Georgia. GDOT's interest in the CMF stemmed from its strong interest in continuing to improve its corridor-based RTOP approach. GDOT assembled a group consisting of its planning and traffic operations divisions as well as consultants working on the RTOP.

In 2011, GDOT leveraged its communications network, central traffic signal system software, and local signal control standards to initiate their RTOP. The program is focused on improving traffic flow and reducing vehicle emissions through improved signal timing, specifically in the Atlanta metropolitan area. The RTOP initiative provided the framework for the agency to build a high level of capability in the corridor. Conversely, GDOT also noticed that the rest of the State lagged significantly in many of the dimensions of traffic signal management capability. The level of traffic signal management process documentation varied and needed improvement, especially as the needs of the agency grew to new corridors or newer parts of the State.

Snapshot of TSS CMF Use at GDOT

Timeframe: December 2014.

Sponsoring agency: GDOT.

Motivation: Build from the traffic signal capability assessments to accelerate regional and statewide traffic signal management capability.

Feedback on CMF: "The CMF process has helped us understand where our growth opportunities are in better managing our transportation system. It is also something that we can apply with our partners in Georgia to improve safety and mobility." — GDOT

Message for other agencies: The CMF process helped create a sense of challenge on the direction of the agency rather than acting as a "slap on the wrist," thereby creating motivation from optimism.

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Figure 6. Image. GDOT's strong Traffic Signal Management Program is managed in part out of the TMC (Source: GDOT).

Key Outcomes

GDOT continued to work on capability maturity, not only through its existing program but also by taking part in later workshops related to traffic signal management plans and benchmarking exercises. These follow-up events helped further identify areas of focus and define actions for the agency. Details of these actions are provided below:

- Since the workshop and other capability assessments, GDOT continues to transition and grow its traffic signal program to have more regional focus. The program has matured and is now able to analyze geographic zones beyond the corridors in Atlanta. GDOT made organizational changes within the TSMO group to unify the operations across the State (in and out of the Atlanta region). This included identification of contexts outside the metro area where better arterial management could be employed.
- GDOT also revised its official TSS plans with the goal of better documenting its traffic signal management policies in several areas. This improved documentation helped GDOT to better deal with staff turnover.
- GDOT introduced Automated Traffic Signal Performance Measures (ATSPM), started during the fourth round of the Every Day Counts technology initiative. Automated reporting using signal performance measures has helped to balance resources and target GDOT's maintenance and operations efforts.
- GDOT continues to improve workforce capabilities, with an emphasis on building more statewide and regional operations capabilities to supplement field technicians. However, requiring staff engineers to relocate to different parts of the State is challenging.

The preparation and planning efforts undertaken by GDOT and partners came to fruition when the national college football championship was held in Atlanta, as well as during the opening of the new Atlanta Braves stadium. GDOT's work from the previous two years demonstrated the value of the programs and has proven successful in supporting proactive management of traffic. For a long time, GDOT had dedicated funding for arterial management, but because of continued success at these key events, GDOT has ensured long-term funding support for the program.

GDOT noted the value in process improvement and used capability-related activities to start talking about longer-term strategy, and to step away from the day-to-day fires. Planners are adept at doing that, but operations staff focus on very near-term issues. Bringing these groups together is a valuable product of these exercises.

Challenges

One of the biggest continuing institutional capability challenges noted by GDOT was changing workforce needs for TSMO. There are new job requirements in terms of information technology (IT), big data, and software development that are needed to effectively take on projects like adding dedicated short-range communications–based infrastructure to traffic signals, but GDOT's agency structure is geared only to hire civil engineers. The time it takes to get a new position lined up combined with the rapid pace of technology make it very hard for the agency to keep the right workforce on hand for some of the new developments in traffic signal management.

CHAPTER 4. WORK ZONE MANAGEMENT CAPABILITY MATURITY FRAMEWORK

Framework Overview

The Work Zone Management (WZM) CMF assesses the capability for effective work zone traffic management, including assessing work zone impacts and implementing strategies for mitigating the impacts.

Sample of Actions from the Framework

The WZM CMF identifies around 100 actions across all the dimensions of capability. Below are some sample actions:

- Convene key personnel within the agency to decide how road user charges resulting from WZM efforts will be included in project development.
- Develop information resources for work zone designers and managers on the availability and expected effect of new WZM technologies and innovations. Establish mechanisms to periodically update these resources.
- Identify work zone safety, mobility, customer satisfaction, and work productivity or efficiency outcome measures that are specified or implied in the agency's work zone safety and mobility policy.
- Distribute a list of critical WZM knowledge and skills throughout the agency and encourage training and capability-building efforts to develop the knowledge and skills.
- Establish a process for reporting critical WZM benefits and innovative practices for big projects to key staff within the organization and to key external partners.
- Periodically review processes for considering WZM needs for law enforcement, funding levels, and implementation procedures.

Use of the Framework

Recommended if an agency has significant upcoming reconstruction and maintenance activities, is considering implementing work zone ITS technology, or is in the middle of updating the State's process review for work zones.

Link to the CMF

https://ops.fhwa.dot.gov/tsmoframeworktool/available_frameworks/work_zone.htm

Level of Deployment

To date, 16 DOTs have used the CMF process and have involved close to 350 personnel involved in work zone activities. There are several States in the pipeline for the CMF assessment. While there is no requirement to use the framework, FHWA has used the CMF to conduct the work zone process reviews, which are required per 23 CFR Part 630.

CASE STUDY 4: KANSAS DEPARTMENT OF TRANSPORTATION

Representatives from many offices within the Kansas Department of Transportation (KDOT) met with FHWA for the WZM CMF assessment in Lawrence, Kansas. KDOT requested the CMF assessment to identify work-zone-related needs and communicate them throughout the agency, to help gain buy-in with upper management, and to help secure resources to complete priority action items. The aim from KDOT's perspective was to identify the gaps in KDOT's existing WZM program, focus on how to better minimize work zone impacts on regional travel, and integrate WZM into other forms of traffic management.

Snapshot of WZM CMF Use at KDOT

Timeframe: December 2014.

Sponsoring agency: KDOT.

Motivation: Identify the gaps in KDOT's existing WZM program, focus on how to better minimize work zone impacts on regional travel, and integrate WZM into other forms of traffic management.

Feedback on CMF: Overall, the CMF aided KDOT's process reviews and spurred the creation of a guidebook that will likely have cascading positive effects. However, many of the desired outcomes were encumbered by staff departures, organizational shakeups, and limited resources.

Message for other agencies: While the CMF can identify actions and areas for improvement, staff resources must be made available and sustained for the improvements to occur.

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Figure 7. Image. KDOT's interest in the WZM CMF was to provide more visibility into WZM-related needs and gaps (Source: FHWA).

Key Outcomes

The WZM CMF assessment noted that KDOT had room for growth in WZM, particularly in the development of more clearly defined performance measures, policies, and procedures. The workshop highlighted KDOT's strong collaborative abilities within its many divisions and with outside parties, but to advance WZM further, there would need to be more clearly defined processes to streamline operations. While KDOT is actively implementing action items, changes to staffing and other resource challenges have limited the ability of KDOT to carry out some recommendations from the assessment at this time.

Nonetheless, KDOT has focused its efforts on improving business processes and especially in documenting some of the work zone process steps—considered the most critical development from the CMF workshop. KDOT is currently developing a work zone policy and procedures guide. This guide will compile and document the many practices and procedures that KDOT has used for many years but have not yet been in a single resource. This formal documentation will allow for easier delegation, delineation of responsibility, and efficiency within the organization.

As is the case in many agencies, day-to-day responsibilities create challenges to long-term investments in capability—one of the key issues the new guidance should help with. This guidebook is still the top priority for KDOT staff in advancing the agency's capability because it formalizes a lot of process steps that will make the staff responsibilities clearer.

KDOT staff already has strong collaborative relationships, resulting in a higher level of capability in communication. Thus, the CMF did not identify any action items needed related to agency communications. Instead, the biggest remaining cultural challenge is staffing since the heavy focus on existing work often precludes KDOT staff from being open to new ideas.

Finally, as a side outcome, KDOT's process review was due in the months following the CMF workshop. Assessment results helped KDOT improve its process reviews. Additionally, KDOT indicated that the workshop summary report was helpful during staff turnover. It helped them established well-documented and supported priorities, allowing new staff to immediately continue work on action items that were the responsibility of their predecessor.

Challenges

Unfortunately, staffing turnover and limited resources have stymied much of KDOT's recommended technology- and data-related actions in the workshop. The departure of a key staff member who orchestrated the first workshop presented a large challenge.

Also, KDOT's technological capabilities are still limited and have perhaps regressed. Compounding the existing issues of finding time and resources for new endeavors, a reorganization of the IT department has made it more cumbersome for KDOT staff to seek help on technology-related matters.

CHAPTER 5. TRAFFIC MANAGEMENT CAPABILITY MATURITY FRAMEWORK

Framework Overview

Broadly, the Traffic Management (TM) CMF assesses the capability to efficiently manage the movement of traffic on streets and highways and includes corridor management approaches. The capability levels and the actions are defined from a traffic manager's perspective. The actions may require other regional agencies to be the responsible party, fostering multiagency collaboration and dialogue about traffic management at the regional level.

Sample of Actions from the Framework

The TM CMF identifies around 150 actions across all the dimensions of capability. Below are some sample actions:

- Draft standard operational procedures, roles, and responsibilities for other agencies to review and agree upon.
- Create corridor-level traffic management operating concepts.
- Make sure that information technology structure (agency or outsourced) has the knowledge and ability to handle complex integration requirements for new systems and technologies.
- Identify the output and outcome measures useful for determining agency efficiency in traffic management strategies.
- Use regional architecture in congestion management, safety planning, and project selection processes.
- Develop a simple tool (e.g., spreadsheet based) for producing specific measures or analysis, or both, as needed.
- Create a library of resources related to all aspects of traffic management and incorporate into operations training plans.

Use of the Framework

Recommended for agencies considering integrated corridor management (ICM), active transportation and demand management applications, or changes to existing TMC operations.

Link to the CMF

https://ops.fhwa.dot.gov/tsmoframeworktool/available_frameworks/traffic.htm

Level of Deployment

To date, eight regions have used the CMF process and have involved close to 170 personnel in traffic management activities. While there is no requirement to use the framework, FHWA has used the CMF to support the ICM planning grants.

CASE STUDY 5: OHIO-KENTUCKY-INDIANA COUNCIL OF GOVERNMENTS

Representatives from the Ohio-Kentucky-Indiana Regional Council of Governments (OKI), Ohio Department of Transportation (Ohio DOT) Central Office and District 8, FHWA, and other stakeholders met for the TM CMF assessment in Cincinnati, Ohio. The assessment focused on current capabilities for traffic management and data analysis, with a goal of understanding how Ohio DOT and OKI could bolster their ongoing programs through improved interagency coordination and culture for better management of traffic in the Cincinnati metropolitan area. OKI is the Federally-recognized metropolitan planning organization representing the Cincinnati metropolitan area which is responsible for developing the long range transportation plan and the programming of projects for the region.

Snapshot of TM CMF Use at OKI

Timeframe: May 2016.

Sponsoring agency: OKI.

Motivation: Understanding how Ohio DOT and OKI could bolster their ongoing programs through improved interagency coordination and culture for better management of traffic in the Cincinnati metropolitan area.

Feedback on CMF: Since the workshop, there has been significant change in how traffic management occurs in Ohio, with more centralized operations. Some of the actions identified in the assessment no longer apply. However, the process did point to some data gaps that OKI is significantly remedying.

Message for other agencies: While the CMF can identify actions and areas for improvement, broader shifts in operations and management responsibilities in the region may impact the planned roadmap.

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Key Outcomes

OKI is an interesting case study on the lasting impacts of the CMF since its organizational structure and role have evolved significantly since its assessment in 2016. While traffic management used to be largely under OKI, it has shifted to the Ohio DOT offices. However, OKI still acts as a crucial traffic data source to inform planning efforts in the region and has expanded its data collection capability and efforts significantly since its workshop.

In addition to processing data from other agencies, OKI directly employs traffic counters for vehicles and bike/ped counts on trails. OKI receives traffic volume data on its region from a contractor on a biannual basis. More recently, OKI collaborated with the Kentucky Transportation Cabinet to deploy collection devices at a key river crossing, allowing the agency to track vehicle speed, distribution by type, and total travel volume. OKI is also currently working on refining transportation performance measures.

Last, OKI has strengthened its focus on using advanced technologies especially for data collection; the agency now includes technology advancement and integration in its project prioritization process.

Overall, the CMF was viewed as a useful tool by the OKI staff. The CMF assessment is credited in helping to advance the culture of traffic management in the organization and in creating a strong technology and data focus. However, many of the actions identified in the CMF relating to traffic management are now part of statewide Ohio DOT operations.

CHAPTER 6. TRAFFIC INCIDENT MANAGEMENT CAPABILITY MATURITY FRAMEWORK

Framework Overview

As part of the Traffic Incident Management (TIM) CMF, the TIM Capability Maturity Self-Assessment (CMSA) tool was developed with input from State DOTs, law enforcement, and other TIM responders. The TIM CMSA allows an agency to assess and benchmark its existing capabilities and, upon completion, provides an action plan with tangible actions for the agency.

Sample of Actions from the Framework

The TIM CMF is slightly different from the other TSMO program area CMFs due to its emphasis on a national-level aggregation of results. The TIM CMSA includes about 50 questions to benchmark TIM programs. Some sample questions are provided below:

- Is there a formal TIM program that is supported by a multidiscipline, multiagency team or task force that meets regularly to discuss and plan for TIM activities?
- Is roadway clearance time being measured using FHWA's standard definition— "time between first recordable awareness of an incident by a responsible agency and first confirmation that all lanes are available for traffic flow"?
- Is an authority removal law in place and understood by TIM stakeholders?
- Is a driver removal law in place and understood by TIM stakeholders?
- What activities are in place to outreach and educate the public and elected officials about TIM?
- Is there a safety service patrol program in place for incident and emergency response?
- Are TIM stakeholders aware of and actively using TMC/TOC resources to coordinate incident detection, notification, and response?
- What TIM data (e.g., number of involved vehicles, number of lanes blocked, length of queue) are captured via TMCs or public safety computer-aided design systems, or both, and are they shared with other disciplines for real-time operational purposes?

Use of the Framework

Recommended for agencies looking for ways to improve TIM institutional capability in the region.

Link to the CMF

https://ops.fhwa.dot.gov/tsmoframeworktool/available_frameworks/traffic_incident.htm

Level of Deployment

The deployment of the TIM CMF is handled differently than the other program areas. Starting in 2015, the TIM CMF was integrated with an existing national assessment tool called the TIM Self-Assessment. Since 2015, the top 75 urban areas have recognized the value of the TIM CMSA and have been conducting them voluntarily on an annual basis. Results are shared annually with the national TIM community.

CASE STUDY 6: OREGON DEPARTMENT OF TRANSPORTATION

Representatives from the Oregon Department of Transportation (ODOT) and FHWA met for the TIM CMF assessment in Salem, Oregon. Oregon already had a particularly strong TIM program, but ODOT was looking for a more structured means of further advancing the program. The assessment timing coincided with ODOT's efforts to make its program more multidisciplinary and to involve more stakeholders.

ODOT's workshop used the 2015 TIM Self-Assessment to guide participants through a discussion that covered (a) the state of the TIM program; (b) possible ways to improve the TIM operations; and (c) prioritized action items to enhance TIM in Oregon. The workshop resulted in a high-level description of Oregon's TIM program and identified actions for program enhancement.

Snapshot of TIM CMF Use at ODOT

Timeframe: May 2015.

Sponsoring agency: ODOT.

Motivation: Looking for a structured means of further advancing the program to be more multidisciplinary and to involve more stakeholders.

Feedback on CMF: The CMF assessment was critical in formalizing TIM-related processes rather than initializing them. Still, several key actions arose specifically from the CMF, and many others, while not directly attributable, were considered to have been aided by the assessment.

Message for other agencies: CMF offers an off-the-shelf structure to advance TIM activities.

For More Information

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Figure 8. Image. ODOT's interest in the TIM CMF was to formalize TIM processes and make its program more multidisciplinary (Source: ODOT).

Key Outcomes

Identified actions included updating the State's TIM strategic plan, streamlining the TIM responder training program, and setting up a clear after-action review process. Details of these actions are provided below:

- ODOT was able to formalize and take meaningful steps on many of the priority action items from the assessment. Notably, the first item on the list was to update the Oregon TIM strategic plan, which was updated for the entire State in 2015 and is slated to be updated again in 2020. This was the first time in which the agency had done a TIM plan that involved stakeholders from across the State rather than just within ODOT.
- ODOT also continued to improve its TIM responder training program after 2015, with the implementation of an online registration site, marketing documents, and a refined process to register trainers and advertise courses.
- TIM performance measures and data collection have also been improved in recent years since the CMF. The State has increased data collection and analysis efforts. Oregon has progressed from having only two regional TIM teams to having six to seven teams by the end of 2018. While the TIM strategic plan has not yet begun in all parts of the State, other teams will help expand its reach.
- Each of the above teams has an ongoing goal to track performance measure data for its activities. Further, ODOT has started releasing a quarterly TIM newsletter with key measures and a preview of the coming quarter.
- ODOT started a TIM-specific Facebook page with the goal of building a community of drivers and responders to promote TIM messaging.
- Oregon's diversity in urban form, culture, and political climate across the State complicates the task of creating a statewide, unified approach to handling TIM. Still, ODOT and other entities have taken significant steps toward advancing interagency communication and harmonization.
- ODOT has had recent success in growing the understanding of TIM among senior leadership across several State agencies. In 2017, for the first time, an executive-level meeting was held with staff from organizations across the State, such as fire departments, the sheriff's department, towing authorities, local police forces, and transportation planning agencies. While multiagency TIM meetings occurring regularly, hosting a meeting with executive-level attendance from all these agencies required a heightened momentum on TIM.
- ODOT is looking to capitalize on its improved performance measure data by making it more readily available, understandable, and actionable. The agency is planning to create intuitive performance dashboards for public and agency communication. Ideally, useful information on incident hot spots (geographically and temporally) could be provided to law enforcement.
- While the TIM responder training is already advanced within the agency, ODOT intends to expand its outreach and training efforts by contacting fire department rosters and advertising on stakeholder websites.

Overall, ODOT expressed positive reviews of the CMF and its ability to facilitate growth. For ODOT, the staff buy-in on TIM development was largely present, so CMF was critical in formalizing that process, rather than initializing it. Still, several key actions arose specifically from the CMF, and many others, while not directly attributable, were considered to have been aided by the workshop.

CHAPTER 7. SUMMARY OF IMPACTS AND LESSONS LEARNED

While each case study has differing subject matter, agency structures, and goals, they collectively elicit some common themes and takeaways on the usefulness and challenges of the CMFs.

Bringing internal staff together who would not meet otherwise—Multiple agency officials noted how the CMF process served as a more formalized way to bring together a diverse range of staff and stakeholders who may otherwise not find an opportunity to meet. WYDOT officials asserted that simply bringing maintenance and operations staff together for an in-depth review of the system was a valuable activity and perhaps the most important aspect of its workshop.

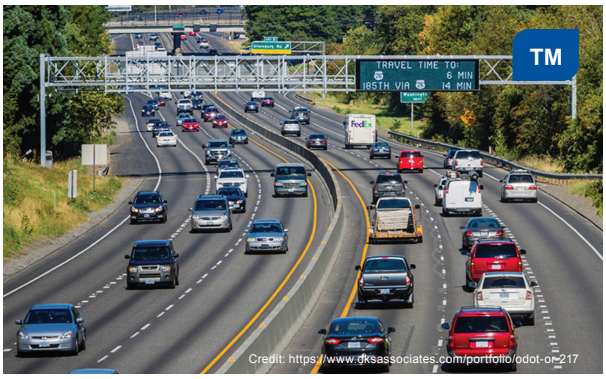
Improving interdepartmental relationships—Bringing diverse staff together also has the benefit of strengthening interdepartmental relationships. Perhaps the strongest example is with ODOT, which credits its TIM CMF workshop with leading to a TIM strategic plan that involved stakeholders from across the State, unlike previous plans that focused exclusively within ODOT. As another example, GDOT was able to improve TSS coordination with regional authorities outside of Atlanta through continued workshops that spurred from the agency's original CMF workshop.

THINKING BEYOND THE NEXT CRISIS

TSMO, by its very definition, is a day-to-day activity. Staff involved in the TSMO program areas have ongoing responsibilities and crises needing management, whether a winter storm or a special event.

Planning for TSMO often takes a backseat to daily response activities. One case study respondent noted that the CMF workshops provide a venue for TSMO managers and operators to think more like "planners" and business analysts in other organizations.

Creating a venue for long-term discussions about programs—The day-to-day duties at many agencies prevent large groups of staff from meeting to discuss longer-term issues, priorities, and goals. Several agencies contend that the structured nature of the CMF helped begin conversations that may otherwise have been delayed or simply not have occurred.



Identifying focus areas—As a critical part of the CMF process, attendees work to identify agency priorities and goals, helping to gain momentum toward targeted improvements. One GDOT official said that the CMF "has helped us understand where our growth opportunities are in better managing our transportation system. It is also something that we can apply with our partners in Georgia to improve safety and mobility."

Generating broader agency understanding and appreciation of TSMO program areas—The CMF process helps call attention to the importance of the program area and generate more agency support of the program area activities. In the case of the KDOT work zone program, the need to generate support was the main reason for undertaking the CMF. Even in the case of the ODOT TIM program, which already had agency buy-in, the CMF process was credited with advancing that priority within the agency and expanding the program's reach to other stakeholders.

Formalizing policies and procedures—The CMF process helps to promote the formalization of agency policies and plans. For example, GDOT revised its official TSS plans to better document policies, and KDOT is actively working on a formal work zone policy and procedures guide to help streamline processes and free up agency time spent clarifying day-to-day issues. Formalization can also be present in staff roles, as with ADOT, which created a new official role dedicated to RWM—the first of its kind at the agency—titled "Road Weather/RWIS Coordinator/Winter Ops Support Manager."

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