

Organizing for TSMO

Case Study 7: Integrating the Capability Maturity Model into Agency Processes

July 2019



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List of Abbreviations and Acronyms

AASHTO	American Association of State Highway and Transportation Officials
Caltrans	California Department of Transportation
CMM.....	Capability Maturity Model
FHWA.....	Federal Highway Administration
ICM	Integrated Corridor Management
MPO	Metropolitan Planning Organization
NCDOT.....	North Carolina Department of Transportation
SHRP2.....	Strategic Highway Research Program 2
TRB.....	Transportation Research Board
TSMO	Transportation Systems Management and Operations
TxDOT.....	Texas Department of Transportation
WSDOT	Washington State Department of Transportation

EXECUTIVE SUMMARY

Transportation systems management and operations (TSMO) provides tools for transportation managers to address safety, system performance, and reliability. TSMO is “an integrated set of strategies to optimize the performance of existing infrastructure through the implementation of multimodal and intermodal, cross-jurisdictional systems, services, and projects designed to preserve capacity and improve security, safety, and reliability of the transportation system.”¹ Through participation in the second Strategic Highway Research Program workshops, transportation agencies are working to better support TSMO programs. Deploying intelligent transportation systems, hiring internal information technology staff, and using performance measures for data-driven decisions are just a few examples of the many activities a TSMO program can support.

Given the varying stages of TSMO adoption and advancement, the Federal Highway Administration identified the need for case studies to provide examples of common challenges and best practices for transportation agencies to learn from each other. This is one of 12 case studies developed to support organizing for TSMO. This case study focuses on how integrating the capability maturity model (CMM) can improve TSMO program planning and enhance continuous improvement.

Four agencies were interviewed to discuss their progress with integrating the CMM: Texas Department of Transportation (TxDOT), Washington State Department of Transportation (WSDOT), California Department of Transportation (Caltrans), and North Carolina Department of Transportation (NCDOT). Each agency provided information on their lessons learned and the next steps to continually improve these efforts. Some of the best practices identified include:

- Caltrans’ integration of CMM with integrated corridor management.
- TxDOT’s CMM assessment as a framework for TSMO plans.
- NCDOT’s integration of CMM using functional mobility areas.
- WSDOT’s use of the CMM assessment to improve business processes and culture.

¹ Source: <https://ops.fhwa.dot.gov/tsmo/index.htm>

CHAPTER 1 – INTRODUCTION

Historically, transportation agencies have managed congestion primarily by funding major capital projects that focused on adding capacity to address physical constraints such as bottlenecks. Operational improvements were typically an afterthought and considered after the new infrastructure was already added to the system. Given the changing transportation landscape that includes increased customer expectations, a better understanding of the sources of congestion, and constraints in resources, alternative approaches were needed. Transportation systems management and operations (TSMO) provides such an approach to overcome these challenges and address a broader range of congestion issues to improve overall system performance. With agencies needing to stretch transportation funding further and demand for reliable travel increasing, TSMO activities can help agencies maximize the use of available capacity and implement solutions with a high benefit-cost ratio. This approach supports agencies' abilities to address changing system demands and be flexible for a wide range of conditions.

Effective TSMO efforts require full integration within a transportation agency and should be supported by partner agencies. This can be achieved by identifying opportunities for improving processes, instituting data-driven decision-making, establishing proactive collaboration, and performing activities leading to development of performance optimization processes.

Through the second Strategic Highway Research Program (SHRP2), a national partnership between the Federal Highway Administration (FHWA), the American Association of State Highway and Transportation Officials (AASHTO), and the Transportation Research Board, (TRB), a self-assessment framework was developed based on a model from the software industry. The SHRP2 program developed a framework for agencies to assess their critical processes and institutional arrangements through a capability maturity model (CMM). The CMM uses six dimensions of capability to allow agencies to self-assess their implementation of TSMO principles¹:

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

Within each capability dimension, there are four levels of maturity (performed, managed, integrated, and optimized), as shown in Figure 1. An agency uses the CMM self-assessment to

¹ FHWA, Office of Operations, "Organizing for Reliability – Capability Maturity Model Assessment and Implementation Plans Executive Summary," May 2015. <https://ops.fhwa.dot.gov/docs/cmmexesum/sec1.htm>

identify their level of maturity in each dimension, to determine their strengths and weaknesses, and to determine actions they can take to improve their capabilities.

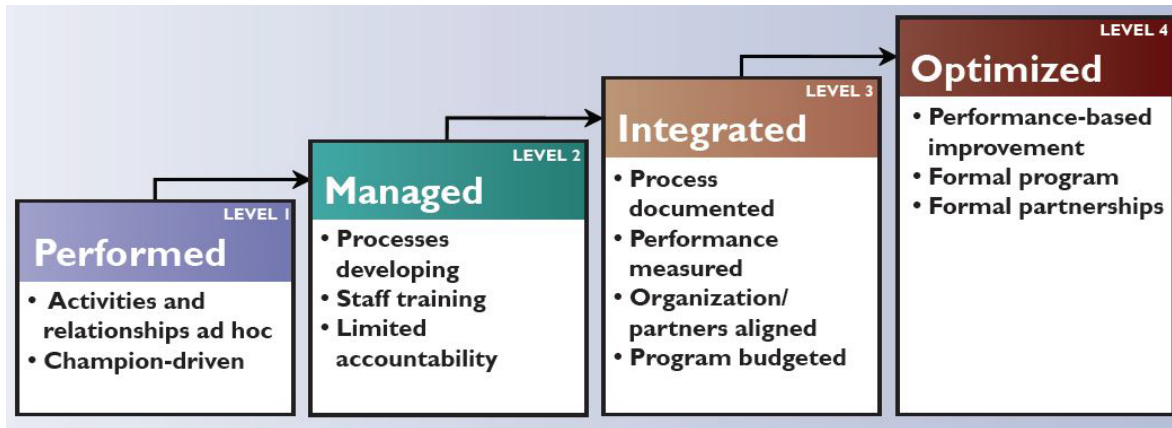


Figure 1. Chart. Four Levels of Maturity

Source: Creating an Effective Program to Advance Transportation System Management and Operations, FHWA Jan 2012

Purpose of Case Studies

In the first 10 years of implementation of the TSMO CMM, more than 50 States and regions used the tool to assess and improve their TSMO capabilities. With the many benefits experienced by these agencies, FHWA developed a series of case studies to showcase leading practices to assist other transportation professionals in advancing and mainstreaming TSMO into their agencies. The purposes of the case studies are to:

- Communicate the value of changing the culture and standard practices towards TSMO to stakeholders and decision-makers.
- Provide examples of best-practices and lessons learned by other State and local agencies during their adoption, implementation, and mainstreaming of TSMO.

These case studies support transportation agencies by showing a wide range of challenges, opportunities, and results to provide proof for the potential benefits of implementing TSMO. Each case study was identified to address challenges faced by TSMO professionals when implementing new or expanding existing practices in the agency and to provide lessons learned.

Identified Topics of Importance

The topic of integrating the CMM into agency processes is important for many reasons. The assessment provides agencies with a baseline for their current TSMO maturity and identifies next steps for improvement. The CMM dimensions provide agencies with a framework for TSMO program development and provides transparency to how each dimension is interrelated to the other.

The agencies highlighted for this case study used the CMM assessment to identify strengths and opportunities for improvement in their respective programs. The assessment highlights activities and best practices these organizations performed to mature their TSMO programs.

Interviews

Agencies were selected for each case study based on prior research indicating that the agency was excelling in particular TSMO capabilities. Care was taken to include a diversity of geographical locations and agency types (departments of transportation, cities, and MPOs) to develop case studies that other agencies could easily relate to and learn from. Interviews were conducted with selected agencies to collect information on the topic for each case study.

Description of Integrating the Capability Maturity Model

CMM is a valuable resource to help agencies identify opportunities to improve their TSMO activities. It is used during a self-assessment process to evaluate strengths, weaknesses, and action steps for advancing TSMO capabilities. FHWA, through the SHRP2 program, has collaborated with over 50 State departments of transportation and agencies to complete CMM assessments. This has been a catalyst for initiating or continuing development of many agencies' TSMO program planning efforts.

Discussions that arise when completing the CMM assessment can help form consensus within an agency or among multiple agencies. With a unified understanding and framework for considering challenges, agencies are able to openly collaborate along the same strategic direction.

Some agencies have used CMM as a guide to complete TSMO program planning. CMM dimensions help highlight TSMO elements being successfully performed or where gaps may exist that should be addressed; it offers direction for where enhancements can be made. The identified TSMO elements are then incorporated into TSMO planning documents, processes, or institutional arrangements.

A CMM assessment can be completed periodically to check on the progress of activities for a TSMO program. Implementing consistent reviews of the overall program will establish a culture of continuous improvement. It is important to develop action items during each CMM assessment to make appropriate modifications to challenges or opportunities experienced in the implementation of a TSMO program.

CHAPTER 2 – BEST PRACTICE EXAMPLES

California Department of Transportation (Caltrans), North Carolina Department of Transportation (NCDOT), Texas Department of Transportation (TxDOT), and Washington State Department of Transportation (WSDOT) participated in the second Strategic Highway Research Program (SHRP2) capability maturity model (CMM) workshops and used the results to guide them in implementing transportation systems management and operations (TSMO) in their agencies. The following section highlights how each agency has improved TSMO in their organization.

California Department of Transportation (Caltrans)

Caltrans supports the diverse transportation needs of the entire State of California through 12 regional districts. Caltrans manages over 50,000 miles of highway and freeway lanes, provides rail services, and permits more than 400 public-use airports and special-use hospital heliports for the State.

Caltrans used the CMM assessment as a tool to benchmark their TSMO capabilities while identifying areas of strength and opportunities for improvement. In 2013, Caltrans developed a strategic implementation plan based on an initial statewide CMM assessment with the Federal Highway Administration (FHWA). The strategic implementation plan included hosting TSMO regional operations forums (ROF) with CMM assessments for each district in the State. The results from the ROFs/CMM assessments were evaluated during a re-assessment in 2017.

CMM assessments completed by Caltrans were unique in that CMM was directly applied to specific corridors in the State. For decades, the agency has had well-established traffic operations, so some management and operations strategies, such as Integrated Corridor Management (ICM), were already deployed and implemented. In 2012, Caltrans began developing their Connected Corridors Program to help achieve a new multi-modal, multi-agency ICM vision. The purpose of this program is to identify opportunities to improve the operational performance of the corridor network with travel demand strategies—reviewing how freeways, arterials, transit, and parking systems work together. The agency had been enhancing ICM concepts before TSMO practices emerged; however, when FHWA provided TSMO guidance, Caltrans realized there was an opportunity to provide a solid TSMO foundation for stakeholders to collaborate and identify enhanced ICM activities. Caltrans developed their TSMO plan with guidance from FHWA and began evaluating how they could merge their existing ICM activities with TSMO concepts. Caltrans held ROFs focused on specific corridors and, through multi-agency collaboration, began developing a Connected Corridors Plan. In the forums, Caltrans' districts and other local partners joined together for three days of TSMO education and to complete corridor-specific CMM assessments. Following the assessments, action items and implementation plans were developed to strengthen the TSMO capabilities for each corridor. The agency felt the CMM assessment would be a critical tool in advancing their ICM program because TSMO concepts and activities provide the necessary processes and funding mechanisms to enhance mobility strategies.

Each district developed TSMO strategic plans for their regions. After these plans were completed, Caltrans followed up with each district to determine whether action items identified from corridor-specific CMMs had been completed or incorporated into the region's TSMO strategic plans. Districts provided feedback identifying challenges and successes they experienced during TSMO implementation.

Caltrans used CMM assessment concepts and applied them to strategy-specific assessments, leveraging projects and funding as a means to make the business case for TSMO in the State. Caltrans felt the ICM program would have greater success using TSMO strategies. Caltrans plans to use CMM dimensions and maturity assessments to show progress to statewide senior leadership.

A key component to Caltrans' success is the support district leadership provided in their respective districts. Their unique approach to integrating CMM into existing strategies alongside district-level support enables Caltrans to realize the importance of TSMO and to increase the maturity of State-supported mobility strategies.

North Carolina Department of Transportation (NCDOT)

NCDOT has several divisions of transportation including highways, ferry systems, aviation, public transit, and more. They are responsible for maintaining over 80,000 miles of highways and more than 13,500 bridges. NCDOT divides highway responsibilities across the State into 14 regions—referred to as highway divisions—that receive support from various sections and units within the Division of Highways.¹

After completing the CMM assessment, NCDOT identified several areas where they could improve TSMO in their organization. The agency took a unique approach to integrating CMM dimensions in their existing processes, looking first at the strategic and tactical elements of TSMO program planning. During development of the strategic plan, the agency held several breakout sessions to discuss the following seven key functional areas:

- Freeway Management (Traffic Incident Management/Tactical).
- Freeway Management (Operations/Strategic).
- Arterial Management.
- Traveler Information.
- Asset Management.
- Data Performance.
- Return on Investment.

When determining functional areas to highlight in their strategic plan, consolidating transportation data into one output enabled the agency to see the larger picture. NCDOT collaborated with relevant stakeholders on each respective functional area. In breakout sessions, NCDOT did not focus explicitly on CMM dimensions, but rather collected input from local partners to determine how each region was doing in these functional areas using questions

¹ <https://www.ncdot.gov/divisions/highways/Pages/about.aspx>

similar to those asked during CMM evaluations. From feedback received in the collaborative sessions, NCDOT was able to infer how each functional area was maturing in CMM dimensions. Figure 2 shows the capability maturity for each of NCDOT's functional areas.

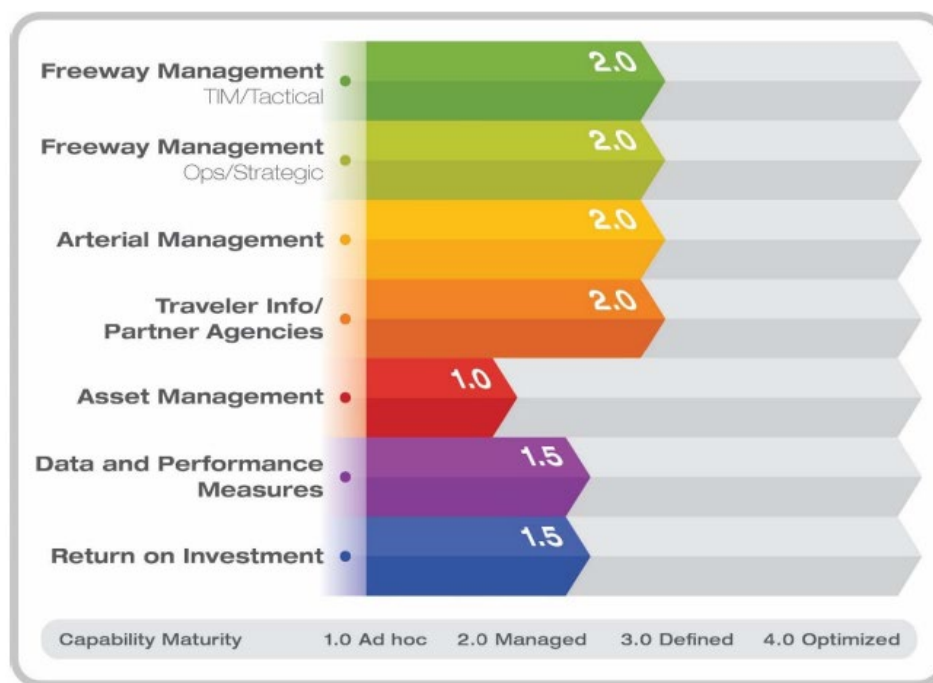


Figure 2. Chart. CMM Assessment for each of NCDOT's Functional Areas

Source: NCDOT's Mobility and Safety Transportation Systems Management and Operations Strategic Plan, January 2017.

The next step in the agency's TSMO program development was to focus on programmatic TSMO elements, such as staffing and performance measures, to enhance and support functional areas. In the future, NCDOT plans to complete additional CMM assessments for each of their functional areas. This approach to using the CMM assessment will enable agencies to direct their resources to one task at a time, focusing on specific mobility and safety solutions desired by each individual region.

The following is a sample of best practices that have assisted NCDOT in managing their TSMO program:

- Using a tactical approach to TSMO programming.
- Increasing collaboration with the regional MPO, resulting in the highest amount of co-agency communications in decades.
- Organizational restructuring to place operations in the same group as planning and design.
- Including all disciplines in planning meetings.
- Discussing specific challenges and tactical solutions with other regions.
- Using multi-state collaboration on managed motorways.
- Seizing all opportunities to advocate for TSMO and mobility strategies.

- Consolidating available traffic data into one output to assist with identification of applicable TSMO strategies.

For these and other activities, NCDOT expressed that frequent and efficient communication across disciplines was critical to success and growth.

Each dimension of the CMM assessment identifies specific needs for a TSMO program as a whole. Performing a CMM assessment for specific TSMO strategies is a unique approach to utilizing CMM evaluation tools and enables the agency to develop a mature TSMO program one piece at a time. Bringing specific TSMO services and strategies to maturity is one way to maturing the entire program.

Texas Department of Transportation (TxDOT)

TxDOT is a largely decentralized organization. The headquarters, located in Austin, TX, is home to several divisions of TxDOT, including Traffic Safety, Bridge, Design, and more. TxDOT is divided into 25 districts that oversee construction and maintenance of 197,000 miles in the State's highway system.

Because of TxDOT's decentralized structure and the varying mobility needs across the State, their TSMO planning initiative is currently split into two efforts: a statewide strategic plan and district-level program plans. To begin development of the statewide strategic plan, TxDOT performed several CMM workshops around the State in 2016 in which metropolitan, urban, and rural TxDOT districts as well as other local partners were invited to participate. These invitations facilitated a powerful opportunity for establishing relationships. Communicating that all agencies were welcome to join prompted attendance from an assortment of partners such as towing companies, planning organizations, and first responders who provided a wide range of feedback. Once data from initial workshops had been compiled, a second round of workshops were held to confirm assumptions and ensure all perspectives were properly documented and considered. The CMM assessment baseline identified in these workshops, as shown in Figure 3, set the framework of the statewide strategic plan.

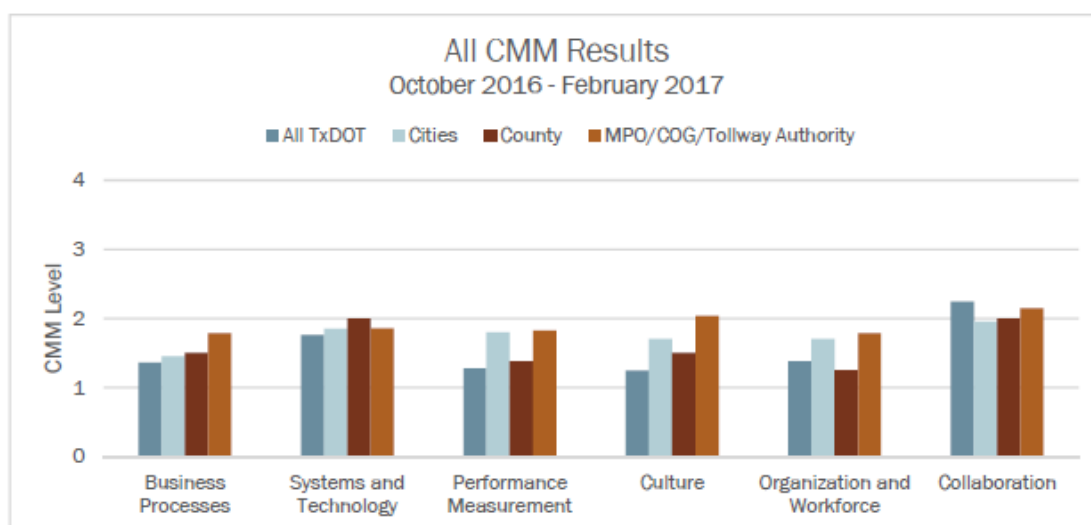


Figure 3. Chart. TxDOT Statewide CMM Workshop Results

Source: TxDOT Statewide TSM&O Strategic Plan Development, TSM&O Outreach Event Summary, May 2017.

<http://ftp.dot.state.tx.us/pub/txdot-info/trf/tsmo/outreach-summary.pdf>

The statewide strategic plan discusses CMM dimensions and TxDOT’s current level of maturity in each dimension. It also identifies high-level activities that the State, regional, and local entities should perform to improve TSMO capabilities in each dimension.

The second element of TxDOT’s TSMO planning initiative is development of district-level program plans for each of TxDOT’s 25 districts. The needs of each TxDOT district vary based on geography, population, location of interstate corridors, weather, and more. Shortly after development of the statewide strategic plan, TxDOT began working with its Austin District to initiate the first district-level program plan. Similar to the statewide effort, the Austin District performed a CMM assessment to identify opportunities for growth in TSMO activities, solely for their district. Again, TxDOT used CMM dimensions to set the framework for the Austin District’s program plan. District-level plans identify specific needs and action items for each district. For example, in the organization and workforce dimension of the Austin district plan, recommendations were made for specific intelligent transportation systems maintenance needs. This recommendation may or may not be carried over to other district program plans based on the existing needs of each district. As all other TxDOT districts begin developing their own program plans, each district will first complete a CMM assessment to set the baseline for their region.

TxDOT TSMO plans are considered living documents to be continually updated as TSMO maturity changes in the State. The agency plans to continue using the CMM assessment to track progress and identify additional opportunities for improvement.

TxDOT’s approach to CMM integration is using the assessment as a framework for TSMO planning. They noted support from executive level staff and educational outreach as critical elements to facilitating the TSMO cultural shift in the organization. A key component of TxDOT’s TSMO planning initiative is building upon and optimizing existing activities to include

TSMO. TxDOT's TSMO champions work diligently to identify opportunities where findings from the CMM assessment can be further integrated into agency policy and processes.

Washington State Department of Transportation (WSDOT)

WSDOT supports the changing transportation needs of the State of Washington through six regional districts. WSDOT operates and maintains more than 18,600 miles of highway lanes, nearly 3,300 bridge structures, and runs a ferry system that moves 24.2 million passengers and 10 million vehicles per year.

WSDOT completed their first CMM assessment in 2014 and identified the need to improve workforce development. Their second CMM assessment was held in 2017. During the second assessment, WSDOT was tougher in scoring their maturity levels than on their original evaluation because they had a better understanding of general TSMO strategies and processes. WSDOT felt that they had much more room to improve than originally identified. A key action item developed from the 2017 assessment was to work on improving TSMO business processes in agency divisions and disciplines. From this, they identified the need to develop a TSMO strategic plan. In the strategic plan, they define critical processes such as planning, budgeting, and funding mechanisms to strengthen their TSMO capabilities. The agency used these processes to tie TSMO strategies to projects.

WSDOT also used the CMM assessment to identify action items for improving the TSMO culture in the agency. They began implementing several tasks such as providing TSMO education to multi-discipline employees and advocating for TSMO through an educational website that provides the “when-where-why” to use TSMO and how to deploy TSMO strategies.

WSDOT attributes the growth of their TSMO program to action items developed from the CMM assessment, such as engaging staff, establishing TSMO planning processes, and tying TSMO strategies to projects. During development, they found that by improving their TSMO culture, they made headway on business processes development; as they developed TSMO business processes, the TSMO culture improved. WSDOT noted that tasks such as identifying a TSMO champion who advocates for TSMO in the agency was critical to initiating and utilizing the CMM assessment. They also noted that taking advantage of programs like SHRP2 is a great way to move TSMO forward because the program provides resources that an agency may not already have. As SHRP2 is nearing an end, WSDOT is now working on processes to sustainably support TSMO in the future.

WSDOT is one of many agencies to complete more than one CMM assessment for their TSMO program. These assessments enabled the agency to develop action items for further improvements, with the second round of action items building on the first. Integrating CMM assessments into an agency's TSMO program development helps identify needs and supports continued growth with each assessment becoming a new baseline for the agency's TSMO maturity.

CHAPTER 3 – SUMMARY

The capability maturity model (CMM) assessment is a tool that can assist agencies in identifying areas in which they are successful or where there is opportunity for improvement. CMM dimensions outline elements that agencies should consider when advancing transportation systems management and operations (TSMO). Each agency interviewed for CMM integration utilized the findings from their respective assessments in varying ways to mature TSMO in their organizations. Some of the lessons learned using the CMM assessment include:

- As a tool, CMM assessments can be used in many different ways for evaluating programs, projects, or the agency's or region's performance as a whole.
- The CMM assessment can be used as a tool to establish a baseline of TSMO maturity and can be performed several times as a TSMO program grows to ensure agency objectives are being met.
- Integrating CMM dimensions into TSMO programs one at a time enables agencies to efficiently focus resources. When this approach is taken, maturing one dimension can affect the success of another simultaneously because CMM dimensions are interrelated. There is no specific method on how to integrate the CMM assessment into agency processes. It is up to the agency to leverage lessons learned from CMM dimensions to help address their needs. CMM can be used to identify the health of an overall TSMO program or on a project, corridor, or strategy-specific level.

Concepts established through systemically assessing the maturity of a program or asset enable agencies to make well-informed decisions in support of continuous improvement. Best practices identified in this case study can educate agency administration and leadership on the value of performing a CMM assessment and integrating its findings into day-to-day operations.

REFERENCES

Information for use in this case study was gathered from sources noted throughout the report together with the following web sites:

- FHWA’s What is Transportation Systems Management and Operations (TSMO)?
 - <https://ops.fhwa.dot.gov/tsmo>
- AASHTO’s TSMO Guidance
 - <http://www.aashtotsmoguidance.org/>
- FHWA’s Organizing and Planning for Operations
 - <https://ops.fhwa.dot.gov/plan4ops/>
- FHWA’s Organizing for Operations Resources
 - https://ops.fhwa.dot.gov/plan4ops/focus_areas/organizing_for_op.htm
- FHWA’s Organizing for Reliability – Capability Maturity Model Assessment and Implementation Plans
 - <https://ops.fhwa.dot.gov/docs/cmmexesum/sec1.htm>
- FHWA’s Creating an Effective Program to Advance Transportation Systems Management and Operations, Primer
 - <https://ops.fhwa.dot.gov/publications/fhwahop12003/index.htm>
- California Department of Transportation (Caltrans)
 - <http://www.caltrans.ca.gov/>
- Texas Department of Transportation (TxDOT) TSMO
 - <https://www.txdot.gov/inside-txdot/division/traffic/tsmo.html>
- Washington Department of Transportation (WSDOT) TSMO
 - <http://fratis.trac.washington.edu/TSMO/>
- North Carolina Department of Transportation (NCDOT)
 - <https://www.ncdot.gov/Pages/default.aspx>

Table 1. Interview Participants and Agencies

Agency	California Department of Transportation (Caltrans)	Texas Department of Transportation (TxDOT)	Washington Department of Transportation (WSDOT)	North Carolina Department of Transportation (NCDOT)
Agency Representative Name:	Nicholas Compin	Marco Cameron	Monica Harwood	Jennifer Portanova
Agency Representative Title:	Chief of the Office of Strategic Development	Transportation Engineer	Workforce Development & Traffic Operations Engineer	State Systems Operations Engineer
Agency Representative Email:	Nicholas.Compina@dot.ca.gov	Marco.Cameron@txdot.gov	HarwoodM@wsdot.wa.gov	Jportanova@ncdot.gov
Interview Date:	June 6, 2018	June 8, 2018	August 13, 2018	August 14, 2018

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