



# Transportation Systems Management and Operations (TSMO)

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## Statewide Strategic Plan

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## Table of Contents

Executive Summary .....	1
Introduction .....	3
TxDOT TSMO Program Structure .....	3
Development of the TxDOT Statewide TSMO Strategic Plan .....	4
Business Case for TSMO .....	6
TSMO Mobility Improvements .....	7
Statewide TSMO Vision, Mission, Goals, and Objectives .....	7
Statewide TSMO Vision .....	8
Statewide TSMO Mission .....	8
Statewide TSMO Goals and Objectives .....	8
Statewide TSMO Program Strategy .....	8
Business Processes .....	9
Systems and Technology .....	11
Performance Measurement .....	14
Culture .....	15
Organization and Workforce .....	17
Collaboration .....	19
APPENDIX A: TxDOT District TSMO Program Plan Table of Contents .....	22
TxDOT District TSMO Program Plan Table of Contents .....	22
APPENDIX B: TxDOT Chief Engineer’s Memos .....	23

## List of Tables

Table 1: Statewide TSMO Goals and Objectives .....	8
Table 2: District Responsibilities for Business Processes .....	10
Table 3: Central Office Responsibilities for Business Processes .....	11
Table 4: District Responsibilities for Systems and Technology .....	12
Table 5: Central Office Responsibilities for Systems and Technology .....	13
Table 6: District Responsibilities for Performance Management .....	14
Table 7: Central Office Responsibilities for Performance Management .....	15
Table 8: District Responsibilities for Culture .....	16
Table 9: Central Office Responsibilities for Culture .....	17
Table 10: District Responsibilities for Organization and Workforce .....	18
Table 11: Central Office Responsibilities for Organization and Workforce .....	19
Table 12: District Responsibilities for Collaboration .....	20
Table 13: Central Office Responsibilities for Collaboration .....	20

## List of Figures

Figure 1: TxDOT TSMO Program Components .....	2
Figure 2. CMM Levels of Maturity .....	5
Figure 3: TSMO Mobility Improvement Examples .....	7

## Executive Summary

Many of Texas' metropolitan cities are among the most congested cities in the nation. Rural areas also have seen an increase in vehicles on the roadways—most notably, freight and commercial vehicles. With vehicle miles traveled (VMT) continually increasing, congestion throughout Texas is expected to get worse with the current pace of infrastructure development. To maximize mobility using the available transportation funding, the Texas Department of Transportation (TxDOT) is implementing a Transportation Systems Management and Operations (TSMO) program statewide. A TSMO program in Texas will improve the project delivery process by integrating mobility-focused solutions throughout planning, design, construction, operations, and maintenance. By collaborating with partner agencies and implementing data-driven decisions, the transportation network will be safer and more efficient, and will improve reliability for travelers of all modes.

Due to the large size of Texas' transportation network, TxDOT is implementing TSMO using a three-pronged approach: a statewide strategic plan, district program plans, and district service layer plans, as shown in the example hierarchy in Figure 1. The statewide strategic plan will provide guidance on how TSMO will be conducted throughout the state. Districts or geographic regions will use the strategic plan as the framework to develop their own TSMO programs to meet their unique needs, one output of which is a district program plan. Depending on the needs of each district, service layer plans may be developed to provide additional details and protocols for how certain mobility strategies (such as incident management, work zone management, etc.) will be conducted. These three components will provide actionable guidance to implement TSMO activities across the state and integrate management and operations into the fabric of the organization to maximize the potential efficiencies.

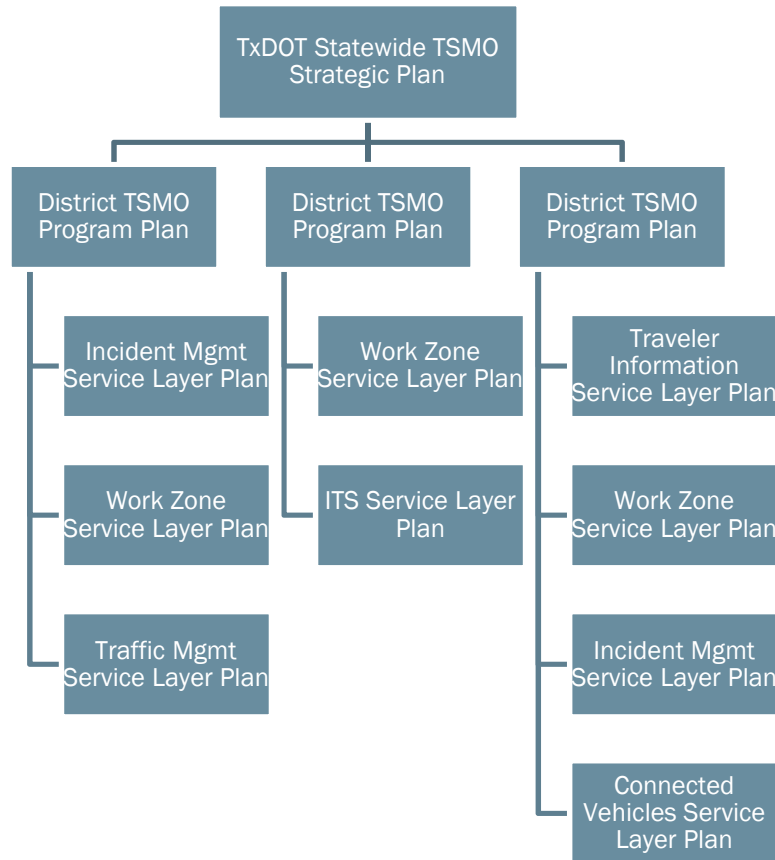


Figure 1: TxDOT TSMO Program Components

The purpose of the TxDOT Statewide TSMO Strategic Plan is to:

- Provide background information and a business case regarding the value of TSMO
- Provide a framework and guidance for districts and/or regions to develop a district- or region-specific TSMO Program Plan
- Identify central support available from the TxDOT divisions

The TxDOT Statewide TSMO Strategic Plan includes a business case for TSMO; statewide mission, vision, and goals statements; an introduction to how mobility strategies benefit the TSMO program; and the statewide TSMO strategy. The statewide TSMO strategy highlights the following six TSMO program dimensions:

- Business processes
- Systems and technology
- Performance measurement
- Culture
- Organization and workforce
- Collaboration

These TSMO program dimensions were chosen because they categorize key areas that affect TSMO activities within an agency and they align with agency organizational structures and industry standards.

## Introduction

TxDOT is initiating a statewide TSMO program. TSMO is an approach to improve mobility for all modes of transportation by integrating planning and design with operations and maintenance to holistically manage the transportation network and optimize existing and future infrastructure. Initially, TxDOT leadership recognized a need for performance-based planning as a way to meet the mobility needs of the state using a cost-effective, targeted approach to funding projects. TSMO takes these techniques a step further by integrating innovation and collaboration throughout the entire project delivery process.

Because of the focus on mobility, TSMO is a new approach to managing and operating the transportation system compared to what TxDOT has done in the past. TSMO programs identify specific needs, considering the end user, to improve mobility at a regional level and implement cost-efficient solutions to address those needs. An established TSMO program institutionalizes the prioritization of mobility solutions on projects through technology or other innovative techniques. It integrates operations and management strategies throughout the entire project delivery process through coordination and collaboration of stakeholders to address the end users' needs. The Federal Highway Administration (FHWA) supports TSMO as a means to meet the performance measurement requirements originally identified in the Moving Ahead for Progress in the 21st Century Act (MAP-21) and further in the Fixing America's Surface Transportation (FAST) Act, in addition to the many other benefits.

### *TxDOT TSMO Program Structure*

The TxDOT TSMO program is comprised of three components: a Statewide TSMO Strategic Plan, TSMO District Program Plans, and potential service layer plans, as shown in the organization diagram in Figure 1.

The purpose of the Statewide TSMO Strategic Plan is to set the framework and guidelines for how TSMO will be conducted throughout the state. It also will include information on how centralized support will be provided to the districts to develop and maintain their TSMO programs. District TSMO Program Plans will be developed for individual districts or regions, depending on the needs of the area and local available knowledge of TSMO. A metropolitan planning organization (MPO) or council of governments (COG) also may lead an initiative to develop a local TSMO program that may encompass multiple TxDOT districts and include local agencies. Each TSMO Program Plan will provide detail on the district or regional TSMO responsibilities, business processes, and action items for implementation. Service layer plans will be developed as needed for each district or region. Each service layer will outline how specific mobility strategies will be implemented and provide a high level of detail for the procedures of each strategy. Example service layers include incident management, ITS in work zones, or traffic signal management. This hierarchical approach was taken due to the large geographic size of Texas—each district and region has individual needs that cannot be

effectively outlined in a single document. Additionally, TxDOT has a de-centralized agency structure, where most of the decisions occur at a district-level, so it is necessary that the districts and regions develop TSMO programs based on their specific strengths and challenges.

### ***Development of the TxDOT Statewide TSMO Strategic Plan***

To develop the TxDOT Statewide TSMO Strategic Plan, an approach was established to gather feedback and engage leaders and stakeholders at multiple milestones. Information was gathered through a state of the practice exercise, multiple outreach events, and a statewide survey.

The State of the Practice Report was developed to understand what agencies around the country were implementing for TSMO programs and gather best practices for the TxDOT TSMO program. A literature review of the following types of documents was conducted:

- State and local agency TSMO plans
- Guidance developed by the FHWA, the American Association of State Highway and Transportation Officials (AASHTO), and other national experts
- TxDOT and local agency TSMO or TSMO-related documents

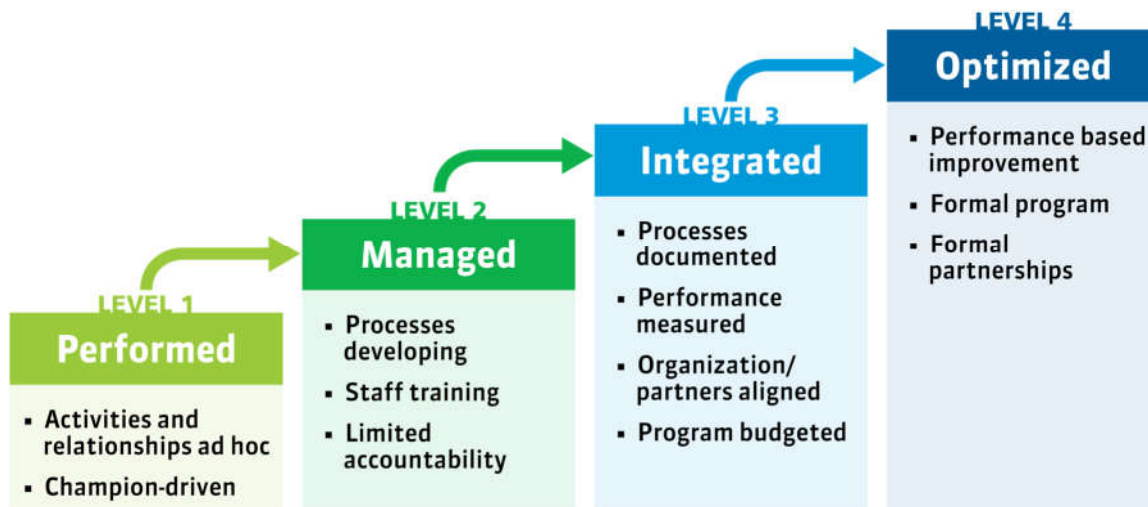
The findings from the State of the Practice Report were used to gain an understanding of national TSMO activities and determine the state of TSMO within Texas prior to the outreach events.

Outreach events were held across the state between October 2016 and January 2017, with more than 256 attendees from more than 80 different national, state, and regional agencies. The purpose of the outreach events was to inform stakeholders of the TxDOT TSMO initiative, provide training on the benefits of TSMO, and gather feedback through a capability maturity model (CMM) assessment. A CMM is a methodology, originally developed in the software engineering industry, to evaluate an organization's progress toward developing a specific program. For TSMO, there are six dimensions, defined by AASHTO, at which TSMO programs are evaluated:

- Business processes
- Systems and technology
- Performance measurement
- Culture
- Organization and workforce
- Collaboration

Individuals rate their own organizations using the levels of maturity shown in Figure 2, for each TSMO program dimension to develop the CMM. Level 1, performed, means the TSMO program dimension is completed on an ad-hoc basis and one or two individuals champion the activity without integrating with the team. Level 2, managed, may involve more individuals on a team performing the activity and beginning to integrate into other processes; however, there is little accountability for achieving performance measures. At

level 3, integrated, the program dimension is part of a more formalized process and budgets are coordinated around the activity. Once an organization has achieved level 4, optimized, the program dimension is continuously improved based on performance measures and activities are organized with local partners.



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

Figure 2. CMM Levels of Maturity

At least one representative from each division, district, and agency that attended an outreach event completed a CMM assessment. After all of the outreach events had concluded, the results of the CMM assessments were compiled to understand the state’s and local agencies’ level of maturity in TSMO. Overall, most state and local agencies rated themselves between Level 1 and Level 2 in all TSMO program dimensions; however, some of the metro districts rated themselves higher for some of the TSMO program dimensions.

Based on the CMM assessments and additional comments received during the outreach events, recommendations were made to include certain elements in the TxDOT Statewide TSMO Strategic Plan, as well as action items that must be taken in each TSMO program dimension to advance a statewide TSMO program. In May of 2017, the recommendations for the TxDOT Statewide TSMO Strategic Plan were summarized and distributed to all outreach event attendees. To continue the effort of gathering feedback throughout this process, stakeholders were asked to provide input on Strategic Plan recommendations via an online survey. Most survey respondents reported that the elements recommended to be included in the TxDOT Statewide TSMO Strategic Plan were relevant to them. The comments received for the open-answer questions reaffirmed that the proposed content addressed their needs.

Simultaneous to the TSMO program development, a Traffic Management System (TMS) initiative has been led by the Information Management Division (IMD) in collaboration with



the Traffic Operations Division (TRF), to enhance intelligent transportation systems (ITS) along state roadways. Construction and maintenance efforts are strongly encouraged to include TMS and operational improvements in projects. It is essential that districts begin planning and budgeting for TMS going forward to ensure TMS is included in future projects to improve roadway system operations. TMS will complement the TSMO initiative, as they both work to improve system operations, with TMS focusing on ITS infrastructure. The TxDOT Statewide TSMO Strategic Plan was developed based on input TRF and IMD received through their TSMO Program and TMS efforts.

## **Business Case for TSMO**

According to the Texas Transportation Plan (TTP) 2040, the population of Texas is expected to reach 45 million by 2040. This rapid growth leads to an increase in daily VMT, and historically, improvements to transportation infrastructure have not expanded at the same rate as demand. The results of this inconsistency are significant increases in delay and reduction in reliability. Many of the metropolitan areas in Texas are among the most congested cities in the nation, including Houston, Dallas, Fort Worth, and Austin (Texas Department of Transportation, 2015). In rural areas, with the increase in an aging population needing transportation alternatives and the increasing number of heavy vehicles due to oil and gas production, mobility challenges are prevalent throughout the state (Texas Department of Transportation, Transportation Planning and Programming Division, 2012).

With inadequate funding available, state and local agencies have learned to do more with less, yet it is a continual struggle to keep up with increasing demand. TSMO is an effective approach to planning for and delivering projects using innovative and efficient strategies. TSMO helps agencies provide safe, reliable, efficient, and sustainable mobility for all users for the following reasons:

1. TSMO initiatives lead to effective use of available funding. Implementing innovative, technology-based solutions can add capacity at a lower cost than building more lane miles.
2. TSMO programs are efficient, and conserve agency dollars by encouraging different disciplines and stakeholders to work through challenges together before projects are constructed.
3. Data-driven mobility strategies are funded to provide measurable results to share with the general public and agency leadership.
4. Implementing performance-based mobility strategies leads to effective projects by leveraging TSMO business processes that target the areas of greatest need in transportation systems.
5. A TSMO approach to improve system reliability prioritizes solutions that realize immediate results.
6. Through the integration of all aspects of the project delivery process, projects are planned, designed, constructed, and operated efficiently, improving mobility for all modes of transportation.

- By improving mobility and reliability, safety is improved by reducing the likelihood of secondary crashes. Less delay caused by crashes and other incidents leads to improvements in mobility.

### TSMO Mobility Improvements

The plans and processes of a TSMO program establish opportunities to prioritize operations and ITS solutions to improve overall network mobility. The graphic shown in Figure 3 provides examples of how common problems can be addressed by using TSMO approaches to coordinate multiple traffic operations techniques and improve the end-user’s travel experience.

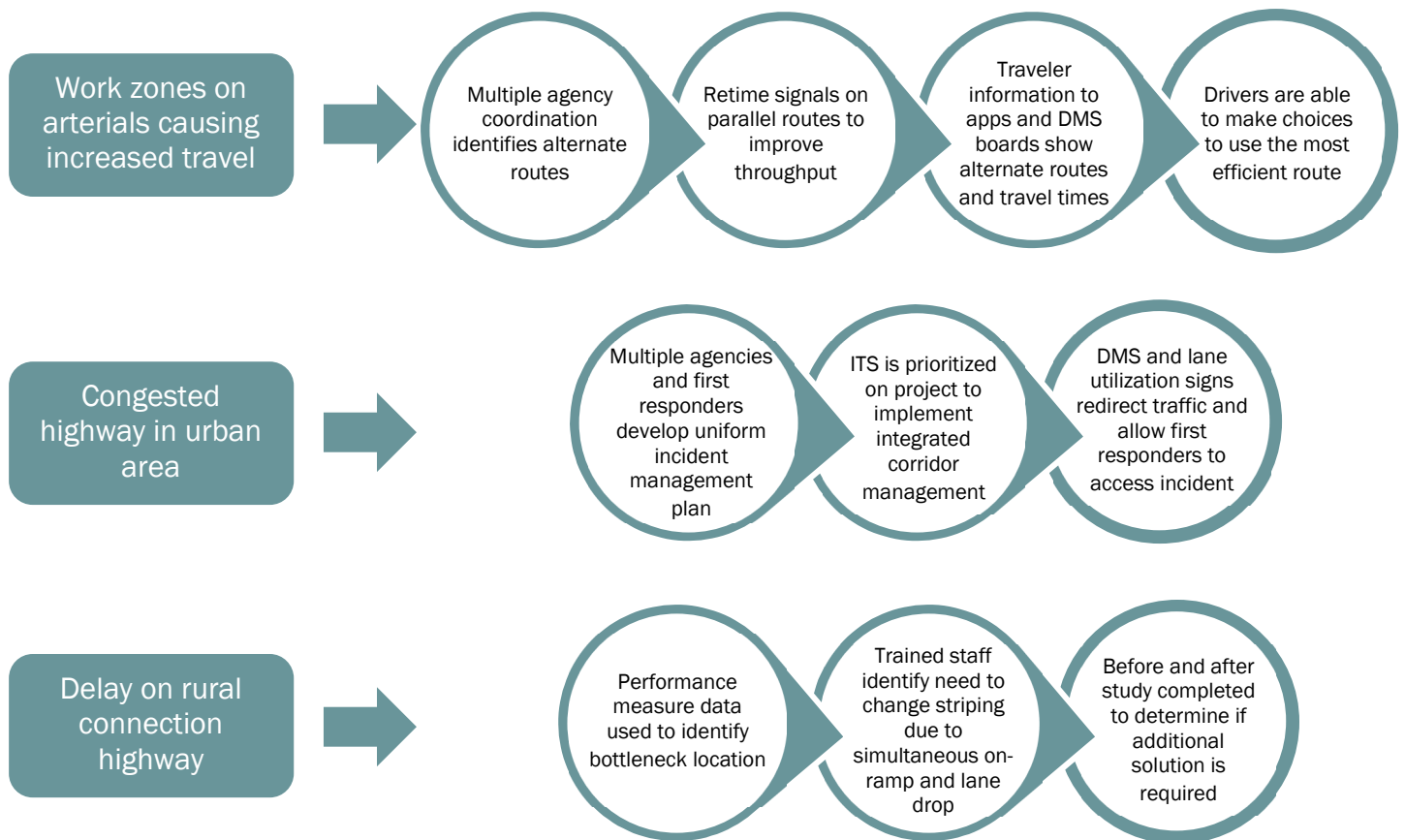


Figure 3: TSMO Mobility Improvement Examples

### Statewide TSMO Vision, Mission, Goals, and Objectives

The following mission, vision, goals, and objectives are from the TxDOT Statewide TSMO Strategic Plan. Districts may add specific interests or additional details when developing district TSMO program plans.

## **Statewide TSMO Vision**

Improve safety and mobility for all modes of transportation by integrating planning, design, operations, and maintenance activities.

## **Statewide TSMO Mission**

Through innovation, collaboration, and performance-based decision making, transportation facilities are developed, maintained, and operated cost-effectively, with the end user in mind.

## **Statewide TSMO Goals and Objectives**

The goals and objectives for the statewide TSMO program identified in Table 1 are based on the TxDOT agency goals and objectives:

*Table 1: Statewide TSMO Goals and Objectives*

<b>Goal</b>	<b>Objective</b>
Safety	Reduce crashes and fatalities through continuous improvement of traffic management systems and procedures.
Reliability	Maintain consistent travel times on transportation systems in critical corridors to ensure travelers are reaching their destinations in the amount of time they expected for the journey.
Efficiency	Implement projects that optimize existing transportation system capacity and alleviate congestion.
Customer Service	Provide timely and accurate travel information to customers so they can make informed mobility decisions.
Collaboration	Proactively manage and operate an integrated transportation system through multi-jurisdictional coordination, and cooperation between various transportation disciplines and partner agencies.
Integration	Prioritize TSMO as a core objective in the agency's planning, design, construction, operations, and maintenance activities.

## **Statewide TSMO Program Strategy**

The Statewide TSMO Program Strategy is divided into six components that align with the following TSMO program dimensions:

- Business processes
- Systems and technology
- Performance measurement
- Culture
- Organization and workforce
- Collaboration

Although these dimensions are divided for the purposes of this document, they are interrelated and depend on each other to succeed. Each subsection below provides the following information specific to the TSMO program dimensions:

- Guidance information on how districts and/or regions will conduct TSMO programs locally
- Specific guidance for how centralized support will be provided to the districts and/or regions

(Note: for the purposes of this report, the term “district” refers to both TxDOT districts and other agencies divided into geographic regions.)

The districts will be responsible for the planning and implementation of local TSMO activities. TRF will provide overall leadership and policy management of the statewide TSMO program, relying on coordination with other units and divisions to carry out the objectives of the program.

### ***Business Processes***

Business processes include all of the planning, budgeting, procurement, and process development that is required for TSMO programs. To be implemented, TSMO activities and initiatives must be supported financially and institutionally. Protocols and procedures are necessary for TSMO to become ingrained in agency culture.

Based on the results of the 2016-2017 CMM, processes and financial support are not in place to ensure TSMO is incorporated into day-to-day operations for the development and delivery of projects. To develop a successful TSMO program district-wide, the following action items related to business processes need to be completed, as summarized in Table 2:

- **Planning**—Using a needs-based, data-driven approach, mobility-focused projects will be identified, as well as opportunities to include mobility strategies in existing projects. These projects will be included in long-term planning efforts, including the Unified Transportation Plan (UTP). Project scopes must be developed to align with the performance-based planning requirements that guide project selection criteria and funding distributions in the UTP.
- **Programming**—Districts will develop a budget for TSMO efforts that includes funding for mobility-focused projects and implementing mobility strategies in existing projects. Per the Chief Engineer’s memo from April 2017, funding for TMS is expected to be included in each project’s planning, development, design, construction, maintenance, and operation. Consideration also will need to be given for training, staffing, data acquisition, or any additional engineering resources required. When applying for federal grants funding, districts will include information regarding the TSMO program and the resulting data-driven decision making.
- **Process Development**—Existing processes for project delivery will be revised to consider TSMO and other efforts outlined in this TSMO Program Plan. Similarly, an evaluation of existing project development manuals will be reviewed and revised to address the changes in protocol. As a resource for considering innovative ideas, a

TSMO evaluation tool is being developed to assist districts in determining how TSMO can be applied to projects to improve mobility during conceptualization, planning, design, construction, operation, management, and maintenance. The use of the tool can be scaled according to project size, but it will be a valuable resource to encourage a TSMO culture in the organization.

- **Continuous Improvement**—As districts continue to implement TSMO practices, revisions to the TSMO Program Plan will be made so continuous improvement and optimization of business processes can occur. Regular assessments will be completed to determine what has been successful and what resources are needed to overcome challenges.

Table 2: District Responsibilities for Business Processes

	Objective	Evaluation Metric	Timeframe
District Responsibilities	Identify list of operation-based projects & budget for the next 10 years to include in UTP.	Send projects and budget to TRF for TSMO tracking purposes.	1–2 years
	Identify list of projects & budget where operations/ITS solutions can be added over the next 10 years to include in UTP.	Send projects and budget to TRF for TSMO tracking purposes.	1–2 years
	Develop template language for project scopes to align with performance-based planning requirements.	Implement scoping language in projects.	1 year
	Develop budget for training, staffing, data acquisition, or other resources.	Send budget to TRF for TSMO tracking purposes.	1–2 years
	Revise project delivery process to include TSMO activities & TSMO tool.	Include project delivery process in TSMO Program Plan.	1–2 years
	Review/revise project manuals/protocols to include TSMO activities & TSMO tool.	Implement revised project manuals/protocols.	1–2 years
	Develop TSMO Program Plan, including plan for re-assessment.	Send TSMO Program Plan to TRF for TSMO tracking purposes.	1–2 years

To sustain the districts with their individual TSMO programs, centralized support will be provided to assist with planning and leadership of the TSMO initiative. As summarized in Table 3, support from divisions will include:

- **Coordination**—TRF will coordinate with the Transportation Planning and Programming Division (TPP) to provide guidance to the districts for including mobility-focused projects or additional funding for mobility strategies on existing projects in the UTP.
- **Funding Support**—TRF will support the districts’ efforts to obtain federal grants to fund TSMO-specific projects or mobility strategies on existing projects. This may

include technical expertise, providing statewide best practice information, or developing statewide standard practices.

- **Policy and Procedural Documentation** – TRF will lead an effort to develop TSMO policy or similar procedural documentation. This will highlight the support from executive leadership and the necessity of the initiative throughout the state.
- **Continuous Improvement**—As necessary, the TxDOT Statewide TSMO Strategic Plan will be updated by TRF in response to changes to the agency’s mission, vision, and strategic goals. TRF will also support districts in developing and maintaining their TSMO program plans. This may include re-evaluating statewide, regional, or district-level CMM assessments to identify where action items can be enhanced. The culture section of the TxDOT Statewide TSMO Strategic Plan describes the roles in the central office and districts required to support the TSMO program.

Table 3: Central Office Responsibilities for Business Processes

Central Office Responsibilities	Objective	Evaluation Metric	Timeframe
	Develop guidance on including/funding operations/ITS projects in UTP.	Send UTP guidance to districts.	1 year
	Develop TSMO policy.	Send TSMO policy to districts.	6 months–1 year
	Review and revise TSMO Strategic Plan regularly.	Send revised TSMO Strategic Plan to districts.	Biennial review
	Maintain the overall statewide TSMO plan, comprised of the statewide strategic plan and the regional plans	Maintain all TSMO plans online	Continuous

### Systems and Technology

Appropriate planning, construction, operations, and maintenance of systems and technology ensures that the operational needs of an agency are met. By developing standard protocols and an iterative data management process, transportation solutions can be effective in enhancing mobility.

The 2016-2017 CMM indicated a need for faster procurement and upgrade processes, statewide software standards, and a platform to share data. As summarized in Table 4, to develop a successful TSMO program district-wide, the following action items related to systems and technology need to be completed:

- **Regional Architecture**—Districts will develop a systematic approach to planning, defining, and integrating an ITS architecture to accommodate regional needs. This can be done in coordination with the statewide requirements for including TMS on all projects. Per the Chief Engineer’s memo from July 2016, all new roadway construction projects should include infrastructure which supports Traffic Management Systems (TMS), including the underground conduit that supports a fiber optic-based communications network. The Chief Engineer’s memo from April 2017

requires that TMS be included in each project’s planning, development, design, construction, maintenance, and operation. Specific TMS projects must be identified where gaps exist between typical road and bridge projects. The regional architecture should be updated at regular intervals, no less than every five years.

- **Systems Engineering**—Districts will develop processes to implement the federally required systems engineering analysis (SEA). Training on the SEA, provided by FHWA or TRF, may be necessary for new staff.
- **Emerging Technology**—With new types of detectors, communication, and connected vehicle technology becoming available each day, a vetting process needs to be developed. The current device acceptance process will be re-evaluated regularly based on agency needs, industry standardization, and type of device.
- **Interoperability**—Districts will develop a plan to continue to coordinate with partner agencies to support interoperability of systems, potentially through a statewide data sharing platform or existing memoranda of understanding. This will allow agencies to access data for supporting analyses and performance measures.

Table 4: District Responsibilities for Systems and Technology

	Objective	Evaluation Metric	Timeframe
<b>District Responsibilities</b>	Develop and/or update regional architecture (update no less than every five years).	Send regional architecture to TRF for TSMO tracking purposes.	3 years
	Implement SEA process on projects as necessary.	Include SEA process in project delivery process in TSMO Program Plan.	1–2 years
	Consider re-evaluating current ITS processes based on emerging technology.	Include plan for considering re-evaluating ITS processes in TSMO Program Plan.	1–2 years
	Establish formal agreements to share data with partner agencies.	Send formal agreements to TRF to facilitate their execution	Continuous

When managing systems and technology, there are many considerations to evaluate. TRF and other central offices are available to provide technical expertise and statewide management. As summarized in Table 5, support from centralized divisions will include:

- **Technical Support**—TRF and IMD will provide technical support and guidance, including, but not limited to, the following TMS challenges: system coverage, planning for expansion or upgrades, systems engineering, and ITS deployments in the field. They also can provide input on best practices for regional ITS architectures and concepts of operations. TRF may consider revising the approach to the development of regional ITS architectures to standardize practices across the state. TRF and IMD will continue to provide support for statewide software and technologies.

- **Standards and Specifications Development**—TRF will lead the development of statewide construction specifications and standards for ITS equipment. A standard statewide data platform or standards and specifications for sharing data also would help with multi-agency interoperability and improve efficiency. This can be done with an iterative process—adding additional resources and stakeholders after initial concepts are proven.
- **Procurement**—TRF will develop procurement procedures to address the common procurement challenges faced by the districts. Purchasing ITS hardware is often subject to statewide procurement procedures that are not always well suited for the special characteristics of ITS systems and software, and the technology lifecycles. TRF will also manage statewide procurements and blanket purchase orders. An approved vendor product list will be maintained to facilitate purchasing ITS elements on construction projects, reducing the time needed to obtain the products, and overcoming the challenge of continually maintaining and updating specifications.
- **Statewide Management**—TxDOT central offices will develop and maintain statewide technology solutions for various needs, such as asset management, network management, software management and upgrades, and performance measurement. They will also support the implementation of statewide mobility strategies, such as incident management, data analytics, or intelligent work zones.
- **Cyber Security**—In an effort to protect assets and technology systems, a plan to improve cyber security of all TxDOT networks will be developed. The centralized offices will evaluate existing threats, implement protocols to protect existing technologies, and develop a strategy to assess and protect new assets.
- **Connected and Autonomous Vehicles (CAV)**—A statewide plan will be developed for how connected vehicle technology will be implemented throughout the state of Texas. Employing an incremental approach to implement emerging technology, the plan should be responsive to industry capabilities. The plan should be updated on an annual basis to continue to provide information on relevant technologies.

Table 5: Central Office Responsibilities for Systems and Technology

	Objective	Evaluation Metric	Timeframe
Central Office Responsibilities	Develop statewide data management and analysis platform.	Implement data management platform statewide.	2 years—scalable
	Develop statewide procurement procedures, including approved product vendor list.	Send statewide procurement procedures to districts.	Continuous
	Access cyber security threats and establish security protocols.	Implement security protocols statewide.	2 years—scalable
	Develop statewide connected and autonomous vehicle guidance/plan.	Send CAV guidance/plan to districts.	1 year



## *Performance Measurement*

Performance measures are used to evaluate the effectiveness of mobility strategies and whether additional changes need to be made to achieve mobility goals. They are essential for making the business case for TSMO to decision makers and the public, and for gauging program success. Furthermore, monitoring performance measures regularly allows the program to be constantly improved and advances institutional continuous improvement.

Based on the 2016-2017 CMM, districts need specific definitions of performance measures to track, a better understanding of how to use them to make decisions, and the ability to automate the process to reduce employee workload. As summarized in Table 6, to develop a successful TSMO program district-wide, the following action items related to performance measurement need to be completed:

- **Measures Definition**—Districts will identify what their needs are for performance measurement management, considering state and federal reporting requirements (i.e., MAP-21/FAST Act), as well as needs to improve regional mobility. Per the Chief Engineer’s April 2017 memo, districts are required to track and report the following performance measures: TMS asset operation uptime, incident clearance times, travel time reliability, and TMS system coverage. Definitions of these performance measures can be found in Appendix B. In addition to these performance measures, other performance measures will be monitored, depending on the needs of the district.
- **Measures Utilization Strategy**—In coordination with defining the performance measures, districts will develop a strategy to determine reporting frequency, coordination with other divisions, output functions, and other protocols. Districts may use performance measures for internal purposes, such as advocating for mobility strategies, and for external purposes, such as providing traveler information. Data can be used for accountability to understand if strategies are successful or need additional technical support and will be integrated into the planning process and evaluation of TSMO.
- **Data Acquisition**—Districts will identify what data already are available and what data will need to be acquired. ITS or third-party vendors may need to be contracted to meet the districts’ needs.

*Table 6: District Responsibilities for Performance Management*

District Responsibilities	Objective	Evaluation Metric	Timeframe
	Develop measures definitions, utilization strategy, and data acquisition plan for district-specific performance measures.	Include measures definitions, utilization strategy, and data acquisition plan in TSMO Program Plan.	1-2 years
	Monitor performance measures regularly.	Provide summary of status of achieving performance measures objectives at Statewide TSMO Meeting	Continuous

Reporting and monitoring performance measures is a major role of the TMS initiative. As summarized in Table 7, support from centralized divisions will include:

- **Measures Definition**—TRF, in coordination with IMD, will promote the development of a standard set of performance measures that have a common definition statewide and are consistent with the MAP-21 requirements, as well as the performance-based planning requirements that guide project selection criteria and funding distributions in the UTP.
- **Measures Utilization Strategy**—The centralized office will maintain and revise accountability and reporting policies, as necessary. Existing and potential statewide technology solutions for performance measurement and reporting will be developed and maintained by centralized divisions.
- **Data Acquisition**—TRF will evaluate the potential of statewide private sector data and connected vehicle data acquisition.

Table 7: Central Office Responsibilities for Performance Management

	Objective	Evaluation Metric	Timeframe
Central Office Responsibilities	Develop measures definitions, utilization strategy, and data acquisition plan for statewide performance measures.	Provide statewide performance measures definitions to all districts	1–2 years
	Verify and consolidate districts' performance measure strategy into statewide platform dashboard.	Share consolidated district performance strategies with all districts.	1–2 years

### Culture

The culture of an organization represents the values and beliefs that lead to certain decisions being made. Through a business case or outreach opportunities, TSMO messaging can be communicated to others inside and outside of the agency to gain support.

Respondents in the 2016-2017 CMM identified a need for local TSMO champions, advocacy on projects and development of new processes, and a business case encouraging executive leadership in TSMO. As summarized in Table 8, to develop a successful TSMO program district-wide, the following action items related to culture need to be completed:

- **Outreach**—Because the concepts will be new to most people in an agency, it is important to seek out opportunities to discuss the value of TSMO. Districts will take advantage of opportunities, such as regularly scheduled multi-disciplinary meetings, to share information using statewide resources such as presentations or handouts. Training, internal campaigns, and newsletters also will help develop commitment and advocates for the TSMO program. These are great opportunities not only to engage

the transportation planners and engineers who will be directly involved with TSMO activities, but also other staff within an agency so that it is understood why certain strategies or projects are prioritized over others. These outreach opportunities will be organized in a district-level engagement plan. As part of the development of a district program plan, districts will customize the business case from the TxDOT Statewide TSMO Strategic Plan to meet their unique needs. It also may be revised to speak to different audiences, such as executive leadership, implementers, or the general public. This is a powerful tool to succinctly describe the value and potential benefits for prioritizing mobility strategies and to communicate directly to the audience’s core values.

- **Leadership**—Districts will engage a TSMO coordinator to be a leader and a connection to other resources for technical expertise. The TSMO coordinator will encourage thoughtful discussion, advocate for innovative ideas on projects, and be a point of contact to centralized TxDOT divisions for support. This position would be held by an available staff member from the district, potentially the Statewide ITS Leadership Committee representative or designee. Districts will also identify a TSMO champion to show support for the initiative from a management perspective and advocate for TSMO to a wide range of audiences, including both internally and with TxDOT’s partner agencies. This would be an administration level district staff member.

Table 8: District Responsibilities for Culture

	Objective	Evaluation Metric	Timeframe
District Responsibilities	Develop TSMO engagement plan.	Include engagement plan in TSMO Program Plan.	1–2 years
	Customize TSMO business case to meet individual district needs.	Include business case in TSMO Program Plan.	1–2 years
	Identify TSMO coordinator.	Send TSMO coordinator name to TRF for TSMO tracking purposes.	3–6 months
	Identify TSMO champion.	Send TSMO champion name to TRF for TSMO tracking purposes.	3–6 months

To promote the benefits of TSMO statewide and provide unified messaging, TRF will provide resources to the districts. As summarized in Table 9, support from centralized divisions will include:

- **Outreach**—TRF will facilitate TSMO learning opportunities internally or offered by national organizations, such as the FHWA. TRF will identify and take advantage of opportunities to engage agency staff of all backgrounds into discussions about TSMO at meetings, conferences, and other collaborative work efforts. Resources for district communication and engagement regarding TSMO will be developed. This may

include, but is not limited to, a short presentation, handouts, or case studies of successful TSMO activities. These resources will be available for any district to leverage and customize as necessary. The business case developed in the TxDOT Statewide TSMO Strategic Plan will be distributed to highlight the distinctive payoffs from highly cost-effective and innovative TSMO solutions.

- **Leadership**—Centralized divisions will promote TSMO concepts as a multi-discipline activity involving planning, design, construction, maintenance, traffic operations, and others. This may involve providing a forum for senior management to collaborate and learn about the benefits of TSMO to help them advocate for it in their districts or divisions. Central divisions will identify a TSMO coordinator to support the statewide TSMO activities and provide guidance to the districts. The list of divisions that require a TSMO coordinator will be determined by TRF and may include information management, transportation planning and programming, maintenance, and others.

Table 9: Central Office Responsibilities for Culture

	Objective	Evaluation Metric	Timeframe
<b>Central Office Responsibilities</b>	Develop engagement plan for advocating for TSMO.	Implement engagement plan statewide.	6-9 months
	Develop engagement resources (presentations, handouts, etc.) for districts.	Send engagement resources to districts.	6 months
	Divisions determined by TRF will identify a TSMO coordinator	Send TSMO champion name to TRF for tracking purposes	3-6 months

### ***Organization and Workforce***

Technically qualified staff and an organizational structure that unites TSMO activities into an integrated project delivery approach are key to supporting effective TSMO solutions. Through training, identifying TSMO responsibilities, and building relationships across teams, TSMO functions will be engrained in an agency’s day-to-day work efforts.

Based on the 2016-2017 CMM, to institutionalize a TSMO program, districts need formal training, revised position responsibilities, and guidance on recruitment and development of current employees to assist with TSMO activities. As summarized in Table 10, to develop a successful TSMO program district-wide, the following action items related to organization and workforce need to be completed:

- **Training**—Districts will participate in training provided by centralized divisions, FHWA, or other national experts. Districts also may coordinate with agency partners to

participate or develop training. Potential training topics include benefits of TSMO, applications and case studies of mobility strategies, or emerging technology.

- **Organizational Development**—A review of the organizational structure will be completed to determine which roles will take on TSMO activities and what new positions or core capabilities need to be developed to support the program. Rearranging the organizational structure may be necessary to promote collaboration between teams and provide project authority. This should be done in coordination with the TSMO champion(s) to share expertise and lessons learned from other agencies. Additionally, a strategy for providing adequate staffing, recruitment, and succession will be developed.

Table 10: District Responsibilities for Organization and Workforce

District Responsibilities	Objective	Evaluation Metric	Timeframe
	Develop TSMO training plan.	Include training plan in TSMO Program Plan.	1–2 years
	Review and revise agency structure to accommodate TSMO activities.	Include revised agency structure in TSMO Program Plan.	1–2 years
	Develop staffing plan, including revised position responsibilities, recruitment, and succession, to accommodate TSMO activities.	Include staffing plan in TSMO Program Plan.	1–2 years

A majority of the organization and workforce decisions lie with the districts; however, central offices will provide training and resources to the districts as needed. As summarized in Table 11, support from centralized divisions will include:

- **Training**—TRF will develop or provide access to training for districts and partner agencies. Training may be facilitated as a standalone activity, through multi-district meetings (e.g., Statewide ITS Meeting), or at conferences. TRF also is engaged with national forums, including the National Operations Center of Excellence (NOCoE), Transportation Research Board (TRB), AASHTO, and others. These organizations can be resources to the districts and provide insight on best practices from around the country.
- **Organizational Development**—Centralized offices will assist the districts with identifying core capabilities and developing job descriptions to support TSMO activities with respect to both technical and managerial roles. This also may include reviewing all project delivery responsibilities to identify where the integration of TSMO activities can be included.

Table 11: Central Office Responsibilities for Organization and Workforce

Central Office Responsibilities	Objective	Evaluation Metric	Timeframe
	Provide TSMO training opportunities to districts.	Provide training biannually.	Continuous

### Collaboration

The effectiveness of TSMO activities depends on the ability of divisions, districts, partner agencies, and other stakeholders to work together. Taking advantage of opportunities to build internal and external relationships will help with communication and overcoming challenges in the future.

Throughout Texas, interagency partnerships are in place, but more organization is needed to collaborate, engage stakeholders, and develop official agreements for projects. As summarized in Table 12, to develop a successful TSMO program district-wide, the following action items related to collaboration need to be completed:

- **Internal Stakeholders**—Districts will develop processes to find opportunities to encourage collaboration between multiple district units (i.e., design, construction, traffic, maintenance) to identify project challenges as early as possible. This may be done through regularly scheduled meetings, scoping meetings, project reviews, or other opportunities that fit the district’s needs. Districts are also expected to attend the Statewide TSMO Meeting to share information with other districts and divisions, and to gather support or expertise for initiatives.
- **Public Agencies and MPOs**—A review of available long-term planning documents or TSMO plans produced by partner agencies will be completed to identify where regional TSMO efforts can support existing goals. Agencies will work together to identify roles and responsibilities for executing action items. To encourage collaboration between public agencies and MPOs, a Regional TSMO subcommittee will be established and model the format of the statewide ITS meeting. This will be an opportunity to make agreements for collaborating on projects, planning efforts, and sharing data. It also may be valuable to include first responders and other traffic incident management responders.
- **Public-Private Partnerships**—It is becoming increasingly common for companies to promote mobility as a service or provide transportation data. Districts will develop a plan to cultivate strategic relationships with private companies to collaborate on tasks such as incident management or traffic management center staffing, to provide access to data and analytics, or provide alternative mobility solutions (i.e., ride hailing services).

Table 12: District Responsibilities for Collaboration

District Responsibilities	Objective	Evaluation Metric	Timeframe
	Include internal collaboration in revised project delivery process.	Include project delivery process in TSMO Program Plan.	1–2 years
	Attend and participate in Statewide TSMO Meeting.	Attend Statewide TSMO Meeting.	Continuous
	Review planning documents and evaluate where TSMO can support planning objectives.	Include planning document evaluation in TSMO Program Plan.	1–2 years
	Establish Regional TSMO subcommittee.	Attend Regional TSMO subcommittee meetings.	Continuous
	Develop public-private partnerships and strategic alliances.	Include plan for partnerships in TSMO Program Plan.	1–2 years

The TxDOT central offices will be a liaison between multiple organizations to help connect districts to the resources they need. As summarized in Table 13, support from centralized divisions will include:

- **Organize Statewide Meetings**—A statewide TSMO meeting will be initiated to discuss district TSMO activities and share best practices, similar to the existing Statewide ITS Meeting format. TRF will organize the meeting and may coordinate with the Statewide ITS Meeting to leverage traffic engineers’ availability. Presentations also will be made by centralized divisions to deliver strategic direction, present updates on statewide initiatives and technology, and gather information from the districts. The regional TSMO subcommittees may choose to present on progress and current initiatives during this meeting.
- **Coordination**—TRF will support districts through the coordination of multiple districts, partner agencies, and private companies. This may include evaluating formal agreements, developing unified performance measures, or developing technology for sharing data to execute mobility strategies.

Table 13: Central Office Responsibilities for Collaboration

Central Office Responsibilities	Objective	Evaluation Metric	Timeframe
	Initiate a Statewide TSMO Meeting	Hold regular Statewide TSMO Meetings.	3–6 months

## References

- Strategic Highway Research Program (SHRP2). (2014). *Gap Filling Project 6: Business Case Primer Communicating the Value of Transportation Systems Management and Operations*. Washington, D.C.: Transportation Research Board.
- Texas Department of Transportation. (2015). *Texas Transportation Plan 2040*. Austin, TX: Texas Department of Transportation.
- Texas Department of Transportation, Transportation Planning and Programming. (2017). *2017 Unified Transportation Program (UTP)*. Austin, TX: Texas Department of Transportation.
- Texas Department of Transportation, Transportation Planning and Programming Division. (2012). *The Texas Rural Transportation Plan*. Austin, TX: Texas Department of Transportation.



## APPENDIX A: TxDOT District TSMO Program Plan Table of Contents

## ***TxDOT District TSMO Program Plan Table of Contents***

The following outlines a common Table of Contents to be used for district and/or regional TSMO plans. Any modifications to the Table of Contents will require approval of the statewide TSMO committee. The goal is to maintain a common look and feel for the TSMO plans, which will be developed regionally, with multiple contributors.

1. Executive Summary
2. Introduction
  - a. Mission, Vision, Goals, Objectives
  - b. Business Case for TSMO Summary
  - c. Summary of CMM results
  - d. Program Plan Format
3. Capability Components
  - a. Business Processes
    - i. Revised project delivery process to include TSMO activities and TSMO tool
    - ii. Programming/budgeting plan
    - iii. Planning for TSMO
    - iv. Continuous improvement
  - b. Systems & Technology
    - i. TSMO Tool
    - ii. SEA process as part of project delivery process
    - iii. Process to vet innovative technology
    - iv. Regional ITS architecture
    - v. Existing & planned tools
  - c. Performance Measurement
    - i. Measures definitions
    - ii. Utilization strategy
    - iii. Data acquisition plan
  - d. Culture
    - i. Advocating for TSMO – engagement plan
  - e. Organization & Workforce
    - i. Revise organization structure to accommodate TSMO
    - ii. Staffing plan for recruitment, retention, and revised position responsibilities to accommodate TSMO activities
    - iii. Training plan
  - f. Collaboration
    - i. Procedures/plan with internal partners (HQ, design, maintenance, traffic, structures, etc.) & how to include in the project delivery process
    - ii. Procedures with External Partners (COGs, cities, counties, etc.) including study of where TSMO can support planning objectives
    - iii. Plan for developing public-private partnerships and strategic alliances
4. TSMO Service Layer Plan Assessment
5. TSMO Implementation
  - a. Schedule, tasks, identified leads for each TSM&O task

## APPENDIX B: TxDOT Chief Engineer's Memos



# MEMO

July 1, 2016

**To:** District Engineers

**From:** William L. Hale, P.E.  
Chief Engineer

**Subject:** Traffic Management Systems in Construction Projects

As TxDOT moves ahead with the goals of reducing congestion and enhancing safety, it is critical that Traffic Management Systems (TMS) be included on new roadway construction projects. Including TMS at earliest stages of project development planning will maximize investments by leveraging comprehensive project construction cost at the earliest stages when TMS can be included for a fraction of total project cost.

Freeway TMS typically includes Dynamic Message Signs (DMS), Closed Circuit Television (CCTV) Cameras, Traffic Sensor Systems and the telecommunications networks connecting the field devices to the Transportation Operations Center (TOC). Additional TMS devices that are installed due to specific needs include High Water Detection Systems, Wrong Way Driver detection and warning systems, Over Height Detection and Warning Systems and others.

It is critical that roadway construction projects include the fiber optic based communications during construction. Fiber optic cable is the recommended communications mode for Traffic Management for many reasons as described below:

- Capacity – Fiber has greater capacity than wireless technologies. Reliability – Fiber is more reliable than wireless due to its contained environment.
- Redundancy – Fiber is the optimal method to provide network redundancy with TMS field equipment as a best practice under all circumstances and especially for unforeseen emergency situations. Additionally, TMS fiber can enhance ability for metro traffic management centers to support other centers during emergency situations.
- Cost – Although initial capital cost for wireless may be lower, fiber has several cost benefits:
  - No recurring utility/power costs or licensing.
  - Reduced maintenance costs as noted in Reliability.
  - Cost – TxDOT can install fiber on state right-of-way during initial construction for its own use usually at a lower cost than a utility will pay for a right-of-way and fiber installation for lease to TxDOT.

The optimum time to install the underground conduit that will support the fiber networks on state right of way is during roadway construction and reconstruction projects, when the nature of the work already requires significant disturbance of the right of way. The conduit installation should be part of the construction phasing. Where reconstruction projects are planned for roadway segments with

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existing Traffic Management Systems, a plan for the temporary operation of the equipment during construction should be included in the construction plans.

If you have any questions on TMS during project development, please contact Carol T. Rawson (TRF) (512) 416-3200.


**CC:** Carol T. Rawson, P.E., Director, Traffic Operations Division  
C. Michael Lee, P.E., Director, Maintenance Division  
Mark A. Marek, P.E., Director of Engineering & Safety Operations  
Lauren D. Garduño, P.E., Director of Project Planning & Development  
Randy C. Hopmann, P.E., Director of District Operations  
Darran Anderson, Director of Strategy and Innovation  
Rene Garcia, P.E., Director, Design Division  
Gregg A. Freeby, P.E., Bridge Division Direction



## MEMO

April 7, 2017

**To:** District Engineers

**From:** William L. Hale, P.E.  
Chief Engineer 

**Subject:** Statewide Procedures for Traffic Management Systems

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The Traffic Operations Division (TRF) is working to upgrade and coordinate the state's Traffic Management System (TMS). With the Information Management Division (IMD) we are looking to improve technology, processes and procedures, and help all districts implement state-of-the-art TMS practices.

A strategic statewide TMS that includes strong Intelligent Transportation System (ITS) practices and traffic signal operations provides the most cost effective means to address safety, congestion, mobility, connectivity, maintenance and emergency response available. Operating the state roadway system in the most efficient manner is expected.

TRF has outlined a common set of objectives for the Districts. Over the coming months, IMD and Traffic will be working with each district to determine the approach and investments needed to meet these objectives. Each district will be expected to ensure (1) TMS is included in each project's planning, development, design, construction, maintenance and operation, and (2) provide specific TMS projects where gaps exist between typical road and bridge projects. Funding for these efforts is expected to be included as an element of each project in the selection process of the Unified Transportation Program.

TMS procedures will be discussed in next week's Engineering Operations and Quarterly Senior Leadership meeting (April 11-13, 2017), and the upcoming Directors of Operations Meeting (April 24-26, 2017).

Please contact Michael Chacon, 512-965-3073 if you have questions.

Attachment

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## Statewide Procedures for Traffic Management Systems

The Texas Department of Transportation is currently outlining statewide procedures for future implementation and upgrades to Traffic Management Systems (TMS), which includes Intelligent Transportation Systems (ITS) and Traffic Signal operations across the state on-system roadways.

The Traffic Operations Division (TRF) will take the lead in introducing and coordinating these procedures, and Information Management Division (IMD) will support the Districts by assisting with technology solutions for District needs. The Districts have the responsibility of local implementation of these TMS procedures.

The Metro Districts and El Paso will be the focus of these TMS implementation and upgrade procedures. The procedures will later be expanded based on lessons learned and adapted to Urban and Rural Districts.

### Traffic Management Systems

TMS has been proven to improve mobility and safety, and is widely recognized as having high return on investment. Per the Chief Engineer's memo from July 2016, ITS needs must continue to be considered early in project development, design, and construction.

As the department increases investments for congestion relief, it is imperative that TMS and operational improvements complement the construction and maintenance program efforts. This includes ensuring TMS planning is involved in the early stages of project development and design, and adequately preserving these systems during construction. In addition, as technology and data continue to evolve, it is critical to ensure this information and infrastructure is secure, meets industry best practices, and is prepared for future innovations in transportation.

There is large variation in traffic management performance across the state. Some Districts have adopted leading best practices, and some Districts have gaps in performance due to limited resources or prioritization among other efforts. To achieve a level of uniformity and implementation, the Districts working with TRF and IMD, are expected to plan and implement TMS efforts from FY 2017-2019 to achieve the following goals and improvements:

1. Equipment maintenance and asset management: Ensure 90%+ equipment is operational including feasible areas under construction; implement asset and network management

2. System coverage and planning for innovation and expansion: Prioritize, plan, execute projects through UTP process to increase ITS coverage and network connectivity on all interstates and other key roadways on the state system; Prepare the system for future innovations in infrastructure
3. Incident Management: Collect incident clearance data, set targets, and continuously improve incident management processes in collaboration with regional partners
4. Work zone management: Minimize adverse impact of work zones on the public (in terms of crashes or delays), use "smart" technologies, and improve planning and operation of work zones in ongoing construction and maintenance activities
5. Communicating with public through Dynamic Message Signs (DMS) and media: Improve travel time reliability and proactively provide public effective traffic info on-road, online, at home (through DMS and media, sharing with partners, and private sector)
6. Implement strategies to improve traffic flow: Where feasible, expand use of Active Transportation Demand Management (ATDM) and increase integration of Signals and ITS network to manage flow across on-system highways and arterials

While each District has a different starting point, TRF has outlined a common set of objectives for the Districts. Each District can define their own best approach and investments needed to meet these objectives. This includes ensuring TMS is included in the early stages of project development, planning and design, and that district projects adequately preserve systems during construction.

Districts can learn from each other by sharing best practices, how to plan projects to include TMS where appropriate, fund, implement Traffic Management improvements. TRF will facilitate best practice sharing, and IMD will support common technological solutions across districts. In the future, TRF will also provide Transportation Systems Management and Operations (TSM&O) guidance for the Districts. The Administration will regularly review the performance of TMS in TRF and the Districts.

TRF will begin the introduction of these TMS procedures in the upcoming Quarterly Senior Leadership meeting (Apr 11-13, 2017), and the upcoming Directors of Operations Meeting (April 24-26, 2017). With District input and review, performance metrics will be rolled out in the Engineering Operations dashboard initially using data from the Metro Districts and El Paso. As part of the upcoming FY 2018 update of the Unified Transportation Program (UTP), TRF Division will work with Metro Districts and El Paso to compile funding needs for FY 2018-2019 to ensure Traffic Management needs are fully considered.

New Information Technology solutions by IMD to support Districts' traffic management needs are being piloted with Districts in FY 2017, and will be expanded going forward. In meetings with the ITS and Operations District staff, TRF will continue to facilitate best-practice sharing across Districts, and TRF and the Districts will review progress of implementing these procedures to report back to Administration.



Based on District, TRF and Administration input, the following 4 metrics will be reviewed as a pilot in FY 2017.

- TMS asset operational uptime to measure how Districts maintain their traffic management equipment, is the most critical metric to improve in the short-term
- Incident clearance times to measure mobility on our system, driven by District incident management processes in collaboration with regional partners
- Level of travel time reliability, an FHWA MAP-21 recommendation, to measure impact on the public from traffic management strategies applied to on-system roads e.g. work zone management, DMS, etc.
- TMS system coverage to measure and understand what portion of on-system roadways are adequately covered with ITS equipment and communications, or where coverage needs to be expanded

IMD has been tasked with leading the aggregation of data across Districts for Engineering Operations and ADM dashboards. IMD will work with the Metro and El Paso Districts and TRF to address gaps in systems, with the goal to have full data across these metrics established by the end of FY 2017. Additional data or analyses may be used by Districts to demonstrate progress or improve performance.

As part of the District interviews conducted, several technology solutions have been identified as a priority need for Districts to improve Traffic Management systems and operations. IMD will lead the implementation of the following technology solutions to meet District needs.

- Asset management system: IMD will prototype a software with Forth Worth District in FY17 to set up processes to track asset details, manage repairs, and support better planning and use of maintenance funds.
- Network monitoring and management: IMD will prototype a system with Austin District and TRF's Cedar Park facility in FY17 to monitor the traffic management network to diagnose and troubleshoot ITS or Signal connectivity issues and manage network connections. Solutions to improve the network monitoring will also incorporate IMD's recommendations for improving security of the traffic management network infrastructure.
- Data analytics: IMD will define analytical tools for traffic management operations and planning using historical or real-time traffic data. These may include use of existing tools or new complex approaches such as simulation of traffic situations, in collaboration with the research community and private sector.
- Resource Requirements: IMD will advise ADM on a continuing basis of the technology and monetary resources needed to upgrade and implement TMS technology both at the statewide level as well as the individual district level.

These solutions will help improve system performance and reliability, reduce time or risk of manual efforts in the field, and help Districts best allocate their resources. District are requested to work with TRF and IMD to provide feedback on how these common technology solutions can be adopted to meet the Districts' needs and industry best practices. The goal is to expand these solutions to other Districts as appropriate in FY 2018-2019.

Initially, each Metro District and El Paso will submit the current status of their TMS and upgrade/implementation plans for the next twelve months to TRF on September 1, 2017 and March 1, 2018. TRF will compile these status reports and annual plan reports for the Chief Engineer on October 1, 2017 and April 1, 2018. TRF will provide a format for these reports.

For any questions related to the TMS upgrades and implementation, or performance metrics, please contact Michael Chacon, Traffic Operations Division Director. For any questions around the technology solutions, please contact Cassie Jordan, IMD Section Director for Strategy and Portfolio Management.