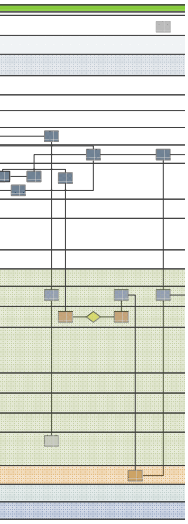
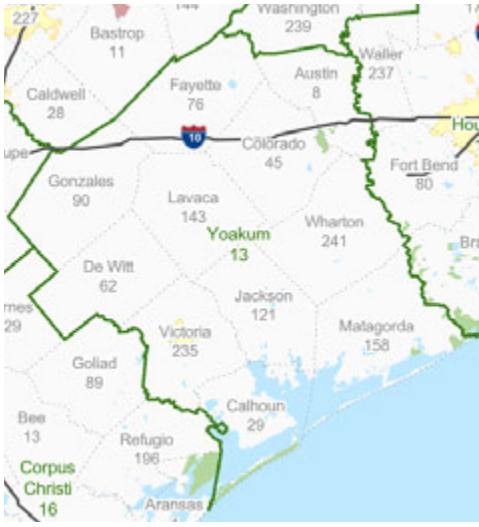
TRANSPORTATION SYSTEMS MANAGEMENT AND OPERATIONS (TSMO)





YOAKUM DISTRICT PROGRAM PLAN

January 2021

Texas Department of Transportation

Document Control

Version	Date	Description of Change	Author
0.1	06/18/2020	Initial draft for Yoakum District Operations staff review	DKS Associates Team
0.2	07/02/2020	Revised draft with initial comment incorporation based on 07/02/2020 review meeting	DKS Associates Team
0.3	07/20/2020		
0.4	11/03/2020	Incorporated 07/30/2020 workshop comments	DKS Associates Team
0.5	12/03/2020	Incorporated final comments from Yoakum District staff	DKS Associates Team
1.0	01/07/2021	Added front cover and back cover	TxDOT Communications Division

Table of Contents

List of Figures

List of Tables

List of Acronyms

Acronym	Definition
AADT	Annual Average Daily Traffic
AASHTO	American Association of State Highway and Transportation Officials
AE	Area Engineer
ARC-IT	Architecture Reference for Cooperative and Intelligent Transportation
AUS	Austin District
BP	Business Processes
CMF	Capability Maturity Framework
CMM	Capability Maturity Model
CO	Collaboration
CRIS	Crash Records Information System
CU	Culture
DE	District Engineer
DMS	Dynamic Message Sign
DOT	Department of Transportation
DPS	Department of Public Safety
EA	Engineering Assistant
EOC	Emergency Operations Center
FAST	Fixing America's Surface Transportation
FHWA	Federal Highway Administration
FTE	Full Time Equivalent (referring to full-time staff position)
FY	Fiscal Year
HSIP	Highway Safety Improvement Program
HOU	Houston District
I2V	Infrastructure-to-Vehicle
IT	Information Technology
ITS	Intelligent Transportation Systems
LOTTR	Level of Travel Time Reliability
MAP-21	Moving Ahead for Progress in the 21st Century Act
MPO	Metropolitan Planning Organization
MTP	Metropolitan Transportation Plan
N/A	Not Applicable
NHS	National Highway System
NPMRDS	National Performance Management Research Data Set

Acronym	Definition
NWS	National Weather Service
O&M	Operations and Maintenance
OW	Organization and Workforce
PIO	Public Involvement Office
PM	Performance Measurement
RIMS	Regional Incident Management System
RtZ	Road to Zero
SAT	San Antonio District
SHRP	Strategic Highway Research Program
SOP	Standard Operating Procedure
ST	Systems and Technology
STIP	Statewide Transportation Improvement Program
TIM	Traffic Incident Management
TIP	Transportation Improvement Program
TMC	Transportation Management Center
TMS	Traffic Management System
TP&D	Transportation Planning & Development
TRF	Traffic Division (Central Office)
TSMO	Transportation Systems Management & Operations
TTI	Texas A&M Transportation Institute
TxDOT	Texas Department of Transportation
US	United States
US DOT	United States Department of Transportation
UTP	Unified Transportation Program
YKM	Yoakum District

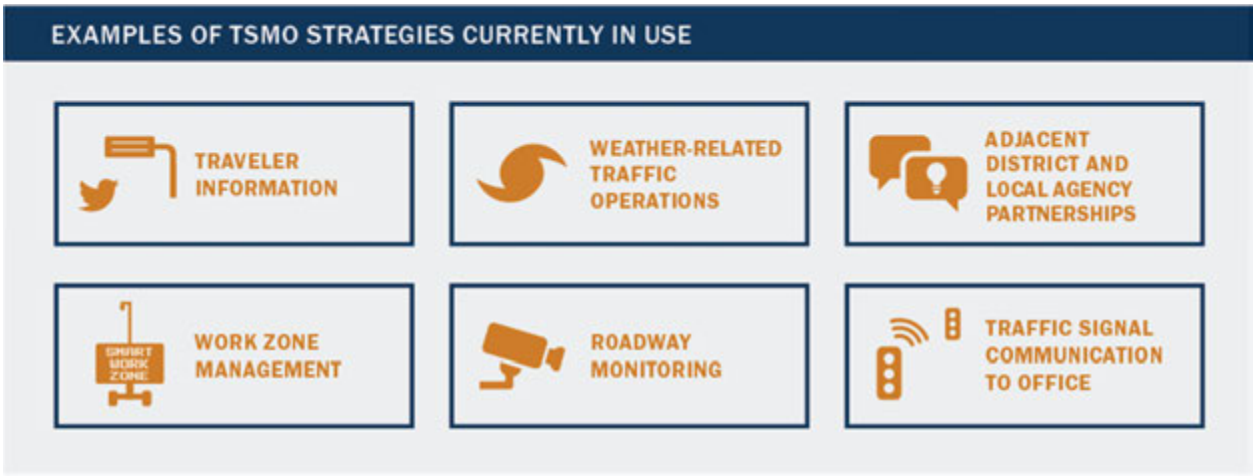
Executive Summary

The Yoakum District Transportation Systems Management and Operations (TSMO) Program Plan documents the Yoakum District's strategic vision, mission, and goals; current TSMO processes; and recommended actions to implement data-driven decisions to make the transportation network safer, more efficient, and reliable.

The TSMO Plan includes recommendations to improve workforce development, business processes, systems and technology, collaboration, and performance measurement to support, streamline, and institutionalize TSMO projects and practices.

WHAT IS *TSMO*?

TSMO represents a philosophical shift in how agencies manage their transportation systems in recognition of the limits of traditional roadway capacity expansion for managing congestion and operations. It employs state of the art traffic management practices coordinated across multiple jurisdictions, agencies, and modes.



TSMO Vision, Mission, and Goals

STATEWIDE TSMO VISION

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

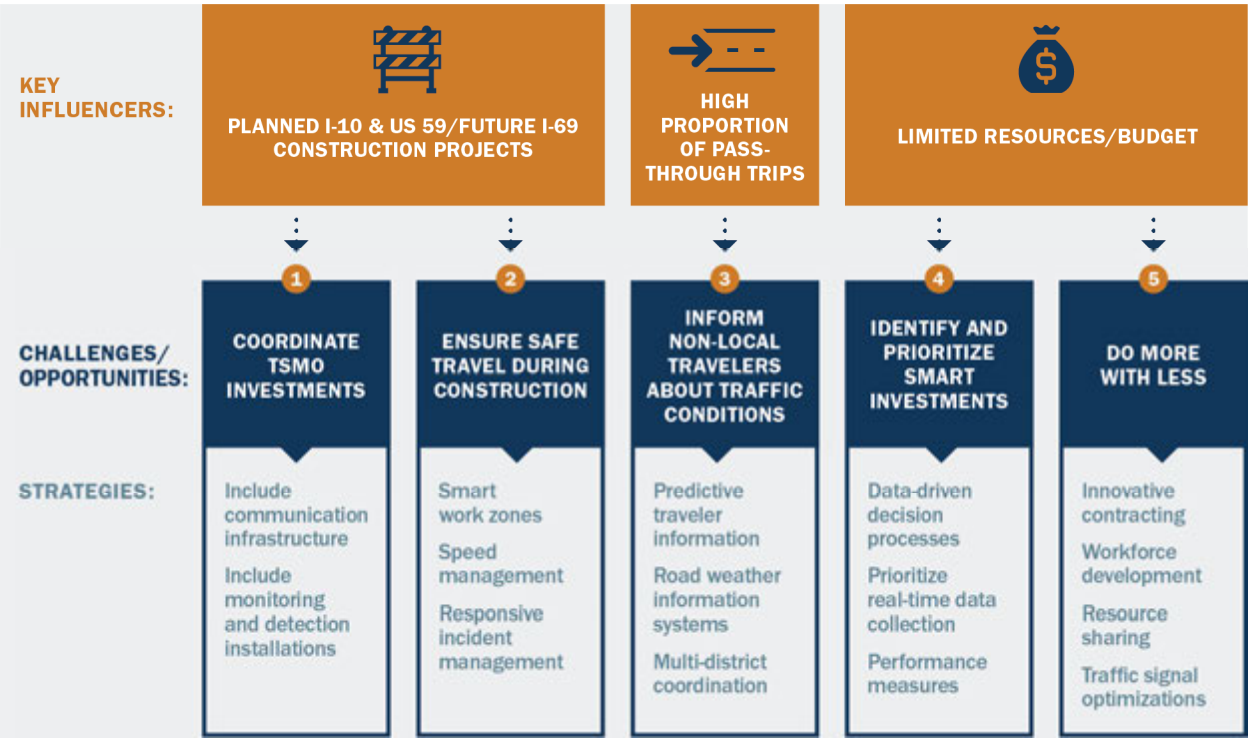
STATEWIDE TSMO MISSION

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

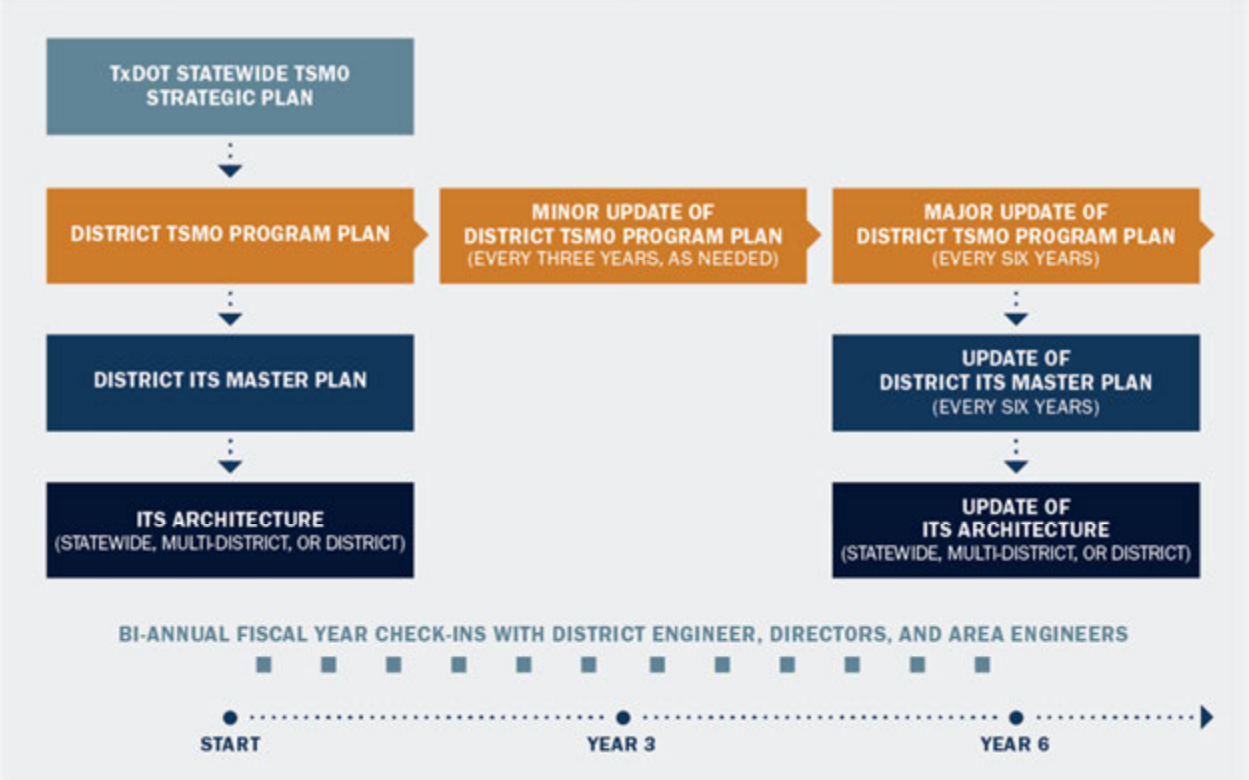
STATEWIDE TSMO GOALS AIM TO IMPROVE:

SAFETY | RELIABILITY | EFFICIENCY | CUSTOMER SERVICE | COLLABORATION | INTEGRATION

The Business Case for TSMO



Yoakum District Update Process



Proposed Early Actions

	Business Processes (BP)
BP 01	Review construction projects, including as part of the pre-design agenda, to incorporate TSMO and document the process for consideration and incorporation of TSMO elements.
BP 02	Consider all available traffic signal management approaches and statewide standards as part of the traffic signal upgrade decisions for the district.
BP 03	Formalize intelligent transportation system (ITS) operations & maintenance agreement with TxDOT Houston District (HOU)—funding, roles, responsibilities.
BP 06	Document process, including roles and responsibilities, for reporting incidents to Houston TranStar and San Antonio TransGuide traffic management centers (TMCs).
BP 07	
	Systems and Technology (ST)
ST 01	
	Collaboration
	Collaborate with the Traffic Division (TRF) to implement statewide TSMO initiatives within the Yoakum District.

Introduction

The Yoakum District Transportation System Management and Operations Plan (Yoakum TSMO Plan) prioritizes reliable strategies for operations and management of the existing transportation infrastructure to utilize it at its full potential. The Yoakum TSMO Plan supports the TxDOT TSMO Statewide Strategic Plan (TxDOT, 2018) by providing a district-level approach. Strategies including traffic incident management, traveler information, work zone management and freight management will help transportation engineers and planners to proactively manage the system in real time and improve system efficiency. TSMO has become a key strategy across the country to prepare for ever-increasing congestion, limited funding, and the expanding role of technology in our transportation network.

The Yoakum TSMO Plan includes recommendations to improve workforce development, business processes, systems and technology, collaboration, and performance measurement designed to support, streamline and institutionalize TSMO projects and practices. Implementing the Yoakum TSMO Plan will improve project delivery processes by integrating mobility-focused solutions throughout planning, programming, design, construction, operations, and maintenance phases. By collaborating with partner agencies and implementing data-driven decisions, the transportation network will be safer, more efficient, and improve reliability for all travelers.

Program Plan Format

Key components of the Yoakum TSMO Plan:

- An introduction to TSMO and a description of the Yoakum District boundaries
- The business case for why TSMO is needed in the Yoakum District
- The TxDOT statewide mission, vision, goals, and objectives based on which the Yoakum TSMO objectives were created, and which forms the foundation of the action items in the implementation plan
- A brief discussion of the capability maturity model (CMM) dimensions with the successes and challenges of the district identified in each of the six dimensions
- An Implementation Plan of action items including timeline, Yoakum District lead, partners (e.g., adjacent districts, Traffic Division, external agencies), resources, and measures of success

What is TSMO?

Traditionally, roadway capacity expansion has been the primary tool for managing transportation congestion and operations. However, capacity expansion does not adequately address the needs of the modern transportation system:

- Increasing congestion overwhelms new capacity projects even before completion
- Limited funding requires that departments must decide between maintaining the system they have or adding more capacity

PHILOSOPHICAL SHIFT

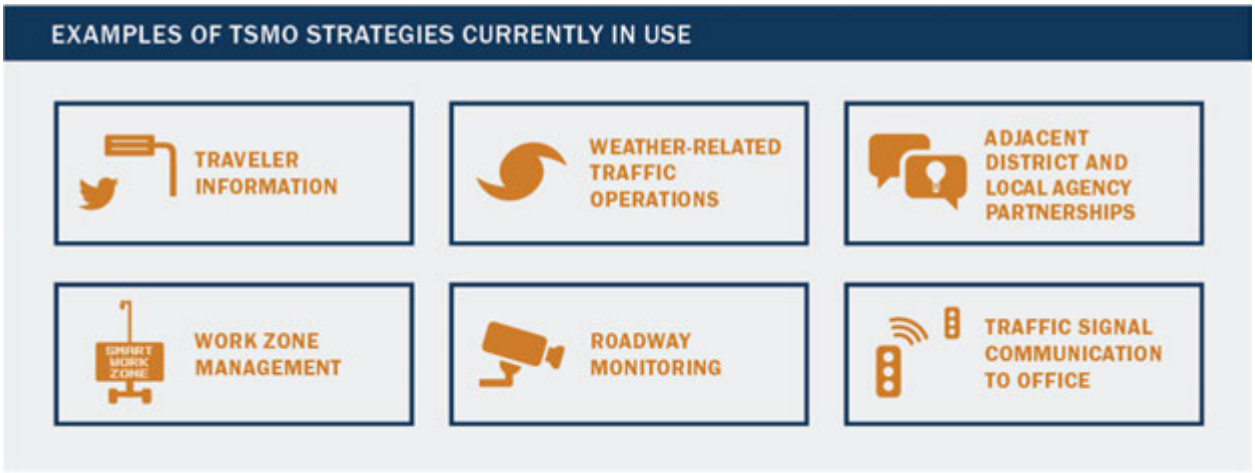
TSMO represents a philosophical shift in how agencies manage their transportation systems. It employs state-of-the-art traffic management practices coordinated across multiple jurisdictions, agencies, and modes.

- The expanding role of technology including connected and automated vehicles, traveler information, system maintenance, and safety improvements

Implementing a TSMO Program Plan encourages the Yoakum District and partners to evaluate a broad range of options, in addition to considering capacity solutions, to solve safety, mobility, and reliability challenges.

The Yoakum TSMO Plan supports district Traffic Management Systems (TMS) performance measures, a priority identified by Chief Engineer Bill Hale. Initial metrics identified that are currently being monitored include TMS asset operational uptime and TMS coverage. Incident clearance times and level of travel time reliability have been identified as future measures for the Yoakum District. The Chief Engineer's memos are included in the appendix of the TxDOT TSMO Statewide Strategic Plan (TxDOT, 2018).

TSMO will be integrated into existing plans, programs, and business processes as much as possible. Like the Yoakum District, each TxDOT district is developing a District TSMO Program Plan.



Project Boundaries

The Yoakum District is shown in Figure 1, and includes 11 counties, 11 Maintenance Offices (one located within each county), and three Area Offices. The City of Victoria is the largest metropolitan area in the district and the only city to have a Metropolitan Planning Organization (MPO).

Current Yoakum District TSMO State of the Practice

The Yoakum District is already applying TSMO tools at varying levels and consistency as described in Table 1 for the district, transportation planning and development (TP&D), construction, and operations. Additional details and supporting documents are provided in the Yoakum District State of the Practice Report (TxDOT Yoakum District, 2020). The current TSMO activities were reviewed as part of the Capability Maturity Model, described later in this plan.

TABLE 1. YOAKUM DISTRICT TSMO CURRENT STATE OF THE PRACTICE

Group	TSMO Activity
TP&D	▪ Permanent ITS to support TSMO strategies are included during project planning and programming phases, including prioritized TSMO investments along major hurricane evacuation routes ▪ Many ongoing and upcoming design projects include ITS and communications
Construction	
Maintenance	▪ District traffic technicians help troubleshoot power and communications issues for ITS devices but rely heavily on the Houston District for ITS maintenance ▪ Maintenance crews respond to traffic incidents when requested by law enforcement
Operations	▪ Houston TranStar operates and manages the ITS devices in the district through an informal agreement; Conversations have taken place with San Antonio TransGuide for a similar arrangement for the western portion of the district ▪ District plans to have all 144 traffic signals connected by cellular modems within the next few years to connect with the statewide central signal system under development ▪ An ITS Master Plan was recently developed that describes existing and planned infrastructure (dynamic message signs, cameras, detection, future high-water detection system) and includes a prioritized deployment plan (TxDOT Yoakum District, 2020)

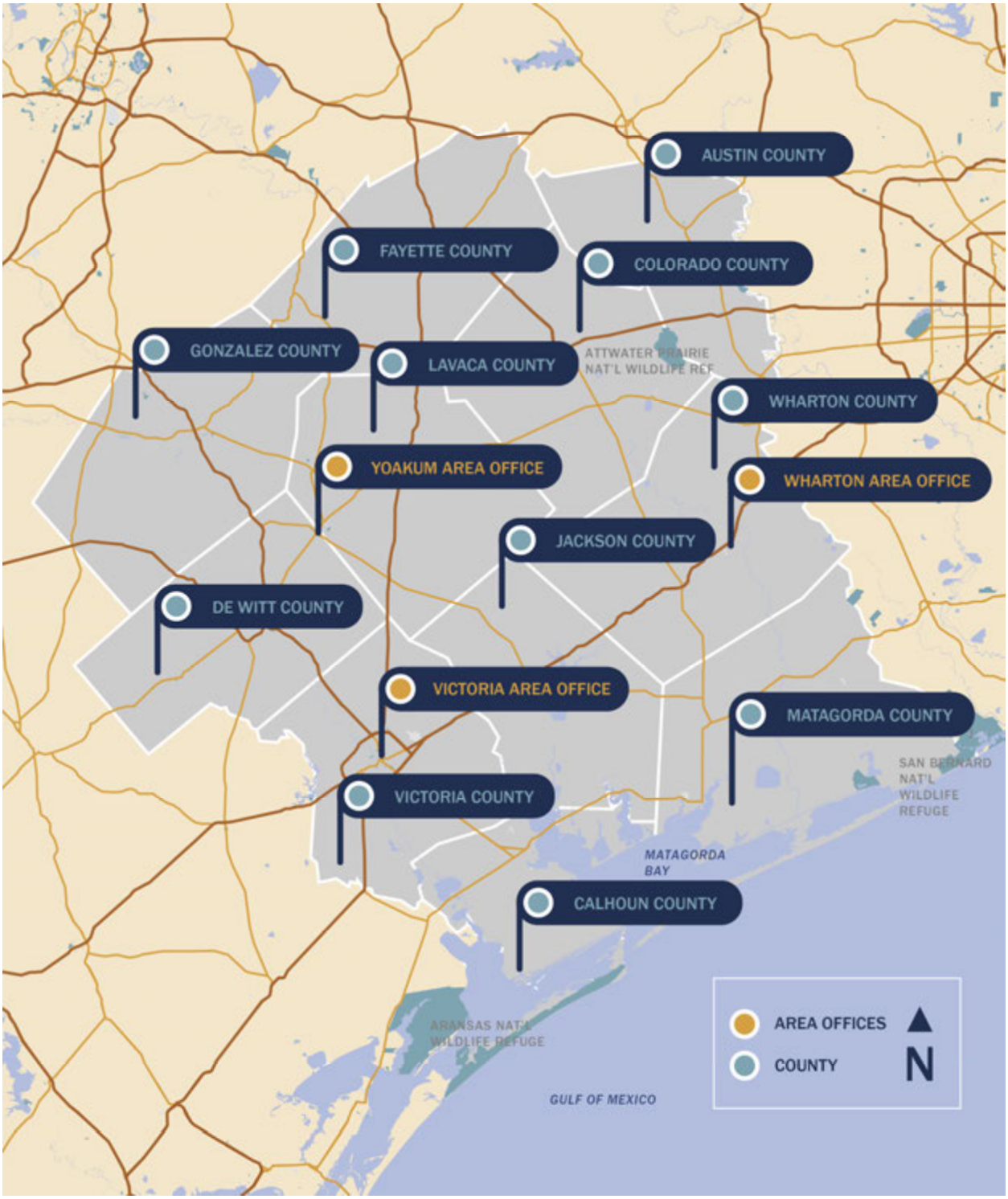


FIGURE 1. YOAKUM DISTRICT AREA MAP

Stakeholder Involvement

Stakeholders from a variety of practice areas within the district were engaged in the development of the Yoakum TSMO Plan through a series of meetings, workshops and phone calls between August 2019 and October 2020. Stakeholders are acknowledged in Appendix A. The stakeholder process is documented in the Outreach Plan (TxDOT Yoakum District, 2020) and depicted below in Figure 2. The Operations Group works closely with the District Engineer (DE), who attended the ITS Needs Assessment workshop. Both the Director of Operations and District Traffic Engineer have provided status updates to the DE as this TSMO Plan was developed.

FIGURE 2. STAKEHOLDER OUTREACH PROCESS

Business Case for TSMO in the Yoakum District

The Yoakum District plans, designs, builds, operates, and maintains the state transportation system in 11 counties: Austin, Calhoun, Colorado, DeWitt, Fayette, Gonzales, Jackson, Lavaca, Matagorda, Victoria and Wharton. The district is responsible for two major corridors, I-10 and US 59/Future I-69. Other key corridors include US 87, US 77, US 183, and SH 36. There is a high volume of energy-related traffic in the district as well. Several construction and design projects are underway to upgrade US 59 throughout the district to I-69 standards and add additional lanes to I-10. The district spends an average of $12 million to seal coat 300 miles of roadway each year. Due to the district's proximity to the Gulf of Mexico, hurricane evacuation planning is a critical function of the Yoakum District. Many state highways throughout the area have been designated as hurricane evacuation routes. The district's safety program has over $40 million budgeted for the next four years, which includes projects underway to widen roads, add turn lanes and improve curve safety. Also, the district is working on upgrading existing traffic signals and adding overhead lighting.

In light of the profile of the district, the business case of TSMO stems from the ability of TSMO strategies to support travel reliability, economic activity and transportation safety in the region. TSMO brings together many disparate activities currently underway in the district under a unifying umbrella that builds connections both within the agency (between various sections in the district – planning, design, construction, operations, maintenance) and with regional partners (law enforcement, cities, counties, weather service, etc).

Figure 3 below summarizes the business case for TSMO in the Yoakum District, highlighting the key influencers in the district, challenges and/or opportunities resulting from these influencers, and relevant TSMO strategies to address them. The paragraphs that follow provide additional discussion about the business case.

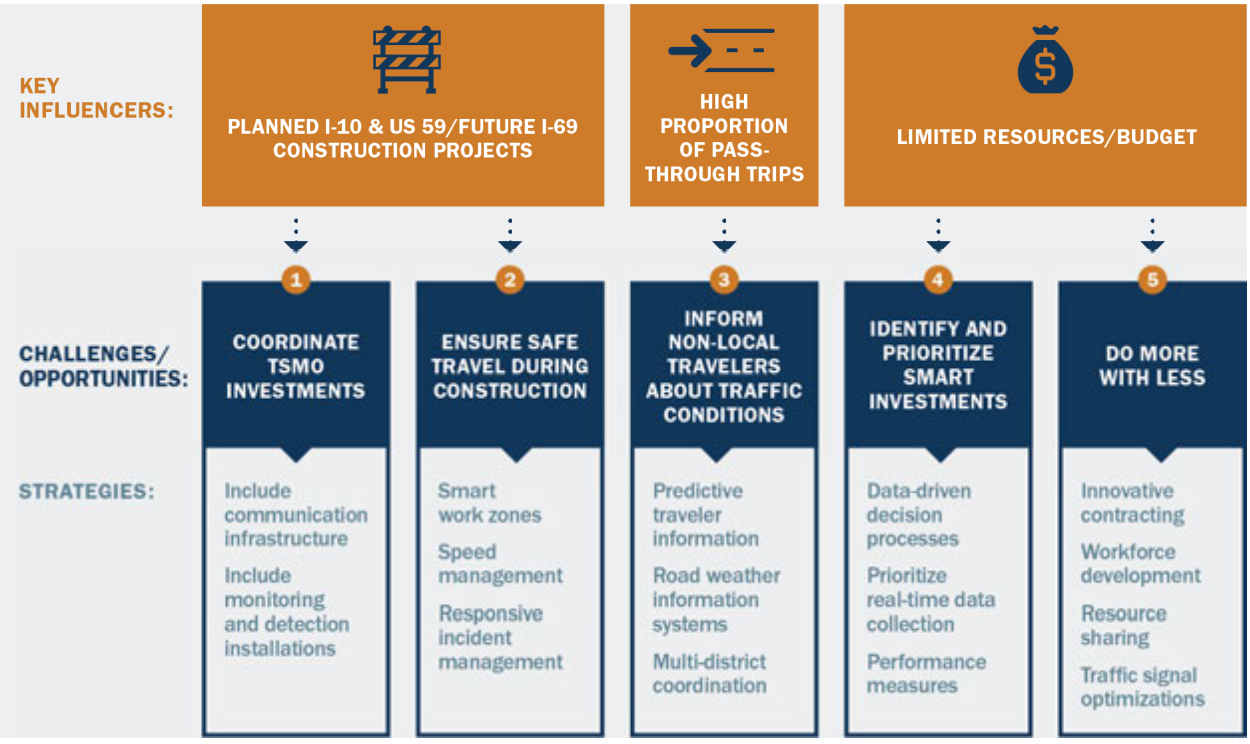


FIGURE 3. YOAKUM DISTRICT BUSINESS CASE FOR TSMO — INFLUENCERS, CHALLENGES / OPPORTUNITIES, AND STRATEGIES

I-10 classifies as primary highway freight system roadway i.e. most critical highway portions of the United States. Traffic also continues to grow on US 59/Future I-69, which needs upgrades to bring sections up to interstate standards. The role and the business case of TSMO is two-fold for the Yoakum District.

- Can we utilize the reconstruction and capacity investment opportunities to add capabilities for improved communications, monitoring and control along the facility? By using the construction projects as opportunities to integrate TSMO strategies, safety and reliability of travel can be improved. TSMO strategies that reduce conflict points, provide information to travelers, and allow quicker incident response are becoming more widely available. Traffic incident management can decrease incident duration by 30% to 40%. Smart work zones reduce delay and improve safety and customer satisfaction.
- Second, can we manage travel and continuity of traffic better during periods of construction? TSMO strategies, especially around work zone management, speed management and traveler information can reduce queues, reduce overall delays, improve safety of travelers and responders and support overall freight movement.

Decisions about travel, especially for freight and long-distance through travel are made outside the district boundaries. As a consequence, travelers and truck traffic arriving in the Yoakum District may not be aware of work zones, lane closures or weather-related capacity restrictions. TSMO strategies like predictive traveler information especially for long-distance travel (like the I-35 Work Zone Project) might be particularly useful especially in combination with statewide resources as well as when used in conjunction with the Houston and San Antonio Districts. Road weather information systems can reduce traveler delay and lower crash rates by 7% to 83%.

TSMO strategies are generally low-cost compared to capacity investments. More importantly, they are extremely cost-effective in terms of the impacts produced. By utilizing the data generated by TSMO and combining it with existing TxDOT resources, investments for both TSMO or for other transportation investments can be based on performance. TSMO is a catalyst to establish and ensure the availability of reliable real-time data sources, expert staff, and clear performance measures to effectively collect, report, and share data and to monitor performance for the district. Traffic signal optimization can decrease delay substantially (13% to 94%) while improving safety at a fraction of the cost of infrastructure capacity expansion.

Compared to large urban districts, the region has less resources (in terms of workforce, funding and systems) to devote to TSMO. Limited TSMO asset management tools and practices make it difficult to plan for system maintenance, upgrades, and replacement. This creates an onus on the district to integrate TSMO into transportation planning, programming, scoping, and in particular engineering, with more collaboration between highway design and operations. The case to creatively address operations & maintenance (O&M) and information technology (IT) issues associated with TSMO assets (ITS infrastructure, back-office systems, traffic signal infrastructure, and priority treatments) through innovative contracting, workforce development, resource sharing (with other districts) are critical to TSMO in the district.

TSMO Vision, Mission, Goals, and Objectives

The Yoakum District supports the statewide TSMO vision, mission and goals and has developed district-specific objectives to support the statewide goals as described in this section.

Yoakum District TSMO Goals and Objectives

The Yoakum District supports each of the six statewide TSMO goals (safety, reliability, efficiency, customer service, collaboration, and integration) and has developed objectives for the district under each goal to support ongoing monitoring of the effectiveness of the TSMO Plan. Measurable objectives have been set where baseline data is available to track performance. Other objectives are aspirational and should be re-visited with future TSMO Plan updates once the district has established more performance metrics and data sources. The Yoakum District objectives are listed in Table 2.

TABLE 2. STATEWIDE AND YOAKUM DISTRICT TSMO GOALS AND OBJECTIVES

Goal	Strategic Statewide Objectives	Strategic Yoakum District Objectives
Safety	Reduce crashes and fatalities through continuous improvement of traffic management systems and procedures.	▪ Reduce 5-year average fatalities by half by 2035. ▪ Reduce fatalities to approach zero by 2050. ▪ Reduce severe injury crashes (both incapacitating and non-incapacitating). ▪ Reduce work zone crashes.

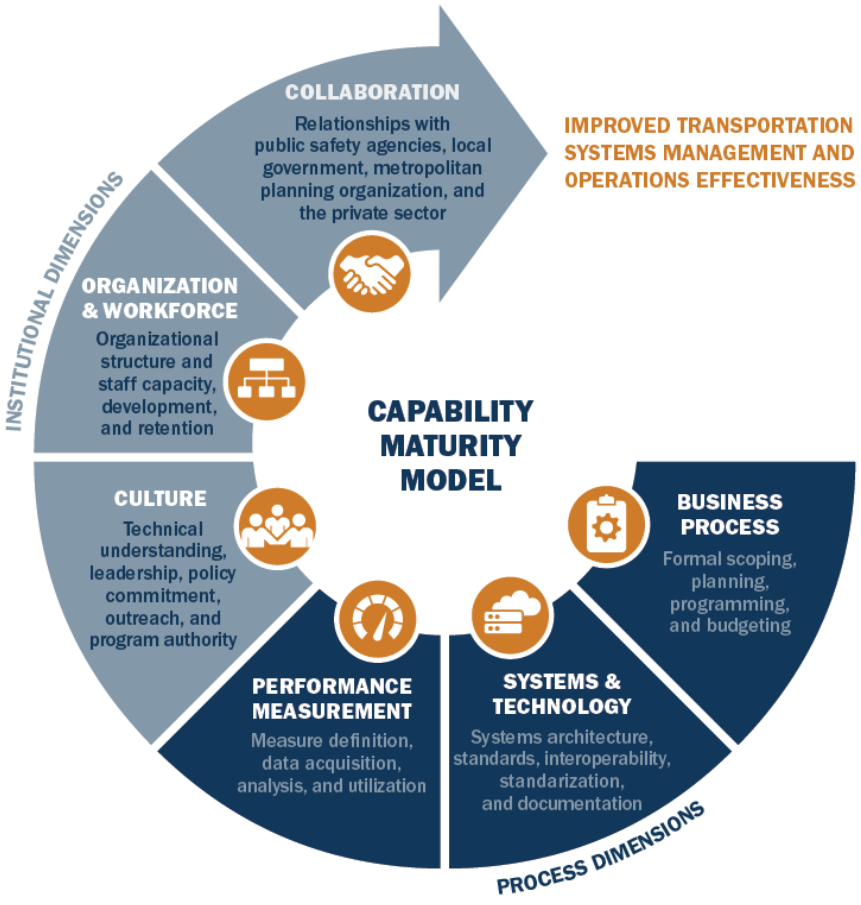
Goal	Strategic Statewide Objectives	Strategic Yoakum District Objectives
		▪ Increase the implementation of data-driven safety countermeasures on district highways and review status annually.
Reliability 	Optimize travel times on transportation systems in critical corridors to ensure travelers are reaching their destinations in the amount of time they expected for the journey.	▪ Increase travel time reliability of person-miles traveled on I-10 and US 59/Future I-69. ▪ Increase ITS-related assets in use for incident and emergency detection/response on I-10 and US 59/Future I-69 to 100 percent coverage by 2030. ▪ Reduce average incident clearance time on state highways.
Efficiency 	Implement projects that optimize existing transportation system capacity and vehicular throughput.	▪ Maintain a program of evaluating 100 percent of signals for retiming every three years.
Customer Service 	Provide timely and accurate travel information to customers so they can make informed mobility decisions.	▪ Reduce time between incident/emergency verification and posting an alert to traveler information outlets (e.g. dynamic message sign (DMS), website, social media). ▪ Reduce the time between recovery from incident/ emergency and removal of traveler alerts for that incident. ▪ Increase number of repeat visitors to Yoakum section of DriveTexas.org during major events (e.g. floods, hurricanes).
Collaboration 	Proactively manage and operate an integrated transportation system through multi-jurisdictional coordination, internal collaboration, and cooperation between various transportation disciplines and partner agencies.	▪ Meet twice each fiscal year with representatives from the four core departments TP&D, Construction, Maintenance, and Operations) and the three Area Offices to review TSMO implementation status. ▪ Hold after-action review meetings with attendance from at least 90 percent of the agencies involved in the response to a major incident/emergency or adverse weather event.
Integration 	Prioritize TSMO as a core objective in the agency's planning, design, construction, operations, and maintenance activities.	▪ Maintain 90 percent TMS asset operational uptime annually. ▪ Expand network monitoring with automated failure alerts to 100% of traffic signals by 2023. ▪ Conduct joint training exercises in the district that support shared implementation of TSMO strategies.

Capability Maturity Model

Existing capabilities, gaps and needs for TSMO in the Yoakum District were identified through a combination of interviews and workshops. Tools used to gather capabilities were the TSMO Capability Maturity Model and Frameworks. The Capability Maturity Model (CMM) self-assessment framework is comprised of six dimensions of capability—three process-oriented dimensions and three institutional dimensions. The Capability Maturity Frameworks (CMFs) are based on the same dimensions but are focused on specific aspects of TSMO like work zone management.

The use of the capability maturity concepts provides an approach to review common barriers to adoption and success of TSMO and allows agencies to understand and identify actions for improvement of institutional issues that an agency faces on a continual and consistent basis. The process fosters an agency's ability to develop consensus around needed agency improvements; identify their immediate priorities for improvements; and identify concrete actions to continuously improve capabilities to plan, design, and implement TSMO.

The six dimensions of capability assessed for the Yoakum District are illustrated in Figure 4. Note that the first three dimensions—Business Process, Systems & Technology, and Performance Measurement—are process-oriented, while the final three—Culture, Organization & Workforce, and Collaboration—are institutional-oriented.



Source: Strategic Highway Research Program (SHRP2), American Association of State and Highway Officials (AASHTO), and Federal Highway Administration (FHWA-HOP-17-017)

FIGURE 4. CAPABILITY MATURITY DIMENSIONS

Consistent with federal CMM and CMF guidance (SHRP2/AASHTO/FHWA, 2017), the capabilities for each dimension are described as a matrix that defines the process improvement areas and levels (from Level 1, ad-hoc, to Level 4, optimized level of capability). Following a self-assessment process, specific actions are identified to increase capabilities across the desired process areas.

The capability assessment process, tool, and instructions were discussed with stakeholders during the workshop (TxDOT Yoakum District, 2020). The overall assessment of capability provided in Table 3 is based on the input provided during the workshop. Workshop participants rated themselves at a Level 3 for business processes, a Level 2 for organization and workforce and collaboration, and between Levels 1 and 2 for systems and technology, performance measurement, and culture. Table 3 presents the criteria for CMM assessment and Table 4 presents the self-assessment results.

TABLE 3. CMM ASSESSMENT CRITERIA

DIMENSION	LEVEL 1 PERFORMED	LEVEL 2 MANAGED	LEVEL 3 INTEGRATED	LEVEL 4 OPTIMIZED
Business Processes	Processes related to TSMO activities ad hoc and un-integrated	Multi-year, statewide TSMO plan and program exists with deficiencies, evaluation, and strategies	Programming, budgeting, and project development processes for TSMO standardized and documented	Processes streamlined and subject to continuous improvement
Systems & Technology	Ad hoc approaches outside systematic systems engineering	Systems engineering employed and consistently used for ConOps, architecture, and systems development	Systems and technology standardized, documented, and trained statewide, and new technology incorporated	Systems and technology routinely upgraded and utilized to improve efficiency performance
Performance Measurement	No regular performance measurement related to TSMO	TSMO strategies measurement largely via outputs, with limited after-action analyses	Outcome measures identified and consistently used for TSMO strategies improvement	Mission-related outputs/ outcomes data is routinely utilized for management, reported internally and externally, and archived
Organization & Workforce	Fragmented roles based on legacy organization and available skills	Relationship among roles and units rationalized and core staff capacities identified	Top level management position and core staff for TSMO established in central office and districts	Professionalization and certification of operations core capacity positions, including performance incentives
Culture	Value of TSMO not widely understood beyond champions	Agency-wide appreciation of the value and role of TSMO	TSMO accepted as a formal core program	Explicit agency commitment to TSMO as key strategy to achieve full range of mobility, safety, and liveability/ sustainability objectives
Collaboration	Relationships on informal, infrequent, and personal basis	Regular collaboration at regional level	Collaborative interagency adjustment of roles/ responsibilities by formal interagency agreements	High level of operations coordination institutionalized among key players –public and private

Source: Strategic Highway Research Program (SHRP2), American Association of State and Highway Officials (AASHTO), and Federal Highway Administration (FHWA-HOP-17-017)

TABLE 4. CAPABILITY MATURITY ASSESSMENT BY WORKSHOP STAKEHOLDERS

Dimension	Level 1 Performed	Level 2 Managed	Level 3 Integrated	Level 4 Optimized
Business Processes			● ●	
Systems and Technology		● ●		
Performance Measurement		● ●		
Organization and Workforce		● ●		
Culture		● ●		
Collaboration		●	●	

● = 2020 ● = 2026

During the workshop stakeholders also assessed each of the six dimensions for six frameworks. Table 5 includes the overall assessment and a detailed assessment report and survey are included in the CMF Assessment (TxDOT Yoakum District, 2020).

TABLE 5. CAPABILITY MATURITY FRAMEWORK ASSESSMENT BY WORKSHOP STAKEHOLDERS

Framework	Capability Level	Framework Description
Traffic Management	1 – 2	Ability to monitor and control traffic and the roadway network to coordinate traffic information
Traffic Signal Management	1 – 2	Planning, design, integration, maintenance, and proactive operation of a traffic signal system
Work Zone Management	1 – 2	

Framework	Capability Level	Framework Description
Traffic Incident Management 	2	Planned and coordinated multi-disciplinary process to detect, respond to, and clear traffic incidents
Road Weather Management 	1 – 2	Management of traffic flow and operations before and during adverse weather conditions
Planned Special Events 	1	Advanced operations planning, stakeholder coordination, resource sharing, and public awareness of potential travel impacts

The following sections breakdown the district's existing capabilities and needs among the six capability maturity dimensions.

Business Processes

This section describes the Yoakum District organization and the recommendations for incorporation TSMO into the project delivery process.

Yoakum District Organization

The TSMO program at the Yoakum District is championed by the Director of Operations and supported by the District Engineer. Directors of TP&D, Construction and Operations (which includes maintenance and traffic engineering) sections report to the District Engineer and conduct TSMO practices in their domain. As TSMO is related to all three core sections within the district, all three directors practice TSMO at varying degrees. The three Area Offices in Yoakum, Victoria, and Wharton coordinate the TSMO process at the field level. The Area Engineer for each Area Office reports directly to the District Engineer but also coordinates TSMO efforts with the Directors and support staff of the three core sections. The Safety Office and Public Information Office (PIO) report directly to the District Engineer and support all districtwide functions, including TSMO.

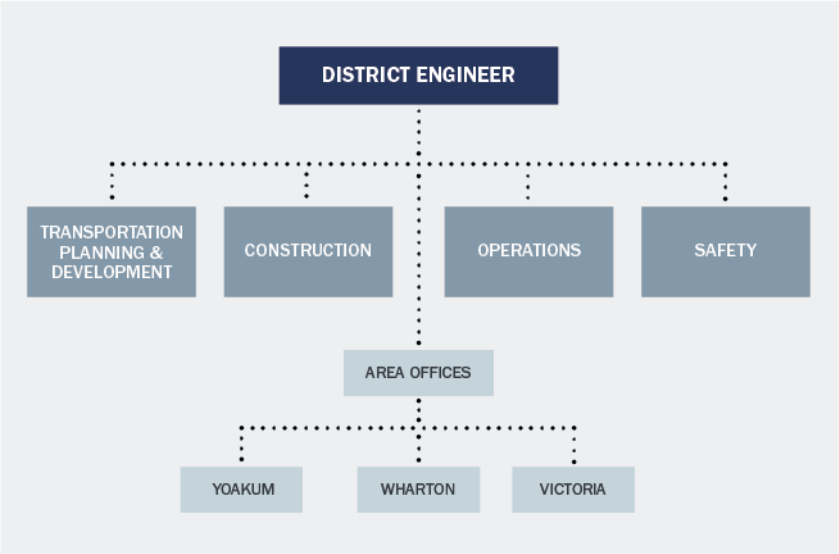


Figure 5 provides a high-level overview of the Yoakum District's organizational chart. Staff at the district may find the current detailed organizational chart with additional sub-sections, names of district leadership, and full-time equivalent (FTE) staffing numbers at any time on TxDOT's Intranet.

FIGURE 5. YOAKUM DISTRICT ORGANIZATIONAL CHART

Project Delivery Process

The Yoakum District is responsible for planning, programming, design, construction, operations, and maintenance of projects within the district. Within each of these areas, the Yoakum District applies TSMO tools at varying levels and consistency. At the CMM workshop, participants rated the business processes at a Level 3. The Yoakum District has a four-year plan, and the district meets with each Area Office annually to discuss projects and priorities. The Yoakum District has a documented process in place for programming and budgeting. They noted that their small size and good communication makes it easier for the district to be flexible and to adapt to arising needs. The Yoakum District also noted they need to increase the incorporation of TSMO into construction, safety, and maintenance projects.

The project development process at the Yoakum District comprises of six steps: Planning, Programming, Design, Construction, Operations, and Maintenance. While this process has typically been used to develop more traditional capital improvement projects, it also supports the development of projects that use TSMO strategies. Projects are identified through the planning process and prioritized projects progress through the process as funding and resources permit. Figure 6 illustrates that successes or challenges experienced in the process are communicated back to groups responsible for earlier stages so that practices are improved. Some performance metrics are also used to support the project development cycle. In the Yoakum District, this feedback loop is functional especially for larger projects and is strongest between Design and Construction and also between Construction and Maintenance.

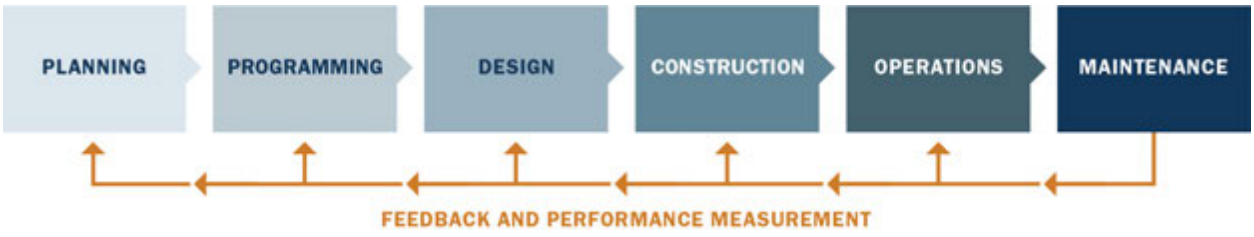


FIGURE 6. PROJECT DEVELOPMENT PROCESS AND FEEDBACK LOOP

While the Yoakum District has strong business process in place, Table 6 includes recommendations for further revising the project delivery process to incorporate TSMO. Implementation of these actions by fiscal year 2026 will advance the CMM assessment to a higher Level 3.

TABLE 6. REVISED PROJECT DELIVERY PROCESS

Project Delivery Step	Revised Process to Include TSMO
Planning	▪ Continue to consider TSMO strategies as part of the project planning process
Programming	▪ Unified Transportation Program (UTP)- include TMS infrastructure, as part of other capital projects or as stand-alone projects, that support TSMO strategies ▪ Highway Safety Improvement Program (HSIP) and Road to Zero (RtZ): Include TSMO strategies that improve safety in project calls ▪ Victoria MPO Transportation Improvement Program (TIP): Coordinate TSMO projects within Victoria County with the Victoria MPO
Design	▪ Add a section to discuss TSMO on the pre-design meeting agenda and document the process for consideration and incorporation of TSMO elements ▪ Continue to use statewide standards for traffic signal and ITS design decisions
Construction	▪ Continue to evaluate and use smart work zone strategies
Operations & Maintenance	▪ Formalize agreements with the Houston and San Antonio Districts for ITS operations and maintenance ▪ Document process for reporting incidents to Houston TranStar and San Antonio TransGuide ▪ Develop incident detour maps for I-10 and US-59/Future I-69 to identify traffic control strategies, roles, and responsibilities for major incidents that result in lane closures or full directional closures

Systems and Technology

This section describes the district's ITS Master Plan, ITS architecture, processes to vet innovative technologies, and the systems engineering analysis process.

Yoakum District ITS Master Plan and Architecture

The Yoakum District recently developed an ITS Master Plan and plans to pursue funding for implementation (TxDOT Yoakum District, 2020). This document will help the district decide where and how to implement TSMO strategies and feed into the planning and programming part of the project development process. The Yoakum District will track the implementation of the ITS Master Plan and update the plan as needed on the same planning cycle as the TSMO Plan.

The district noted a preference for a multi-district or statewide ITS architecture that the district provides input on but not one they maintain. Although the use of ITS is relatively new to the Yoakum District, the ITS regional architecture developed in 2005 is documented online (ConSysTec, 2005). The 2005 architecture was created in Turbo Architecture. Any updated district, multi-district, or statewide architecture would need to use the new Architecture Reference for Cooperative and Intelligent Transportation (ARC-IT) (US DOT, 2019). ITS devices currently used by the Yoakum District include cameras, dynamic message signs, and detection (data stations and Bluetooth). More of these devices are being installed with current or upcoming construction projects. One high-water indicator system is programmed for implementation.

The Yoakum District currently uses cellular modems at limited locations for communications to traffic signals and ITS devices. The district noted the need for a funding stream for signal replacement and communications. On the few, larger projects in the district, ITS devices that support TSMO strategies such as cameras, detection, and dynamic message signs are being included with projects during the district's planning and programming phases. For example, the upcoming design and construction projects on US 59/Future I-69 and I-10 include the installation of fiber optic cable.

Houston TranStar operates all of the Yoakum District's ITS devices to actively monitor cameras and detectors and to post messages on dynamic message signs. The San Antonio District's also manages some of the Yoakum District's ITS devices from the TransGuide TMC. The TxDOT Yoakum District is currently making upgrades to its District Office and noted the need for a video wall in several locations (e.g., signal shop, Emergency Operations Center (EOC)) to view cameras to support effective TSMO. Area Offices would also like access to camera views from their workstations.

The Yoakum District noted a number of truck incidents on US 77 at the bluff south of La Grange, and geometric improvements are not an option. They noted that due to the distance from the Yoakum Area Office, local officials typically arrive to the scene prior to TxDOT staff. The district is interested in developing a strategy to more effectively manage incidents and detours for this location.

The Yoakum District is currently implementing smart work zone trailers on a current I-10 construction project with the intention of using smart work zones on future planned construction on I-10 and the conversion of US 59 to I-69. In the Yoakum District, many of the state highways cannot accommodate a smart work zone trailer for a repaving project due to limited right-of-way or geometric conditions.

The CMM workshop participants rated systems and technology between Levels 1 and 2. The Yoakum District noted that in the past five to six years, there has been an improvement in traffic signal deployment and upgrades, and they are working on incorporating upgrades to systems and technology in other projects. The district does not currently have a central traffic signal system for remote traffic signal management but the Traffic Division is exploring the development of a system that can be shared by the districts.

Key activities to advance Systems and Technology to a solid Level 2 over the next six years:

- Implement the projects in the Yoakum District ITS Master Plan as funding allows.
- Incorporate statewide systems into operations (e.g., video brokerage, central signal control, asset management system, third-party data use)
- Establish relationship with National Weather Service (NWS) to incorporate a direct weather feed to Yoakum District and Area Offices.
- Develop Concept of Operations for queue detection for overlay projects where smart work zone trailer use is not feasible.

Processes to Vet Innovative Technologies

Although open to innovative technologies, the Yoakum District relies heavily on the Traffic Division and adjacent metropolitan districts to vet innovative technologies first before considering them for use. Pilot projects and a thorough use of the systems engineering analysis process will be considered for any innovative technologies.

Systems Engineering Analysis Process

Systems engineering, in relation to ITS, assesses the value and functionality of a high-technology project, service, or system from inception to end of life. It considers what the system requires operationally throughout its lifespan, results in better project cost and schedule adherence, and ensures that stakeholder needs are met. Systems engineering reduces the risk of schedule and cost overruns and increases the likelihood that the implementation will meet the user's needs. A detailed systems engineering process will give ITS program managers the information to identify life cycle costs for near-term and long-term budget preparation.

Systems engineering is an interdisciplinary approach to enable the realization of successful systems that:

- Focus on defining customer needs and required functionality early in the development cycle, documenting requirements, then proceeding with design synthesis and system validation while considering the complete problem
- Integrate all the disciplines and specialty groups into a team effort forming a structured development process that proceeds from concept to production to operation
- Consider both the business and the technical needs of all customers with the goal of providing a quality product that meets the user needs

In 2002, the United States Department of Transportation (US DOT) established requirements for a systems engineering analysis for any ITS project that uses funds from the Highway Trust Fund (US DOT, 2002). Currently the systems engineering process is a mature process. US DOT policy specifies that the systems engineering process should include seven requirements:

1) Identification of portions of the regional ITS architecture being implemented
2) Identification of participating agencies' roles and responsibilities
3) Requirements definitions
4) Analysis of alternative system configurations and technology options to meet requirements
5) Procurement options
6) Identification of applicable ITS standards and testing procedures
7) Procedures and resources

Benefits of the systems engineering process:

- Improved stakeholder participation
- More adaptable, resilient systems
- Verified functionality and fewer defects
- Higher level of reuse from one project to the next
- Better documentation
- Cost efficiencies

The systems engineering process represented by the "V" (or "Vee") model shown in Figure 7 has been broadly adopted in the transportation industry (FHWA California Division, 2009). The left wing shows the regional ITS architecture, feasibility studies, and concept exploration that support initial identification and scoping of an ITS

project based on regional needs. A gap follows the regional architecture step because the regional architecture is a broader product of the planning process that covers all ITS projects in the region. The central core of the V shows the project definition, implementation, and verification processes. The right wing shows the operations and maintenance, changes and upgrades, and ultimate retirement of the system.

The systems engineering approach defines project requirements before technology choices are made and the system is implemented. On the left side of the V, the system definition progresses from a general user view of the system to a detailed specification of the system design. The system is then parsed into distinct subsystems, and the subsystems into components. As the distinct subsystems are identified, the requirements for each subsystem requirements that are allocated to the system components, and documented baselines are established. The system hardware and software are implemented at the bottom of the V, and the components of the system are then integrated and verified in iterative fashion on the right. Ultimately, the completed system is validated to measure how well it meets the agency's needs.

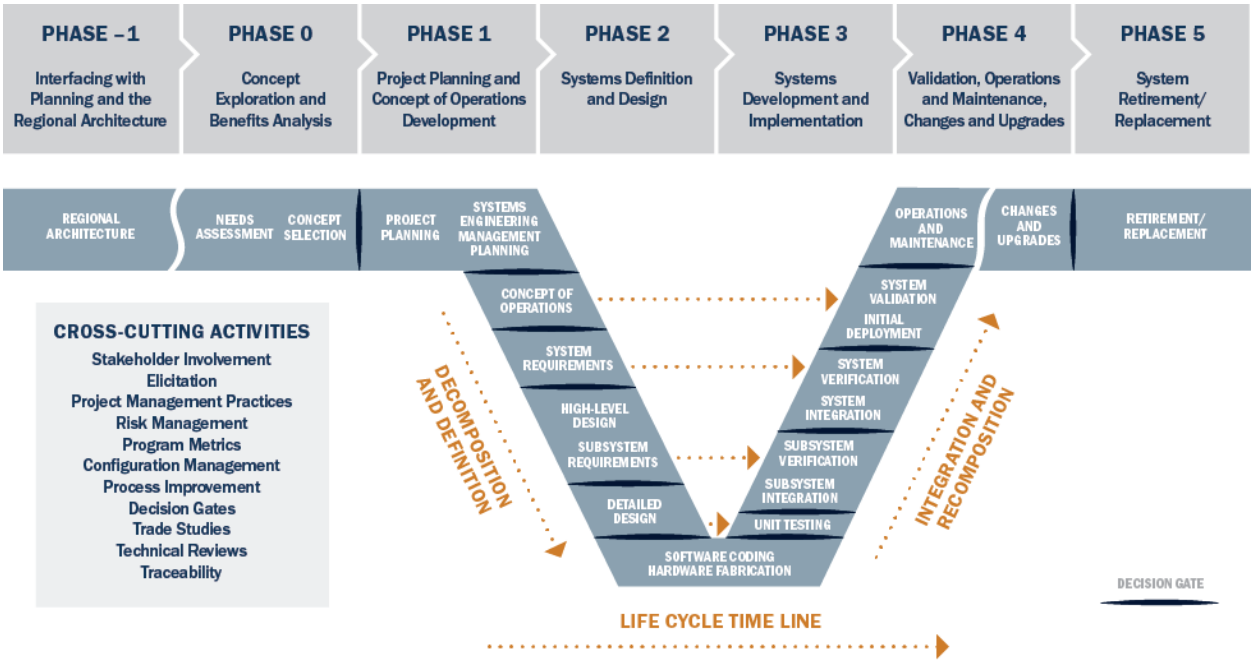


FIGURE 7. SYSTEMS ENGINEERING "V" DIAGRAM

Performance Measurement

This section provides an overview of national performance measurement, Yoakum District performance measure capability, and a performance measurement assessment.

National Performance Measurement

The Moving Ahead for Progress in the 21st Century (MAP-21) Act of 2012 established performance-based planning and management to improve the transparency and accountability of investment decisions for Federal-aid highway programs. A performance-based approach ensures transportation investments are linked to agency goals and objectives through structured performance evaluation, monitoring and reporting methods. MAP-21 requires State DOTs and MPOs to establish performance targets and track progress made toward

seven national performance goals: safety, infrastructure condition, congestion reduction, system reliability, freight movement and economic vitality, environmental sustainability, and reduced project delivery delays. The Fixing America's Surface Transportation (FAST) Act of 2015 continues this approach and requires States to invest in projects that collectively make progress toward national goals (US DOT, 2015).

TxDOT Agency-Wide Performance Measures

TxDOT launched a Performance Dashboard in 2018 to quantitatively track statewide performance and targets relative to its core mission, goals, and objectives (TxDOT, 2018). The dashboard is grouped according to seven goal areas and includes 19 performance measures, as summarized in Table 7. TxDOT's goals related to system performance and safety include TSMO-oriented performance measures (denoted in italics).

TABLE 7. TXDOT AGENCY-WIDE PERFORMANCE DASHBOARD GOALS, OBJECTIVES, AND PERFORMANCE MEASURES

TxDOT Goal	Objectives	Performance Measures (*Italics denote TSMO oriented measures*)
Optimize System Performance	▪ Mitigate congestion ▪ Enhance connectivity and mobility ▪ Improve the reliability of our transportation system ▪ Facilitate the movement of freight and international trade ▪ Foster economic competitiveness through infrastructure improvements	▪ *Congestion and Reliability Indexes* o *Urban Congestion* o *Urban Reliability* o *Rural Reliability* o *Truck Reliability* ▪ Vehicle Miles Traveled ▪ *Annual Delay per Person*
Deliver the Right Projects	▪ Use scenario-based forecasting, budgeting and resource-management practices to plan and program projects ▪ Align plans and programs with strategic goals ▪ Adhere to planned budgets and schedules ▪ Provide post-delivery project and program analysis	▪ Percent of Highway Infrastructure Contracts Completed on Time ▪ Percent of Highway Infrastructure Contracts Completed on Budget
Promote Safety	▪ Reduce crashes and fatalities by continuously improving guidelines and innovations along with increased targeted awareness and education ▪ Reduce employee incidents	▪ *Annual Fatalities & Fatality Rate* ▪ *Annual Serious Injuries & Serious Injury Rate* ▪ *Fatality Emphasis Areas involving:* o *Run off the road* o *Distracted driving* o *Driving under the influence* o *Intersections* o *Pedalcyclist* o *Pedestrian* ▪ Employee Injury Rate

TxDOT Goal	Objectives	Performance Measures (*Italics denote TSMO oriented measures*)
Preserve Our Assets	▪ Maintain and preserve system infrastructure to achieve a state of good repair and avoid asset deterioration ▪ Procure, secure, and maintain equipment, technology, and buildings to achieve a state of good repair and prolong life cycle and utilization	▪ Percentage of Lane Miles in Good or Better Condition ▪ Bridge Condition Score
Focus on the Customer	▪ Be transparent, open, and forthright in agency communications ▪ Strengthen our key partnerships and relationships with a customer service ▪ Incorporate customer feedback and comments into agency practices, project development, and policies ▪ Emphasize customer service in all TxDOT operations	▪ Percentage of Customer Complaint Cases Closed on Time ▪ Customer Complaint Case Type (Top 5) ▪ Average TxTag Call Wait Time ▪ Average TxTag Call Handle Time
Value our Employees	▪ Emphasize internal communications ▪ Support and facilitate the development of a successful and skilled workforce through recruitment, training and mentoring programs, succession planning, trust, and empowerment ▪ Encourage a healthy work environment through wellness programs and work-life balance	▪ Employee Engagement Score
Foster Stewardship	▪ Use fiscal resources responsibly ▪ Protect our natural resources ▪ Operate efficiently and manage risk	▪ Disadvantaged Business Enterprise (DBE) Attainment ▪ Historically Underutilized Business (HUB) Attainment ▪ Direct Transportation Funding

Yoakum District Performance Measure Capability

This section describes the Yoakum District's performance measure capability with regards to the TMS program, TxDOT's Road to Zero initiative, and the Victoria MPO. TxDOT division offices require districts to monitor and report on specific performance measures through the TMS program. Table 8 summarizes the performance measures mandated in Chief Engineer William Hale's memos, along with the Yoakum District's current capabilities with regards to each measure. In the future, the DE's performance for the Yoakum District may include an assessment of TMS asset operational uptime.

TABLE 8. YOAKUM DISTRICT TMS PERFORMANCE MEASURE CAPABILITY

TMS Program Performance Measure	TMS Program Performance Measure
Measure the portion of interstates and other	This plan includes an objective to increase ITS-related assets on I-10 and US 59/Future I-69 to 100 percent coverage by 2030.
TMS asset operational uptime – Measure the percent of time ITS equipment is operational	Asset uptime for district ITS devices are measured through Lonestar. Signal connectivity efforts are underway. Once complete, traffic signal asset uptime will be measured.
Travel time reliability – MAP-21 measure to assess the reliability of travel times on the interstate or non-interstate National Highway System (NHS)	Not currently measured at the Yoakum District. The Traffic Division is working on a statewide approach to help urban and rural districts measure travel time reliability.
Incident clearance time – Measures the time to clear incidents	The Yoakum District does not currently measure incident clearance time, since first responder agencies receive these calls and respond to incidents. TxDOT does assist when requested by first responders. The Traffic Division is working on a statewide approach to help urban and rural districts measure incident clearance time.

TxDOT has adopted a statewide "Road to Zero" initiative to reduce fatalities on all Texas roadways by half by 2035 and to zero by 2050. The public messaging for this initiative is *#EndtheStreakTX*. The Yoakum District recently developed a District Safety Plan to support this initiative (TxDOT Yoakum District, 2020). District staff use TxDOT's statewide Crash Record Information System (CRIS) database to regularly review crashes to identify potential system improvements to address crash causality. The Texas A&M Transportation Institute (TTI) is developing a new safety-driven data tool to support safety analysis statewide.

The Victoria MPO's 2045 Metropolitan Transportation Plan (MTP) includes performance measures to support regional goals (Victoria MPO, 2020). The MPO covers all of Victoria County. TxDOT is a voting member of the MPO board and has set performance targets in the MTP related to:

- Safety: fatalities and serious injuries
- Pavement and bridge conditions
- Level of travel time reliability for Future I-69: all traffic and trucks

Performance Measurement Assessment

The CMM workshop participants rated performance measurement between Levels 1 and 2. The TxDOT Houston District reports asset uptime on I-10 within the Yoakum District because the Houston District operates and monitors those devices through Lonestar. At a district level, few TSMO-related measures are used on a day to day basis. The Yoakum District intends to work toward formalizing a process to access data to understand what information is readily available so that TSMO-related performance measures can be considered. The Traffic Division has some agreements with third-party data providers and are exploring options to expand that coverage for use by all the districts.

From a practical standpoint, the Yoakum District will require additional staffing capabilities to develop, collect, and monitor performance measures for TSMO. The district would also have to rely on statewide efforts at performance measure definition to ensure that its measures are consistent with statewide needs. This is particularly important for traffic incident management, federal Moving Ahead for Progress in the 21st Century (MAP-21) reporting, reliability and safety-related measures.

Performance measurement is a critical activity to test and improve how TSMO is advancing progress toward state and district goals of Safety, Reliability, Efficiency, Customer Service, Collaboration, and Integration. The implementation plan identifies Performance Measures action items to formalize processes to access data and to develop metrics for asset uptime, incident clearance time, and evacuation-related congestion management. Suggested performance measures are provided over the next few pages in Table 9 and will advance performance measurement for the Yoakum District to a solid Level 2 by 2026.

TABLE 9. TSMO PLAN PERFORMANCE MEASURES

Goal / Performance Measure	Calculation	Data Required	Data Source	Update Frequency	Ref.
Safety					
Number of fatalities	5-year rolling average $\frac{K_n+K_{n-1}+K_{n-2}+K_{n-3}+K_{n-4}}{}$ where: K = number of fatalities N = year of calculation	▪ Total number of deaths in reportable motor vehicle traffic crashes each calendar year for the past five years on all public roads in the Yoakum District	TxDOT Crash Records Information System (CRIS)	Annually	(1)
Number of serious injuries	5-year rolling average $\frac{n+\ n-1+\ n-2+\ n-3+\ n-4}{}$ where: A = number of incapacitating injuries N = year of calculation	▪ Total number of incapacitating injuries in reportable motor vehicle traffic crashes each calendar year for the past five years on all public roads in the Yoakum District	CRIS	Annually	(1)
Number of work zone crashes	5-year rolling average $n+\ n-1+\ n-2+\ n-3+\ n-4$ where: C = number of work zone crashes N = year of calculation	▪ Total number of work zone crashes each calendar year for the past five years on all public roads in the Yoakum District ▪ Work zone crash defined using the following CRIS crash database table codes: Crash Road Construction Zone Flag ID = "Y", or Crash Road Construction Zone Worker Flag ID = "Y", or OTHR_FACTR = 49 or 50 or 51 or 52	CRIS	Annually	N/A

Goal / Performance Measure	Calculation	Data Required	Data Source	Update Frequency	Ref.
Reliability					
Percent of person-miles traveled on the Interstate System that are reliable	▪ Determine 80th and 50th percentile travel times for all reporting segments ▪ Calculate Level of Travel Time Reliability (LOTTR) as the ratio of longer travel times (80th percentile) to a normal travel time (50th percentile); LOTTR is calculated for each reporting segment of the Interstate system for each of four time periods for an entire year: AM peak 6am-10am weekdays; midday 10am-4pm weekdays; PM peak 4pm-8pm weekdays, and weekends 6am-8pm ▪ Determine if reporting segment is included in measure calculation (reliable person miles). A segment is reliable if the LOTTR is less than 1.5 for *all four* time periods. If one or more time periods has a LOTTR of 1.5 or above, that segment is unreliable. ▪ Calculate person miles traveled that are reliable as Segment Length × Annual Traffic Volume × Average Vehicle Occupancy for all Interstate reporting segments with LOTTR < 1.50 for all four time periods ▪ Calculate total person-miles of travel as Segment Length × Annual Traffic Volume × Average Vehicle Occupancy for all Interstate reporting segments ▪ Calculate measure as the ratio of person-miles of travel that are reliable to total person-miles of travel	▪ Reporting segment length ▪ Travel time on segment (all vehicles) in 15-minute intervals for the hours of 6 AM to 8 PM each day for an entire year ▪ Highway type (Interstate NHS) ▪ Annual Average Daily Traffic (AADT) for each segment ▪ Average vehicle occupancy for all vehicles	FHWA's National Performance Management Research Data Set (NPMRDS) or TxDOT-approved equivalent	Biennially	(2)

Goal / Performance Measure	Calculation	Data Required	Data Source	Update Frequency	Ref.
TMS system coverage	▪ Divide the number of centerline roadway miles equipped with ITS equipment and communications for incident and emergency detection/response by the total number of Interstate centerline roadway miles	▪ Total centerline miles of I-10 and US-59/Future I-69 in the district ▪ Total centerline miles equipped with ITS-related assets for incident and emergency detection/response	TBD	Annually	N/A
Average incident clearance time	▪ For each incident, calculate the time between first recordable awareness of the incident and the time the last responder leaves the scene ▪ Calculate the average incident clearance time for all incidents of interest in the region for an entire year	▪ Incident notification time and time last responder leaves the scene for each incident of interest in the region	Public safety/first responders (police, fire, medical), TMC operations staff, or Houston TranStar staff as part of their Regional Incident Management System (RIMS) database	Annually	(3)
Efficiency					
Percent of traffic signals retimed	Divide the number of traffic signals retimed by the total number of traffic signals on TxDOT maintained roadways in the Yoakum District.	▪ Number of traffic signals on TxDOT maintained roadways retimed ▪ Total number of traffic signals on TxDOT maintained roadways in the Yoakum District	Yoakum District Operations technicians	Annually	N/A

Goal / Performance Measure	Calculation	Data Required	Data Source	Update Frequency	Ref.
Customer Service					
Time between incident/ emergency verification and posting an alert to traveler information outlets (e.g., DMS, website, social media)	▪ For each incident of interest, calculate the time between incident/emergency verification and the time an alert is posted to traveler information outlets (e.g., DMS, website, social media). ▪ Calculate the average alert post time for all incidents of interest in the region for an entire year	▪ Incident verification time ▪ Time an alert is posted to traveler information outlets for each incident of interest in the region	First responders, TMC operations staff, or Houston TranStar RIMS database Yoakum District PIO	Annually	N/A
Time between recovery from incident/ emergency and removal of traveler alerts for that incident	▪ For each incident of interest, calculate the time between last responder leaving the scene and the time an alert is removed from traveler information outlets (e.g., DMS, website, social media) ▪ Calculate the average alert post removal time for all incidents of interest in the region for an entire year	▪ Time last responder leaves the scene ▪ Time an alert is removed from traveler information outlets for each incident of interest in the region	First responders, TMC operations staff, or Houston TranStar RIMS database Yoakum District PIO	Annually	N/A
Repeat visitors to Yoakum section of Drive Texas.org	▪ For each major event, pull the number of unique visitors to the Yoakum section of the DriveTexas.org website during a one-year period ▪ Compare unique visitors to other major events to track increases or decreases in visitors	▪ Unique visitors that click on information within the Yoakum District during major events ▪ List of major events that occurred each year	DriveTexas.org database	Annually	N/A

Goal / Performance Measure	Calculation	Data Required	Data Source	Update Frequency	Ref.
Collaboration					
Number of TSMO implementation status meetings					N/A
Number of after-action review meetings	▪ Number of after-action review meetings with attendance from at least 90 percent of agencies involved in the response to a major incident/emergency or adverse weather event	▪ Number, date, and percent of responder agencies represented at after-action review meetings	TSMO Champion	Annually	N/A
Integration					
Percent TMS asset operational uptime	▪ For each TMS asset of interest, divide the number of hours (or other time increment) the asset is operational by the total number of hours (or other time increment) in a calendar year ▪ Calculate the average percent TMS asset operational uptime across all TMS assets.	▪ Number of hours (or other time increment) each TMS asset is operational	Lonestar, Central signal system	Annually	N/A
Percent traffic signals monitored through the network and equipped with automatic failure alerts	▪ Divide the number of traffic signals monitored through the network and equipped with automatic failure alerts by the total number of traffic signals	▪ Number of traffic signals monitored through the network and equipped with automatic failure alerts ▪ Total number of traffic signals	District Traffic Engineer	Annually	N/A

Goal / Performance Measure	Calculation	Data Required	Data Source	Update Frequency	Ref.
Number of joint training exercises conducted	▪ Number of joint training exercises in the region that support shared implementation of TSMO strategies	▪ Number and dates of joint training exercises in the region	TSMO Champion	Annually	N/A

References:

(1) Safety Performance Measures Fact Sheet. https://safety.fhwa.dot.gov/hsip/spm/docs/safety_pm_fs.pdf

(2) Overview of Performance Measures: Travel Time Reliability (NHPP) and Annual Hours of Peak Hour Excessive Delay (CMAQ), September 2017. https://www.fhwa.dot.gov/tpm/workshop/az/reliability.pdf

FHWA Computation Procedure for Travel Time Based and Percent Non-Single Occupancy Vehicle (non-SOV) Travel Performance Measures. FHWA HIF-18-024. May 2018. https://www.fhwa.dot.gov/tpm/guidance/hif18024.pdf

(3) FHWA Traffic Incident Management Performance Measurement Presentation. https://ops.fhwa.dot.gov/publications/fhwahop10010/tim_pm_pres.ppt

Organization & Workforce

The existing organizational structure of the Yoakum District is comprised of members from Transportation Planning and Development, Construction, Operations, and Area Offices as previously shown in Figure 5. Many of these district employees already perform some TSMO activities; however, standardizing collaboration in all projects will promote TSMO, and defining the person responsible for ensuring this activity is carried out further enables the success of TSMO in the District. The Yoakum District has identified potentially new and expanded staff positions for consideration:

TSMO Coordinator – Coordinate district progress toward mainstreaming TSMO including integrating TSMO into all stages of project development and delivery, funding requests, training, and interagency coordination. This position may only require a partial FTE and will become important as more ITS infrastructure is constructed and traffic signals are brought online and connected to a central signal system that the Traffic Division is leading. With current mindset shifts in the positive direction regarding teleworking, this could be an opportunity to share a TSMO Coordinator that supports more than one district.

Traffic Engineer – The Yoakum District ITS Master Plan identified the need for an additional 0.5 to 1.0 traffic engineer FTE (TxDOT Yoakum District, 2020).

For the time being the district plans to fill FTE needs using professional services contracts as budget allows.

The Yoakum District has consistently had challenges retaining staff due to the competitive area market and a younger generation of staff with different needs and expectations. Currently, TSMO activities are diffused across many positions within TxDOT. To promote retention, a career path for operations within TxDOT could be identified more broadly across TxDOT.

The Yoakum District implements a program that rotates Engineering Assistants (EAs) into the four core discipline areas and Area Offices. This allows staff to cross-train and collaborate between sections, which is critical to successful TSMO practice and supports the implementation of TSMO across program areas. However, some improvements such as teleworking options may help strengthen the program due to staff members living in geographically diverse areas within the district.

Overall, workshop participants rated organization and workforce as a Level 2. The TxDOT Yoakum District plans to focus on internal training to develop a TSMO-competent workforce that continues beyond individual champions and grows roots in the organization. Actions that will advance organization and workforce to a high Level 2 include making improvements to the EA rotation program, and developing succession plans for key staff planning to retire in the next few years.

Culture

The Yoakum District has a strong relational culture, and it is important to supplement the personal communication with technology. Workshop participants rated the district's culture as between a Level 1 and a Level 2. The availability of funding to build capacity can affect prioritization of TSMO efforts, and it was noted that focusing on Operations sections within each TxDOT district can help focus on effective operations within existing facilities. Given the statewide focus on TSMO, the Yoakum District expects to improve the culture in

the context of TSMO. No specific action items were identified under culture since this will continue to develop organically through implementation of actions in the other five dimensions.

Collaboration

The Yoakum District and regional stakeholders, including city and county governments, the Victoria MPO, the Department of Public Safety (DPS), and local emergency responders have strong personal working relationships. They collaborate across district boundaries for emergency management and applicable projects. These relationships support coordinated construction traffic management planning, traffic control, and strategic assistance by law enforcement. Workshop participants rated the district's collaboration as a Level 2 and noted that most of their personal relationships can be maintained in their current state.

Additionally, Yoakum District maintenance crews assist law enforcement agencies and local jurisdictions on a routine basis in responding to traffic incidents. This includes activities such as helping protect a crash scene with temporary traffic control devices, clearing debris, and checking flood conditions during heavy rainfall events.

Recommended collaboration actions will advance the Yoakum District to a Level 3:

- Coordinate with the Traffic Division to implement statewide TSMO initiatives within the Yoakum District.
- Document how existing relationships with external partners work to develop go-by for future staff.
- Develop a I-10 operational plan in partnership with the Houston and San Antonio Districts to support regional travel between San Antonio and Houston.
- Develop a relationship with the National Weather Service (NWS) to have earlier access to weather data to support emergency operations and DPS. (This action also falls under systems and technology.)
- Improve effectiveness of construction and work zone management. Work with stakeholder agencies to share information and monitor queues.

TSMO Implementation Plan

This section includes a prioritized implementation plan for advancing TSMO in the Yoakum District over the next six years. Based on the discussions and action needs for the Yoakum District brought forward in the Working Group meetings, stakeholder meetings within the district, and then further discussed through the Capability Maturity Model (CMM) and Capability Maturity Framework (CMF) surveys and workshops, numerous action items were identified.

Yoakum District Six-Year Action Plan

Table 10 includes the following information as it relates to each of the TSMO strategy action items identified for implementation by the Yoakum District:

- **Action Number:** Provides a number for identification and tracking of the action. The initials stand for the related CMM dimension: business processes (BP), systems and technology (ST), performance measurement (PM), culture (CU), organization and workforce (OW) and collaboration (CO).
- **Action Description:** Provides a brief description of the action, which may include multiple steps.
- **Supports District TSMO Goals:** Identifies which of the TSMO goals the action supports. Some actions may not directly support a goal, but their implementation will help in achieving the goal. The six statewide TSMO goals supported by the district are described in Table 2: safety, reliability, efficiency, customer service, collaboration, and integration.
- **Timeline:** A target fiscal year (FY) has been identified within the next six years. TxDOT's fiscal year runs from September 1 through August 31. These targets were set based on the time it will take to implement an action, the urgency of the action, whether there are dependencies on other actions, or available resources. Priorities may shift as major events occur or staffing and funding resources change.
- **TxDOT Yoakum District Lead:** Identifies the individual at the Yoakum District who will take ownership of the action and will oversee that implementation progresses as planned.
- **Partners:** Identifies TxDOT Districts or Divisions or external stakeholders needed for coordination or resources for successful action implementation.
- **Resources:** Identifies staff, funding, and other tools needed to support the action.
- **Measures of Success:** Provides performance metrics that will help action tracking and reporting.

This Yoakum TSMO Plan includes actions to advance the TSMO program within the district. The Yoakum District ITS Master Plan includes a prioritized project list of field devices or systems (e.g., signal upgrades, DMS) and equipment (e.g., video wall) (TxDOT Yoakum District, 2020).

TABLE 10. YOAKUM DISTRICT TSMO IMPLEMENTATION PLAN PROJECTS

ACTION NO.	ACTION DESCRIPTION	SUPPORTS DISTRICT TSMO GOALS						TIMELINE	TXDOT YOAKUM DISTRICT LEAD	PARTNERS	RESOURCES	MEASURES OF SUCCESS
		SAFETY	RELIABILITY	EFFICIENCY	CUSTOMER SERVICE	COLLABORATION	INTEGRATION					
BUSINESS PROCESSES (BP)												
BP 01	Review construction projects, including as part of the pre-design agenda, to incorporate TSMO and document the process for consideration and incorporation of TSMO elements.	✓	✓	✓	✓	✓	✓	Ongoing	TSMO Coordinator	YKM Directors of TP&D, Construction, and Operations	Staff hours	% of projects reviewed as part of every STIP update
BP 02	Consider all available traffic signal management approaches and statewide standards as part of the traffic signal upgrade decisions for the district.	✓	✓	✓	✓	✓	✓	FY21/FY22	District Traffic Engineer	YKM Special Crews, TRF	Staff hours	% complete until finalized
BP 03	Formalize ITS operations and maintenance agreement with TxDOT HOU (i.e., funding, roles, responsibilities).		✓	✓	✓	✓		FY21				
BP 04	Formalize ITS operations and maintenance agreement with TxDOT SAT (i.e., funding, roles, responsibilities).		✓	✓	✓	✓		FY22	TSMO Coordinator	YKM District Engineer, TRF, TxDOT SAT	Staff hours, legal documentation	% complete until finalized
BP 05	Consider whether an ITS operations and maintenance agreement with TxDOT Austin District (AUS) is needed (i.e., funding, roles, responsibilities).		✓	✓	✓	✓		FY26				

ACTION NO.	ACTION DESCRIPTION	SUPPORTS DISTRICT TSMO GOALS						TIMELINE	TXDOT YOAKUM DISTRICT LEAD	PARTNERS	RESOURCES	MEASURES OF SUCCESS
		SAFETY	RELIABILITY	EFFICIENCY	CUSTOMER SERVICE	COLLABORATION	INTEGRATION					
BP 06	Document process, including roles and responsibilities, for reporting incidents to Houston TranStar and San Antonio TransGuide.	✓		✓	✓	✓	✓	FY21	TSMO Coordinator	TxDOT HOU, Houston TranStar, TxDOT SAT	Staff hours	% complete until finalized
BP 07	Consider documentation of standard operating procedures (SOPs) to support business processes and organization and workforce.			✓	✓			FY21	TSMO Coordinator	YKM Special Crews, TRF	Staff hours	% complete until finalized
BP 08	Develop interactive/online incident detour maps for I-10 and US-59 / I-69 to identify traffic control strategies, roles, and responsibilities for major incidents that result in lane closures or full directional closures.	✓		✓	✓	✓	✓	FY22	TSMO Coordinator	YKM Maintenance Offices, DPS, Local Law Enforcement, Cities, Counties	Staff hours	% complete until finalized
BP 09	Update Yoakum ITS Architecture *(pending decision on whether a statewide or multi-district architecture will be developed; YKM prefers a statewide architecture)*	✓	✓	✓	✓	✓	✓	FY24	TSMO Coordinator	TRF	Staff hours, knowledge of ARC-IT software	% complete until finalized
SYSTEMS AND TECHNOLOGY (ST)												
ST 01	Incorporate future statewide plans for video brokerage, asset systems, signal control, and third-party data use (e.g. INRIX, WAZE).		✓	✓	✓	✓	✓	Ongoing	TSMO Coordinator	TRF	Staff hours, workstations that can link to systems	% complete until finalized
ST 02	Establish relationship with National Weather Service (NWS) and incorporate direct weather feed from NWS to YKM offices. Incorporate approaches used by other districts (e.g., Bryan District) for engaging services outside their district.	✓			✓	✓	✓	FY23	TSMO Coordinator	TRF, Other Districts	Staff hours, workstations that can link to systems	% complete until finalized

ACTION NO.	ACTION DESCRIPTION	SUPPORTS DISTRICT TSMO GOALS						TIMELINE	TXDOT YOAKUM DISTRICT LEAD	PARTNERS	RESOURCES	MEASURES OF SUCCESS
		SAFETY	RELIABILITY	EFFICIENCY	CUSTOMER SERVICE	COLLABORATION	INTEGRATION					
ST 03	Develop Concept of Operations for queue detection for overlay projects where smart work zone trailers are not feasible. Include on agenda and advance this action during safety review meetings.	✓	✓	✓	✓		✓	FY24	Director of Construction, Director of Maintenance	YKM TSMO Coordinator, Director of Operations, Maintenance Offices	Technology, location, Staff hours for planning, implementation and management	% complete until finalized
PERFORMANCE MEASUREMENT (PM)												
PM 01	Formalize process to access data.			✓	✓	✓	✓	FY23	TSMO Coordinator	TRF	Staff hours	% complete until finalized
PM 02	Refine metric for asset uptime once TRF develops guidelines for rural districts and once the connectivity is added to traffic signals.		✓	✓	✓			FY24	TSMO Coordinator	TRF	Staff hours	% complete until finalized
PM 03	Start measuring incident clearance time once TRF develops guidelines for rural districts.	✓	✓	✓	✓	✓		FY26	TSMO Coordinator	TRF, DPS, Local Law Enforcement	Staff hours	% complete until finalized
PM 04	Consider a metric for congestion management to identify issues for hurricane evacuations.	✓		✓	✓	✓		FY25	TSMO Coordinator	TRF	Staff hours	% complete until finalized
ORGANIZATION AND WORKFORCE (OW)												
OW 01	Consider options to improve Engineering Assistant (EA) rotation opportunities.				✓			FY22	District Engineer		Staff hours	% complete until finalized
OW 02	Develop succession plan for key staff planning to retire in the next few years (e.g. Directors, District Traffic Engineer)			✓	✓			FY22	District Engineer	YKM Directors and Area Engineers	Manager hours	% complete until finalized

ACTION NO.	ACTION DESCRIPTION	SUPPORTS DISTRICT TSMO GOALS						TIMELINE	TXDOT YOAKUM DISTRICT LEAD	PARTNERS	RESOURCES	MEASURES OF SUCCESS
		SAFETY	RELIABILITY	EFFICIENCY	CUSTOMER SERVICE	COLLABORATION	INTEGRATION					
CULTURE (CU)												
	No actions identified at this time.											
COLLABORATION (CO)												
CO 01	Collaborate with TRF to implement statewide TSMO initiatives within the Yoakum District.			✓		✓	✓	Ongoing	TSMO Coordinator	TRF	Staff hours	Attendance at statewide operations meetings/calls, participation in initiative rollouts
CO 02	Document how existing relationships with external partnerships work (e.g. cities, counties, law enforcement) to develop go-by for future staff			✓	✓	✓		FY22	TSMO Coordinator	YKM PIO, Directors, Area Engineers, Maintenance Offices	Staff hours	% complete until finalized
CO 03	Develop I-10 operational plan to support regional travel between San Antonio and Houston. Plan to identify coordination and standardization opportunities across districts Consider district responsibilities and how coordination is handled for consistent application along the corridor (e.g. response efforts, traveler information). Include considerations for Connected Vehicle infrastructure-to-vehicle (I2V) communications in coordination with the I-10 Freight Plan.	✓	✓	✓	✓	✓	✓	FY23	TSMO Coordinator	TxDOT SAT, TxDOT HOU	Staff hours	% complete until finalized

Advancing Statewide TSMO Actions in the Yoakum District

In addition to efforts led by the Yoakum District, part of the implementation plan includes working with the Traffic Division to roll out statewide initiatives at the district or working with other districts who may be leading efforts. Table 11 includes an overview of statewide Traffic Division initiatives and the Yoakum District's role. This list will continue to evolve as more statewide initiatives are rolled out. The Yoakum District TSMO Champion and TSMO Coordinator should continue to work with district staff to support or roll out statewide initiatives as applicable.

TABLE 11. IMPLEMENTATION OF TSMO STATEWIDE INITIATIVES

TxDOT ITS Design Manual- The development of a statewide manual is underway. TRF has been reaching out to the districts to gather existing practices, standards, and specifications.	Provide existing documentation to TRF. Review draft manuals based on experience.
Third Party Data Integration- TRF is currently working with third party data providers to evaluate how to supplement TxDOT mobility data (e.g., volume, speed) to provide coverage where there are currently gaps.	Provide input on gaps on system coverage as requested by TRF.
TSMO Training- TRF has provided and will continue to provide training opportunities for TSMO, including presentations and discussions at the annual Traffic Safety/Operations/ Maintenance Conference and annual Short Course. Other webinars or in-person trainings may also be available.	Participate in available training opportunities. Share new knowledge with applicable Yoakum District staff.
Develop Methodology to Allocate ITS/Signals O&M Funding to Align with TSMO Goals	Provide input and guidance for help allocating more TMS O&M funding.
Develop Statewide Standard Operating Procedures to Improve Operational Interoperability	Consider using SOPs to cover any gaps.
Improve Procurement Processes to Support TSMO Program Objectives	Provide existing procurement processes. Apply new processes as applicable.
Develop Emergency Response Plan to Improve Preparedness, Response and Recovery	Provide current capabilities and provide feedback on areas to improve within the Yoakum District.
Develop Enhanced Traffic Signal System Implementation Plans	Provide existing enhanced traffic signal implementation plans and work to expand existing program.
Strengthen Traffic Incident Management (TIM) Teams Collaboration with Stakeholders to Safely Reduce Incident Clearance Times	Work with TRF to expand interagency agreements in the region if deemed applicable.

TSMO Implementation Plan Process

The Yoakum District TSMO Implementation Plan is intended to be a living document that is updated as progress on actions gets made or as things change, as illustrated in Figure 8. A key activity in maintaining the plan is the bi-annual check-in of progress of the implementation plan. Part of this check-in will be a performance assessment using the objectives and measures established as part of this plan and the measures of success listed in the implementation plan table. As the district continues to refine performance metrics and include new data sources, existing and aspirational objectives should be re-visited as part of the TSMO Plan update process.

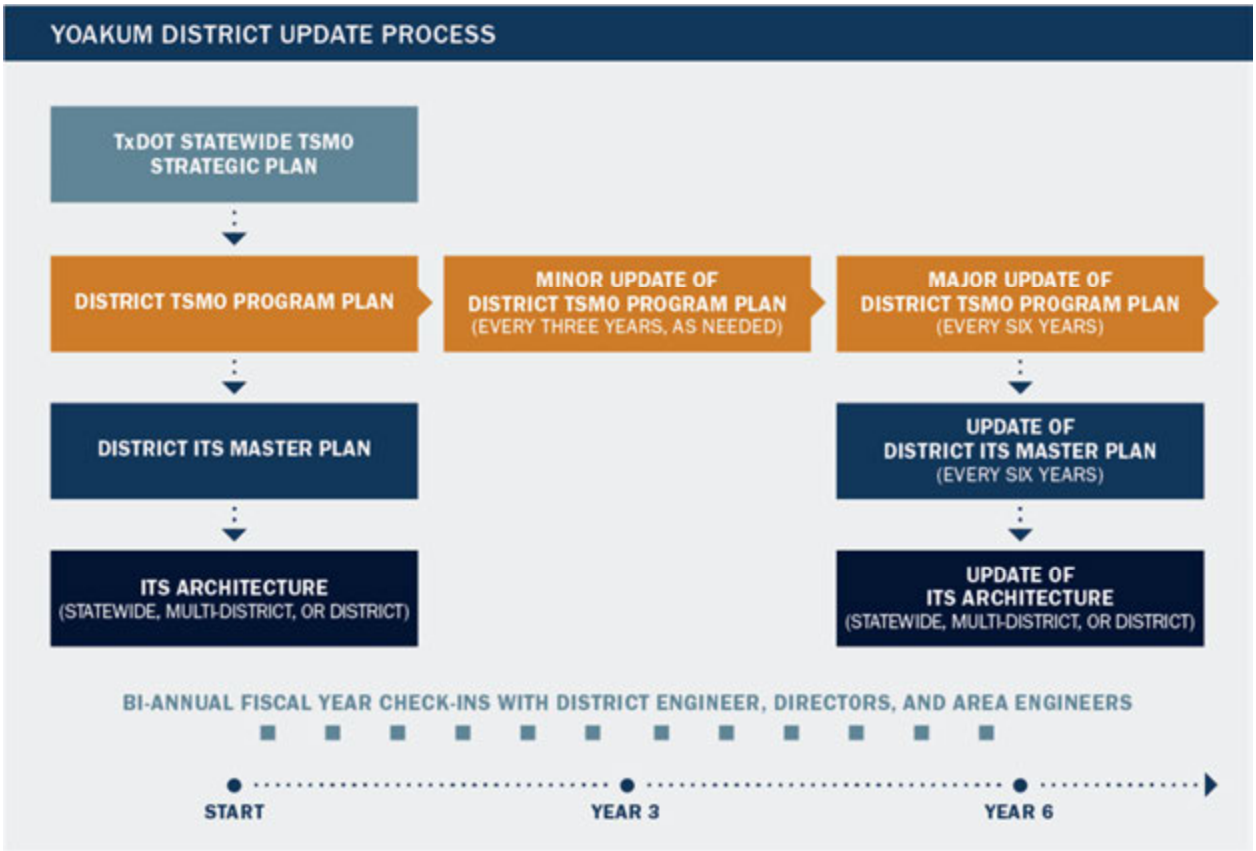


FIGURE 8. YOAKUM DISTRICT TSMO PLAN UPDATE PROCESS

TSMO Tactical Plan Assessment

This TSMO Program Plan has established the Yoakum District's *strategic* elements—relating TSMO strategies to the district's mission, vision, goals, and objectives —and *programmatic* elements—organizational structure and business processes necessary to support TSMO implementation. This third and final piece focuses on the *tactical* elements—the actions necessary to operationalize the services, programs, and priorities identified in the Implementation Plan.

A TSMO Tactical Plan should be considered in the future for any Yoakum District prioritized services, activities, or projects that may need additional efforts to advance. This section describes tactical plan criteria, tactical plan components, and recommended tactical plans.

Tactical Plan Criteria

Tactical criteria were developed by TxDOT's Traffic Division using qualitative descriptors with the intent that, as tactical plans advance to implementation, quantitative analyses will be performed (e.g., cost estimates, benefit-cost ratios, funding sources, detailed schedules). Criteria for tactical plans applied at the strategic plan level are as follows:

- Alignment with TxDOT's mission, vision, and goals (safety, reliability, efficiency, customer service, collaboration, and integration)
- TxDOT Yoakum District staff support (e.g., low, medium, high)
- Stakeholder partnerships (e.g., internal, external)
- Costs (e.g., low, medium, or high for initial and recurring costs)
- Return-on-investment (e.g., low, medium, high)

Tactical Plan Components

The Traffic Division recommends that each Tactical Plan contain these components:

1. A description of the prioritized service, activity, or project
2. An identification of the key enabling implementation guidelines and policies
3. An investment/financial plan
4. An annual action/deployment plan
5. An identification of the performance measures to be used to monitor and evaluate investments

These five tactical plan components are described more fully in the following subsections.

Description of the Prioritized Service, Activity, or Project

Describe the initiative and how it supports the district's TSMO goals and objectives. Describe existing services such as devices and systems, staffing, priorities, and stakeholder coordination. Perform a gap analysis to review how emerging technologies, operating models, data acquisition and utilization, resources and staffing, and business process relate to the initiative. Describe the future of the initiative.

Supporting Implementation Policies and Guidelines

Identify the relevant TxDOT statewide, district, or federal policies and guidelines needed for the specific service or strategy. Examples include standards and specifications for communications technologies, guidelines for selection or deployment of ITS devices, policies and guidance on public/private data sharing initiatives, decision-making guidelines for implementation, and service levels standards for devices.

Investment/Financial Plan

Effective planning for TSMO involves identifying the costs associated with deployment of services, which may include new infrastructure investments, technology purchases, staff time and resources, or other resources. Use benefit/cost or other criteria analysis methods to support project prioritization and funding requests. Identify current funding resources for the deployment and any potential funding sources that could be matched to the initiative or each action item or project.

Annual Action Plans

Drawing from funding resources and opportunities to integrate TSMO in other activities and projects, develop a set of specific actions for deployment, on an annualized timeframe. These annual plans should be developed in coordination with larger district or agency planning efforts and integrated in standard programs, which often have a four-year timeframe.

Tracking Progress: Performance Assessment

Finally, the TSMO Tactical Plan should address how performance analysis will be conducted to measure the effectiveness of tactics in meeting program objectives. Select from the metrics identified earlier in this TSMO Plan to be used to conduct on-going monitoring of system performance and project evaluation. Clearly identify how we will measure how well we are meeting the program's stated objectives. Also identify what data are currently available and what additional data are still needed. Finally, consider ways that data can be used to tell success stories to justify future TSMO investments and to promote a TSMO culture within the district.

Recommended Tactical Plans

Tactical plans are not yet recommended for the Yoakum District. With a heavy reliance on adjacent districts for operational and maintenance support, the TSMO action items to develop formal agreements are a high priority. The Yoakum District should consider systems engineering documentation for some TSMO actions or ITS Plan projects, such as queue detection for overlay projects, freeze monitoring on I-10, and a system to address safety on US 77 south of La Grange.

References

- TxDOT (2018) *Transportation Systems Management and Operations (TSMO) Statewide Strategic Plan*
- TxDOT Yoakum District (2020) *TSMO State of the Practice*
- TxDOT Yoakum District (2020) *2020 Safety Plan*
- TxDOT Yoakum District (2020) *ITS Master Plan*
- TxDOT Yoakum District (2020) *Leadership and Stakeholder Outreach Plan*
- Strategic Highway Research Program (SHRP2), American Association of State and Highway Officials (AASHTO), and Federal Highway Administration (2017) *Developing and Sustaining a Transportation Systems Management & Operations Mission for Your Organization: A Primer for Program Planning* (FHWA-HOP-17-017)
- FHWA (2020) *Capability Maturity Frameworks Overview*
- TxDOT Yoakum District (2020) *Capability Maturity Model (CMM) Workshop Summary*
- TxDOT Yoakum District (2020) *Capability Maturity Framework (CMF) Assessment*
- TxDOT (2021) *Unified Transportation Program*
- Victoria MPO (2021 – 2024) *Transportation Improvement Program*
- ConSysTec (2005) *Yoakum Regional ITS Architecture*
- US DOT (2019) *Architecture Reference for Cooperative and Intelligent Transportation (ARC-IT)*
- US DOT (2002) *Building Quality Intelligent Transportation Systems Through Systems Engineering*
- FHWA California Division (2009) *Systems Engineering Guidebook for ITS, version 3.0*
- US DOT (2015) *Fixing America's Surface Transportation Act or "FAST Act"*
- TxDOT (2018) *Performance Dashboard*
- Victoria MPO (2020) *2045 Metropolitan Transportation Plan*
- FHWA (2016) *Safety Performance Measures Fact Sheet* (FHWA-SA-16-044)
- FHWA (2017) *Overview of Performance Measures: Travel Time Reliability (NHPP) and Annual Hours of Peak Hour Excessive Delay (CMAQ)*
- FHWA (2018) *FHWA Computation Procedure for Travel Time Based and Percent Non-Single Occupancy Vehicle (non-SOV) Travel Performance Measures* (FHWA-HIF-18-024)
- FHWA (2009) *Traffic Incident Management Performance Measurement Presentation* (FHWA-HOP-10-010, Appendix A)
- TxDOT (2018) *Transportation Systems Management & Operations*

Yoakum District TSMO Program

TSMO Program Plan

APPENDIX

Appendix A: Acknowledgments

TxDOT YKM Operations

Kalea Zikuhr, *TxDOT Project Manager*
Camille Marek
Mike Walsh
Greg Dubose
Bernard Jurena

TxDOT YKM TP&D

Jeff Vinklarek

TxDOT YKM Construction

David Stephens

TxDOT YKM Area Offices

Ryan Simper (Wharton)
Clayton Harris (Wharton)
Michael Brzozowski (Victoria)
James Janak (Victoria)
Rodney Svec (Yoakum)

TxDOT YKM District Engineer

Paul Reitz

TxDOT Traffic Division (TRF)

Barbara Russell, *TxDOT TSMO Program Manager*
Jianming Ma

DKS Associates

Renee Hurtado, *Consultant Project Manager*
Dennis Mitchell
Elliot Hubbard
Charlie Henry
Akanksha Sinha

ICF

Deepak Gopalakrishna
Kerri Snyder
Kristina Heggedal

JM Engineering

Jay Weinberger
David Carey

In association with

Version 1.0