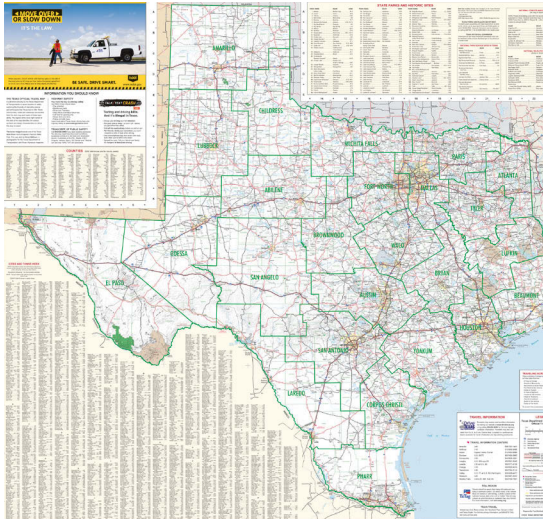
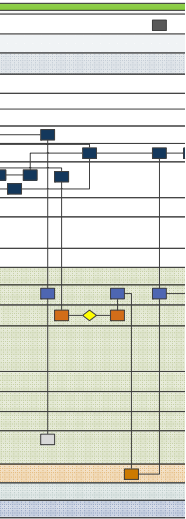


# TRANSPORTATION SYSTEMS MANAGEMENT AND OPERATIONS (TSMO)



2021 STATEWIDE STRATEGIC PLAN

July 2021



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## DOCUMENT CONTROL

Date	Version	Description
6-15-17	0.5	Traffic Operations Safety Division Review (Prepared by Atkins)
7-10-17	1.0	Traffic Operations Safety Division Review (Prepared by Atkins)
8-15-17	1.1	Formal Release to Public
6-30-18	2.0	Traffic Operations Safety Division Review (Prepared by Atkins)
7-19-18	2.1	Traffic Operations Safety Division Review (Prepared by Atkins)
4-22-20	3.0	Traffic Operations Safety Division Review (Prepared by AECOM)
5-20-20	3.1	Traffic Operations Safety Division Review (Prepared by AECOM)
7-2-21	4.0	Includes additional TSMO Strategies

## List of Acronyms

Acronym	Definition
AASHTO	American Association of State Highway and Transportation Officials
ATSPM	Automated Traffic Signal Performance Measures
CAT	Cooperative Automated Transportation
CCAT	Construction Communication Assistance Team
CMAQ	Congestion Mitigation and Air Quality
CMM	Capability Maturity Model
ConOps	Concept of Operations
COVID	Coronavirus Disease
CRSC	Connected Roadway Classification System
CRIS	Crash Records Information System
DMS	Dynamic Message Sign
FAQ	Frequently Asked Questions
FAST Act	Fixing America's Surface Transportation Act
FHWA	Federal Highway Administration
HERO	Highway Emergency Response Operator
HSIP	Highway Safety Improvement Program
ICM	Integrated Corridor Management
ITD	Information Technology Division
ITS	Intelligent Transportation Systems
LCE	Low Cost Enhancement
LMS	Learning Management System
L RTP	Long Range Transportation Plan
MPO	Metropolitan Planning Organization
NHPP	National Highway Performance Program
O&M	Operations and Maintenance
PIO	Public Involvement Office
PS&E	Plans, Specifications & Estimates
PSEMP	Project Systems Engineering Management Plan

Acronym	Definition
SHRP	Strategic Highway Research Program
SME	Subject Matter Expert
SOP	Standard Operating Procedures
STBG	Surface Transportation Block Grant
TCAT	Traffic Control Assessment Team
TDM	Transportation Demand Management
TEMPO	Association Texas Metropolitan Planning Organizations
TIM	Traffic Incident Management
TIP	Transportation Improvement Program
TMC	Transportation Management Center
TRF	Traffic Division (Central Office)
TMS	Traffic Management System
TSMO	Transportation Systems Management & Operations
TTP	Texas Transportation Plan
TxDOT	Texas Department of Transportation
UTP	Unified Transportation Program
VMT	Vehicle Miles Traveled

## Executive Summary

In recent years, Transportation Systems Management & Operations (TSMO) has played an important role in managing, maintaining, and improving the safety and efficiency of existing roadway infrastructure at both the national and state levels. The Texas Department of Transportation (TxDOT) has adopted a TSMO vision and mission statement as presented below.

- **TSMO Vision Statement:** Improve safety and mobility for all modes of transportation by integrating planning, design, operations, construction, and maintenance activities and acknowledging all opportunities for innovation.
- **TSMO Mission Statement:** Through innovation, collaboration, and performance-based decision making, transportation facilities are developed, constructed, maintained, and operated cost-effectively, with the end user in mind.

In support of the above TSMO mission and vision statements, the initial “TxDOT Statewide TSMO Strategic Plan” was issued on August 21, 2017 by Michael Chacon (Director, Traffic Operations Safety Division), then revised and released on September 17, 2018. The plan was developed using input from the TxDOT districts and divisions, and a variety of local and regional partner agencies. As a result of the plan, specific objectives and evaluation metrics were defined, at both the Central and District levels, that supports the TSMO mission statement.

The purpose of this Statewide TSMO Strategic Plan Update is to advance the recommendations included in the 2018 version in providing the framework to develop, implement, operate, and maintain a cost-effective program to leverage ITS and emerging technologies to address traffic safety and mobility needs within metro, urban, and rural areas. The “Road to Zero” policy, that the Texas Transportation Commission approved on May 30, 2019, is an important update that is reflected in this version of the Statewide TSMO Strategic Plan. Specifically, the goal is to achieve zero fatalities on roadways by 2050 and cut fatalities in half by 2035.

### ***What is TSMO?***

The Federal Highway Administration (FHWA) defines TSMO as “integrated strategies to optimize the performance of existing infrastructure through the implementation of multimodal and intermodal, cross-jurisdictional systems, services, and projects to preserve capacity and improve security, safety, and reliability of a transportation system.” Essentially, TSMO is a set of strategies that focus on the operational improvements that can maintain and even restore the performance of the existing transportation system before extra capacity is needed.

TSMO is a shift in how the management of transportation systems are approached to optimize existing infrastructure and focus on the end user. TSMO encourages all stakeholders to consider operations throughout the project development process and prioritize the quality of life of the road user along with the safety and maintenance of a facility. It requires a collaborative effort among the various divisions and districts within TxDOT as well as through multiple agencies and regional partnerships to ensure that mobility and efficiency is upheld throughout the project life cycle. Strategies address both recurring and non-recurring congestion to improve system reliability, while still preserving capacity when possible.

## Why is TSMO Important?

TSMO is important, within the state of Texas as well as nationally, to improve traffic safety and mobility for our travelers.

### Traffic Safety

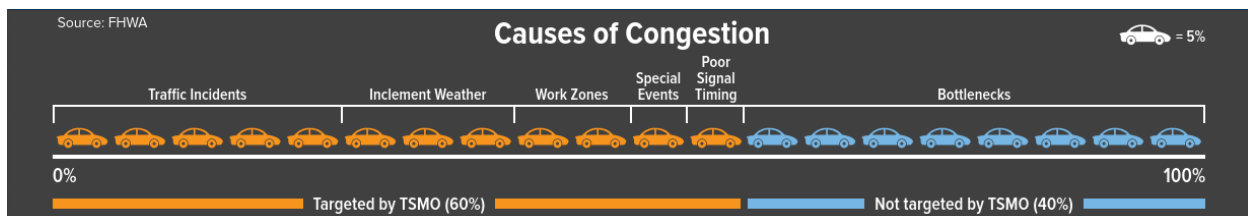
During 2019, 3,610 fatalities occurred along Texas roadways, averaging ten people killed per day. 12,897 serious injury crashes contributed to 15,843 serious injuries and 256,338 total injuries. The last deathless day on Texas roads was November 7, 2000. TSMO strategies will help contribute to achieving the “Mission Zero” goal. For example:

- Road Weather Information Systems can lower crash rates by 83% by providing drivers with advanced warnings on flooding, wet pavement, ice, fog, high winds, and other adverse weather conditions.
- Active Work Zone Management Systems can reduce crash rates by 18-45% utilizing a combination of ITS devices to warn drivers of lane closures and upcoming construction.
- Traffic Incident Management can reduce secondary crashes by 69%. According to a study published in the ITE Journal, the likelihood of a secondary crash increases by 2.8% for every minute that the primary incident remains a hazard.

These and many other TSMO strategies (e.g., connected vehicles, HERO patrols, ramp metering, intersection improvements, signal timing changes) are considered in this Statewide TSMO Strategic Plan Update.

### Mobility

In 2017, congestion caused urban Americans to travel an extra 8.8 billion hours, or 54 hours delay per average commuter. This translates to an extra 3.3 billion gallons of wasted fuel consumption. (Source: Texas A&M Transportation Institute, 2017). These are real impacts to people and businesses in cities, and the problem does not appear to be letting up, especially for fast growing areas. The value of investing in the nation’s transportation infrastructure in a strategic and effective manner cannot be overstated as these added costs impact national productivity, quality of life, economic efficiency and global competitiveness. (Source: Marc Williams, TxDOT). The figure below summarizes the typical causes of congestion where TSMO strategies can address about 60% and capacity improvements can address the other 40% of congestion.



While many roadways are already congested, travel demand continues to increase. Texas's population added 380,000 new people from 2017 to 2018. Over that same time period vehicle miles traveled by Texans grew by 3.31% to over 282 billion miles. Growing traffic demands require growing budgetary needs; however, TxDOT has a funding gap between their needs and annual budget of \$8 billion/year. While new construction will continue to be important, we can't build our way out of congestion. Innovations are needed by applying TSMO strategies to accommodate the growing transportation demand needs throughout the state.

### ***How to Identify TSMO Needs?***

To improve TSMO capabilities among the districts and Texas as a whole, it is important to have a performance-based planning framework to follow. The six dimensions of capability that define the Capability Maturity Model (CMM) offers such a framework. The CMM process helps agencies identify strengths, weaknesses, and next steps for improvement. The six capability dimensions are: business processes, systems & technology, performance measurement, organization and workforce, culture and collaboration.

The CMM process was applied by conducting workshops with TxDOT leadership at the Central Office level based on several operational scenarios: traffic incident management; traffic management; road weather management; planned special events; traffic signal management; and work zone management. Specific questions were asked to the workshop groups in conducting a self-assessment of the level of maturity that currently exists. The results of the CMM workshops provided input in identifying TSMO strategies to consider in advancing the maturity level to improve the effectiveness in operating and managing the statewide transportation system.

### ***TSMO Strategies?***

TSMO strategies include a broad range of solutions to address each of the CMM's six dimensions. The table below summarizes the strategies that are further detailed in Appendix A.



## TSMO Strategies

### Business Processes

1. Develop methodology to allocate ITS/Signals O&M funding to align with TSMO goals
2. Develop Statewide Standard Operating Procedures to Improve operational interoperability
3. Engage the Procurement Division to support TSMO program objectives
4. Develop Emergency Response Plan to Improve preparedness, response and recovery
5. Conduct Cybersecurity Vulnerability Analyses of IT networks to improve resiliency
6. Formalize TSMO processes for succession planning to retain institutional knowledge and partnerships
7. Bring Procurement Division in project development process earlier to provide input & achieve schedules
8. Develop a framework to identify “what’s next” in terms of innovations to support TSMO

### Systems and Technology

9. Conduct Connected Roadway Classification System (CRSC) analysis to prepare for CAT
10. Develop Artificial Intelligence/Machine Learning applications that address common operational scenarios
11. Increase ITS systems support by TRF to the districts to improve asset uptime
12. Develop and implement Integrated Corridor Management along applicable strategic corridors
13. Develop Enhanced Traffic Signal System Implementation Plans
14. Develop and implement Lonestar™ enhancements
15. Improve TxDOT ITS infrastructure by filling in the gaps; maintaining the system; and focusing on arterials
16. Develop a roadmap to design, build, and maintain an integrated data platform
17. Prepare a database of unit costs for TSMO project planning and budgeting

### Performance Measures

18. Develop performance dashboards for safety and travel reliability during construction
19. Apply performance measures to all applicable phases of a project’s lifecycle (planning - operations)
20. Develop consistent performance data management process to continually track system performance
21. Develop process to include operations performance measures into district decision-making
22. Develop a process to improve safety by applying historic, real-time, and predictive performance measures

### Organization and Workforce

23. Develop a succession plan for essential staff to provide continuity of operations
24. Develop a comprehensive TxDOT TSMO Training Program
25. Build and develop the workforce needed to manage the TSMO infrastructure
26. Develop an action plan to address staff vacancies in critical traffic management program capabilities
27. Rotate TxDOT staff through different positions in the Transportation Management Centers

### Culture

28. Apply gamification strategies as an Incentive to continuously Improve operational performance
29. Realize the full potential of TxDOT’s ITS infrastructure during pandemic events
30. Develop managers in District departments to consider TSMO in project development and implementation

31. Provide high level of integration of TSMO strategies between TRF, Districts, and ITD
32. Conduct annual reviews of the TSMO Program to determine what is working and not working

### Collaboration

33. Support Rural District Operations that have limited resources to support TSMO goals
34. Strengthen TIM Teams collaboration with stakeholders to safely reduce incident clearance times
35. Develop Special Event Checklist to apply TSMO strategies
36. Maintain strong collaboration between TRF, ITD, and Strategy & Innovation Division to support TSMO
37. Develop a stronger collaboration with first responders in better understanding and serving their needs
38. Develop Rural Incident Management Plans for strategic corridors

## ***Keys to TSMO Success***

The keys to implementing a successful TSMO program are communication, documentation and coordination.

**Communication** is a team effort. For example, Traffic Incident Management (TIM) requires police, fire-rescue, hazardous materials cleanup crews and towing companies to work together to clear incidents quickly and safely. This is critical where every minute counts. For every minute that a traffic lane is closed, four minutes of delay and queueing can be expected.

**Documentation** is critical to provide a consistent approach to statewide TSMO implementation. Two examples of documentation include Standard Operating Procedures (SOPs) and Performance Measures. SOPs are one example of how documentation needs to be continuously updated to keep pace with TSMO programs. SOPs should be updated on a regular basis to document new or revised policies in alignment with continuous improvements using performance measures as a guide.

**Coordination** is another success factor in managing an effective TSMO program. Each TxDOT district needs to coordinate with cities, counties and MPOs to avoid conflicts with local government projects; coordinate with transit agencies to minimize service impacts and improve schedule adherence for buses and trains; coordinate with the local media for providing accurate, reliable, timely, and useful travel information so that they may share it with their audience; coordinate with utilities to avoid schedule and traffic impacts for planned upgrades; coordinate with local businesses to avoid disruptions; and coordinate with contractors to provide a more structured approach to scheduling lane closures.

## ***TSMO Performance Measures***

Performance measurement provides an indicator of how well the system is performing in terms of incident response and clearance; travel time reliability; system availability; customer satisfaction; and other criteria as identified by TxDOT Central Office, the Districts and their stakeholders. Performance measures should be defined from the perspective of end users - operations staff and the traveling public. They should be customer focused; a road user may never see the data, but they can instinctually tell if a facility is increasing or decreasing in reliability. Performance measures require significant work in collecting, reporting, analyzing, and summarizing the data. While policy and decision-makers rely on this data to justify funding, operations staff

rely on this data in making real-time decisions regarding incident, traffic and asset management. As per Chief Engineer Bill Hale's April 2017 memo, districts are required to track and report the following performance measures: Traffic Management System (TMS) asset operation uptime, incident clearance times, travel time reliability, and TMS system coverage. For example, TxDOT has an operation uptime goal of 90% for its TMS assets.

### **Summary**

In summary, the Statewide TSMO Strategic Plan Update provides guidance in leveraging ITS and emerging technologies to address traffic safety and mobility needs in metro, urban, and rural areas. In addition, TSMO addresses leveraging stakeholder partnerships in developing and executing inter-agency agreements. While each of the 25 districts are developing District TSMO Program Plan to address their specific needs, the Statewide TSMO Strategic Plan provides the framework to establish consistency and interoperability. As there will be stand-alone TSMO strategies, it is anticipated that many TSMO strategies will be mainstreamed into existing funding programs during the planning, design, construction, operations and maintenance phases of the project development life cycle.

## Introduction

Ever increasing congestion, limited funding and the increasing role of technology has now more than ever highlighted the need for transportation agencies to prioritize operations and management resulting in the emergence of TSMO as a separate transportation industry discipline. This is exacerbated by the current COVID-19 pandemic where future funding for transportation programs is uncertain.

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.

In 2015, state of the practice research was conducted to raise awareness of the high return on investment in traffic management systems, to increase safety and manage congestion, and highlight opportunities from improvements within TxDOT, at both the agency and district levels.

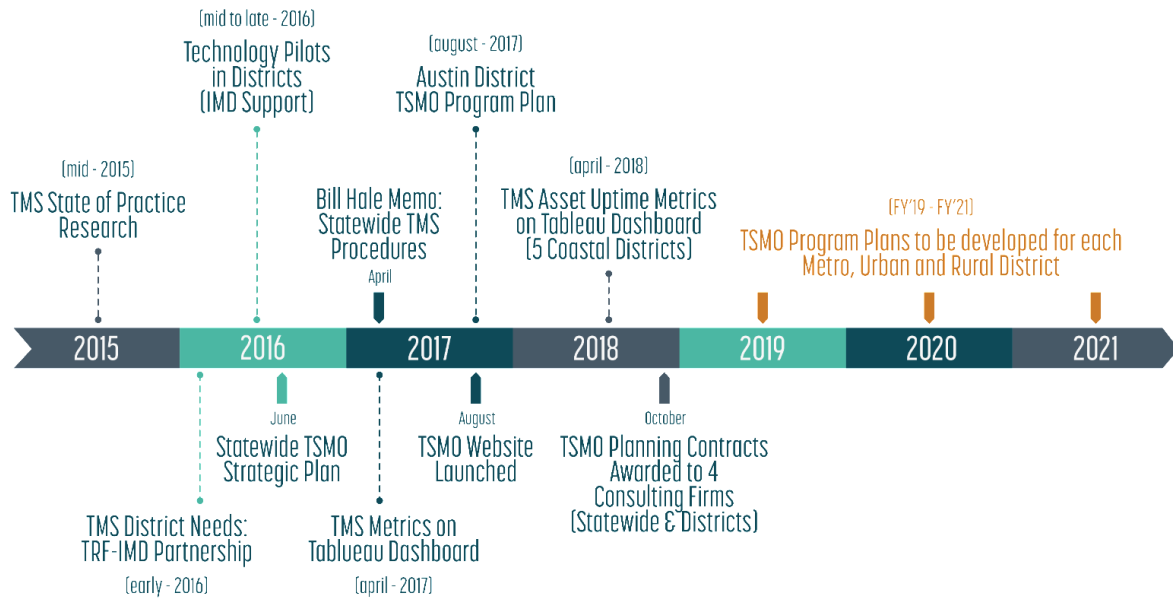
The districts were found to have good recognition and understanding of areas to improve, but there was found to be variation in execution, primarily due to the variation of District or Metropolitan Planning Organization (MPO) focus and prioritization of traffic management system investment in transportation planning and funding processes. Three actions were identified to help support districts in improving traffic management:

- 1) Cross-District problem solving and best practice sharing, especially around planning and funding traffic management systems. Since 2016, the TRF Traffic Management Section has facilitated regional and statewide ITS meetings.
- 2) Common Information Technology Solutions: districts identified and prioritized four technology solutions, namely asset management, network monitoring, data analytics and video sharing. Since 2017 the Information Technology Division (ITD), formerly the Information Management Division, has been leading the implementation and evaluation of third-party products and services via pilot projects in various districts around the state.
- 3) Performance Metrics: three priority metrics (i.e., travel time reliability, incident clearance time, asset up time), established by TxDOT Leadership, and 16 additional operations metrics were identified to promote traffic management. Since 2017, three priority metrics have been tracked and reported monthly on Engineering Operations Dashboard in Tableau (data visualization software application).

To support the above listed actions, and better communicate expectations and goals for traffic management, the TxDOT Chief Engineer, Bill Hale issued two policy memos: Traffic Management Systems in Construction Projects (July 1, 2016), and Statewide Procedures for Traffic Management Systems (April 7, 2017).

Additionally, it was recognized that to achieve and sustain improvements in those areas, a performance-based planning framework needs to be implemented.

The initial TxDOT Statewide TSMO Strategic Plan was released on August 21, 2017, then subsequently revised and issued on September 17, 2018. With a statewide framework having been established, the next step is to develop TSMO Program Plans for the TxDOT districts. The Austin District was the first district to have its TSMO Program Plan developed. A chronological history of the TxDOT TSMO program is presented below.



TSMO Program Plans serve as deployment plans by providing details, responsibilities and cost estimates for specific TSMO strategies throughout the state. The focus areas covered in these plans can be safety and mobility strategies that already are in place but need to be institutionalized or progressed and/or solutions that are new to TxDOT. They will support data-driven decisions and further the integration and prioritization of safety and mobility strategies with existing efforts, including:

- **Multimodal/Active Transportation:** Texas residents in metro and urban areas are increasingly using active transportation (e.g., walking, biking or riding transit). It is important to provide appropriate facilities for these modes. Processes for considering active transportation or a plan to improve safety and access could be included as a multimodal or active transportation TSMO strategy. This may include, but not limited to, integrated corridor management, mobility on demand, smart mobility hubs, transportation demand management and other strategies.
- **Traffic Incident Management:** Eight of the 25 TxDOT districts actively participate in Traffic Incident Management (TIM) Teams. An incident management TSMO strategy will formalize existing activities and provide an opportunity to implement new strategies, such as dynamic alternate routing or first responder training.

- **Emerging Technologies:** New technologies such as video analytics, warning systems for wrong way driving and overweight vehicles, and queue warning systems are becoming available to improve safety and mobility. Emerging technologies should be considered as part of TSMO strategies to address safety and mobility needs.
- **Data Integration:** TxDOT has ITS devices throughout most of the state; however, beyond being used for travel time information, the data collected are not currently archived to use for operations or planning purposes. A TSMO strategy should be considered to collaborate with ITD to enhance many of the efforts that already are in progress. The data integration plan will develop protocols for entire network monitoring and archiving of data. This will help TxDOT and its partners take advantage of existing sources of data to make informed decisions to improve regional mobility.

TSMO Program Plans are being developed for each TxDOT District. The program plan format applies the same table of contents as used in this Statewide TSMO Strategic Plan Update to establish consistency.

TxDOT has retained AECOM to support the Central Office for preparing the Statewide TSMO Strategic Plan Update, for coordinating with other consultants preparing TSMO Program Plans for each district and for providing support in implementing these plans. This document, presented herein, is the 2021 Update of the Statewide TSMO Strategic Plan. The intent of this update is to advance the recommendations included from the 2018 Statewide TSMO Strategic Plan while minimizing repetition of content in the 2018 version; however, some sections are worth repeating to maintain consistency with previous efforts. This updated version includes specific TSMO strategies from a statewide perspective that provides a framework for the districts in preparing TSMO Program Plans.

## Business Case

According to the Texas Transportation Plan (TTP) 2040, the population of Texas is expected to reach 45 million by the year 2040. This rapid growth leads to an increase in daily VMT. Historically, improvements to the 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. In rural areas, with the increase in an aging population needing transportation alternatives and the increasing number of heavy vehicles, mobility challenges are prevalent throughout the state.

### A. Mobility Challenges

The national congestion tables in the 2019 Urban Mobility Report provide a summary of congestion levels within very large, large, medium and small urban areas within Texas as shown below.

National Congestion Tables for Urban Areas within Texas								
Urban Area	Yearly Delay per Auto Commuter		Travel Time Index		Excess Fuel per Auto Commuter		Congestion Cost per Auto Commuter	
	Hours	Rank	Value	Rank	Gallons	Rank	Dollars	Rank

Very Large Urban Areas								
Houston	75	9	1.34	11	31	7	1,508	10
Dallas-Ft Worth-Arlington	67	13	1.26	23	25	20	1,272	18
Large Urban Areas								
Austin	66	14	1.34	11	25	20	1,163	23
San Antonio	51	34	1.23	30	22	32	964	38
Medium Urban Areas								
El Paso	41	70	1.16	61	17	68	794	57
McAllen	38	80	1.16	61	13	93	701	81
Small Urban Areas								
Beaumont	41	70	1.13	83	16	77	718	76
Corpus Christi	38	80	1.13	83	17	68	745	69
Brownsville	29	96	1.13	83	12	96	571	95
Laredo	32	93	1.17	49	15	84	593	94

**Notes:**

Very Large Urban Area: over 3 million population.

Large Urban Area: over 1 million and less than 3 million population.

Medium Urban Area: over 500,000 and less than 1 million population.

Small Urban Area: less than 500,000 population.

Rank: National ranking of all US cities considered as part of this study.

Yearly Delay per Auto Commuter—Extra travel time during the year divided by the number of people who commute in private vehicles in urban areas.

Travel Time Index—The ratio of travel time in the peak period to the travel time at free-flow conditions. A value of 1.30 indicates a 20-minute free-flow trip takes 26 minutes in the peak period.

Excess Fuel Consumed—Increased fuel consumption due to travel in congested conditions rather than free-flow conditions.

Congestion Cost—Value of travel time delay (estimated at \$18.12 per hour of person travel and \$52.14 per hour of truck time) and excess fuel consumption (estimated using state average cost per gallon for gasoline and diesel). Values are rounded to nearest \$10; ranking based on calculated value.

The 2019 Urban Mobility Report was based on a review of 494 urban areas throughout the United States. The report findings indicate the following:

- Very Large Urban Areas: Houston and the Dallas-Fort Worth Arlington region experienced 75 hours (Rank #9) and 67 hours (Rank #13) of annual delay per auto commuter.
- Large Urban Areas: Austin and San Antonio experienced 66 hours (Rank #14) and 51 hours (Rank #34) of annual delay per auto commuter.
- Medium Urban Areas: El Paso and McAllen experienced 41 hours (Rank #70) and 38 hours (Rank #80) of annual delay per auto commuter.
- Small Urban Areas: Beaumont, Corpus Christi, Brownsville, and Laredo experienced between 29 and 41 hours (Rank #70 – #96) of annual delay per auto commuter.

In summary, Texas has ten urban areas that rank in the top 96 (of 494) in terms of congestion as measured by annual delay per auto commuter. Similar rankings are reported for travel time index, excess fuel per auto commuter and congestion cost per auto commuter.

## ***B. Safety Challenges***

The traveling public experiences a variety of safety challenges on Texas' roadways. The 2003 - 2018 Comparison of Motor Vehicle Traffic Deaths, Vehicle Miles, Death Rates and Economic Loss provide a summary of these. Deaths and Vehicle Miles Traveled (VMT) have been on the rise since 2008. In 2018, there were 3,639 lives lost on Texas roads. Overall, economic loss as a result of traffic accidents represented over 2% lost in Texas' GDP, or \$38 billion. Though the COVID-19 crisis may resulted in downward trends of vehicle-miles traveled, deaths on roadways TxDOT increased during 2020 with speeding being a contributing factor, TSMO strategies that directly intervene to limit crashes will save lives and save potentially billions in economic costs related to crashes.



**COMPARISON OF MOTOR VEHICLE TRAFFIC DEATHS, VEHICLE MILES, DEATH RATES, AND ECONOMIC LOSS 2003 - 2018**

YEAR	DEATHS	% INCREASE OR % DECREASE (DEATHS)	VEHICLE MILES TRAVELED (VMT) (MILLIONS)*	% INCREASE OR % DECREASE (VMT)	DEATHS PER 100,000,000 VEHICLE MILES TRAVELED	ESTIMATED ECONOMIC LOSS OF ALL MOTOR VEHICLE CRASHES** (\$MILLIONS)	GDP*** (\$MILLIONS)	Estimated Economic Loss due to Crashes as % of GDP
2003	3,822	-0.03%	218,209	1.08%	1.75	\$20,700	\$829,764	2.49%
2004	3,700	-3.19%	229,345	5.10%	1.61	\$19,400	\$906,321	2.14%
2005	3,558	-3.84%	234,231	2.13%	1.52	\$19,200	\$986,401	1.95%
2006	3,521	-1.04%	236,486	0.96%	1.49	\$20,400	\$1,085,295	1.88%
2007	3,462	-1.68%	241,746	2.22%	1.43	\$20,600	\$1,178,583	1.75%
2008	3,479	0.49%	234,593	-2.96%	1.48	\$22,900	\$1,237,395	1.85%
2009	3,122	-10.26%	231,976	-1.12%	1.35	\$21,300	\$1,163,401	1.83%
2010	3,060	-1.99%	234,261	0.98%	1.31	\$22,300	\$1,237,197	1.80%
2011	3,066	0.20%	237,443	1.36%	1.29	\$23,400	\$1,331,221	1.76%
2012	3,417	11.45%	237,821	0.16%	1.44	\$26,000	\$1,411,379	1.84%
2013	3,406	-0.32%	244,536	2.82%	1.39	\$27,800	\$1,502,250	1.85%
2014	3,538	3.88%	242,989	-0.63%	1.46	\$38,000	\$1,572,818	2.42%
2015	3,585	1.33%	258,122	6.23%	1.39	\$36,700	\$1,568,457	2.34%
2016	3,794	5.83%	271,263	5.09%	1.4	\$38,800	\$1,565,632	2.48%
2017	3,727	-1.77%	272,989	0.63%	1.37	\$39,400	\$1,665,632	2.37%
2018	3,639	-2.36%	282,037	3.32%	1.29	\$38,400	\$1,802,511	2.13%

\*2018 VMT is an estimate.

\*\*Economic Loss figures are estimated using the National Safety Council's (NSC) Average Economic Cost on a per death basis figure for the year identified. Figures are rounded to the 2018 figures are based on 2017 cost.

\*\*\*Source: St Louis Fed <https://fred.stlouisfed.org/series/TXNGSP#>

Information contained in this report represents reportable data collected from Texas Peace Officer's Crash Reports (CR-3) received and processed by the Department as of May 6, 2019.

**C. TSMO Strategies**

TSMO includes a broad range of strategies. The table below lists several of the operations strategies that have been applied across the country; and that have made substantial positive impacts on the safety, mobility and reliability of the surface transportation network.

TSMO Operations Strategies	
Work Zone Management	Traffic Signal Coordination
Traffic Incident Management	Traveler Information
Service Patrols	Ramp Management
Special Event Management	Managed Lanes
Road Weather Management	Active Traffic Management
Transit Management	Integrated Corridor Management
Freight Management	Rural Emergency Response

These strategies, in which ITS and traffic signals play a major role, are most effective when they are considered in early stages of the project development process, sustained over time with dedicated funding, and optimized via coordination among transportation agencies in the region. Some TSMO strategies have already been deployed or are currently being researched for use in various parts of the state.

These strategies are relatively low in cost compared to adding capacity, can be implemented in two to three years and offer substantial benefits (e.g., benefit-cost ratio of 10:1). Specifically, these benefits include savings in travel time, delay, and reliability; vehicle operating costs; and crashes. A methodology for conducting benefit cost analyses for TSMO projects is included in the USDOT publication [TSMO Benefit Cost Analysis Compendium](#), July 2015.

While TSMO can be very beneficial to metro and urban areas, there is also a need for TSMO in rural areas. These types of TSMO projects include minor operational improvements, also known as low-cost enhancements (LCEs), which are defined as small, low-cost projects that can be implemented quickly to improve operational safety or reduce congestion on the highway system. Below are several low-cost enhancement strategies:

- Channelization - can be used to restrict or direct traffic flow or to change a roadway's type. It can allow motorists to move at different speeds and in conflicting directions as well as provide areas for pedestrians. Channelization can be created with pavement markings, islands or curbs.
- Delineation - refers to methods used to define vehicular travel paths for drivers. Delineation can include one or a combination of devices used on and adjacent to the roadway, such as painted, thermoplastic, or other durable pavement markings (e.g., chevrons), light retroreflecting guideposts and post-mounted delineators, raised pavement markers and rumble strips. Delineation is often part of channelization.
- Low-cost safety enhancements - are a collection of minor operational roadway improvements that allow TxDOT to increase safety without expending major resources or without a major planning or design effort. Some examples of low-cost safety enhancements include (1) adding clear zones at the side of the road to provide a clear, traversable area in which a vehicle can recover if it runs off the roadway; (2) flattening the sides of the roadway to improve the roadway cross-section and reduce the chances that an errant vehicle will become airborne; (3) improving the super-elevation of the bank of a roadway along a horizontal curve

so that motorists can safely and comfortably maneuver the curve at reasonable speeds; and (4) installing new rumble strips or altering existing ones, to reduce the risk of run-off-the-road crashes.

- Signage - regulates the flow of traffic and provides information, guidance, and warnings to drivers and other roadway network users, such as pedestrians and bicyclists. TxDOT publications such as the Texas Manual on Uniform Traffic Control Devices provides standards and guidance for roadway signage. Installing signage is often a low-cost TSMO solution. Linking signs with message boards or flashing lights to detectors can create smart signs.
- Traffic calming - relies on physical design and other measures to slow vehicle speeds and reduce traffic volumes by obstructing traffic flow and by increasing the cognitive load of drivers. The goals of traffic calming include altering driver behavior, improving conditions for non-motorized street users and reducing the impacts of motor vehicle use. Furthermore, technologies such as variable message signs posting driver's speed may be considered.

The above TSMO strategies focus on operational improvements. In addition, the CMM process is used to identify other TSMO strategies addressing the six CMM dimensions

#### ***D. Funding***

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

7. 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.

Building the necessary infrastructure and maintaining it have historically been the core attributes of the planning process. Operating and managing the infrastructure has historically been left out of the planning process. Operations strategies and the supporting ITS technologies must therefore become a formal core program with the same emphasis in the planning and programming processes. This is important in realizing the full potential of these technologies. A reliable ITS infrastructure needs to be maintained with minimal system down time. If CCTV cameras, dynamic message signs, and vehicle detectors are not functioning properly they become ineffective in helping to manage traffic and disseminate accurate information to motorists.

The Long-Range Transportation Plan (LRTP) developed by MPOs, should guide the selection of projects that are funded in the Transportation Improvement Program (TIP). As such, regions that place importance on TSMO in the LRTP have a strong basis for devoting funding to these strategies. The process of developing agreement on regional goals and objectives that includes system operations can help to support dedication of funding to TSMO strategies or development of project prioritization processes in programming that enable TSMO strategies to effectively compete for funding.

Management and operations projects may be eligible for funding from several sources: State and local governments, the Surface Transportation Block Grant program (STBG, formerly Surface Transportation Program), the Congestion Mitigation and Air Quality (CMAQ) program and others. In the context of the objectives-driven, performance-based approach to planning for operations, operations objectives should guide decisions on funding projects or programs for operations. This creates a clear link between the plan and the State or metropolitan transportation improvement program (S/TIP). (Source: FHWA Planning for Operations – Programming and Funding for Operations:

[https://ops.fhwa.dot.gov/plan4ops/focus\\_areas/integrating/funding\\_for\\_ops.htm](https://ops.fhwa.dot.gov/plan4ops/focus_areas/integrating/funding_for_ops.htm))

While the CMAQ program is a primary source of funding for TSMO in several regions, STBG is also frequently used. Other Federal funding sources used in the case study regions include Highway Safety Improvement Program (HSIP) and National Highway Performance Program (NHPP). In some air quality nonattainment or maintenance regions, CMAQ is a primary source of funding for TSMO projects and programs. In these areas, CMAQ Program funds are being used for strategies that meet both air quality and congestion relief objectives, such as traffic signal coordination and transportation demand management (TDM) programs.

Some local jurisdictions within the case study regions chose to raise transportation funds through local taxes and have additional funding to devote to TSMO strategies. In some cases, local taxes are instituted with a commitment to spend a certain share on TSMO projects.

MPO activities to support TSMO include data collection, regional coordination efforts, and creation of subcommittees on TSMO. Examples of TSMO efforts that were observed in MPOs' Unified Planning Work

Program include: data collection, development of regional operations platforms. intergovernmental coordination and organization of ITS working groups/committees, programs that educate the public (traveler information, commuter information) that are hosted at the MPO, and programs for use by the public, such as incident response or vanpool matching. These may be staffed by MPO staff.

MPOs may set aside funding, allows open competition, or a combination of both. The TSMO programming approaches for the MPOs studies for this report fell into three main categories: 1) set aside dedicated funding for TSMO projects, 2) allow TSMO projects to compete with other types of projects for funding, or 3) combine a set-aside with the ability for TSMO projects to compete for other funding.

Operational performance measures enable TSMO strategies to compete effectively for funding. The use of operational performance measures creates a system where TSMO projects may score highly enough to compete with other types of projects. Some MPOs use separate criteria for evaluating TSMO projects even when competing with other types of projects.

Collaboration between member agencies including use of TSMO committees can be a key element of TSMO project selection. MPOs create formal, collaboratively developed operations objectives and priorities in the Regional Concept for Transportation Operations, LRTP, and ITS Strategic Plan. These carry over into the programming phase for project selection criteria and project prioritization in the TIP.

MPOs may use measures of cost-effectiveness to evaluate TSMO projects. A project prioritization process that focuses strongly on cost-effectiveness, allows TSMO projects to do well in the project selection process.

(Source: FHWA Office of Operations, Programming for Operations: MPO Examples of Prioritizing and Funding TSMO Strategies,

<https://ops.fhwa.dot.gov/publications/fhwahop13050/s3.htm#s3.2>)

In summary, ongoing support will be provided by Central Office (TRF) to provide guidance to the districts in identifying and obtaining federal grants to implement TSMO-specific projects or mobility strategies. This includes: identification of potential funding sources; matching and prioritizing projects to grant funding opportunities based on evaluation criteria and project details; applying statewide experience with prior federal grant programs to potential future applications; providing technical expertise based on previous federal grant experience to proactively assess a project's potential competitiveness for grant opportunities; and offering strategic advice to anticipate future grant applications.

## TSMO Vision, Mission, Goals and Objectives

The following vision, mission, goals, and objectives are presented in the 2018 TxDOT Statewide TSMO Strategic Plan. Districts may add specific interests or additional details when developing district TSMO program plans.

### A. *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.

### B. *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.

### C. *Statewide TSMO Goals and Objectives*

The goals and objectives for the statewide TSMO initiative, identified in the table below, are based on the TxDOT agency goals and objectives.

TxDOT Statewide TSMO Goals and Objectives	
Goal	Objective
Safety	Reduce crashes and fatalities through continuous improvement of traffic management systems and procedures.
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.
Efficiency	Implement projects that optimize existing transportation system capacity and throughput.
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, internal collaboration 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.

## Capability Maturity Model

To improve TSMO capabilities among the districts and Texas as a whole, it is important to have a performance-based planning framework to follow. The six dimensions of capability that define the Capability Maturity Model (CMM) offers such a framework. Agencies with higher levels of maturity in the CMM capability dimensions demonstrate the highest effectiveness in the operation and management of their respective transportation network.

### CMM Process

The CMM process, and four levels of maturity, are defined in the exhibit below.

Process Improvement Areas		Capability Levels			
Dimensions or Process Areas	What is it	Level 1 Ad Hoc, Low Level of Capability	Level 2 Managed, Medium Level of Capability	Level 3 Integrated, High Level of Capability	Level 4 Optimized, Highest Level of Capability
Business Processes	Plans, Programs, Budgets				
Systems & Tech	Approach to Building Systems		Self-Assessment. Work with your stakeholders to assess where you are in terms of the capabilities in each area.		Identify areas of improvement the desired levels of capability to improve program effectiveness.
Performance Measurement	Use of Performance Measures				
Organization & Workforce	Improving Capability of Workforce				
Culture	Changing Culture and Building Champions		Identify actions that you need to take to move to the desired levels of capability.		
Collaboration	Improving Working Relationships				

The CMM process helps agencies identify strengths, weaknesses and next steps for improvement. The six capability dimensions are: business processes, systems & technology, performance measurement, organization and workforce, culture and collaboration.

- Business Processes – formal scoping, planning, programming and budgeting. For example, “Is there a dedicated funding mechanism for implementing and maintaining ITS infrastructure? Is there a process to ensure TSMO is considered in the early stages of project development?”
- Systems and Technology – use of systems engineering, systems architectures, standards (and standardization) and interoperability. Research has shown that in many agencies there are challenges with enterprise requirements (such as low bid, IT security) which might not align with ITS or TSMO requirements. This dimension focuses on how well defined our software and hardware requirements are, and whether our procurement processes are compatible with the technology being procured.
- Performance Measurement – defining measures, targets, data acquisition, analytics, reporting, and utilization. For example, “Are we reporting data that shows how well we are doing operating and managing the transportation system?”
- Organization and Workforce – programmatic status of TSMO, organizational structure, staff development, recruitment, and retention. This focuses on how well the agency (or district) is organized and staffed to carry out TSMO objectives and responsibilities.

- Culture – with respect to TSMO, culture is understanding, leadership, outreach, and program legal authority in a DOT. For example, “How well is the value of TSMO understood throughout the agency (or district)?” “Is there overall support for TSMO from the agency’s leadership?”
- Collaboration – relationships and partnering among levels of government and with public safety agencies, local governments, MPOs and the private sector.

**CMM Results**

The CMM process was applied to the TxDOT Statewide TSMO Strategic Plan by conducting surveys with TxDOT TRF Division staff based on several operational scenarios: traffic incident management; traffic management; road weather management; planned special events; traffic signal management; and work zone management. Specific questions were asked to the workshop groups in conducting a self-assessment of the level of maturity that currently exists. The results of the CMM workshop provided input in identifying TSMO strategies to consider in advancing the maturity level to improve the effectiveness in operating and managing the statewide transportation system.

The surveys for the six focus areas were conducted using the online SurveyMonkey platform. The survey links were sent via email to stakeholders on July 29, 2020. Follow up reminders were sent on August 11, August 21, and then on August 31. Stakeholders included personnel from TxDOT’s TRF Division. Stakeholders were encouraged to self-evaluate the capabilities in as many of the six focus areas as applicable. The surveys were closed on September 2, 2020.

The table below provides a summary of overall survey responses received for each focus area. Some respondents answered “Not Applicable” as the answer choice for all the questions or skipped the entire survey after providing their contact information. These respondents were not included in the analysis for identifying CMM levels since the “Not Applicable” answer does not provide a maturity level for any dimension.

Focus Area	Total Responses	Responses Analyzed
Traffic Signal Management	7	6
Traffic Management	6	6
Road Weather Management	6	6
Work Zone Management	6	5
Planned Special Events	5	4
Traffic Incident Management	5	5

Detailed survey results for each of the focus areas are presented in the following sections.



## CMM Survey Results – Traffic Signal Management

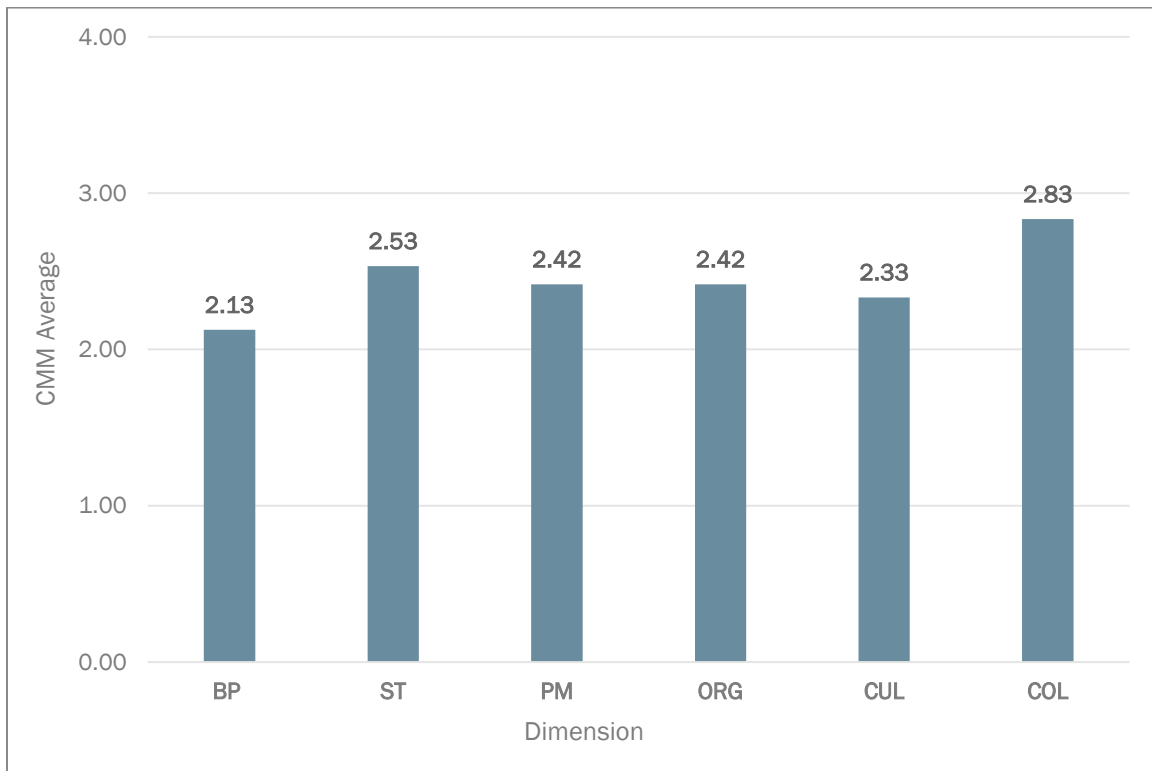
A total of 7 stakeholders responded to the Traffic Signal Management CMM questionnaire either partially or completely. Each of the survey questions had 5 answer choices, the first 4 choices represented CMM level 1 through 4 while the fifth choice was to be selected if the respondent found the question to be non-applicable. The survey design also allowed participants to skip one or more questions without answering. The table below shows a summary of responses by questions answered for Level 1 through 4 or skipped/NA by each respondent.

*Traffic Signal Management – Summary of Survey Response*

Name	Total of 17 Questions Answered	
	Level 1 through 4	NA or Skipped
Respondent 1	17	0
Respondent 2	17	0
Respondent 3	17	0
Respondent 4	17	0
Respondent 5	17	0
Respondent 6	17	0
Respondent 7	0	17

When analyzing the survey responses to identify capability maturity level for each question and/or dimension, responses with “Not Applicable” choice were not used in the analysis.

To demonstrate the distribution of maturity levels selected by individual stakeholders, all responses for each level in a given CMM dimension were calculated as a percent of total responses for that dimension. The figure below shows average maturity level by dimension for traffic signal management.



*Average CMM Level by Dimension – Traffic Signal Management*

Self-assessment results for the Traffic Signal Management focus area show maturity level between 2 and 3 for each dimension. There may be some differences in capabilities as responded to by different staff; however overall a level 2 maturity suggests:

- TxDOT utilizes formal or informal systematic processes to identify user needs and operational objectives.
- TxDOT has established policies and processes that support timely responses to critical infrastructure malfunctions.
- Signal systems and equipment are generally upgraded through special capital improvements.
- Committed funding is available for traffic signals operations.
- Funding is also available for limited traffic monitoring and management activities.
- Current procurement policies and practices utilize limited number of suppliers for purchase of traffic signal system and communications technologies, but do not provide flexibility to address specific operational issues.

The survey results show collaboration and systems & technology dimensions have higher level capabilities as compared to other CMM dimensions. There is need for improved business processes and performance measures. Based on goals and objectives to improve capabilities in the signal management focus area, TxDOT can select actions/strategies for implementation.

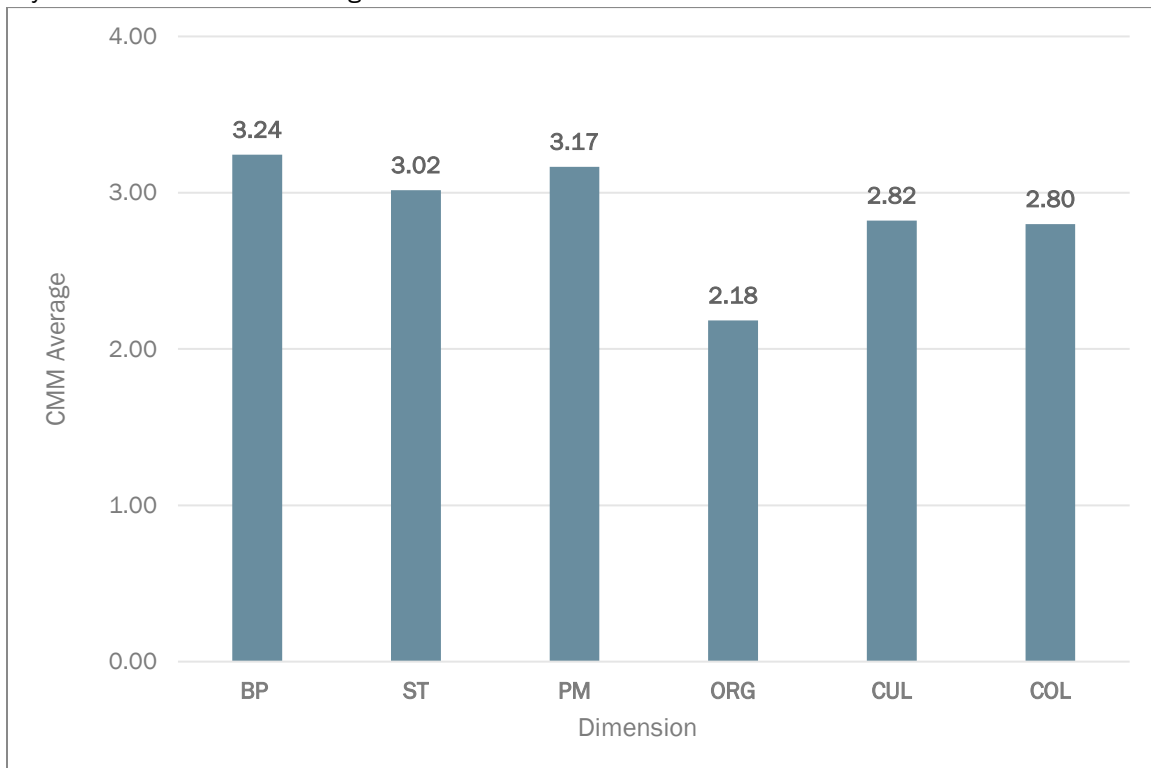
## CMM Survey Results – Traffic Management

A total of 6 stakeholders responded to the Traffic Management CMM questionnaire either partially or completely. Each of the survey questions had 5 answer choices, the first 4 choices represented CMM level 1 through 4 while the fifth choice was to be selected if the respondent found the question to be non-applicable. The survey design also allowed participants to skip one or more questions without answering. The table below shows a summary of responses by questions answered for Level 1 through 4 or skipped/NA by each respondent

*Table 1. Traffic Management – Summary of Survey Respondents*

Name	Total of 21 Questions Answered	
	Level 1 through 4	NA or Skipped
Respondent 1	21	0
Respondent 2	21	0
Respondent 3	9	12
Respondent 4	19	2
Respondent 5	21	0
Respondent 6	21	0

When analyzing the survey responses to identify capability maturity level for each question and/or dimension, responses with “Not Applicable” choice were not used in the analysis. The figure below shows average maturity level by dimension for traffic management.



*Average CMM Level by Dimension – Traffic Management*

Self-assessment results for the Traffic Management focus area show a maturity level close to 3 for each dimension except organization and workforce where the maturity level is close to 2. In general, a level 3 maturity suggests the following:

- Traffic management development and deployment processes are standardized and have a well-documented system-wide approach.
- Systems Engineering process is used for ITS projects. Advanced technologies are applied with limited automation.
- Performance measures are consistently utilized to identify and deploy strategies for operational improvements.
- Workforce has limited traffic management experience and there is a strong need for training and specialized skill development of staff.
- Traffic management is a recognized core program that coordinates with other programs on a regular basis.
- Collaboration with other agencies and the private sector for sharing of resources, data, and control of ITS systems is through informal agreements that works, but there is a need to formalize these agreements.

Overall, the survey results suggest consistency in maturity among all dimensions. In traffic management, more than 60% of the respondents selected level 3 or level 4 in all dimensions except organization and workforce. A lower score for organization and workforce dimension suggests the need for staff training and specialized skill development.

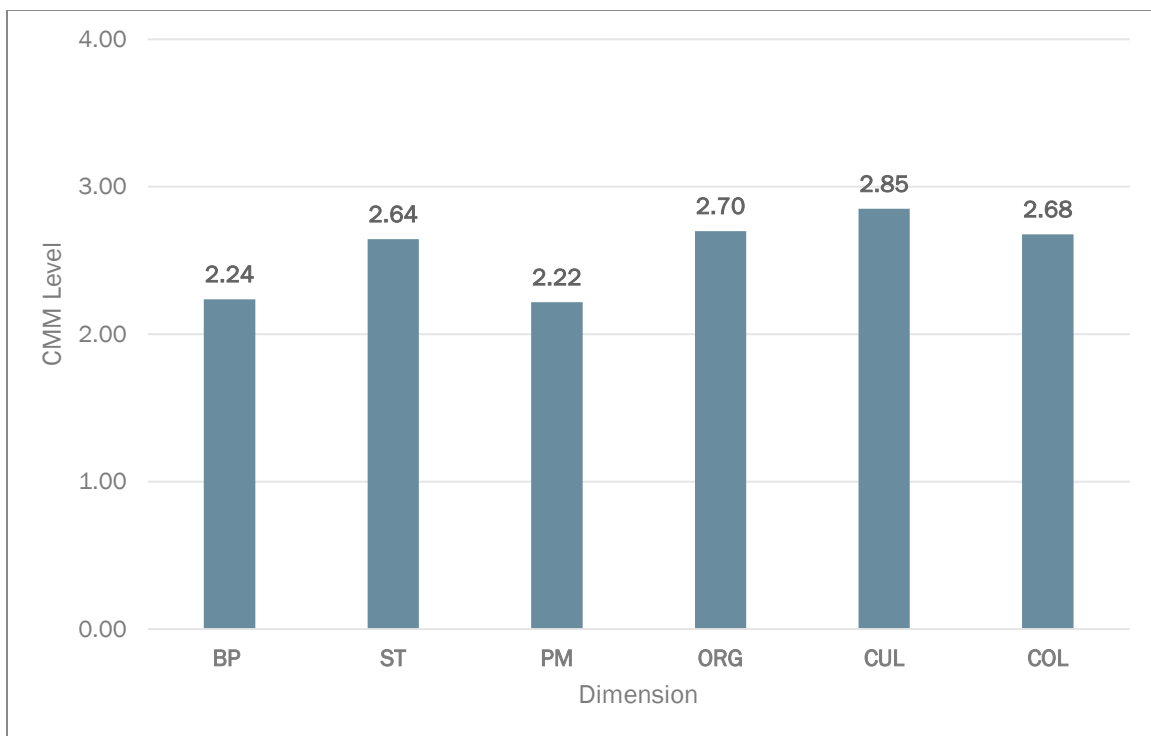
### **CMM Survey Results – Road Weather Management**

A total of 6 stakeholders responded to the Road Weather Management CMM questionnaire either partially or completely. Each of the survey questions had 5 answer choices, the first 4 choices represented CMM level 1 through 4 while the fifth choice was to be selected if the respondent found the question to be non-applicable. The survey design also allowed participants to skip one or more questions without answering. The table below shows a summary of responses by questions answered for Level 1 through 4 or skipped/NA by each respondent.

*Road Weather Management – Summary of Survey Respondents*

Name	Total of 19 Questions Answered	
	Level 1 through 4	NA or Skipped
Respondent 1	19	0
Respondent 2	13	6
Respondent 3	4	15
Respondent 4	17	2
Respondent 5	19	0
Respondent 6	19	0

When analyzing the survey responses to identify capability maturity level for each question and/or dimension, responses with “Not Applicable” choice were not used in the analysis. The figure below shows average maturity level by dimension for road weather management.



*Average CMM Level by Dimension – Road Weather Management*

Self-assessment results for the Road Weather Management focus area show maturity level between 2 and 3. Overall based on the survey results, current TxDOT capabilities in this focus area include:

- Business processes support identified requirements, key technology, and development of core capacities, but there is limited internal accountability and uneven alignment with external partners.
- A comprehensive and formal road weather management concept of operations that integrates field centers, and communications to achieve operational objectives driven by weather conditions and travel impacts.
- Performance measures during weather events may have been established but may need to develop a procedure/dashboard for reporting.
- Dedicated and trained staff is available to handle operations during weather events.
- Post event reviews of operations are often conducted to assess shortcomings and formulate plans for improvement.
- Standardized procedures are available to receive and broadcast weather information to media and public as it relates to roadway infrastructure.

Survey results suggest the need for improvement in the business processes and performance measures dimensions. Considering the wide range of weather patterns that Texas experiences (snow/ice in the north,

extreme heat in the west, and hurricanes in the southeast), improvement strategies should be deployed suitable for each geographical area.

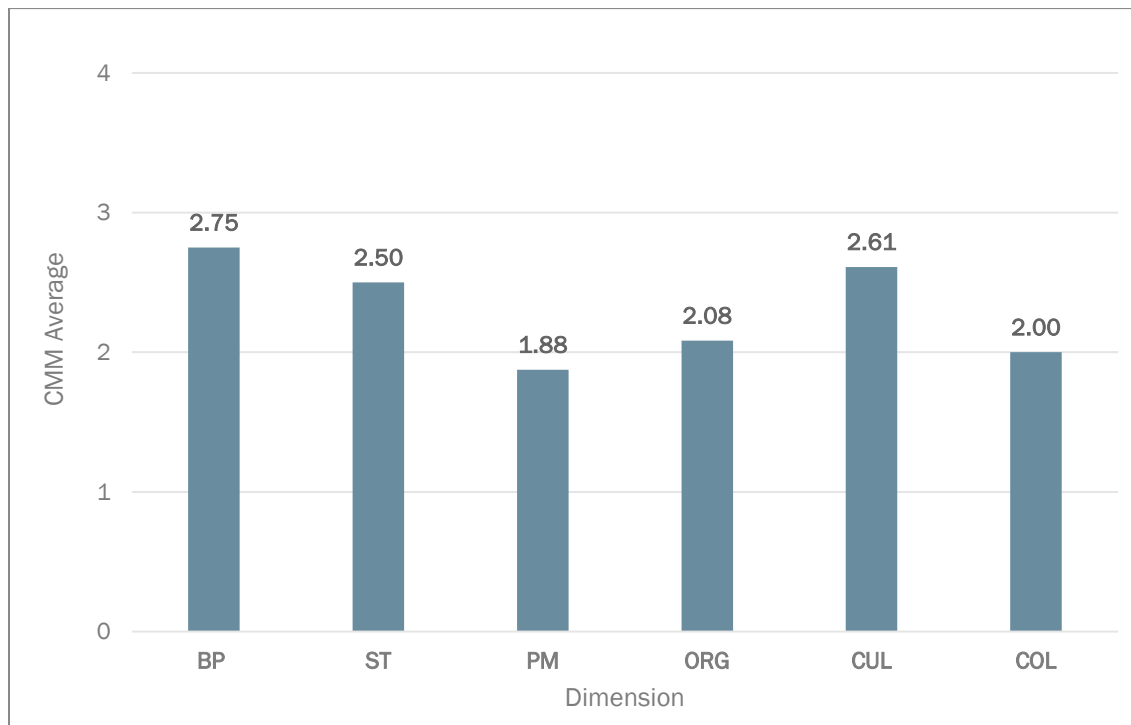
### CMM Survey Results – Work Zone Management

A total of 6 stakeholders responded to the Work Zone Management CMM questionnaire either partially or completely. Each of the survey questions had 5 answer choices, the first 4 choices represented CMM level 1 through 4 while the fifth choice was to be selected if the respondent found the question to be non-applicable. The survey design also allowed participants to skip one or more questions without answering. The table below shows a summary of responses by questions answered for Level 1 through 4 or skipped/NA by each respondent

*Work Zone Management – Summary of Survey Respondents*

Name	Total of 18 Questions Answered	
	Level 1 through 4	NA or Skipped
Respondent 1	18	0
Respondent 2	17	1
Respondent 3	3	15
Respondent 4	6	12
Respondent 5	0	18
Respondent 6	18	0

When analyzing the survey responses to identify capability maturity level for each question and/or dimension, responses with “Not Applicable” choice were not used in the analysis. The figure below shows average maturity level by dimension for work zone management.



*Average CMM Level by Dimension – Work Zone Management*

Self-assessment results for the Work Zone Management focus area show a maturity level between 2 and 3 except for performance measures and collaboration dimensions. Based on survey results, current capabilities include:

- Work zone management business processes are institutionalized throughout the organization.
- Use of innovative technologies and strategies for improving work zone management on projects occurs. However, use of innovative technologies is uneven across TxDOT.
- Some project-level and regional (program)-level outcome-based WZM performance measures have been established. Data to evaluate these measures are sometimes collected for big projects, but not for all projects.
- There is uneven implementation of training programs to develop work zone related skills and workforce knowledge.
- Work zone management efforts and benefits/successes at a programmatic or regional level are documented and shared internally, with external partners, and decision makers.
- Procedures for considering and adopting good work zone management contributions/suggestions from external partners have been developed, but adoption throughout TxDOT is uneven.

Overall, the survey results suggest the need for improved performance measurement, better collaboration, and additional training programs in the area of work zone management.

## CMM Survey Results – Planned Special Events Management

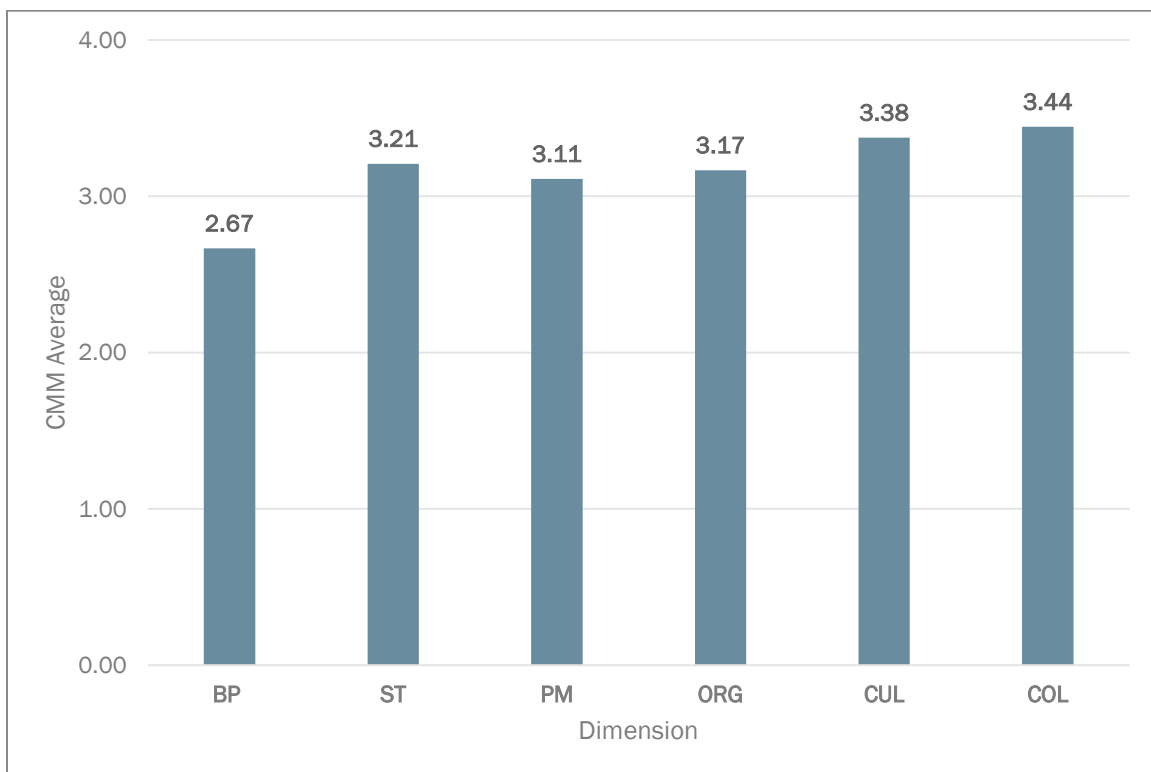
A total of 5 stakeholders responded to the Planned Special Events Management CMM questionnaire either partially or completely. Each of the survey questions had 5 answer choices, the first 4 choices represented CMM level 1 through 4 while the fifth choice was to be selected if the respondent found the question to be non-applicable. The survey design also allowed participants to skip one or more questions without answering.

The table below shows a summary of responses by questions answered for Level 1 through 4 or skipped/NA by each respondent

*Planned Special Events Management – Summary of Survey Respondents*

Name	Total of 16 Questions Answered	
	Level 1 through 4	NA or Skipped
Respondent 1	16	0
Respondent 2	15	1
Respondent 3	0	16
Respondent 4	5	11
Respondent 5	16	0

When analyzing the survey responses to identify capability maturity level for each question and/or dimension, responses with “Not Applicable” choice were not used in the analysis. The figure below shows average maturity level by dimension for planned special event management.



*Average CMM Level by Dimension – Planned Special Events Management*



Self-assessment results for the Planned Special Events Management focus area show a maturity level above 3 except for the business processes dimension. Based on survey results, current capabilities include:

- An established and formal planning process for planned events management. However, funding is often not sufficient to address identified needs.
- Systems and technology solutions are routinely utilized for special events management.
- Outcome measures have been identified and consistently utilize performance measure analyses to improve strategy deployment and overall operations.
- There is on-the-job training available. In addition, operational exercises in preparation for PSEs are often conducted. Some cross-training occurs but is largely reactionary to an imminent departure of an individual with legacy knowledge.

Overall, the survey results suggest the need for continuous improvement through performance measurement analyses.

### **CMM Survey Results – Traffic Incident Management**

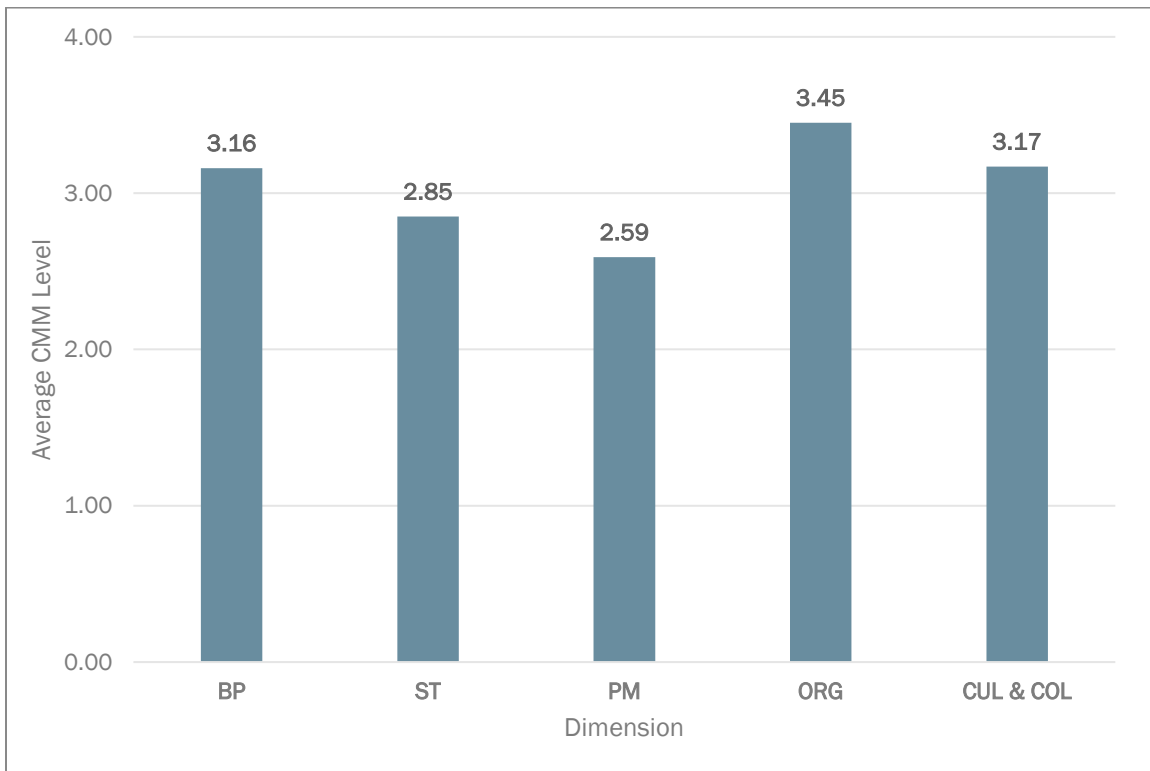
A total of 5 stakeholders responded to the Traffic Incident Management CMM questionnaire either partially or completely. Each of the survey questions had 5 answer choices, the first 4 choices represented CMM level 1 through 4 while the fifth choice was to be selected if the respondent found the question to be non-applicable. For the traffic incident management survey, some of the questions had follow on questions. The survey design also allowed participants to skip one or more questions without answering. The table below shows a summary of responses by questions answered for Level 1 through 4 or skipped/NA by each respondent.

*Traffic Incident Management – Summary of Survey Respondents*

Name	Total of 56 Questions Answered	
	Level 1 through 4	NA or Skipped
<b>Respondent 1</b>	53	3
<b>Respondent 2</b>	56	0
<b>Respondent 3</b>	33	23
<b>Respondent 4</b>	39	17
<b>Respondent 5</b>	56	0

The traffic incident management survey follows the FHWA model for this focus area and is loosely organized as per the typical CMM dimensions. Due to the regional nature of traffic incident management activities, culture and collaboration were considered a single dimension. When analyzing the survey responses to identify capability maturity level for each question, responses with “Not Applicable” choice were not used in the analysis.

To demonstrate the distribution of maturity levels selected by individual stakeholders, all responses for each level in a given CMM dimension were calculated as a percent of total responses for that dimension. The figure below shows average maturity level by dimension for traffic incident management.



*Average Maturity Level by Dimension – Traffic Incident Management*

Self-assessment results for Traffic Incident Management focus area show maturity level close to 3 except for systems & technology and performance measurement dimensions. Overall, the survey results suggest the need for continuous improvement through performance measurement analyses. Though averages suggest higher levels of capability in managing traffic incidents, there is not uniform adoption of best practices across TxDOT's geographic districts. Improvements in Traffic Incident Management could address the following:

- A formal data collection and reporting process for Roadway Clearance Time (RCT) and Incident Clearance Time (ICT) may not be uniformly adopted across TxDOT Districts.
- Regional training for Traffic Incident Management is not adopted across the state. Traffic Incident Management training is available, but some TIM stakeholders may not be aware of it.
- Secondary crashes are reported, but the collection of data and sharing of secondary crash data is not uniform. TxDOT is working to standardize secondary crash reporting through the CRIS system by adding this as a new field.
- TIM funding sources are not mainstreamed by all involved TIM agencies – some regions may not have a line item in the TIP for TIM improvement and/or activities.
- Regional implementation of removal laws is not uniform.

## CMM Progress and Next Steps

The 2018 Statewide TSMO Strategic Plan recommended specific actions for both central office and the districts. Since 2018, TxDOT has made significant progress addressing each of these recommendations as presented in the tables below for each CMM dimension.

### Business Processes

Business processes include 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.

Progress in Improving “Business Processes” Capability Maturity		
Central Office Responsibilities		
Strategic Plan Recommendation	Progress	Next Steps
Central Office Responsibilities		
Develop guidance on including funding of operations for ITS projects in UTP.	Need to include life-cycle costs, including operations and maintenance (O&M) as part of funding requests for ITS projects.	Develop five-year funding program for ITS projects inclusive of required operations and maintenance (O&M) and replacement costs.
Develop TSMO policy.	Ongoing: The two policy memos issued by TxDOT Chief Engineer, Bill Hale have resulted in preparing the 2018 Statewide TSMO Strategic Plan which is being advanced into the implementation phase.	Implement TSMO Program Plans for each district.
Review and revise TSMO Strategic Plan regularly.	Ongoing: Progress made since 2018 is being incorporated into this Statewide TSMO Strategic Plan Update.	Support districts in maintaining their TSMO Program Plans, including re-evaluating CMM assessments to identify where action items may be needed.
Review/revise project manuals/protocols to include TSMO activities & TSMO tool.	TSMO input should be provided during the TSMO Implementation Phase. This would include review/revisions to the State “PS&E Plans Preparation Manual” and “Modernize Portfolio and Project Management” system.	Review/revise the Roadway Design Manual that pertains to Corridor Management (Traffic). Include a checklist of items to be considered as part of the design. This checklist should be reviewed and modified considering TSMO.

Maintain the overall statewide TSMO plan, comprised of the statewide strategic plan and the district TSMO Program Plans.

Ongoing: The progress made since 2018 is being addressed in the Statewide TSMO Strategic Plan Update and District TSMO Program Plans.

Continue to update the Statewide TSMO Strategic Plan and District TSMO Program Plans as living documents.

Progress in Improving “Business Processes” Capability Maturity		
District Responsibilities		
Strategic Plan Recommendation	Progress	Next Steps
District Responsibilities		
Identify list of operation-based projects and budget for the next 10 years to include in the UTP.	Ongoing: Operation-based projects and budgets for the next ten years are being developed as part of the TSMO Program Plans.	Continue to update the list of operations-based projects and budgets for the next ten years as input into the UTP updates.
Identify list of projects and budgets where operations/ITS solutions can be added over the next 10 years to include in UTP.	Ongoing: Operations and ITS projects and budgets for the next ten years are being developed as part of District ITS Implementation Plans and TSMO Program Plans.	Continue to update the list of operations and ITS projects and budgets for the next ten years as input to UTP updates.
Develop template language for project scopes to align with performance-based planning requirements.	Need to develop template language for project scopes to align with performance-based planning requirements. 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 should be developed to assist districts in determining how TSMO can be applied to projects to improve mobility during planning, design, construction, operation, management and maintenance.
Develop budget for training, staffing, data acquisition and/or other resources.	Ongoing: District TSMO Program Plans are addressing the requirements for training, staffing, data acquisition and/or other resources.	Budgets for training, staffing, data acquisition and/or other resources need to be developed after the District TSMO Program Plans are completed.
Revise project delivery process to include TSMO activities and TSMO tool.	Ongoing: Existing processes for project delivery will be revised to consider TSMO and other efforts outlined in District TSMO Program Plans.	Process revisions should be implemented to consider TSMO and other efforts outlined in District TSMO Program Plans.
Develop TSMO Program Plan, including plan for re-assessment.	Ongoing: TSMO Program Plans are being developed for each district.	Reassessment of District TSMO Program Plans will be an ongoing effort.

## Systems & Technology

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

Progress in Improving “Systems and Technology” Capability Maturity		
Strategic Plan Recommendation	Progress	Next Steps
<b>Central Office Responsibilities</b>		
Develop statewide data management and analysis platform.	Ongoing: A TSMO Planning Dashboard System is under development.	This system can be linked to the TxDOT “Open Data Portal” and serve as a tool to track the progress of projects and work programs.
Develop statewide procurement procedures, including approved product vendor list.	Need to review current procurement processes and approved product list to identify improvements.	Once procurement processes are updated, apply on one selected ITS procurement to assess its effectiveness.
Assess cyber security threats and establish security protocols.	Ongoing: Document lessons learned from ransomware and other cybersecurity events.	Conduct Cybersecurity Vulnerability Analyses of IT networks on a regular basis to improve resiliency.
Develop statewide connected and autonomous vehicle guidance/plan	Ongoing: A Cooperative Automated Transportation (CAT) Strategic Plan has been developed.	Apply the CAT Strategic Plan in developing statewide policy and procedural decisions including critical steps TxDOT should take to prepare for CAT implementation.
<b>District Responsibilities</b>		
Develop and/or update regional architecture (update no less than every five years).	Ongoing: Regional ITS Architecture updates are being conducted in a few districts.	Develop a strategy to update ITS Architectures more efficiently and make it more user friendly to apply on projects.
Implement Systems Engineering Analysis (SEA) process on projects as necessary.	Provide training on how to advance ITS projects through the SEA process.	ITS projects will need to comply with the SEA (i.e., ITS Master Plan, Architecture, ConOps, PSEMP, RVTM, etc.)

Strategic Plan Recommendation	Progress	Next Steps
Consider re-evaluating current ITS processes based on emerging technology.	The current device acceptance process needs to be re-evaluated based on TxDOT's needs, industry standardization and type of device.	Update device acceptance processes on a regular basis.
Collaborate with ITD and TRF to establish formal agreements to share data with partner agencies.	Ongoing: ITD and TRF are working on projects to support interoperability between districts.	These divisions should be included in interoperability activities to provide guidance and technical support.

### **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.

Progress in Improving “Performance Management” Capability Maturity		
Strategic Plan Recommendation	Progress	Next Steps
<b>Central Office Responsibilities</b>		
Develop measures definitions, utilization strategy and data acquisition plan for statewide performance measures.	Ongoing: Continuing effort as Statewide SOPs are being developed and standards and manuals are being updated.	Apply performance dashboards to identify TSMO strategies in addressing operations and maintenance deficiencies where targets are not being consistently achieved (e.g., 90% uptime for TMS devices).
Verify that definitions for key performance measures are consistent across the state.	Statewide consistency has been established for asset up time in most districts.	Coordinate with districts to establish statewide consistency for key performance measures.
Verify and consolidate districts' performance measure strategy into statewide platform dashboard.	Ongoing: Continuing effort as the TSMO Program Plans are developed for each district.	As the District TSMO Program Plans are completed, the statewide platform dashboard for performance measures will be implemented.

District Responsibilities		
Strategic Plan Recommendation	Progress	Next Steps
Develop measures definitions, utilization strategy and data acquisition plan for district-specific performance measures.	Ongoing: Being developed as part of the TSMO Program Plans for each district.	Apply performance measures as per the District TSMO Program Plans to assess performance of applicable functions.
Monitor performance measures regularly.	Ongoing: Performance dashboards are currently being monitored for the following TMS Metrics – incident clearance times; ITS asset uptime availability; and travel time reliability.	Begin to apply performance measures in a real-time mode within the TMCs to be more proactive in avoiding congestion and crashes.



## 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 TxDOT's day-to-day work efforts.

Progress in Improving "Organization and Workforce" Capability Maturity		
Strategic Plan Recommendation	Progress	Next Steps
<b>Central Office Responsibilities</b>		
Provide TSMO training opportunities to districts.	Ongoing: TxDOT has provided several opportunities for staff to engage in TSMO training (e.g., Statewide ITS Meetings, ITS Texas, FHWA) and have staff actively engage in developing TSMO strategies as part of CMM workshops.	Apply the results of the CMM workshops to develop specific training modules for different operational scenarios (e.g., work zones, signal operations), systems (i.e., ITS maintenance), TIM (e.g., SHRP2) and other topics to support the districts.
<b>District Responsibilities</b>		
Develop TSMO training plan.	Development of TSMO training plans are being considered as part of TSMO Program Plans.	Develop a structured TSMO training plan indicating content, schedule, venue and staff to attend.
Review and revise agency structure to accommodate TSMO activities	District organizational structures are being revisited to reflect the specific needs of TSMO activities.	Coordinate with TSMO Champion to assign specific TSMO functions to staff as a primary or secondary function.
Develop staffing plan, including revised position responsibilities, recruitment and succession to accommodate TSMO activities.	Ongoing: Staffing estimates have been developed for each TxDOT TMC.	Staffing plans should be developed as part of TSMO Program Plans to include revised position responsibilities, recruitment, retention, and succession strategies.

## 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.

**Progress in Improving “Culture” Capability Maturity  
Central Office Responsibilities**

Strategic Plan Recommendation	Progress	Next Steps
<b>Central Office Responsibilities</b>		
Develop engagement plan for advocating for TSMO.	Completed: Statewide TSMO Engagement Plan and Stakeholder Outreach Plan were developed identifying key leadership groups and contacts; leadership roles, responsibilities, and outreach schedule; and an outline of leadership activities.	Utilize the Statewide TSMO Engagement Plan and Stakeholder Outreach Plan as guidelines to continue engagement with TxDOT Leadership.
Develop standard format for case studies.	Ongoing: TSMO Case Studies in other states are being referenced as part of engagement materials.	Develop a database of TSMO typical costs and benefits based on case studies in Texas as well as nationally.
Develop engagement resources (presentations, handouts, etc.) for districts.	Completed: A TSMO video, brochure, executive message flyer, FAQs and presentations have been prepared to support the districts as part of their TSMO outreach efforts.	Continue to update engagement resources as TSMO Program Plans are rolled out in each district. The TxDOT TSMO website is being updated based on current information and best practices from other states.
Divisions determined by TRF will identify a TSMO coordinator.	Completed: A TSMO Steering Committee has been formed including TSMO Coordinators for each applicable division.	Actively engage the TSMO Steering Committee to oversee the implementation of TSMO strategies and make changes as deemed necessary.

Progress in Improving “Culture” Capability Maturity District Responsibilities		
Strategic Plan Recommendation	Progress	Next Steps
District Responsibilities		
Develop TSMO engagement plan	Ongoing: TSMO Engagement Plans are being developed as part of each District’s TSMO Program Plan.	Actively apply the Engagement Plan by taking a leadership role in implementing the recommendations of the TSMO Program Plan with the appropriate stakeholders.
Customize TSMO business case to meet individual district needs.	Ongoing: TSMO Business Cases are being developed as part of each District’s TSMO Program Plan.	Utilize the Business Cases as a framework in developing specific TSMO strategies to address how traffic safety, reliability, mobility and asset uptime can be improved within the districts.
Identify TSMO Coordinator.	Completed: TSMO Coordinators have been assigned in each district.	Provide TSMO Coordinators with the support they need to successfully roll out the TSMO program in their districts (i.e., TSMO Program Plan).
Identify TSMO Champion.	Completed: TSMO Champions have been assigned in each district.	Provide TSMO Champions with the support they need to successfully roll out the TSMO program in their districts (i.e., TSMO Program Plan).

**Collbaoration**

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.

Progress in Improving “Collaboration” Capability Maturity		
Strategic Plan Recommendation	Progress	Next Steps
<b>Central Office Responsibilities</b>		
Initiate a Statewide TSMO Meeting, including district and division representatives.	Completed: Initial Statewide TSMO Meeting was held during 2019 with followup meetings anticipated on a biannual basis.	Begin to share TSMO case examples and best practices throughout Texas and establish consistency in delivery of TSMO services, as applicable.
Traffic Management Section regional representatives will provide support to districts in their region.	Ongoing: Traffic Management Section is participating in ITS Meetings and CMM workshops to identify strengths and weaknesses at the district level.	Develop structured plan to offer Subject Matter Experts, training and on call support, to address specific issues in delivering quality TSMO services at the district level.
<b>District Responsibilities</b>		
Include internal collaboration in revised project delivery process	Ongoing: Improvements to project delivery processes are being addressed as part of the TSMO Program Plans.	Begin to implement the project delivery processes for each phase of the project development process (planning – operations).
Establish opportunity to engage internal stakeholders, including division support such as district TSMO working group.	Ongoing: As TSMO Program Plans are being developed for each district, in collaboration with TRF, they are anticipated to continue during the implementation phase.	Begin conducting annual assessments of the effectiveness of TRF/District collaboration in delivering the TSMO programs; identify areas needing improvement.
Attend and participate in Statewide TSMO Meeting.	Ongoing: Districts actively engaged during the 2019 Statewide TSMO meeting and is expected to continue to engage in followup meetings.	Share best practices and lessons learned by the Districts in developing and implementing their TSMO Program Plans.
Review planning documents and evaluate where TSMO can support planning objectives.	Ongoing: TSMO is being mainstreamed in the planning process as integrated strategies.	Develop checklist of TSMO strategies that may be included in the TSMO planning process.
Establish Regional TSMO subcommittee with internal and external stakeholders.	Regional TSMO subcommittees are anticipated to form as the TSMO Program Plans advance through implementation.	Begin developing interagency agreements that formalizes partnership discussions among public and private stakeholders.

## TSMO Implementation Plan

TSMO strategies include a broad range of solutions to address each of the CMM's six dimensions. The table below summarizes the strategies that are further detailed in Appendix A. Specific next steps, timeframe, task leads, and key support partners are identified for each strategy.

TSMO Implementation Plan	
Business Processes	
1.	<b>Develop methodology to allocate ITS/Signals O&amp;M funding to align with TSMO goals</b>
	Next Steps: 1. Research annual funding allocations versus needs for each district. 2. Review FAST Act Reauthorization to identify eligible funding sources. 3. Develop 5-year funding program considering annual ITS O&M and replacements.
	Timeframe: Near Term      Task Lead: Traffic Safety Division – Traffic Management Section
	Key Support Partners: FHWA, TxDOT Maintenance Division, TxDOT Districts
2.	<b>Develop Statewide SOPs to Improve operational interoperability</b>
	Next Steps: 1. Collect and review TMC and HERO SOPs for each district. 2. Develop overarching Statewide SOPs to provide consistency and interoperability. 3. Apply Statewide SOPs in developing TMC Operations and HERO training program.
	Timeframe: Near Term      Task Lead: Traffic Safety Division – Traffic Management Section
	Key Support Partners: Human Resources Division, Maintenance Division, TxDOT Districts
3.	<b>Engage the Procurement Division to support TSMO program objectives</b>
	Next Steps: 1. Assess existing processes used to procure systems & technology for TRF & districts. 2. Assess existing processes for vendors to obtain Approved Product List certifications. 3. Conduct industry outreach in modifying processes to be more performance based.
	Timeframe: Long Term      Task Lead: Procurement Division
	Key Support Partners: Traffic Safety, Design, Construction and Maintenance Divisions, TxDOT Districts

TSMO Implementation Plan			
4.	<p><b>Develop Emergency Response Plan to Improve preparedness, response and recovery</b></p> <p>Next Steps:</p> <ol style="list-style-type: none"> <li>1. Assess existing processes used to conduct emergency management.</li> <li>2. Assess the need and feasibility to expand the use of RIMS to other districts.</li> <li>3. Prepare statewide Comprehensive Emergency Management Plan.</li> </ol> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 30%;">Timeframe: Mid Term</td> <td>Task Lead: Texas Division of Emergency Management</td> </tr> </table> <p>Key Support Partners: Traffic Safety, Maintenance Divisions, TxDOT Districts, Dept. of Public Safety</p>	Timeframe: Mid Term	Task Lead: Texas Division of Emergency Management
Timeframe: Mid Term	Task Lead: Texas Division of Emergency Management		
5.	<p><b>Conduct Cybersecurity Vulnerability Analyses of IT networks to improve resiliency</b></p> <p>Next Steps:</p> <ol style="list-style-type: none"> <li>1. Document after action review of ransomware and other cybersecurity events.</li> <li>2. Develop (or modify) processes and checklists to conduct vulnerability analyses.</li> <li>3. Conduct periodic cybersecurity vulnerability analyses on a regular basis.</li> </ol> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 30%;">Timeframe: Mid Term</td> <td>Task Lead: Information Technology Division</td> </tr> </table> <p>Key Support Partners: Traffic Safety Division</p>	Timeframe: Mid Term	Task Lead: Information Technology Division
Timeframe: Mid Term	Task Lead: Information Technology Division		
6.	<p><b>Formalize TSMO processes for succession planning to retain institutional knowledge and partnerships</b></p> <p>Next Steps:</p> <ol style="list-style-type: none"> <li>1. Establish a portal for sharing Statewide TSMO Strategic and District Program Plans.</li> <li>2. Update and maintain all TSMO related systems engineering documentation.</li> <li>3. Update and maintain all TSMO operations and maintenance documentation.</li> </ol> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 30%;">Timeframe: Near Term</td> <td>Task Lead: Traffic Safety Division – Traffic Management Section</td> </tr> </table> <p>Key Support Partners: TxDOT Districts, Information Technology Division, Maintenance Division</p>	Timeframe: Near Term	Task Lead: Traffic Safety Division – Traffic Management Section
Timeframe: Near Term	Task Lead: Traffic Safety Division – Traffic Management Section		
7.	<p><b>Bring Procurement Division in project development process earlier to provide input &amp; achieve schedules</b></p> <p>Next Steps:</p> <ol style="list-style-type: none"> <li>1. Notify Procurement of TSMO project during the planning phase.</li> <li>2. Notify Procurement of system requirements of technology components.</li> <li>3. Collaborate with Procurement during the design phase in preparing specifications.</li> </ol> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 30%;">Timeframe: Long Term</td> <td>Task Lead: Traffic Safety Division – Traffic Management Section</td> </tr> </table>	Timeframe: Long Term	Task Lead: Traffic Safety Division – Traffic Management Section
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TSMO Implementation Plan			
	Key Support Partners: Procurement Division, Strategy & Innovation Division, Information Technology Division, Research and Technology Implementation Division, TxDOT Districts		
8.	<p><b>Develop a framework to identify “what’s next” in terms of innovations to support TSMO</b></p> <p>Next Steps:</p> <ol style="list-style-type: none"> <li>1. Identify the needs for innovations (e.g., safety, mobility, congestion relief, etc.).</li> <li>2. Develop ConOps indicating how the innovation will be used in operations.</li> <li>3. Issue a RFI to vendors describing the innovation and soliciting feedback.</li> </ol> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 30%;">Timeframe: Mid Term</td> <td>Task Lead: Strategy &amp; Innovation Division</td> </tr> </table> <p>Key Support Partners: Traffic Safety Division, Information Technology Division, Research and Technology Implementation Division, TxDOT Districts</p>	Timeframe: Mid Term	Task Lead: Strategy & Innovation Division
Timeframe: Mid Term	Task Lead: Strategy & Innovation Division		
Systems and Technology			
9.	<p><b>Conduct Connected Roadway Classification System (CRSC) analysis to prepare for CAT</b></p> <p>Next Steps:</p> <ol style="list-style-type: none"> <li>1. Select strategic corridors to conduct the first round of CRCS analyses.</li> <li>2. Fine tune the CRSC analysis process by examining the usefulness of results.</li> <li>3. Roll out the CRSC analysis for other corridors throughout the state.</li> </ol> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 30%;">Timeframe: Long Term</td> <td>Task Lead: Traffic Safety Division – Traffic Management Section</td> </tr> </table> <p>Key Support Partners: Research and Technology Implementation Division</p>	Timeframe: Long Term	Task Lead: Traffic Safety Division – Traffic Management Section
Timeframe: Long Term	Task Lead: Traffic Safety Division – Traffic Management Section		
10.	<p><b>Develop Artificial Intelligence (AI)/Machine Learning applications that address common operational scenarios</b></p> <p>Next Steps:</p> <ol style="list-style-type: none"> <li>1. Select one operational scenario (e.g., incident management) to develop pilot project.</li> <li>2. Prepare ConOps and system requirements to deploy the pilot project.</li> <li>3. Implement pilot project and assess effectiveness based on performance measures.</li> </ol> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 30%;">Timeframe: Long Term</td> <td>Task Lead: Strategic Planning Division</td> </tr> </table> <p>Key Support Partners: Traffic Safety Division, Information Technology Division, Maintenance Division</p>	Timeframe: Long Term	Task Lead: Strategic Planning Division
Timeframe: Long Term	Task Lead: Strategic Planning Division		
11.	<p><b>Increase ITS systems support by TRF to the districts to improve asset uptime</b></p> <p>Next Steps:</p> <ol style="list-style-type: none"> <li>1. Identify Subject Matter Experts (SME) to support technology needs of the districts.</li> <li>2. SMEs develop SOPs and training materials to support district needs.</li> <li>3. Develop a structured program to make SMEs available to provide on-call support.</li> </ol>		

TSMO Implementation Plan	
	<p>Timeframe: Task Lead: Maintenance Division Near Term</p> <p>Key Support Partners: Traffic Safety Division, Information Technology Division, TxDOT Districts</p>
12.	<p><b>Develop and implement Integrated Corridor Management along applicable strategic corridors</b></p> <p>Next Steps:            1. Prepare statewide ICM Master Plan identifying feasible corridors for deployment.            2. Develop ConOps and system requirements to implement priority projects.            3. Prepare joint SOPs and execute interagency agreements with partner stakeholders.</p> <p>Timeframe: Task Lead: Transportation Planning and Programming Division Mid Term</p> <p>Key Support Partners: FHWA, Traffic Safety Division, Public Transportation Division, TEMPO</p>
13.	<p><b>Develop Enhanced Traffic Signal System Implementation Plans</b></p> <p>Next Steps:            1. Prepare Statewide Enhanced Traffic Signal System Implementation Plan.            2. Prepare District Enhanced Traffic Signal System Implementation Plans.            3. Implement District Enhanced Traffic Signal Implementation Plans in phases.</p> <p>Timeframe: Task Lead: Traffic Safety Division – Traffic Management Section Mid Term</p> <p>Key Support Partners: TxDOT Districts</p>
14.	<p><b>Develop and implement Lonestar™ enhancements</b></p> <p>Next Steps:            1. Complete Lonestar™ survey and summarize results, findings and recommendations.            2. Prioritize Lonestar™ enhancements.            3. Implement Lonestar™ enhancements at TxDOT TMCs throughout the state.</p> <p>Timeframe: Near Term Task Lead: Traffic Safety Division – Traffic Management Section</p> <p>Key Support Partners: Information Technology Division</p>
15.	<p><b>Improve TxDOT ITS infrastructure by filling in the gaps; maintaining the system; and focusing on arterials</b></p> <p>Next Steps:            1. Update District ITS Master Plans to determine ITS device and communication needs.            2. Update regional ITS architectures to identify interfaces among TMC, ITS devices, etc.</p>



TSMO Implementation Plan	
	<p>3. Design/construct ITS to fill in the gaps in alignment with work program funding.</p> <p>Timeframe: Near Term      Task Lead: Traffic Safety Division – Traffic Management Section</p> <p>Key Support Partners: TxDOT Districts</p>
16.	<p><b>Develop a roadmap to design, build, and maintain an integrated data platform</b></p> <p>Next Steps:</p> <ol style="list-style-type: none"> <li>1. Identify users’ data needs from TxDOT’s Division and District staff.</li> <li>2. Develop Data Platform Architecture planning for future scalability and extensibility.</li> <li>3. Prepare Data Platform ConOps obtaining input on how TxDOT staff would use it.</li> </ol> <p>Timeframe: Near Term      Task Lead: Information Technology Division</p> <p>Key Support Partners: Traffic Safety Division, Strategy &amp; Innovation Division, Research and Technology Implementation Division, TxDOT Districts, Other TxDOT Divisions</p>
17.	<p><b>Prepare a database of unit costs for TSMO project planning and budgeting</b></p> <p>Next Steps:</p> <ol style="list-style-type: none"> <li>1. Data collection of unit costs for existing TMS devices (initial and O&amp;M costs).</li> <li>2. Research unit cost data for emerging technologies to support TSMO strategies.</li> <li>3. Prepare unit cost database and summarize by metro, urban, and rural areas.</li> </ol> <p>Timeframe: Mid Term      Task Lead: Traffic Safety Division – Traffic Management Section</p> <p>Key Support Partners: Procurement, TxDOT Districts, Information Technology Division</p>
Performance Measures	
18.	<p><b>Implement performance dashboards for safety and travel reliability during construction</b></p> <p>Next Steps:</p> <ol style="list-style-type: none"> <li>1. Select one TMC to begin posting performance dashboards on video wall and website.</li> <li>2. Develop system requirements for implementing performance dashboards.</li> <li>3. Begin posting dashboards, assess their effectiveness, then roll out to other TMCs.</li> </ol> <p>Timeframe: Near Term      Task Lead: Traffic Safety Division – Traffic Management Section</p> <p>Key Support Partners: Information Technology Division, TxDOT Districts</p>
19.	<p><b>Apply performance measures to all applicable phases of project’s lifecycle (planning - operations)</b></p> <p>Next Steps:</p> <ol style="list-style-type: none"> <li>1. Assess gaps in performance measures for each phase of a project’s lifecycle.</li> </ol>

TSMO Implementation Plan			
	<p>2. Prepare a plan to develop missing performance measures and refine existing ones.</p> <p>3. Develop missing performance measures dashboards and assess their effectiveness.</p>		
	<table border="1"> <tr> <td>Timeframe: Near Term</td> <td>Task Lead: Transportation Planning and Programming Division</td> </tr> </table>	Timeframe: Near Term	Task Lead: Transportation Planning and Programming Division
Timeframe: Near Term	Task Lead: Transportation Planning and Programming Division		
	Key Support Partners: Traffic Safety, Design, Construction and Maintenance Divisions		
20.	<p><b>Develop consistent performance data management process to continually track system performance</b></p>		
	<p>Next Steps:</p> <ol style="list-style-type: none"> <li>1. Collect performance measures for all aspects of TxDOT programs.</li> <li>2. Select applicable performance measures and map to TxDOT goals.</li> <li>3. Define Key Performance Measures and targets for each performance measure.</li> </ol>		
	<table border="1"> <tr> <td>Timeframe: Mid Term</td> <td>Task Lead: Transportation Planning and Programming Division</td> </tr> </table>	Timeframe: Mid Term	Task Lead: Transportation Planning and Programming Division
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	Key Support Partners: Traffic Safety Division, TxDOT Districts, Other TxDOT Divisions		
21.	<p><b>Develop process to include operations performance measures into district decision-making</b></p>		
	<p>Next Steps:</p> <ol style="list-style-type: none"> <li>1. Assess performance dashboards and identify upgrades to support decision-making.</li> <li>2. Analyze KPMs for TxDOT goals and identify strategies to reverse undesirable trends.</li> <li>3. Identify TSMO strategies to improve KPMs.</li> </ol>		
	<table border="1"> <tr> <td>Timeframe: Mid Term</td> <td>Task Lead: Transportation Planning and Programming Division</td> </tr> </table>	Timeframe: Mid Term	Task Lead: Transportation Planning and Programming Division
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	Key Support Partners: Traffic Safety Division, TxDOT Districts, Other TxDOT Divisions		
22.	<p><b>Develop a process to improve safety by applying historic, real-time, and predictive performance measures</b></p>		
	<p>Next Steps:</p> <ol style="list-style-type: none"> <li>1. Identify additional data fields needed to address gaps in the CRIS.</li> <li>2. Identify methods to capture information on secondary crashes.</li> <li>3. Apply video analytics at safety hot spots using near-miss algorithms.</li> </ol>		
	<table border="1"> <tr> <td>Timeframe: Long Term</td> <td>Task Lead: Traffic Safety Division</td> </tr> </table>	Timeframe: Long Term	Task Lead: Traffic Safety Division
Timeframe: Long Term	Task Lead: Traffic Safety Division		
	Key Support Partners: TxDOT Districts		
Organization and Workforce			
23.	<p><b>Develop a succession plan for essential staff to provide continuity of operations</b></p>		
	<p>Next Steps:</p> <ol style="list-style-type: none"> <li>1. Identify specific training needs with input from each district.</li> </ol>		

TSMO Implementation Plan			
	<ul style="list-style-type: none"> <li>2. Assess various training platforms (e.g., classroom, online, videos).</li> <li>3. Develop and implement training and certification program.</li> </ul>		
	<table border="1"> <tr> <td>Timeframe: Near-Term</td> <td>Task Lead: Human Resources Division</td> </tr> </table>	Timeframe: Near-Term	Task Lead: Human Resources Division
Timeframe: Near-Term	Task Lead: Human Resources Division		
	Key Support Partners: Traffic Safety, Maintenance Division		
24.	<p><b>Develop a comprehensive TxDOT TSMO Training Program</b></p> <p>Next Steps:</p> <ul style="list-style-type: none"> <li>1. Conduct workshop with TxDOT divisions and districts to identify training needs.</li> <li>2. Develop a comprehensive TSMO training program that addresses training needs.</li> <li>3. Integrate TSMO training program into the TxDOT Learning Management System.</li> </ul> <table border="1"> <tr> <td>Timeframe: Near Term</td> <td>Task Lead: Human Resources Division</td> </tr> </table> <p>Key Support Partners: Information Technology Division, Other TxDOT Divisions</p>	Timeframe: Near Term	Task Lead: Human Resources Division
Timeframe: Near Term	Task Lead: Human Resources Division		
25.	<p><b>Build and develop the workforce needed to manage the TSMO infrastructure</b></p> <p>Next Steps:</p> <ul style="list-style-type: none"> <li>1. Refresh job descriptions to better align with education and experience required.</li> <li>2. Attract top talent by revisiting compensation package to be more competitive.</li> <li>3. Assign relevant TSMO training modules and certification courses to staff.</li> </ul> <table border="1"> <tr> <td>Timeframe: Long Term</td> <td>Task Lead: Human Resources Division</td> </tr> </table> <p>Key Support Partners: Traffic Safety Division, TxDOT Districts</p>	Timeframe: Long Term	Task Lead: Human Resources Division
Timeframe: Long Term	Task Lead: Human Resources Division		
26.	<p><b>Develop an action plan to address staff vacancies in critical traffic management program capabilities.</b></p> <p>Next Steps:</p> <ul style="list-style-type: none"> <li>1. Determine critical staff shortages for TRF and each district.</li> <li>2. Estimate number and type of staff required to deliver the TSMO program.</li> <li>3. Prepare staffing plan addressing recruitment, training, and retention.</li> </ul> <table border="1"> <tr> <td>Timeframe: Mid Term</td> <td>Task Lead: Traffic Safety Division – Traffic Management Section</td> </tr> </table> <p>Key Support Partners: Human Resources, TxDOT Districts</p>	Timeframe: Mid Term	Task Lead: Traffic Safety Division – Traffic Management Section
Timeframe: Mid Term	Task Lead: Traffic Safety Division – Traffic Management Section		
27.	<p><b>Rotate TxDOT staff through different positions in the Transportation Management Centers.</b></p> <p>Next Steps:</p> <ul style="list-style-type: none"> <li>1. Prepare schedule of various TMC functions staff will rotate through.</li> <li>2. Select the staff that will participate in the TMC rotation program.</li> <li>3. Introduce the selected staff to the TMC, TMC Manager, and Operators.</li> </ul>		

TSMO Implementation Plan					
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Timeframe: Long-Term	Task Lead: Human Resources Division				
Key Support Partners: TxDOT Districts, TMC Managers					
Culture					
28.	<p><b>Apply gamification strategies as an incentive to continuously improve operational performance</b></p> <p>Next Steps:</p> <ol style="list-style-type: none"> <li>1. Prepare ConOps for one selected TMC with input from operations staff.</li> <li>2. Develop software tools to automate and integrate gaming functions with Lonestar™.</li> <li>3. Implement gaming at one TMC, assess its effectiveness, then roll out to other TMCs.</li> </ol> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 30%;">Timeframe: Long-Term</td> <td>Task Lead: Strategy &amp; Innovation Division</td> </tr> <tr> <td colspan="2">Key Support Partners: Information Technology Division, Traffic Safety Division, Other TxDOT Divisions</td> </tr> </table>	Timeframe: Long-Term	Task Lead: Strategy & Innovation Division	Key Support Partners: Information Technology Division, Traffic Safety Division, Other TxDOT Divisions	
Timeframe: Long-Term	Task Lead: Strategy & Innovation Division				
Key Support Partners: Information Technology Division, Traffic Safety Division, Other TxDOT Divisions					
29.	<p><b>Realize the full potential of TxDOT's ITS infrastructure during pandemic events</b></p> <p>Next Steps:</p> <ol style="list-style-type: none"> <li>1. Summarize lessons learned during the COVID pandemic to identify ITS opportunities.</li> <li>2. Develop a Concept of Operations addressing similar pandemic events.</li> <li>3. Prepare Pandemic Response Action Plans (e.g., staffing, SOPs, supplies, systems).</li> </ol> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 30%;">Timeframe: Long Term</td> <td>Task Lead: Traffic Safety Division – Traffic Management Section</td> </tr> <tr> <td colspan="2">Key Support Partners: Research and Technology Implementation Division, TxDOT Districts</td> </tr> </table>	Timeframe: Long Term	Task Lead: Traffic Safety Division – Traffic Management Section	Key Support Partners: Research and Technology Implementation Division, TxDOT Districts	
Timeframe: Long Term	Task Lead: Traffic Safety Division – Traffic Management Section				
Key Support Partners: Research and Technology Implementation Division, TxDOT Districts					
30.	<p><b>Develop managers in District departments to consider TSMO in project development and implementation.</b></p> <p>Next Steps:</p> <ol style="list-style-type: none"> <li>1. Provide basic TSMO training (i.e., three TSMO Overview modules).</li> <li>2. Provide targeted TSMO training in area(s) of specialty and interest.</li> <li>3. Apply TSMO checklists for planning, design, construction, and project close-out.</li> </ol> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 30%;">Timeframe: Mid Term</td> <td>Task Lead: Traffic Safety Division – Traffic Management Section</td> </tr> <tr> <td colspan="2">Key Support Partners: TxDOT Districts and Divisions, Human Resources Division</td> </tr> </table>	Timeframe: Mid Term	Task Lead: Traffic Safety Division – Traffic Management Section	Key Support Partners: TxDOT Districts and Divisions, Human Resources Division	
Timeframe: Mid Term	Task Lead: Traffic Safety Division – Traffic Management Section				
Key Support Partners: TxDOT Districts and Divisions, Human Resources Division					
31.	<p><b>Provide high level of integration of TSMO strategies between TRF, Districts, and ITD</b></p> <p>Next Steps:</p> <ol style="list-style-type: none"> <li>1. TRF to periodically update ITD on proposed statewide TSMO strategies.</li> </ol>				

TSMO Implementation Plan			
	<p>2. ITD to engage with Districts to understand TSMO implementation needs.</p> <p>3. Encourage partnership with technology vendors, OEMs, data providers, etc.</p>		
	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 30%; padding: 5px;">Timeframe: Mid Term</td> <td style="padding: 5px;">Task Lead: Traffic Safety Division – Traffic Management Section</td> </tr> </table>	Timeframe: Mid Term	Task Lead: Traffic Safety Division – Traffic Management Section
Timeframe: Mid Term	Task Lead: Traffic Safety Division – Traffic Management Section		
	Key Support Partners: Information Technology Division, TxDOT Districts		
32.	<p><b>Conduct annual reviews of the TSMO Program to determine what is working and not working</b></p> <p>Next Steps:</p> <ol style="list-style-type: none"> <li>1. TRF to develop a uniform process to audit District TSMO programs.</li> <li>2. TRF to develop checklists applying KPMs to measure TSMO success.</li> <li>3. TRF conducts audits on various TSMO scenarios (e.g., safety, TIM, work zones, etc.).</li> </ol>		
	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%; padding: 5px;">Timeframe: Long-Term</td> <td style="padding: 5px;">Task Lead: Traffic Safety Division</td> </tr> </table>	Timeframe: Long-Term	Task Lead: Traffic Safety Division
Timeframe: Long-Term	Task Lead: Traffic Safety Division		
	Key Support Partners: TxDOT Districts		
Collaboration			
33.	<p><b>Support Rural District Operations that have limited resources to support TSMO goals</b></p> <p>Next Steps:</p> <ol style="list-style-type: none"> <li>1. Prepare checklist to offer guidance in requesting ITS as part of roadway projects.</li> <li>2. Provide SHRP2 training for fire, police and other emergency responders.</li> <li>3. Develop partnering agreements among districts to share maintenance technicians.</li> </ol>		
	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%; padding: 5px;">Timeframe: Mid Term</td> <td style="padding: 5px;">Task Lead: Maintenance Division</td> </tr> </table>	Timeframe: Mid Term	Task Lead: Maintenance Division
Timeframe: Mid Term	Task Lead: Maintenance Division		
	Key Support Partners: Traffic Safety Division, TxDOT Districts, Public Safety, Maintenance Division		
34.	<p><b>Strengthen TIM Teams collaboration with stakeholders to safely reduce incident clearance times</b></p> <p>Next Steps:</p> <ol style="list-style-type: none"> <li>1. Develop TIM strategic plan to address CMM TIM Self-Assessment deficiencies.</li> <li>2. Develop and execute interagency agreements to strengthen agency partnerships.</li> <li>3. Assess TMC/TIM integrated operations to improve their effectiveness.</li> </ol>		
	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%; padding: 5px;">Timeframe: Near Term</td> <td style="padding: 5px;">Task Lead: Traffic Safety Division – Traffic Management Section</td> </tr> </table>	Timeframe: Near Term	Task Lead: Traffic Safety Division – Traffic Management Section
Timeframe: Near Term	Task Lead: Traffic Safety Division – Traffic Management Section		
	Key Support Partners: TxDOT Districts, Public Safety, Emergency Management, Communications		

TSMO Implementation Plan			
35.	<p><b>Develop Special Event Checklist to apply TSMO strategies</b></p> <p>Next Steps:</p> <ol style="list-style-type: none"> <li>1. Create working committee to obtain input for components of the checklist.</li> <li>2. Develop draft checklist for review by working committee.</li> <li>3. Pilot test and refine checklist based on applying it for various special events.</li> </ol> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 30%;">Timeframe: Mid Term</td> <td>Task Lead: Traffic Safety Division – Traffic Management Section</td> </tr> </table> <p>Key Support Partners: Public Safety, Communications, TEMO, Texas A&amp;M, University of Texas</p>	Timeframe: Mid Term	Task Lead: Traffic Safety Division – Traffic Management Section
Timeframe: Mid Term	Task Lead: Traffic Safety Division – Traffic Management Section		
36.	<p><b>Maintain strong collaboration between TRF, ITD, and Strategy &amp; Innovation Division to support TSMO</b></p> <p>Next Steps:</p> <ol style="list-style-type: none"> <li>1. TRF to brief ITD and Strategy &amp; Innovation on the Statewide TSMO Strategic Plan.</li> <li>2. TRF to brief ITD and Strategy &amp; Innovation on District TSMO Program Plans.</li> <li>3. Discuss and agree on key TSMO interfaces between TRF and ITD.</li> </ol> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 30%;">Timeframe: Mid Term</td> <td>Task Lead: Traffic Safety Division – Traffic Management Section</td> </tr> </table> <p>Key Support Partners: ITD, Strategy &amp; Innovation Division</p>	Timeframe: Mid Term	Task Lead: Traffic Safety Division – Traffic Management Section
Timeframe: Mid Term	Task Lead: Traffic Safety Division – Traffic Management Section		
37.	<p><b>Develop a stronger collaboration with first responders in better understanding and serving their needs</b></p> <p>Next Steps:</p> <ol style="list-style-type: none"> <li>1. Review TIM Team CMM surveys to identify areas needing improvement.</li> <li>2. Place TMC Operators at a Highway Patrol Dispatch Center on an interim basis.</li> <li>3. Review the incident timeline to identify areas needing improvement.</li> </ol> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 30%;">Timeframe: Mid Term</td> <td>Task Lead: Traffic Safety Division – Traffic Management Section</td> </tr> </table> <p>Key Support Partners: Statewide TIM Team, TxDOT Districts, First Responders</p>	Timeframe: Mid Term	Task Lead: Traffic Safety Division – Traffic Management Section
Timeframe: Mid Term	Task Lead: Traffic Safety Division – Traffic Management Section		
38.	<p><b>Develop Rural Incident Management Plans for strategic corridors</b></p> <p>Next Steps:</p> <ol style="list-style-type: none"> <li>1. Establish a Rural ITS vision by identifying challenges and incident response goal</li> <li>2. Develop new, or enhance existing, regional TIM teams; provide input to rural plans.</li> <li>3. Apply CMM process to conduct a gap analysis for incident management strategies.</li> </ol> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%;">Timeframe: Mid Term</td> <td>Task Lead: Traffic Safety Division – Traffic Management Section</td> </tr> </table> <p>Key Support Partners: TIM Teams, TxDOT Rural Districts</p>	Timeframe: Mid Term	Task Lead: Traffic Safety Division – Traffic Management Section
Timeframe: Mid Term	Task Lead: Traffic Safety Division – Traffic Management Section		

## TSMO Tactical Plan Assessment

Tactical plans were developed as a result of the CMM process in all six dimensions (i.e., business processes, systems and technology, performance measures, organization and workforce, culture collaboration).

### ***Tactical Plan Criteria***

Tactical plan criteria were developed using qualitative descriptors. As tactical plans advance to the implementation phase, quantitative analyses will be performed (e.g., cost estimates, detailed schedules, funding sources, benefit-cost ratios). At the strategic plan level, the following criteria were applied:

- Goal alignment with TSMO vision and mission (i.e., safety, reliability, mobility asset uptime);
- Costs (i.e., low, medium, high for initial and recurring costs);
- TxDOT staff effort (i.e., low, medium, high);
- Stakeholder partnerships (i.e., internal, external); and
- Return-on-investment (i.e., low, medium, high).

### ***Tactical Plan Components and Recommendations***

The table below identifies TSMO strategies for each CMM dimension and their corresponding qualitative descriptors using the above criteria.

TSMO Tactical Plan Assessment	
<b>Business Processes</b>	
<b>1. Develop methodology to allocate ITS/Signals O&amp;M funding to align with TSMO goals</b>	
Goal Alignment: Safety - Yes / Reliability - Yes / Mobility - Yes / Asset Uptime - Yes	
Costs: Initial: Low / Recurring: Low	TxDOT Staff Effort: Medium
Stakeholders: Internal - Yes / External - No	Return-on-Investment - High
<b>2. Develop Statewide Standard Operating Procedures to improve operational interoperability</b>	
Goal Alignment: Safety - Yes / Reliability - Yes / Mobility - No / Asset Uptime - Yes	
Costs: Initial: Low / Recurring: Low	TxDOT Staff Effort: Medium
Stakeholders: Internal - Yes / External - No	Return-on-Investment - Medium
<b>3. Engage the Procurement Division to support TSMO program objectives</b>	
Goal Alignment: Safety - No / Reliability - No / Mobility - No / Asset Uptime - Yes	
Costs: Initial: Low / Recurring: Low	TxDOT Staff Effort: Medium
Stakeholders: Internal - Yes / External - No	Return-on-Investment - Low
<b>4. Develop Emergency Response Plan to improve preparedness, response and recovery</b>	
Goal Alignment: Safety - Yes / Reliability - Yes / Mobility - No / Asset Uptime - No	

Costs: Initial: Medium / Recurring: Medium	TxDOT Staff Effort: Medium
Stakeholders: Internal – Yes / External - Yes	Return-on-Investment - High
<b>5. Conduct Cybersecurity Vulnerability Analyses of IT networks to improve resiliency</b>	
Goal Alignment: Safety - No / Reliability – Yes / Mobility – No / Asset Uptime - Yes	
Costs: Initial: Medium / Recurring: Medium	TxDOT Staff Effort: Medium
Stakeholders: Internal – Yes / External - No	Return-on-Investment - High
<b>6. Formalize TSMO processes as part of succession planning to retain institutional knowledge and partnerships</b>	
Goal Alignment: Safety - No / Reliability – Yes / Mobility – No / Asset Uptime - Yes	
Costs: Initial: Medium / Recurring: Low	TxDOT Staff Effort: Medium
Stakeholders: Internal – Yes / External - No	Return-on-Investment - High
<b>7. Bring Procurement Division in project development process earlier to provide input &amp; achieve schedules</b>	
Goal Alignment: Safety - No / Reliability – Yes / Mobility – No / Asset Uptime - Yes	
Costs: Initial: Low / Recurring: Low	TxDOT Staff Effort: Low
Stakeholders: Internal – Yes / External - No	Return-on-Investment - Medium
<b>8. Develop a framework to identify “what’s next” in terms of innovations to support TSMO</b>	
Goal Alignment: Safety - Yes / Reliability – Yes / Mobility – Yes / Asset Uptime - Yes	
Costs: Initial: Low / Recurring: Low	TxDOT Staff Effort: Medium
Stakeholders: Internal – Yes / External - Yes	Return-on-Investment - Medium
<b>Systems and Technology</b>	
<b>9. Conduct Connected Roadway Classification System (CRSC) analysis to prepare for CAT</b>	
Goal Alignment: Safety - Yes / Reliability – Yes / Mobility –Yes / Asset Uptime - No	
Costs: Initial: Medium / Recurring: Medium	TxDOT Staff Effort: Medium
Stakeholders: Internal – Yes / External - No	Return-on-Investment - Medium
<b>10. Develop AI/Machine Learning applications that address common operational scenarios</b>	
Goal Alignment: Safety - Yes / Reliability – Yes / Mobility – Yes / Asset Uptime - Yes	
Costs: Initial: High / Recurring: Medium	TxDOT Staff Effort: High
Stakeholders: Internal – Yes / External - Yes	Return-on-Investment - High
<b>11. Increase ITS systems support by TRF to the districts to improve asset uptime</b>	
Goal Alignment: Safety - Yes / Reliability – Yes / Mobility – No / Asset Uptime - Yes	
Costs: Initial: Low / Recurring: Low	TxDOT Staff Effort: Medium



Stakeholders: Internal – Yes / External - No	Return-on-Investment - Medium
<b>12. Develop and implement Integrated Corridor Management along applicable strategic corridors</b>	
Goal Alignment: Safety - Yes / Reliability – Yes / Mobility – Yes / Asset Uptime - No	
Costs: Initial: High / Recurring: Medium	TxDOT Staff Effort: High
Stakeholders: Internal – Yes / External - Yes	Return-on-Investment - High
<b>13. Develop Enhanced Traffic Signal System Implementation Plans</b>	
Goal Alignment: Safety - Yes / Reliability – Yes / Mobility – Yes / Asset Uptime - Yes	
Costs: Initial: Low / Recurring: Low	TxDOT Staff Effort: Medium
Stakeholders: Internal – Yes / External - Yes	Return-on-Investment - Medium
<b>14. Develop and implement Lonestar™ enhancements</b>	
Goal Alignment: Safety - Yes / Reliability – Yes / Mobility – Yes / Asset Uptime - Yes	
Costs: Initial: Medium / Recurring: Medium	TxDOT Staff Effort: Medium
Stakeholders: Internal – Yes / External - No	Return-on-Investment - Medium
<b>15. Improve TxDOT ITS infrastructure by filling in the gaps; maintaining the system; and focusing on arterials</b>	
Goal Alignment: Safety - Yes / Reliability – Yes / Mobility – Yes / Asset Uptime - Yes	
Costs: Initial: Medium / Recurring: Medium	TxDOT Staff Effort: Medium
Stakeholders: Internal – Yes / External - No	Return-on-Investment - High
<b>16. Develop a roadmap to design, build, and maintain an integrated data platform</b>	
Goal Alignment: Safety - Yes / Reliability – Yes / Mobility – Yes / Asset Uptime - Yes	
Costs: Initial: Medium / Recurring: Low	TxDOT Staff Effort: Medium
Stakeholders: Internal – Yes / External - No	Return-on-Investment - High
<b>17. Prepare a database of unit costs for TSMO project planning and budgeting</b>	
Goal Alignment: Safety - Yes / Reliability – No / Mobility – Yes / Asset Uptime - No	
Costs: Initial: Medium / Recurring: Low	TxDOT Staff Effort: Medium
Stakeholders: Internal – Yes / External - No	Return-on-Investment - Medium
<b>Performance Measures</b>	
<b>18. Implement performance dashboards for safety and travel reliability during construction</b>	
Goal Alignment: Safety - Yes / Reliability – Yes / Mobility – Yes / Asset Uptime - Yes	
Costs: Initial: Low / Recurring: Low	TxDOT Staff Effort: Medium
Stakeholders: Internal – Yes / External - No	Return-on-Investment - High
<b>19. Apply performance measures to applicable phases of a project’s lifecycle (planning - operations)</b>	

Goal Alignment: Safety - Yes / Reliability - Yes / Mobility - No / Asset Uptime - Yes	
Costs: Initial: Medium / Recurring: Low	TxDOT Staff Effort: Medium
Stakeholders: Internal - Yes / External - No	Return-on-Investment - High
<b>20. Develop consistent performance data management process to continually track system performance</b>	
Goal Alignment: Safety - Yes / Reliability - Yes / Mobility - Yes / Asset Uptime - Yes	
Costs: Initial: Medium / Recurring: Low	TxDOT Staff Effort: Medium
Stakeholders: Internal - Yes / External - No	Return-on-Investment - High
<b>21. Develop process to include operations performance measures into district decision-making</b>	
Goal Alignment: Safety - Yes / Reliability - Yes / Mobility - Yes / Asset Uptime - Yes	
Costs: Initial: Low / Recurring: Low	TxDOT Staff Effort: Medium
Stakeholders: Internal - Yes / External - No	Return-on-Investment - High
<b>22. Develop a process to improve safety by applying historic, real-time, and predictive performance measures</b>	
Goal Alignment: Safety - Yes / Reliability - No / Mobility - No / Asset Uptime - No	
Costs: Initial: Medium / Recurring: Low	TxDOT Staff Effort: Medium
Stakeholders: Internal - Yes / External - No	Return-on-Investment - High
<b>Organization and Workforce</b>	
<b>23. Develop a succession plan for essential staff to provide continuity of operations</b>	
Goal Alignment: Safety - No / Reliability - Yes / Mobility - No / Asset Uptime - Yes	
Costs: Initial: Low / Recurring: Low	TxDOT Staff Effort: Medium
Stakeholders: Internal - Yes / External - No	Return-on-Investment - Medium
<b>24. Develop a comprehensive TxDOT TSMO Training Program</b>	
Goal Alignment: Safety - Yes / Reliability - Yes / Mobility - Yes / Asset Uptime - Yes	
Costs: Initial: Medium / Recurring: Low	TxDOT Staff Effort: Medium
Stakeholders: Internal - Yes / External - No	Return-on-Investment - Medium
<b>25. Build and develop the workforce needed to manage the TSMO infrastructure</b>	
Goal Alignment: Safety - No / Reliability - Yes / Mobility - No / Asset Uptime - Yes	
Costs: Initial: Low / Recurring: Low	TxDOT Staff Effort: Medium
Stakeholders: Internal - Yes / External - No	Return-on-Investment - High
<b>26. Develop an action plan to address staff vacancies in critical traffic management program capabilities</b>	
Goal Alignment: Safety - No / Reliability - Yes / Mobility - No / Asset Uptime - Yes	
Costs: Initial: Low / Recurring: Low	TxDOT Staff Effort: Medium

Stakeholders: Internal – Yes / External - No	Return-on-Investment - High
<b>27. Rotate TxDOT staff through different positions in the Transportation Management Centers</b>	
Goal Alignment: Safety - Yes / Reliability – Yes / Mobility – Yes / Asset Uptime - Yes	
Costs: Initial: Low / Recurring: Low	TxDOT Staff Effort: Medium
Stakeholders: Internal – Yes / External - No	Return-on-Investment - High
<b>Culture</b>	
<b>28. Apply gamification strategies as an incentive to continuously improve operational performance</b>	
Goal Alignment: Safety - Yes / Reliability – Yes / Mobility – Yes / Asset Uptime - Yes	
Costs: Initial: Medium / Recurring: Medium	TxDOT Staff Effort: Medium
Stakeholders: Internal – Yes / External - No	Return-on-Investment - Medium
<b>29. Realize the full potential of TxDOT's ITS infrastructure during pandemic events</b>	
Goal Alignment: Safety - Yes / Reliability – No / Mobility – Yes/ Asset Uptime - No	
Costs: Initial: Medium / Recurring: Low	TxDOT Staff Effort: Medium
Stakeholders: Internal – Yes / External - Yes	Return-on-Investment - High
<b>30. Develop managers in District departments to consider TSMO in project development and implementation.</b>	
Goal Alignment: Safety - Yes / Reliability – Yes / Mobility – Yes / Asset Uptime - Yes	
Costs: Initial: Low / Recurring: Low	TxDOT Staff Effort: Medium
Stakeholders: Internal – Yes / External - No	Return-on-Investment - Medium
<b>31. Provide high level of integration of TSMO strategies between TRF, Districts, and ITD</b>	
Goal Alignment: Safety - Yes / Reliability – Yes / Mobility – Yes / Asset Uptime - Yes	
Costs: Initial: Low / Recurring: Low	TxDOT Staff Effort: Medium
Stakeholders: Internal – Yes / External - No	Return-on-Investment - High
<b>32. Conduct annual reviews of the TSMO Program to determine what is working and not working</b>	
Goal Alignment: Safety - Yes / Reliability – Yes / Mobility – Yes / Asset Uptime - Yes	
Costs: Initial: Low / Recurring: Low	TxDOT Staff Effort: Low
Stakeholders: Internal – Yes / External - No	Return-on-Investment - Medium
<b>Collaboration</b>	
<b>33. Support Rural District Operations that have limited resources to support TSMO goals</b>	
Goal Alignment: Safety - Yes / Reliability – Yes / Mobility – No / Asset Uptime - Yes	
Costs: Initial: Low / Recurring: Low	TxDOT Staff Effort: Low
Stakeholders: Internal – Yes / External - Yes	Return-on-Investment - High

<b>34. Strengthen TIM Teams collaboration with stakeholders to safely reduce incident clearance times</b>	
Goal Alignment: Safety - Yes / Reliability – Yes / Mobility – No / Asset Uptime - No	
Costs: Initial: Low / Recurring: Low	TxDOT Staff Effort: Medium
Stakeholders: Internal – Yes / External - Yes	Return-on-Investment - High
<b>35. Develop Special Event Checklist to apply TSMO strategies</b>	
Goal Alignment: Safety - Yes / Reliability – Yes / Mobility – Yes / Asset Uptime - No	
Costs: Initial: Low / Recurring: Low	TxDOT Staff Effort: Medium
Stakeholders: Internal – Yes / External - Yes	Return-on-Investment - Medium
<b>36. Maintain strong collaboration between TRF, ITD, and Strategy &amp; Innovation Division to support TSMO</b>	
Goal Alignment: Safety - Yes / Reliability – Yes / Mobility – Yes / Asset Uptime - Yes	
Costs: Initial: Low / Recurring: Low	TxDOT Staff Effort: Medium
Stakeholders: Internal – Yes / External - No	Return-on-Investment - High
<b>37. Develop a stronger collaboration with first responders in better understanding and serving their needs</b>	
Goal Alignment: Safety - Yes / Reliability – Yes / Mobility – No / Asset Uptime - No	
Costs: Initial: Low / Recurring: Low	TxDOT Staff Effort: Medium
Stakeholders: Internal – Yes / External - Yes	Return-on-Investment - High
<b>38. Develop Rural Incident Management Plans for strategic corridors</b>	
Goal Alignment: Safety - Yes / Reliability – Yes / Mobility – Yes / Asset Uptime - No	
Costs: Initial: Medium / Recurring: Low	TxDOT Staff Effort: Medium
Stakeholders: Internal – Yes / External - Yes	Return-on-Investment - High

## ***Performance Measures***

Performance measures enable management of TSMO tactical plans to ensure work efforts are contributing to the improvement of the program, thereby providing rationale for continual funding. To successfully integrate TSMO activities into agency processes, performance measures should be developed to continually track progress and identify areas for improvement. These metrics should align with objectives established by TxDOT’s vision, mission and goals.

TxDOT monitors a set of performance measures required by federal guidance or to receive federal funding, including: crashes and fatalities, project delivery status, air quality, freight reliability and road surface conditions. In addition, TxDOT division offices require monitoring of TSMO specific performance measures through the Traffic Management System (TMS) program, including: incident clearance time, travel time reliability, asset uptime and TMS system coverage. Below are some examples of how performance data may be used.

- Understanding the Effectiveness of Mobility Strategies: Using probe data, performance measures such as the travel time index, planning time index and buffer index for TxDOT facilities can be calculated and compared as part of before and after studies. This information will inform stakeholders if the mobility strategies and TSMO activities are effective in improving congestion.
- Improvement in Alignment with TSMO Goals: For projects to be included in the UTP, they are evaluated and scored to understand how the project will impact system performance. When the project is in the preliminary design stages, a focus on performance of the project must be maintained. Each project should implement performance measures to monitor what the project is expected to accomplish and identify the measures of success. After the project is completed, the performance measures can be reviewed to identify if the TSMO goals and objectives of the project were accomplished. While the performance management structure should be consistent throughout the state, the interpretation of results may be different for metro, urban and rural districts. For example, while Level of Service “D” may be acceptable for facilities located within metro and urban areas, Level of Service “C” may be more appropriate for rural areas. If the TSMO goals are evaluated for each project, they can be continuously improved upon and mobility strategies can be identified to support targeted efforts in an effective manner.

As collecting, monitoring and archiving data becomes more accessible in the district through ITS devices and data services, before-and-after studies will transition from “qualitative” to “quantitative” analyses. It is expected that this will take place during the next two years.

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**Appendix A: TSMO Strategies**



**FOCUS AREA:  
BUSINESS PROCESSES**

**STRATEGY NO. 1**

**Develop methodology to allocate ITS/Signals O&M funding to align with TSMO goals.**

Funding to cover operations and maintenance (O&M) costs for ITS and traffic signals significantly lags the funding amount for ITS infrastructure being added within the districts. District O&M funding is discretionary and often times used for roadway maintenance rather than ITS and traffic signals. There is currently no dedicated funding source for TSMO as it relies on mainstreaming as part of other improvement projects.

As the success of TSMO is largely dependent on leveraging the ITS infrastructure, the manner that O&M funds are allocated to the districts should be revisited. A methodology should be developed for O&M funding that considers applicable guidelines in the FHWA FAST Act as well as any changes that may be included in the FAST Act Reauthorization. Consideration should be afforded to requesting and programming ITS funds to cover lifecycle costs. Lifecycle costs include initial deployment costs, O&M costs, and replacement costs over the useful service life of the investment. The methodology should provide a template that the districts could use to provide an equitable balance of O&M funds for ITS/Signals as compared to roadways, bridges and other TxDOT facilities. In addition, methods for charge backs should be considered when contractors damage critical ITS infrastructure including communications (e.g., fiber). TSMO processes to support ITS/Signals O&M funding, to align with TSMO goals, is presented in the table below.

TSMO Processes to Support ITS/Signals O&M Funding to Align with TSMO Goals	
TSMO Focus Area	Recommended Processes
1. Funding Needs	Research annual funding allocations versus needs for each district.
2. Federal Funding	Review FAST Act Reauthorization to identify eligible funding sources
3. State Funding	Review state funding sources including possible changes to funding eligibility.
4. Innovative Funding	Develop a TxDOT pilot program to procure ITS lifecycle costs.
5. Funding Program	Develop 5-year funding program considering annual ITS O&M and replacements.

**GOAL ALIGNMENT (Check appropriate areas)**

Safety: Yes                      Mobility: Yes  
Reliability: Yes                      Asset Uptime: Yes

**COST (Low, Medium, High)**

Initial: Low                      Recurring: Low

**TXDOT STAFF EFFORT (Low, Medium, High)**

Medium

**STAKEHOLDERS (Yes or No)**

Internal: Yes                      External: No

**TIMEFRAME (Near-term, Mid-term, Long-term)**

Near-term

**RETURN ON INVESTMENT (Low, Medium, High)**

High

**FOCUS AREA:  
BUSINESS PROCESSES**

**STRATEGY NO. 2**

**Develop Statewide Standard Operating Procedures to improve operational interoperability.**

Implementation of an effective statewide TSMO program requires consistency and interoperability in applying business processes among the districts. Business processes should emphasize standardized procedures while enabling the districts flexibility to customize certain processes. Interoperability should be based on a structured plan addressing people, processes, systems, and technologies. Standard Operating Procedures (SOPs) should be revisited from a statewide perspective to establish (reinforce) consistency, and stakeholder inclusion. The SOPs should address a diverse range of scenarios for metro, urban, and rural areas including sharing operational functions to accommodate peak surges (e.g., emergencies, special events, staffing shortages), fail-over operations, weather events, incidents, work zone management, and special events.

SOPs should serve as a foundation for developing and delivering cross-training and stakeholder outreach programs from a statewide perspective. Fail-over operations and security should be addressed to improve interoperability across the districts' TMCs to work effectively as a back-up to one another when operational workload exceeds staffing capability or when a TMC loses operational capability. TSMO processes to support the development of statewide SOPs are presented in the table below.

TSMO Processes to Support Development of Statewide SOPs	
TSMO Focus Area	Recommended Processes
1. Review Existing SOPs	Collect and review TMC and HERO SOPs for each district.
2. Develop Statewide SOPs	Develop overarching Statewide SOPs to support interoperability.
3. TSMO / SOP Alignment	Refine Statewide SOPs to be consistent with Statewide TSMO Strategic Plan.
4. Develop District SOPs	Customize Statewide SOPs to address the specifics of each district.
5. Training Program	Apply SOPs to develop TMC Operations & HERO training program.

**GOAL ALIGNMENT (Check appropriate areas)**

Safety: Yes                      Mobility: No  
Reliability: Yes                      Asset Uptime: Yes

**COST (Low, Medium, High)**

Initial: Low                      Recurring: Low

**TXDOT STAFF EFFORT (Low, Medium, High)**

Medium

**STAKEHOLDERS (Yes or No)**

Internal: Yes                      External: No

**TIMEFRAME (Near-term, Mid-term, Long-term)**

Near-term

**RETURN ON INVESTMENT (Low, Medium, High)**

Medium

**FOCUS AREA:  
BUSINESS PROCESSES**

**STRATEGY NO. 3**

**Engage the Procurement Division to support TSMO program objectives.**

TxDOT procurement processes should be reviewed, and modified if needed, to identify improvements to support TSMO program objectives. This would include the manner that statewide procurement contracts are structured as well as the need for including TRF technical review input during early phases of the procurement process.

Procurement processes may consider, but not be limited to, the following: (1) structuring design, build, operate, and maintain contracts for systems and technology deployments specifying key performance indicators along with incentives and disincentives; (2) fair and equitable risk-sharing for systems and technology deployments that involve public-private partnerships; and (3) facilitating knowledge transfer between TRF and the districts for emerging technologies to be included on the TxDOT Approved Product List after the appropriate testing and certification process has been completed. TSMO processes to engage the Procurement Division to support TSMO program objectives are presented in the table below.

TSMO Processes to Engage the Procurement Division to Support TSMO Program Objectives	
TSMO Focus Area	Recommended Processes
1. Existing Processes	Assess existing processes used to procure systems and technologies.
2. Approved Product List	Assess existing processes for vendors to obtain APL certifications.
3. Industry Outreach	Conduct industry outreach in modifying processes to be performance-based.
4. Performance-Based	Consider incentives/disincentives to improve O&M performance.
5. Technology Procurement	Restructure technology procurements based on input from Steps 1-4.

**GOAL ALIGNMENT (Check appropriate areas)**

Safety: No                      Mobility: No  
Reliability: No                      Asset Uptime: Yes

**COST (Low, Medium, High)**

Initial: Low                      Recurring: Low

**TXDOT STAFF EFFORT (Low, Medium, High)**

Medium

**STAKEHOLDERS (Yes or No)**

Internal: Yes                      External: No

**TIMEFRAME (Near-term, Mid-term, Long-term)**

Long-term

**RETURN ON INVESTMENT (Low, Medium, High)**

Low

**FOCUS AREA:  
BUSINESS PROCESSES**

**STRATEGY NO. 4**

**Develop Emergency Response Plan to improve preparedness, response and recovery.**

A disaster may occur with little or no warning and may escalate more rapidly than the ability of any district or local response organization can handle. Thus, achieving and maintaining effective preparedness reduces the immediate demands on response organizations. This level of preparedness requires continued public awareness and education programs to ensure citizens will take appropriate advance actions to reduce their vulnerability, especially during the initial days (72 hours) after disaster impact.

A statewide Comprehensive Emergency Management Plan (CEMP) should be developed to provide consistency and interoperability among TxDOT districts to prepare for, respond to, and recover from any natural or manmade incidents. The CEMP is a management tool providing policy, assigning responsibilities, describing processes, and delegating authority to managers at the Central Office and District levels. State and local authorities would continue to use the incident command system to manage emergency response scenes in alignment with the CEMP. In addition, the Regional Incident Management System (RIMS), developed by the Houston District, may be applicable for other districts in managing hurricane evacuations, flooding, and other emergency events. RIMS has the ability to assign operator responsibilities, providing a critical manpower management tool. Emergency evacuation shelter and medical facility information, including capacity and available services, is stored for use by the appropriate agencies and can be updated in real time. Tasks and resources can be assigned, scheduled, and tracked. TSMO processes to develop emergency response plans are presented in the table below.

TSMO Processes to Develop Emergency Response Plans	
TSMO Focus Area	Recommended Processes
1. Existing Processes	Assess existing processes used to conduct emergency management.
2. RIMS Applications	Assess the need and feasibility to expand the use of RIMS to other districts.
3. Interoperability	Develop interoperability requirements across districts.
4. Statewide CEMP	Prepare statewide Comprehensive Emergency Management Plan.
5. Exercise CEMP	Conduct simulated drills to test, exercise, and refine the CEMP.

**GOAL ALIGNMENT (Check appropriate areas)**

Safety: Yes                      Mobility: No  
Reliability: Yes                      Asset Uptime: No

**COST (Low, Medium, High)**

Initial: Medium                      Recurring: Medium

**TXDOT STAFF EFFORT (Low, Medium, High)**

Medium

**STAKEHOLDERS (Yes or No)**

Internal: Yes                      External: Yes

**TIMEFRAME (Near-term, Mid-term, Long-term)**

Mid-Term

**RETURN ON INVESTMENT (Low, Medium, High)**

High

**FOCUS AREA:  
BUSINESS PROCESSES**

**STRATEGY NO. 5**

**Conduct Cybersecurity Vulnerability Analyses of IT networks to improve resiliency.**

Some of the greatest management challenges facing the public and private sectors today are from persistent and advanced cyber threats. Today’s dynamic threat environment requires integrated solutions, aligned closely to industry-specific operations and critical business functions. The challenge is understanding potential vulnerabilities and making informed, critical decisions on what and where to budget for security and resilience of assets, systems, and networks.

On May 14, 2020, TxDOT was subjected to a ransomware event. Through swift action, TxDOT was able to stop the ransomware event and limit its impact on the information technology systems. TxDOT was quick to act to investigate, analyze, and remediate the situation. This event caused temporary interruptions on the agency network as well as business and traffic applications. Unfortunately, cybersecurity and ransomware events are an increasingly common occurrence. Therefore, it is recommended that recurring vulnerability analyses be conducted on a regular basis to provide lifecycle protection of critical infrastructure from every type of risk: deliberate, accidental, and natural. The vulnerability analyses should consider cyber, wireless, and physical domains – identifying vulnerabilities and weaknesses within each domain, focusing in on gaps and seams, and aligning critical processes with the critical business technologies to ensure business continuity through improved resilience, preparedness, detection, and response. TSMO processes to conduct cybersecurity vulnerability analyses of IT networks are presented in the table below.

TSMO Processes to Conduct Cybersecurity Vulnerability Analysis of IT Networks	
TSMO Focus Area	Recommended Processes
1. After-Action Review	Document after-action review of ransomware and other cybersecurity events.
2. Checklists	Develop (or modify) processes and checklists to conduct vulnerability analyses.
3. Business Continuity	Update plan to respond to a disaster that may disrupt operations.
4. Security Plan	Safeguard against security breaches of hardware, software, and IT networks.
5. Vulnerability Analyses	Conduct periodic cybersecurity vulnerability analyses on a regular basis.

**GOAL ALIGNMENT (Check appropriate areas)**

Safety: No                      Mobility: No  
Reliability: Yes                      Asset Uptime: Yes

**COST (Low, Medium, High)**

Initial: Medium                      Recurring: Medium

**TXDOT STAFF EFFORT (Low, Medium, High)**

Medium

**STAKEHOLDERS (Yes or No)**

Internal: Yes                      External: No

**TIMEFRAME (Near-term, Mid-term, Long-term)**

Mid-Term

**RETURN ON INVESTMENT (Low, Medium, High)**

High

**FOCUS AREA:  
BUSINESS PROCESSES**

**STRATEGY NO. 6**

**Formalize TSMO processes for succession planning to retain institutional knowledge and partnerships.**

As staff turnover is inevitable within the TxDOT organization - as well as its stakeholders, contractors, and consultants - a formalized structure is needed to hand-over sufficient information to staff replacements to avoid loss of institutional knowledge and the risk of degradation of services. As a minimum, the TSMO processes and documentation in the table below should be documented and updated on a regular basis.

TSMO Processes and Documentation to Support Succession Planning	
TSMO Focus Area	Recommended Processes and Documentation
1. TSMO Plans	Statewide TSMO Strategic Plan & District TSMO Program Plans Updates.
2. TSMO Checklists	Checklists for each phase of the project development lifecycle.
3. Systems Engineering	ITS Master Plans, ITS Architectures, Concepts of Operations, System Requirements, and Requirements Verification Traceability Matrices.
4. ITS Design Manual	Policies, procedures, design criteria, standards, and specifications.
5. Interagency Agreements	MOUs, Cost-Sharing Agreements, and Joint Operations Policies.
6. SOPs	TMC Operations, HERO Operations, and ITS Maintenance.
7. TSMO Training Program	Maintenance and updates of the TxDOT TSMO Training curriculum.
8. Performance Management	Definitions, targets, data, and measures used in planning (project justification, prioritization), project delivery (schedule, budget), operations (safety, performance), and maintenance (uptime availability).
9. Asset Management	Maintaining and updating asset databases for pavement and bridge condition, as well as technology assets (ITS, signals, communications).
10. Configuration Management	Updates, enhancements, fixes, and version control of Lonestar™.

**GOAL ALIGNMENT (Check appropriate areas)**

Safety: No                      Mobility: No  
Reliability: Yes                      Asset Uptime: Yes

**COST (Low, Medium, High)**

Initial: Medium                      Recurring: Low

**TXDOT STAFF EFFORT (Low, Medium, High)**

Medium

**STAKEHOLDERS (Yes or No)**

Internal: Yes                      External: No

**TIMEFRAME (Near-term, Mid-term, Long-term)**

Near-term

**RETURN ON INVESTMENT (Low, Medium, High)**

High

**FOCUS AREA:  
BUSINESS PROCESSES**

**STRATEGY NO. 7**

**Bring Procurement Division in project development process earlier to provide input and achieve schedules.**

The TxDOT Procurement Division is responsible for procurement of goods and services (non-professional); supports Divisions and Districts in contract procurements; maintains contracts so they don't unexpectedly expire; and analyze alternative procurement methods (e.g., best value versus low price). Typical procurements include equipment, facility maintenance & repairs, some ITS procurements, some traffic control procurements to support Maintenance of Traffic, and promotional campaigns.

The Procurement Division should be brought in earlier in the planning process so they can better understand the needs of the Divisions and Districts and be more proactive in managing schedules. This will require improvement in communication and coordination with Divisions and Districts. While the Information Technology Division rules apply to technology procurements, the Procurement Division should be aware of technology needs and required maintenance and replacement programs. TSMO processes to bring the Procurement Division earlier in project development is outlined in the table below.

TSMO Processes to Bring the Procurement Division Earlier in Project Development	
Project Phase	Recommended Processes
1. Planning	Notify Procurement of TSMO project, or technology element of a larger project, after the project is deemed justified and before entering it in the work program.
2. Systems Engineering	Notify the Procurement Division of the anticipated system requirements and their anticipated role in the procurement process.
3. Design	Procurement Process Experts should work closely with customers on the specifications and review to ensure that the specification is properly written.
4. Construction	Coordinate with Procurement to ensure that procurement processes are compatible with system requirements and contractor schedule of payments.
5. O&M	Coordinate with the Districts and Divisions to program technology replacements prior to the systems approaching the end of their service life.

**GOAL ALIGNMENT (Check appropriate areas)**

Safety: No                      Mobility: No  
Reliability: Yes                      Asset Uptime: Yes

**COST (Low, Medium, High)**

Initial: Low                      Recurring: Low

**TXDOT STAFF EFFORT (Low, Medium, High)**

Low

**STAKEHOLDERS (Yes or No)**

Internal: Yes                      External: No

**TIMEFRAME (Near-term, Mid-term, Long-term)**

Long-term

**RETURN ON INVESTMENT (Low, Medium, High)**

Medium

**FOCUS AREA:  
BUSINESS PROCESSES**

**STRATEGY NO. 8**

**Develop a framework to identify “what’s next” in terms of innovations to support TSMO.**

TxDOT’s Strategy and Innovation Division provides leadership and strategic direction for the innovation and continuous improvement of people, processes, and technology. The Division is set up to seek new ways to conduct business and leverage emerging systems and technology to attain TSMO goals.

TRF, in collaboration with the Emerging Technology Task Force, should continue to identify “what’s next” in the areas of advanced sensors, TMS devices, traffic signals, communications, software, hardware, and other systems to support near-term TSMO strategies as well Cooperative Automated Transportation. TxDOT, as well as most other transportation agencies, are continuously approached by vendors desiring to demonstrate their products and services. A structured process should be established to encourage innovations within the framework of contributing to TxDOT’s TSMO vision, mission, goals, and objectives. The TSMO processes should include the steps indicated in the table below.

TSMO Processes to Develop a Framework to Identify Innovations	
TSMO Focus Area	Recommended Processes
1. Identify Needs	Safety, mobility, congestion relief, cost-efficiency, reliability, other.
2. Develop ConOps	How will the innovation be used in an operational environment?
3. Request For Information	Describe the innovation and solicit feedback from vendors.
4. Invitation for Vendor Demos	Demonstrate the product or service in an off-line environment.
5. Reference Checks	Conduct reference checks on customers of the product or service.
6. Proof of Concept	Demonstrate the innovation in a limited operational environment.
7. Before & After Assessment	Does the product or service provide added value at reasonable cost?
8. Define Initial Deployment	Define the minimum operational program for the innovation.
9. Develop System Expansion Plan	Describe a scalable system expansion plan which is cost-effective.
10. Work Program Funding	Identify and program deployment, O&M, and replacement costs.

**GOAL ALIGNMENT (Check appropriate areas)**

Safety:            Yes                            Mobility:            Yes  
Reliability:      Yes                            Asset Uptime:    Yes

**COST (Low, Medium, High)**

Initial:            Low                            Recurring:        Low

**TXDOT STAFF EFFORT (Low, Medium, High)**

Medium

**STAKEHOLDERS (Yes or No)**

Internal:         Yes                            External:         Yes

**TIMEFRAME (Near-term, Mid-term, Long-term)**

Mid-term

**RETURN ON INVESTMENT (Low, Medium, High)**

Medium



**FOCUS AREA:  
SYSTEMS AND TECHNOLOGY**

**STRATEGY NO. 9**

**Conduct Connected Roadway Classification System Analyses to prepare for CAT.**

The Connected Roadway Classification System (CRCS) framework is described in the NCHRP 20-24(112) report prepared for the American Association of State Highway and Transportation Officials (AASHTO) and was released in February 2020. It is a process and set of tools that TxDOT can use to assess the readiness of roadways to accommodate Cooperative Automated Transportation (CAT) while remaining technology agnostic. The CRCS may be used for project planning and prioritization activities, identifying CAT applications, exploring data exchange and open data needs and for communication with the public and other stakeholders as to the readiness of a roadway system to support CAT applications.

The CRCS should also be utilized so that assessments fall along a continuum, rather than in distinct classifications, as some aspects of each of the infrastructure approaches for a given roadway can fall in one classification level while other aspects are characteristic of another level. However, if used as a part of an overall assessment process, the CRCS can provide insight into the current state of a roadway for supporting CAT applications and identify the gaps and opportunities for enhancing that readiness. Several strategic corridors throughout the state should be selected as part of a pilot program before broader roll out to other corridors. TSMO processes to conduct Connected Roadway Classification System Analyses are presented in the table below.

TSMO Processes to Conduct Connected Roadway Classification System (CRCS) Analyses	
TSMO Focus Area	Recommended Processes
1. Strategic Corridors	Select strategic corridors to conduct the first round of CRCS analyses.
2. CRCS Process	Fine tune the CRCS analysis process by examining the usefulness of results.
3. CRCS Analyses	Roll out the CRCS analysis to other corridors throughout the state.
4. System Upgrades	Identify system and infrastructure improvements to prepare for CAT.
5. Deployment	Identify funding then design and build system and infrastructure improvements.

**GOAL ALIGNMENT (Check appropriate areas)**

Safety: Yes                      Mobility: Yes  
Reliability: Yes                      Asset Uptime: No

**COST (Low, Medium, High)**

Initial: Medium                      Recurring: Medium

**TXDOT STAFF EFFORT (Low, Medium, High)**

Medium

**STAKEHOLDERS (Yes or No)**

Internal: Yes                      External: No

**TIMEFRAME (Near-term, Mid-term, Long-term)**

Long-Term

**RETURN ON INVESTMENT (Low, Medium, High)**

Medium

**FOCUS AREA:  
SYSTEMS AND TECHNOLOGY**

**STRATEGY NO. 10**

**Develop AI/Machine Learning applications to address common operational scenarios.**

AI/Machine Learning tools should be developed to apply decision support systems to assist in making more informed decisions regarding traffic, safety, incident, emergency, and asset management. These systems should be highly automated to enable the end-users to quickly select the optimum plan based on configurable performance measures. For example, AI/Machine Learning applications may be developed for Incident Management. These systems can be used to develop and archive incident management plans that have been effective for similar incidents in the past while also taking advantage of predictive models. Development of incident management plans should include input by local and regional traffic incident management team members as a result of after-action reviews. The components of incident management plans may include a library of signal timing plans for diversion routes; automated activation of lane control signals, variable speed limit signs, and dynamic message signs; and route guidance for first responders to reach the incident. AI applications will continue to evolve as more data becomes available. These data sets will need to be managed to enable operations staff to extract what they need, and when they need it. TxDOT's "Development, Integration, Implementation, and Maintenance Services for Traffic Management System" (DIIMS) contracts may be used in developing these tools. TSMO processes to develop AI/Machine Learning applications are presented in the table below.

TSMO Processes to Develop AI/Machine Learning Applications	
TSMO Focus Area	Recommended Processes
1. Identify Pilot Project	Select one operational scenario to develop AI/ML pilot project.
2. Systems Engineering	Prepare ConOps and system requirements to deploy pilot project.
3. Implement Pilot Project	Implement pilot project in at least one location.
4. Measure Effectiveness	Assess effectiveness of pilot project based on performance measures.
5. Expand AI/ML Applications	Develop AI/ML applications to address other operational scenarios.

**GOAL ALIGNMENT (Check appropriate areas)**

Safety: Yes                      Mobility: Yes  
Reliability: Yes                      Asset Uptime: Yes

**COST (Low, Medium, High)**

Initial: High                      Recurring: Medium

**TXDOT STAFF EFFORT (Low, Medium, High)**

High

**STAKEHOLDERS (Yes or No)**

Internal: Yes                      External: Yes

**TIMEFRAME (Near-term, Mid-term, Long-term)**

Long-term

**RETURN ON INVESTMENT (Low, Medium, High)**

High

**FOCUS AREA:  
SYSTEMS AND TECHNOLOGY**

**STRATEGY NO. 11**

**Increase ITS systems support by TRF to the districts to improve asset uptime.**

TRF continues to provide ITS systems and communications support to the districts. This includes “boots on the ground” support in resolving system failures; reviewing Plans, Specifications & Estimate (PS&E) documents to identify and correct errors and omissions early; developing ITS equipment standards; procuring statewide technologies and communications equipment; and responding to requests to address district needs.

This TSMO strategy expands the scope of the above services by having TRF provide Subject Matter Experts to coordinate with District staff in addressing systems and technology procurement and acceptance testing issues; providing advice on the application and value of emerging technologies to replace legacy systems at the end of their service life; assistance in developing preventive and replacement programs; and other services as needed. Subject Matter Experts include technical staff having experience in communications, ITS devices, signals, Lonestar™ software, and other applicable systems and technologies. This effort should be a continuous two-way exchange of information between TRF and the districts to address the evolving systems and technology needs of the TSMO program. TSMO processes to increase ITS systems support by TRF to the Districts are presented in the table below.

TSMO Processes to Increase ITS Systems Support by TRF to the Districts	
TSMO Focus Area	Recommended Processes
1. Identify Districts’ Needs	TRF to survey Districts to identify their ITS systems support needs.
2. Identify TRF SMEs	TRF to identify SMEs to support technology needs of the districts.
3. SOPs / Training Materials	SMEs to develop SOPs and training materials to support district needs.
4. On-Call Support	TRF develops program to make SMEs available to provide on-call support.
5. Emerging Technologies	TRF provide advice and procurement support in applying new technologies.

**GOAL ALIGNMENT (Check appropriate areas)**

Safety: Yes                      Mobility: No  
Reliability: Yes                Asset Uptime: Yes

**COST (Low, Medium, High)**

Initial: Low                      Recurring: Low

**TXDOT STAFF EFFORT (Low, Medium, High)**

Medium

**STAKEHOLDERS (Yes or No)**

Internal: Yes                      External: No

**TIMEFRAME (Near-term, Mid-term, Long-term)**

Near-term

**RETURN ON INVESTMENT (Low, Medium, High)**

Medium

**FOCUS AREA:  
SYSTEMS AND TECHNOLOGY**

**STRATEGY NO. 12**

**Develop and implement Integrated Corridor Management along applicable strategic corridors.**

Integrated Corridor Management (ICM) is a transportation management approach designed to actively monitor and mitigate atypical recurring and nonrecurring events that impact traffic along strategic corridors. ICM requires the institutional, operational, and technical integration of as many participating agencies as are available to combine their assets into one unified real-time response. ICM may encompass several activities, including: cooperative and integrated policies among stakeholders; communications among network operators and stakeholders; improving the efficiency of cross-network junctions and interfaces; mobility opportunities, including shifts to alternate routes and modes; real-time traffic and transit monitoring; congestion, incident, and travel demand management; public awareness programs; and transportation pricing and payment.

This TSMO strategy should focus on developing ICM programs along applicable strategic corridors. ICM strategies should be considered for major freeway corridors in retiming signals along parallel arterials using edge computing. While ICM programs typically focus on metro and urban corridors, they may be applicable to some rural areas where there are reasonable diversion routes as part of incident management plans. TSMO processes to develop and implement ICM along applicable strategic corridors are presented in the table below.

TSMO Processes to Develop and Implement ICM along Strategic Corridors	
TSMO Focus Area	Recommended Processes
1. Statewide ICM Plan	Prepare statewide ICM Plan identifying feasible corridors for deployment.
2. Systems Engineering	Develop ConOps and system requirements to implement priority projects.
3. Team Building	Develop operational partnerships by conducting structured workshops.
4. Interagency Agreements	Memorialize operational and cost-sharing agreements among partners.
5. Integrated SOPs	Prepare Joint Operating Policies and SOPs among partners.
6. Performance Measures	Identify and agree on common KPMs and targets among partners.
7. Lonestar™ Enhancements	Apply system requirements to develop and test Lonestar™ ICM upgrades.
8. Training	Provide initial and refresher training to partners on basic ICM systems.
9. Basic Operations	Commence ICM operational startup based on freeway-arterial integration.
10. Advanced Operations	Add other multimodal ICM systems as applicable for strategic corridors.

**GOAL ALIGNMENT (Check appropriate areas)**

Safety: Yes                      Mobility: Yes  
Reliability: Yes                      Asset Uptime: No

**COST (Low, Medium, High)**

Initial: High                      Recurring: Medium

**TXDOT STAFF EFFORT (Low, Medium, High)**

High

**STAKEHOLDERS (Yes or No)**

Internal: Yes                      External: Yes

**TIMEFRAME (Near-term, Mid-term, Long-term)**

Mid-term

**RETURN ON INVESTMENT (Low, Medium, High)**

High

**FOCUS AREA:  
SYSTEMS AND TECHNOLOGY**

**STRATEGY NO. 13  
Develop Enhanced Traffic Signal System Implementation Plans.**

The “Traffic Signal Benchmarking and State of the Practice Report”, prepared in 2019 by the National Operations Center of Excellence and Institute of Transportation Engineers, includes a self-assessment of 144 agency respondents representing 24% of all traffic signals throughout the United States. The average grade was C+ across five categories: systems and technology (C+); infrastructure (B-), business processes (C+); workforce (C+); management and administration / leadership (C+). Enhanced Traffic Signal System Implementation Plans should be prepared to achieve the following goals:

- Enhance operational consistency and reliability to improve traffic operations along state roads.
- Reduce asset downtime due to incidents, malfunctions, and end-of-life equipment replacement.
- Enable active traffic management along appropriate corridors.
- Reduce delays and queueing due to major incidents.
- Ensure new technologies provide a good return on investment compared to legacy devices.
- Improve coordination with municipal traffic signal systems.

TSMO processes to develop enhanced traffic signal implementation plans are presented in the table below.

TSMO Processes to Develop Enhanced Traffic Signal Implementation Plans	
TSMO Focus Area	Recommended Processes
1. Statewide Plan	Prepare Statewide Enhanced Traffic Signal System Strategic Plan.
2. District Plans	Prepare District Enhanced Traffic Signal System Implementation Plans.
3. Performance Measures	Define applicable KPMs and targets to continually improve performance.
4. Deployment	Deploy District Enhanced Traffic Signal Implementation Plans in phases.
5. ATSPM	Apply ATSPM to systematically improve operations.
6. Training	Provide training to District in support of active traffic management practices.
7. Asset Maintenance	Monitor system up-time and resolve system failures in a timely manner.
8. Cybersecurity	Develop and integrate security upgrades to reduce the risk of hacking.
9. Emerging Technologies	Consider new technologies, and trade-offs, to replace end-of-life systems.
10. Signal Plan Updates	Refresh Statewide & District Plans every 5 years to address deficient KPMs.

**GOAL ALIGNMENT (Check appropriate areas)**

Safety: Yes                      Mobility: Yes  
Reliability: Yes                      Asset Uptime: Yes

**COST (Low, Medium, High)**

Initial: Low                      Recurring: Low

**TXDOT STAFF EFFORT (Low, Medium, High)**

Medium

**STAKEHOLDERS (Yes or No)**

Internal: Yes                      External: Yes

**TIMEFRAME (Near-term, Mid-term, Long-term)**

Mid-term

**RETURN ON INVESTMENT (Low, Medium, High)**

Medium

**FOCUS AREA:  
SYSTEMS AND TECHNOLOGY**

**STRATEGY NO. 14  
Develop and implement Lonestar™ enhancements.**

In April 2020, an anonymous on-line survey was conducted by TxDOT, to gather information from TMC operators about existing operational tools. A total of 24 (out of 40) TMC operations staff responded to the survey to provide insight into their operational needs. This effort, in addition to future operator interviews, will help TxDOT address these needs to develop and enact a vision for future operational tools.

Lonestar™ ATMS Software Survey Findings		
Strengths	Weaknesses	Suggested Improvements
Easy to use with good mapping interface	Frequent crashes, upgrades don't always fix issues in a timely manner	More control over remote CCTV access between metro & rural areas
CCTV easy to use and provides snapshot images in other districts	CCTVs inability to view all roads and affected traffic lanes	Improved mapping interface
CCTV ability to view incidents in real time	Inability to download data and generate operator specific reports	Ability to view older reports and run individual reports on operators
Fast connection to DMS and quick confirmation of posted messages	Inability to operate CCTVs remotely or edit device from rural districts	Real time traffic information for better incident management.
Easy to view and coordinate events with TMC operator accountability	User interfaces are not consistent across all subsystems and applications	Develop predictive and real time analysis for mitigating incidents

TSMO processes to develop and implement Lonestar™ enhancements are presented in the table below.

TSMO Processes to Develop and Implement Lonestar™ Enhancements	
TSMO Focus Area	Recommended Processes
1. District Input	Conduct one-on-one calls with District staff to better understand their needs.
2. Document Needs	Document District staff needs based on input received.
3. Systems Engineering	Develop ConOps, system requirements, and path forward for Lonestar™.
4. Software Development	Utilize DIIMS contract to develop Lonestar™ enhancements.
5. Systems Integration	Utilize DIIMS contract to integrate and support Lonestar™ enhancements.

**GOAL ALIGNMENT (Check appropriate areas)**

Safety: Yes                      Mobility: Yes  
Reliability: Yes                      Asset Uptime: Yes

**COST (Low, Medium, High)**

Initial: Medium                      Recurring: Medium

**TXDOT STAFF EFFORT (Low, Medium, High)**

Medium

**STAKEHOLDERS (Yes or No)**

Internal: Yes                      External: No

**TIMEFRAME (Near-term, Mid-term, Long-term)**

Near-term

**RETURN ON INVESTMENT (Low, Medium, High)**

Medium

**FOCUS AREA:  
SYSTEMS AND TECHNOLOGY**

**STRATEGY NO. 15**

**Improve TxDOT's ITS infrastructure by filling in the gaps, maintaining the system, and focusing on arterials.**

Over the years, TxDOT has made significant investments in the deployment, operations, and maintenance of the ITS infrastructure as well as the Lonestar™ software. This investment should be optimized as a priority before investing in new systems and technology. TSMO processes to achieve this strategy are summarized in the following steps presented in the table below.

TSMO Processes to Improve TxDOT's ITS Infrastructure	
TSMO Focus Area	Recommended Processes
1. Update District ITS Master Plans	Identify ITS devices and communication upgrades needed.
2. Update Regional ITS Architectures	Identify interfaces among TMC, ITS devices, & other systems.
3. Design/Construct ITS to Fill in the Gaps	Incrementally fill in the gaps as per work program funding.
4. Upgrade Communications Infrastructure	Incrementally fill in the gaps as per work program funds or P3.
5. Conduct TMC Operational Assessments	Identify operational improvements at the TMC.
6. Develop TMC System Upgrades Plan	Identify IT and system upgrades at the TMC.
7. Implement Lonestar™ Enhancements	Integrate Lonestar™ enhancements based on user needs.
8. Build Decision Support Systems (DSS)	Develop DSS tools to semi-automate manual processes.
9. Upgrade Signals on Strategic Corridors	Upgrade signal technology and communications on arterials.
10. Transition to ICM on Strategic Corridors	Phase in ICM operations (freeways/arterial integration).

**GOAL ALIGNMENT (Check appropriate areas)**

Safety: Yes                      Mobility: Yes  
Reliability: Yes                      Asset Uptime: Yes

**COST (Low, Medium, High)**

Initial: Medium                      Recurring: Medium

**TXDOT STAFF EFFORT (Low, Medium, High)**

Medium

**STAKEHOLDERS (Yes or No)**

Internal: Yes                      External: No

**TIMEFRAME (Near-term, Mid-term, Long-term)**

Near-term

**RETURN ON INVESTMENT (Low, Medium, High)**

High

**FOCUS AREA:  
SYSTEMS AND TECHNOLOGY**

**STRATEGY NO. 16**

**Develop a roadmap to design, build, and maintain an integrated data platform.**

FHWA defines TSMO as “Integrated strategies to optimize the performance of existing infrastructure through the implementation of multimodal and intermodal, cross-jurisdictional systems, services, and projects to preserve capacity and improve security, safety, and reliability of a transportation system.” Regional ITS architectures provide a roadmap for transportation systems integration. The architecture is developed through a cooperative effort by the region's transportation agencies, covering all modes and all roads in the region. As systems and emerging technologies continue to play an integral role in supporting TSMO strategies, it is critical that traffic management functions from independent systems transition to common platforms for data sharing and operational information. TSMO processes to build an integrated data platform are summarized in the table below.

TSMO Processes to Build an Integrated Data Platform	
TSMO Focus Area	Recommended Processes
1. Identify Users’ Needs	Document data needs from TxDOT’s Division and District staff.
2. Develop Data Platform Architecture	Plan for scalability and extensibility to support future needs.
3. Prepare Data Platform ConOps	Obtain input on how the Data Platform will be used by TxDOT staff.
4. Identify Data Manager	Assign a champion to develop, implement, maintain the program.
5. Identify System Requirements	Address data access, security, QA/QC, data normalization, etc.
6. Build Data Platform	Design and Build the Data Platform within an agile environment.
7. Identify APIs	Prepare list of near, mid, and long-term APIs to serve users’ needs.
8. Configuration Management Board	Use CMB to select / prioritize enhancements of the Data Platform.
9. Maintain Data Platform	Update the Data Platform based on CMB approved enhancements.
10. Scale for Future Needs	Accommodate new data sources and users’ needs in the future.

In summary, the Integrated Data Platform should be designed to deliver the right information to the right user at the right time to optimize decisions, enhance efficiency, and accelerate results. The Data Platform has the potential to enable TxDOT staff, consultants, contractors, and stakeholders to be more entrepreneurial in applying data to innovate in performing their jobs more efficiently and creating new solutions to align with TxDOT’s TSMO vision.

**GOAL ALIGNMENT (Check appropriate areas)**

Safety: Yes                      Mobility: Yes  
Reliability: Yes                      Asset Uptime: Yes

**COST (Low, Medium, High)**

Initial: Medium                      Recurring: Low

**TXDOT STAFF EFFORT (Low, Medium, High)**

Near-term

**STAKEHOLDERS (Yes or No)**

Internal: Yes                      External: No

**TIMEFRAME (Near-term, Mid-term, Long-term)**

Near-term

**RETURN ON INVESTMENT (Low, Medium, High)**

High



**FOCUS AREA:  
SYSTEMS AND TECHNOLOGY**

**STRATEGY NO. 17**

**Prepare a database of unit costs for TSMO project planning and budgeting.**

A database of unit costs should be developed to provide reliable cost estimates for budgeting TSMO projects in the work program. This will help Districts understand funding needs by evaluating costs associated with potential strategies and future device deployment. The Districts can also use the cost estimate as a prioritization tool by determining the expected return on investment for implementation strategies and technology deployments. It is essential to update the cost estimate periodically to ensure that all costs associated with TSMO implementation are developed, updated, and integrated into the District’s planning process. Classifying this cost estimate as a living document will help Districts account for fluctuation in technology and labor costs over time. TSMO processes to prepare a database of unit costs for TSMO project planning and budgeting are summarized in the table below.

TSMO Processes for Developing a Database of Unit Costs for TSMO Projects	
TSMO Focus Area	Recommended Processes
1. Data Collection	Collect unit cost data for existing TMS devices (initial costs and O&M costs).
2. Emerging Technologies	Research unit cost data for emerging technologies to support TSMO strategies.
3. Unit Cost Database	Prepare unit cost database and summarize by metro, urban, and rural areas.
4. TSMO Cost Database	Prepare database for select TSMO strategies (e.g., ATM, ICM, Managed Lanes).
5. Maintain Database	Update data based on input obtained from completed TxDOT TSMO projects.

As advanced TSMO strategies are implemented in the future (e.g., Cooperative Automated Transportation, Freight Connected Corridors, Active Arterial Management), the cost data should be updated based on actual deployment, operations, and maintenance costs. As a separate effort, a TSMO benefit database should be developed to enable cost-effectiveness (i.e., benefit-cost ratios) to be estimated to support project justification and prioritization of TSMO projects being considered as part of the work program and UTP.

**GOAL ALIGNMENT (Check appropriate areas)**

Safety:           Yes                            Mobility:           Yes  
Reliability:       No                                 Asset Uptime:     No

**COST (Low, Medium, High)**

Initial:            Medium                            Recurring:        Low

**TXDOT STAFF EFFORT (Low, Medium, High)**

Medium

**STAKEHOLDERS (Yes or No)**

Internal:          Yes                                 External:          No

**TIMEFRAME (Near-term, Mid-term, Long-term)**

Mid-term

**RETURN ON INVESTMENT (Low, Medium, High)**

Medium

**FOCUS AREA:  
PERFORMANCE MEASURES**

**STRATEGY NO. 18**

**Develop performance dashboards for safety and travel reliability during construction.**

TxDOT’s TRF Traffic Engineering Section’s Traffic Control Assessment Teams (TCAT) conducts compliance reviews of temporary traffic control in work zones, including multi-disciplinary reviews of construction plans beginning in the early phase of plan development. During the latter phases, Public Involvement Officers (PIO) may be included. After the project is let for construction, Construction Communications Assistance Teams (CCAT) may be formed, particularly for large-scale programs, to improve communications among stakeholders and the public. CCAT may include contractor representatives, consultants, PIOs, mobility coordinators, and others. For example, the I-35 Mobility CCAT developed SOPs for their TMC’s Construction Monitoring program.

This TSMO strategy addresses continuing the TCAT/CCAT efforts into the operations phase. Performance measure dashboards may be posted on the TMC’s video wall, workstations, or website to better monitor the impacts of construction. These dashboards may be used to track “actual versus expected” travel time reliability impacts due to construction and maintenance operations. Furthermore, the dashboards may be applied to monitoring, reporting, and mitigating crash potential (i.e., primary and secondary) through more effective work zone methods. TSMO processes to develop performance dashboards for construction safety and travel time reliability are presented in the table below.

TSMO Processes to Develop Performance Dashboards for Construction Safety and Travel Time Reliability	
TSMO Focus Area	Recommended Processes
1. Select Prototype TMC	Select one TMC to post performance dashboards on video wall and website.
2. Performance Measures	Define KPMs and targets for construction safety and travel time reliability.
3. Systems Engineering	Develop system requirements for implementing performance dashboards.
4. Operational Testing	Begin posting dashboards, assess their effectiveness, & make adjustments.
5. Roll Out to Other TMCs	Roll out construction performance dashboards to other TMCs, as applicable.

**GOAL ALIGNMENT (Check appropriate areas)**

Safety: Yes                      Mobility: Yes  
Reliability: Yes                      Asset Uptime: Yes

**COST (Low, Medium, High)**

Initial: Low                      Recurring: Low

**TXDOT STAFF EFFORT (Low, Medium, High)**

Medium

**STAKEHOLDERS (Yes or No)**

Internal: Yes                      External: No

**TIMEFRAME (Near-term, Mid-term, Long-term)**

Near-term

**RETURN ON INVESTMENT (Low, Medium, High)**

High

**FOCUS AREA:  
PERFORMANCE MEASURES**

**STRATEGY NO. 19**

**Apply performance measures to all applicable phases of a project’s lifecycle (planning - operations).**

TxDOT has begun to apply performance measures to each phase of a project’s lifecycle (i.e., planning, design, construction, operations, maintenance). TMS dashboards are currently provided for the following TMS metrics – incident clearance times; ITS asset uptime availability; and travel time reliability. End-users are management and staff who do not have access to Lonestar™. Roadways may be filtered by segment, direction, and priorities. Comparative metrics are displayed in bar charts by month and by district. Similar performance dashboards for planning are under development.

This TSMO initiative focuses on the continuation of applying performance dashboards for all applicable phases of a project’s lifecycle. These tools will be useful in: (1) applying a “Scenario Planner” to predict the impacts of construction lane closures (e.g., length, duration); (2) assessing, approving (or rejecting) contractors’ requests for extending lane closures beyond specified hours; (3) providing live data (i.e., traffic speeds, status of ITS devices and incidents); and (4) archiving historic lane closure information, impacts, and lessons learned resulting from After Action Reviews. This system can be linked to the TxDOT Open Data Portal. As TxDOT is already populating these dashboards with ITS and Traffic Incident Management (TIM) operations metrics, this can be a powerful tool to improve situational awareness statewide and within each district. TSMO processes to apply performance measures to all applicable phases of a project’s lifecycle are presented in the table below.

TSMO Processes to Apply Performance Measures to a Project’s Lifecycle	
TSMO Focus Area	Recommended Processes
1. Gap Assessment	Assess performance measure gaps for each phase of a project’s lifecycle.
2. Performance Measures	Prepare plan to develop missing KPMs and refine existing ones.
3. KPMs and Dashboards	Develop missing KPMs and targets; integrate with performance dashboards.
4. Effectiveness	Assess the effectiveness of performance dashboard enhancements.
5. Training	Train staff on how to apply KPMs and dashboards to improve performance.

**GOAL ALIGNMENT (Check appropriate areas)**

Safety: Yes                      Mobility: No  
Reliability: Yes                      Asset Uptime: Yes

**COST (Low, Medium, High)**

Initial: Medium                      Recurring: Low

**TXDOT STAFF EFFORT (Low, Medium, High)**

Medium

**STAKEHOLDERS (Yes or No)**

Internal: Yes                      External: No

**TIMEFRAME (Near-term, Mid-term, Long-term)**

Near-term

**RETURN ON INVESTMENT (Low, Medium, High)**

High

**FOCUS AREA:  
PERFORMANCE MEASURES**

**STRATEGY NO. 20**

**Develop consistent performance data management process to continually track system performance.**

Performance measurement is described by the FHWA as the use of statistical evidence to determine progress toward specific defined organizational objectives. This includes quantitative measurements such as travel times and pavement surface smoothness, as well as qualitative measures including customer perception that could be measured through a customer satisfaction survey. Performance measures provide information to management level staff about how well the transportation system is performing to meet the objectives that have been defined by the agency and should also reflect the satisfaction of the end system users that are the general public. They also provide useful information to operations staff to continually improve performance.

Performance measures have been adopted by TxDOT over the past decade to evaluate transportation system performance per federal and state requirements. These measures help to identify areas where the overall system is meeting established targets to serve the needs of the general public that relies upon the system. TSMO processes to continually track system performance are summarized in the table below.

TSMO Processes for Developing a Consistent Performance Management System	
TSMO Focus Area	Recommended Processes
1. Data Collection	Collect performance measures for all aspects of TxDOT programs.
2. Classify by TxDOT Goals	Select applicable performance measures and map to TxDOT goals.
3. Key Performance Measures (KPM)	Define KPMs and targets for each performance measure.
4. Baseline Existing KPMs	Collect and summarize historic trends for each KPM.
5. KPMs by User Type	Organize KPMs by user type (e.g., planning, operations, etc.).
6. Aggregate by Region Type	Organize KPMs by region (i.e., metro, urban, rural).
7. Performance Dashboards	Develop performance dashboards for each user type and region.
8. Performance Reports	Prepare template summarizing KPMs (e.g., monthly, annual).
9. Apply KPMs on TMC Video Walls	Develop requirements to post operational KPMs on video walls.
10. Apply KPMs for Operations	Develop procedure to analyze KPMs to improve safety & operations.

**GOAL ALIGNMENT (Check appropriate areas)**

Safety: Yes                      Mobility: Yes  
Reliability: Yes                      Asset Uptime: Yes

**COST (Low, Medium, High)**

Initial: Medium                      Recurring: Low

**TxDOT STAFF EFFORT (Low, Medium, High)**

Medium

**STAKEHOLDERS (Yes or No)**

Internal: Yes                      External: No

**TIMEFRAME (Near-term, Mid-term, Long-term)**

Mid-term

**RETURN ON INVESTMENT (Low, Medium, High)**

High

**FOCUS AREA:  
PERFORMANCE MEASURES**

**STRATEGY NO. 21**

**Develop process to include operations performance measures into district decision-making.**

MAP-21 enacted in 2012 and the Fixing America's Surface Transportation Act (FAST Act) enacted in 2015 by the USDOT and FHWA defined an approach for transportation performance management for state-level DOTs and MPOs as part of their federally-required transportation planning and programming activities. The approach requires the establishment and use of a coordinated performance-based approach to transportation decision-making to support national goals for the federal-aid highway and public transportation programs.

TxDOT has developed several state-level goals that are consistent with federal-level goals established within MAP-21. TxDOT's seven goals are aligned with a series of objectives and key performance measures (KPM) to guide in assessing how the agency is meeting its goals over time. TSMO processes to include operations performance measures into district decision-making are summarized in the table below.

TSMO Processes to Incorporate Performance Measures into District Decision-Making	
TSMO Focus Area	Recommended Processes
1. Assess TxDOT's Performance Dashboards	Identify upgrades needed to support decision-making.
2. Analyze KPM Trends for the 7 TxDOT Goals	Identify strategies to address undesirable KPM trends.
3. Identify TSMO Strategies	Identify how TSMO may improve KPMs.
4. Model TSMO Strategies	Estimate KPM improvements and cost-effectiveness.
5. TSMO Strategy Implementation	Apply models to select, prioritize, and fund TSMO strategies.
6. Technology Solution for KPM Reporting	Obtain District input to define solution for KPM reporting.
7. Expand KPM Reporting to All Districts	Apply KPMs used by metro districts to all districts.
8. Develop Database of TSMO KPM Upgrades	Conduct "KPM Before & After" studies of TSMO strategies.
9. Relate KPMs to TxDOT's Strategic Goals	Maintain linkage between Statewide and District KPMs.
10. Periodically Reassess KPM Reporting	Reassess KPM reporting system for continual improvement.

**GOAL ALIGNMENT (Check appropriate areas)**

Safety: Yes                      Mobility: Yes  
Reliability: Yes                      Asset Uptime: Yes

**COST (Low, Medium, High)**

Initial: Low                      Recurring: Low

**TXDOT STAFF EFFORT (Low, Medium, High)**

Medium

**STAKEHOLDERS (Yes or No)**

Internal: Yes                      External: No

**TIMEFRAME (Near-term, Mid-term, Long-term)**

Mid-term

**RETURN ON INVESTMENT (Low, Medium, High)**

High

**FOCUS AREA:  
PERFORMANCE MEASURES**

**STRATEGY NO. 22**

**Develop a process to improve safety by applying historic, real-time, and predictive performance measures.**

Historically, traffic safety studies have relied heavily on the analysis of crash records collected during the previous three to five years. The TxDOT Crash Record Information System (CRIS) is used by most law enforcement agencies in Texas to document crashes. CRIS provides standard fields that are used by all agencies, but also allows each agency to add up to five customized fields. The Texas Department of Public Safety has added Incident Clearance Time, Roadway Clearance Time and Secondary Crashes as standard fields in their version of CRIS. The TxDOT Statewide Incident Management Coordinator is working to make these three fields standard for all users of CRIS. Having this information would allow TxDOT to be able track performance on incidents in rural areas where TxDOT TMC operators do not have CCTV cameras to monitor incidents (or the TxDOT Districts do not have TMCs to monitor incidents.)

In recent years, other methods and tools are beginning to be used as part of traffic safety and project development studies. TSMO processes to improve safety by applying historic, real-time, and predictive performance measures are summarized in the table below.

TSMO Processes in Developing a Holistic Approach to Traffic Safety Studies	
TSMO Focus Area	Recommended Processes
1. Crash Records Information System	Identify additional data fields needed to address gaps in the CRIS.
2. Secondary Crashes	Identify methods to capture information on secondary crashes.
3. Video Analytics	Apply video analytics at safety hot spots using near-miss algorithms.
4. TIM Team After-Action Reviews	Capture lessons learned as part of Incident After-Action Reviews.
5. Road Safety Audits	Document recommendations by a diverse range of specialists.
6. Highway Safety Manual (HSM)	Apply HSM tools to estimate crash reductions for proposed projects.
7. Community Traffic Safety Teams	Obtain traffic safety input from non-technical communities.
8. Systematic Risk-Based Approach	Apply a systematic approach using standardized incidence ratios.
9. GIS Tools	Apply GIS tools to summarize safety hot spots and characteristics.
10. Emerging Technologies	Consider emerging technologies as safety countermeasures.

**GOAL ALIGNMENT (Check appropriate areas)**

Safety:            Yes                    Mobility:            No  
Reliability:        No                      Asset Uptime:     No

**COST (Low, Medium, High)**

Initial:            Medium                Recurring:         Low

**TXDOT STAFF EFFORT (Low, Medium, High)**

Medium

**STAKEHOLDERS (Yes or No)**

Internal:            Yes                      External:            No

**TIMEFRAME (Near-term, Mid-term, Long-term)**

Long-term

**RETURN ON INVESTMENT (Low, Medium, High)**

High

**FOCUS AREA:  
ORGANIZATION AND WORKFORCE**

**STRATEGY NO. 23**

**Develop a succession plan for essential staff to provide continuity of operations.**

Staff retention is a significant concern as the Texas economy is strong and other opportunities may offer higher salaries for key staff responsible for ITS operations and maintenance. Trained staff is important in achieving the performance goals of the TSMO program. As current staff retires, or leaves for another job opportunity, a succession plan is needed to avoid disruption of services. While on-the-job training, and shadowing experienced staff, is typically used to train new staff, it leaves the districts vulnerable if there is unanticipated turnover of staff.

A formal training program should be developed and implemented to support a succession plan. This program should consider the application of a variety of training methods to afford the trainee an opportunity to receive training on demand, in the control room, in the field, in a classroom (or virtual classroom), or some combination of different techniques. The training program should be developed in modules to avoid information overload and provide the trainee a logical training curriculum to keep pace with their level of experience as they advance through their careers. These modules may include a library of videos for different procedures (e.g., control room operations using Lonestar™). TSMO processes to develop a succession plan for essential staff to provide continuity of operations are presented in the table below.

TSMO Processes to Develop a Succession Plan for Essential Staff to Provide Continuity of Operations	
TSMO Focus Area	Recommended Processes
1. Essential Staff	Identify essential staff to support continuity of operations.
2. Training Needs	Identify specific training needs with input from each district.
3. Training Platforms	Assess various training platforms (e.g., classroom, online, videos).
4. Deliver Training	Develop and deliver training to essential staff to support succession plans.
5. Testing and Certification	Establish testing and certification program to confirm succession readiness.

**GOAL ALIGNMENT (Check appropriate areas)**

Safety: No                      Mobility: No  
Reliability: Yes                Asset Uptime: Yes

**COST (Low, Medium, High)**

Initial: Low                      Recurring: Low

**TXDOT STAFF EFFORT (Low, Medium, High)**

Medium

**STAKEHOLDERS (Yes or No)**

Internal: Yes                      External: No

**TIMEFRAME (Near-term, Mid-term, Long-term)**

Near-term

**RETURN ON INVESTMENT (Low, Medium, High)**

Medium

**FOCUS AREA:  
ORGANIZATION AND WORKFORCE**

**STRATEGY NO. 24  
Develop a comprehensive TxDOT TSMO Training Program.**

A TxDOT TSMO Training Program should be developed to provide a scalable curriculum to enhance the skill sets needed by staff to support the vision, mission and goals of the TxDOT Statewide TSMO Strategic and District TSMO Program Plans. The training program should provide basic, intermediate and advanced training to enable TxDOT division and district staff, as well as stakeholder partners, to develop, implement, operate and maintain an effective TSMO Program. The benefits of this training program include the following:

- Targeted Training – modules should be organized to provide training on specific areas of interest and needs as determined by the employee’s job description and career path.
- Flexibility – modules should be completed by the employees at their own pace, and their desired location, within a timeframe assigned by their supervisor.
- Certification – staff should receive certification in the form of PDHs or as part of a TxDOT certification process. Certifications may be considered during annual reviews for career advancement opportunities.

TSMO training modules should be grouped into five categories: TSMO Overview, TSMO Planning, TSMO Strategies, TSMO Implementation, and TSMO Operations & Maintenance. Processes to develop a comprehensive TSMO training program are presented in the table below.

TSMO Processes to Develop a Comprehensive TSMO Training Program	
TSMO Focus Area	Recommended Processes
1. Training Needs	Conduct workshop with TxDOT Divisions / Districts to identify TSMO training needs.
2. Training Program	Develop a comprehensive TSMO training program that addresses training needs.
3. TSMO Modules	Develop TSMO training and testing materials for each module.
4. LMS Integration	Integrate TSMO training program into the TxDOT Learning Management System.
5. Training Upgrades	Refresh TSMO training every 5 years to address emerging technologies.

**GOAL ALIGNMENT (Check appropriate areas)**

Safety: Yes                      Mobility: Yes  
Reliability: Yes                      Asset Uptime: Yes

**COST (Low, Medium, High)**

Initial: Medium                      Recurring: Low

**TXDOT STAFF EFFORT (Low, Medium, High)**

Medium

**STAKEHOLDERS (Yes or No)**

Internal: Yes                      External: No

**TIMEFRAME (Near-term, Mid-term, Long-term)**

Near-term

**RETURN ON INVESTMENT (Low, Medium, High)**

Medium



**FOCUS AREA:  
ORGANIZATION AND WORKFORCE**

**STRATEGY NO. 25**

**Build and develop the workforce needed to manage the TSMO infrastructure.**

Emerging systems and technologies are being integrated into multimodal transportation systems to improve safety, mobility, and efficiency. Many of these technologies support TSMO strategies planned to be implemented as part of District TSMO Program Plans. While the systems engineering process provides the required structure to develop and implement these systems, a complementary program should be developed to attract, train, and retain the workforce needed to operate and maintain advanced ITS, traffic signal systems, communications, and emerging technologies. TSMO processes to build and develop the workforce needed to manage the TSMO systems infrastructure are summarized in the table below.

TSMO Processes to Build and Develop a Workforce Needed to Manage the TSMO Infrastructure	
TSMO Focus Area	Recommended Processes
1. Job Descriptions	Refresh job descriptions to better align with education and experience required.
2. Staff Recruitment	Attract top talent by revisiting compensation package to be more competitive.
3. Staff Training	Assign relevant TSMO training modules and certification courses to staff.
4. Staff Retention	Provide technical staff with a career path and other benefits (remote working).
5. Succession Planning	Shadow critical staff to maintain continuity of operations as staff resign or retire.

**GOAL ALIGNMENT (Check appropriate areas)**

Safety: No                      Mobility: No  
Reliability: Yes                      Asset Uptime: Yes

**COST (Low, Medium, High)**

Initial: Low                      Recurring: Low

**TXDOT STAFF EFFORT (Low, Medium, High)**

Medium

**STAKEHOLDERS (Yes or No)**

Internal: Yes                      External: No

**TIMEFRAME (Near-term, Mid-term, Long-term)**

Long-term

**RETURN ON INVESTMENT (Low, Medium, High)**

High

**FOCUS AREA:  
ORGANIZATION AND WORKFORCE**

**STRATEGY NO. 26**

**Develop an action plan to address staff vacancies in critical traffic management program capabilities.**

There are current staffing shortages within the districts for transportation and traffic management positions and there will likely be future staffing shortfalls. The districts should create an action plan for addressing these shortages. Potential actions include development of job descriptions and required education/experience for each position to have the information ready to go when an advertisement is authorized. As a first step, the districts should identify what they consider to be critical positions with respect to TSMO. This should be conducted in conjunction with determining how many positions can be filled if there are hiring restrictions. If there are shared responsibility positions or positions that can meet multiple needs, these should be assigned higher priority. The benefit of this strategy is that the districts will be prepared to take action to strategically fill open positions in a shorter time. TSMO processes to develop an action plan to address traffic management staff vacancies are summarized in the table below.

TSMO Processes to Develop an Action Plan to Address Traffic Management Staff Vacancies	
TSMO Focus Area	Recommended Processes
1. Identify Staff Shortages	Determine critical staff shortages for TRF and each district.
2. Forecast Staff Needs	Estimate number/type of staff required to deliver the TSMO Program.
3. Develop Staffing Plan	Prepare staffing plan addressing recruitment, training, and retention.
4. Identify Staff Requirements	List Knowledge, Skills, Abilities (KSA) and certification requirements.
5. Modify Job Descriptions	Revise job descriptions to align with TSMO specialty needs.
6. Identify Recruitment Sources	Expand recruitment sources utilizing non-traditional strategies/methods.
7. Prepare Budget Forecasts	Forecast 5-year budget needs based on competitive staff compensation.
8. Identify Shared Roles	Identify secondary staff functions to provide efficiency and redundancy.
9. Identify Recruitment Sources	Expand recruitment sources utilizing non-traditional strategies/methods.
10. Customize Onboard Training	Promote cross-training, mentoring, and professional capacity building.
11. Share Staff Across Districts	Assign critical staff a “buddy district(s)” to share personnel and mentor.

**GOAL ALIGNMENT (Check appropriate areas)**

Safety: No                      Mobility: No  
Reliability: Yes                      Asset Uptime: Yes

**COST (Low, Medium, High)**

Initial: Low                      Recurring: Low

**TXDOT STAFF EFFORT (Low, Medium, High)**

Medium

**STAKEHOLDERS (Yes or No)**

Internal: Yes                      External: No

**TIMEFRAME (Near-term, Mid-term, Long-term)**

Mid-term

**RETURN ON INVESTMENT (Low, Medium, High)**

High

**FOCUS AREA:  
ORGANIZATION AND WORKFORCE**

**STRATEGY NO. 27**

**Rotate TxDOT staff through different positions in the Transportation Management Centers.**

Transportation Management Centers (TMC) play an important role in TSMO. Many TSMO strategies are monitored and controlled from these facilities. Having TxDOT staff rotate through various positions in the TMCs would enrich their knowledge of TSMO by providing hands-on experience in addressing real-world issues. A rotation program is proposed where selected TxDOT staff would participate. Certain logistics would need to be resolved such as backfilling their role while they are assigned to the TMC, security clearances, and traveling to TMCs in other districts where there is no TMC close by. Completion of this program would provide valuable training in becoming future TSMO champions and coordinators. TSMO processes to establish a TMC rotation program are summarized in the table below.

TSMO Processes to Establish a TMC Rotation Program	
TSMO Focus Area	Recommended Processes
1. Define TMC Functions	Prepare schedule of the various TMC functions staff will rotate through.
2. Select TxDOT Staff Trainees	Select the staff that will participate in the TMC rotation program.
3. Provide TMC Overview	Introduce the selected staff to the TMC, TMC Manager, and Operators.
4. Function: Freeway Operations	Shadow and assist an experienced TMC Freeway Operator for one week.
5. Function: Arterial Operations	Shadow and assist an experienced TMC Arterial Operator for one week.
6. Function: TIM Coordinator	Attend a TIM Team meeting; assist in preparations & meeting minutes.
7. Function: Data Analyst	Support TMC Manager in collecting and analyzing performance metrics.
8. Function: ITS Maintenance	Shadow an experienced TMC staff to identify and diagnose ITS failures.
9. Function: Agency Coordination	Attend TxDOT meeting where TMC staff participates; prepare minutes.
10. Share Best Practices	Present observations based on the staff's TMC rotation experience.

**GOAL ALIGNMENT (Check appropriate areas)**

Safety: Yes                      Mobility: Yes  
Reliability: Yes                      Asset Uptime: Yes

**COST (Low, Medium, High)**

Initial: Low                      Recurring: Low

**TXDOT STAFF EFFORT (Low, Medium, High)**

Medium

**STAKEHOLDERS (Yes or No)**

Internal: Yes                      External: No

**TIMEFRAME (Near-term, Mid-term, Long-term)**

Long-term

**RETURN ON INVESTMENT (Low, Medium, High)**

High

**FOCUS AREA:  
CULTURE**

**STRATEGY NO. 28**

**Apply gamification strategies as an incentive to continuously improve operational performance.**

Gamification is the process of applying gaming techniques (e.g., point scoring, competition with others, rules of play) to motivate operations staff to achieve or exceed performance targets. Gaming applications may be considered for HERO operations, TMC operations, and other functional areas to instill competition among staff and report TSMO successes to executive management.

For example, an algorithm may be developed for measuring HERO performance as a function of number of assists, miles traveled, and customer satisfaction. The algorithm should not be shared with HERO drivers to avoid manipulating the system. HEROs may be assigned “call signs” with their performance scores posted on a daily basis. Gamification may also be used to measure operational performance of the various districts. The algorithm would need to be carefully developed to normalize the diversity among metro, urban, and rural districts. Gamification may also be applied to changing travel behavior (e.g., reduce speeding, taking less congested routes, using alternative modes, or traveling during less congested times of the day). TSMO processes to apply gamification strategies as an incentive to continuously improve operational performance are presented in the table below.

TSMO Processes to Apply Gamification Strategies to Improve Operational Performance	
TSMO Focus Area	Recommended Processes
1. Applications	Identify potential applications of gamification for various TSMO functions.
2. Prototype	Develop a gamification application to be tested on a project off-line.
3. Pilot Project	Apply gamification application in a digital twin environment.
4. Systems Engineering	Prepare system requirements based on a ConOps with operations staff input.
5. Software Tools	Develop software tools to automate gaming functions.
6. Pilot Testing	Implement gaming at one site (e.g., TMC) and assess its pros and cons.
7. Expansion	If desirable, roll the gamification application to other sites (e.g., TMCs).
8. Other Functions	Consider gamification for other functions (e.g., construction, maintenance).
9. Travel Behavior	Consider gamification application to attempt to modify traveler behavior.
10. System Integration	Integrate gamification software tools with other TxDOT systems (e.g., Lonestar).

**GOAL ALIGNMENT (Check appropriate areas)**

Safety: Yes                      Mobility: Yes  
Reliability: Yes                      Asset Uptime: Yes

**COST (Low, Medium, High)**

Initial: Medium                      Recurring: Medium

**TXDOT STAFF EFFORT (Low, Medium, High)**

Medium

**STAKEHOLDERS (Yes or No)**

Internal: Yes                      External: No

**TIMEFRAME (Near-term, Mid-term, Long-term)**

Long-Term

**RETURN ON INVESTMENT (Low, Medium, High)**

Medium

**FOCUS AREA:  
CULTURE**

**STRATEGY NO. 29**

**Realize the full potential of TxDOT's ITS infrastructure during pandemic events.**

Since the early 1990s, TxDOT has made significant investments in building, operating, and maintaining the ITS infrastructure throughout the state. While the focus of ITS has rightfully been on traffic safety, incident management, mobility, and congestion relief, these systems have the potential in providing a broader and more robust role during emergencies (e.g., COVID-19).

This TSMO strategy is focused on making a cultural change on how to capture the untapped potential of our ITS infrastructure during similar events. During the COVID-19 pandemic, virtual TMC operational concepts were developed to support remote operations. Based on lessons learned during the COVID crisis, TMCs may provide on-site or remote operational support in a variety of new services including: (1) advising on where COVID testing stations are located, their wait times, and associated traffic queue management within the vicinity of these facilities; (2) utilizing CCTV cameras to monitor highly infected areas and provide information to police to enforce social distancing policies; (3) supporting call centers as a secondary backup to take calls during overflow situations; (4) developing SOPs for similar pandemic situations based on lessons learned; (5) dynamic messaging indicating what facilities are open or closed and other public service announcements; and (6) providing daily updates on performance measures. TSMO processes to realize the full potential of TxDOT's ITS infrastructure during pandemic events are presented in the table below.

TSMO Processes to Realize the Full Potential of TxDOT's ITS Infrastructure During Pandemic Events	
TSMO Focus Area	Recommended Processes
1. Lessons Learned	Summarize lessons learned during COVID-19 and identify ITS opportunities.
2. Operational Needs	Identify specific functional roles that ITS can support during pandemics.
3. Systems Engineering	Develop a Concept of Operations addressing similar pandemic events.
4. Develop Plan	Prepare Pandemic Response Action Plans (staffing, SOPs, supplies, systems).
5. Training	Prepare and conduct periodic training to apply ITS to manage pandemic events.

**GOAL ALIGNMENT (Check appropriate areas)**

Safety: Yes                      Mobility: Yes  
Reliability: No                      Asset Uptime: No

**COST (Low, Medium, High)**

Initial: Medium                      Recurring: Low

**TXDOT STAFF EFFORT (Low, Medium, High)**

Medium

**STAKEHOLDERS (Yes or No)**

Internal: Yes                      External: Yes

**TIMEFRAME (Near-term, Mid-term, Long-term)**

Long-Term

**RETURN ON INVESTMENT (Low, Medium, High)**

High

**FOCUS AREA:  
CULTURE**

**STRATEGY NO. 30**

**Develop managers in District departments to consider TSMO in project development and implementation.**

Mainstreaming TSMO during each phase of the project development lifecycle is key to success of the program. TxDOT managers in each District should be identified and encouraged to apply TSMO concepts and strategies where applicable. These managers should serve as regional TSMO champions in providing a TSMO-based perspective when discussing solutions to an operational issue and become an operational leader in the region. TSMO processes to develop managers in District Departments to consider TSMO during each phase of the project lifecycle are summarized in the table below.

TSMO Process to Develop Managers in District Departments to Consider TSMO	
TSMO Focus Area	Recommended Processes
1. TSMO Training (Basic)	Provide basic TSMO training (i.e., overview modules).
2. TSMO Training (Advanced)	Provide targeted TSMO training in area(s) of specialty and interest.
3. TSMO Evaluation Tool	Apply TSMO Checklists (Planning, Design, Construction, Close-out).
4. TSMO Best Practices	Share TSMO best practices within the District, State, and Nation.
5. TSMO Policies, Procedures, SOPs	Modify TxDOT policies, procedures, SOPs based on experiences.

**GOAL ALIGNMENT (Check appropriate areas)**

Safety: Yes                      Mobility: Yes  
Reliability: Yes                      Asset Uptime: Yes

**COST (Low, Medium, High)**

Initial: Low                      Recurring: Low

**TXDOT STAFF EFFORT (Low, Medium, High)**

Medium

**STAKEHOLDERS (Yes or No)**

Internal: Yes                      External: No

**TIMEFRAME (Near-term, Mid-term, Long-term)**

Mid-term

**RETURN ON INVESTMENT (Low, Medium, High)**

Medium

**FOCUS AREA:  
CULTURE**

**STRATEGY NO. 31**

**Provide high level of integration of TSMO strategies between the TRF, Districts, and ITD.**

The Information Technology Division (ITD) supports the business operations of TxDOT with innovative IT strategies, resources, systems, and integration. As TSMO continues to change the way TxDOT does business, it is necessary to stay current on the latest trends in information management to achieve the Department’s vision, mission, and goals. A high level of integration of TSMO strategies with ITD is recommended to address a wide array of systems including network monitoring, asset management, video sharing, data mining, cybersecurity, software management, data sharing within TxDOT and stakeholder partners, and other applications. There is a need to maintain a strong relationship with ITD to understand where they are in modernizing the traffic network, understand TRF’s needs and initiatives, and ITD’s proposed solutions. TSMO processes to develop a high level of integration of TSMO strategies are summarized in the table below.

TSMO Processes to Develop a High Level of TSMO Integration between the TRF, Districts, and ITD	
TSMO Focus Area	Recommended Processes
1. TRF Coordination	TRF to periodically update ITD on proposed statewide TSMO strategies.
2. District Coordination	ITD to engage with Districts to understand TSMO implementation needs.
3. Public-Private Partnerships	Encourage partnership with technology vendors, OEMs, data providers, etc.
4. Data Lake Applications	Identify APIs to support TSMO using the Data Lake as a resource.
5. Lonestar™ Enhancements	Identify future upgrades that support TSMO strategies.
6. Performance Measures	Develop a framework that would make performance metrics actionable.
7. MPPM Enhancements	Identify MPPM upgrades from the perspective of Division and District staff.
8. Situational Awareness	Develop portable tools to remotely monitor system reliability and alarms.
9. TIM Operational Integration	Develop tools to provide real-time TMC video and data to first responders.
10. Next Generation Systems	Brainstorm new systems, technologies, apps with Division/District staff.

**GOAL ALIGNMENT (Check appropriate areas)**

Safety: Yes                      Mobility: Yes  
Reliability: Yes                      Asset Uptime: Yes

**COST (Low, Medium, High)**

Initial: Low                      Recurring: Low

**TXDOT STAFF EFFORT (Low, Medium, High)**

Medium

**STAKEHOLDERS (Yes or No)**

Internal: Yes                      External: No

**TIMEFRAME (Near-term, Mid-term, Long-term)**

Mid-term

**RETURN ON INVESTMENT (Low, Medium, High)**

High

**FOCUS AREA:  
CULTURE**

**STRATEGY NO. 32**

**Conduct annual reviews of the TSMO Program to determine what is working and not working.**

TxDOT has made significant investments in developing TSMO programs at the statewide and district levels. During the next few years, many of these TSMO strategies will be implemented. The goal of this initiative is to conduct annual reviews of the TSMO Program to determine what is working and not working. In this manner lessons learned may be shared with other districts and data-driven decisions could be used to determine whether certain TSMO strategies should be expanded, modified, or deleted for future applications. TSMO processes for conducting audits of the TSMO program are summarized in the table below.

TSMO Processes for Conducting Audits of the TSMO Program	
TSMO Focus Area	Recommended Processes
1. Develop Audit Process	TRF develops a uniform process to audit District TSMO programs.
2. Develop Audit Checklists	TRF develops checklists applying KPMs to measure TSMO success.
3. Traffic Safety Audits	TRF develops a process considering CRIS, near-miss algorithms, incident data, and Road Safety Audits to measure TSMO success.
4. TIM Audits	TRF applies the CMM questions in conducting TIM team self-assessments and analysis of the After-Action Review process.
5. Traffic Management Audits	TRF applies KPMs to measure travel reliability on TSMO networks.
6. Work Zone Management Audits	TRF assesses work zones considering primary and secondary crashes, worker injuries and fatalities, traffic queueing and delays.
7. Traffic Signal System Audits	Districts conduct before & after studies and measure improvements in delays, crashes, emissions, # complaints, and benefit-cost ratios.
8. Emergency Management Audits	TRF assesses the effectiveness of evacuation plans (before, during, after the emergency) and collaboration with relevant stakeholders.
9. Special Event Management Audits	TRF assesses select special events to measure efficiency and effectiveness of TSMO strategies deployed and lessons learned.
10. Annual TSMO Summary Audits	TRF summarizes TSMO audits and shares best practices.

**GOAL ALIGNMENT (Check appropriate areas)**

Safety: Yes                      Mobility: Yes  
Reliability: Yes                      Asset Uptime: Yes

**COST (Low, Medium, High)**

Initial: Low                      Recurring: Low

**TXDOT STAFF EFFORT (Low, Medium, High)**

Low

**STAKEHOLDERS (Yes or No)**

Internal: Yes                      External: No

**TIMEFRAME (Near-term, Mid-term, Long-term)**

Long-term

**RETURN ON INVESTMENT (Low, Medium, High)**

Medium



**FOCUS AREA:  
COLLABORATION**

**STRATEGY NO. 33**

**Support Rural District Operations that have limited resources to support TSMO goals.**

TSMO strategies should be developed to encourage rural districts to partner with neighboring districts (or border states) to share operational responsibilities and assets during emergencies (e.g., hazmat spill, railroad crossing blocked). This may include providing DMS messages, TMC operations, and incident response as rural districts may not have the resources to address these issues by themselves in a timely manner.

A checklist should be developed and provided to rural districts to offer guidance in what to request in terms of ITS infrastructure when they are developing a roadway improvement project (e.g., ITS devices, communications, O&M funding). Furthermore, they may desire to share in the development and maintenance of asset management systems. Rural districts may also need support in providing SHRP2 training for fire, police and other local emergency responders.

Rural districts often struggle with recruiting and retaining quality maintenance technicians resulting in a high backlog of repairs that are needed (e.g., knock downs) which are not being addressed in a timely manner. Partnering agreements with adjacent districts should be considered in addressing this concern. TSMO processes to support rural district operations that have limited resources for TSMO are presented in the table below.

TSMO Processes to Support Rural Districts that have Limited Resources to Support TSMO	
TSMO Focus Area	Recommended Processes
1. TSMO Checklists	Prepare checklist to offer guidance to request ITS as part of roadway projects.
2. SHRP2 Training	Provide SHRP2 training for fire, police, and other emergency responders.
3. Partner Agreements	Develop partner agreements among districts to share maintenance technicians.
4. SOPs	Prepare SOPs to share TSMO responsibilities across district lines.
5. Training	Conduct training among neighboring districts in managing various events.

**GOAL ALIGNMENT (Check appropriate areas)**

Safety: Yes                      Mobility: No  
Reliability: Yes                      Asset Uptime: Yes

**COST (Low, Medium, High)**

Initial: Low                      Recurring: Low

**TXDOT STAFF EFFORT (Low, Medium, High)**

Low

**STAKEHOLDERS (Yes or No)**

Internal: Yes                      External: Yes

**TIMEFRAME (Near-term, Mid-term, Long-term)**

Mid-term

**RETURN ON INVESTMENT (Low, Medium, High)**

High

**FOCUS AREA:  
COLLABORATION**

**STRATEGY NO. 34**

**Strengthen TIM Teams collaboration with stakeholders to safely reduce incident clearance times.**

The TxDOT Statewide TIM Team is managed by TRF who communicates and coordinates best practices, training and national programs with the six metro regions. Houston and Dallas: Councils of Government administer the TIM teams and training. The San Antonio and Fort Worth have a full-time TIM Coordinator. The Austin TMC/HERO consultant is managing the TIM team. The El Paso TIM team is managed by TxDOT TMC/ITS staff. Meeting agendas that focus on quick clearance initiatives allow first responders to learn and practice the TIM National Unified Goal when at crash scenes. Dedicated full time TIM Coordinators manage agency outreach, meetings, speakers, after-action-reviews, training and documentation. Currently, data fields are being added to law enforcement Crash Records Information System (CRIS) reports to capture incident timelines, secondary crashes and first responders struck-by incidents.

A Statewide TIM strategic plan should be developed to address deficiencies noted by CMM TIM Self-Assessment surveys. This plan should address TSMO strategies to improve communications and incident notifications with stakeholders (e.g., work zones). This may include developing interagency agreements to strengthen agency partnerships; developing effective communications plans and SOPs; and assessing TMC/TIM integrated operations in making recommendations to improve their effectiveness. TSMO processes to strengthen TIM Teams collaboration with stakeholders to safely reduce incident clearance times are presented in the table below.

TSMO Processes to Strengthen TIM Teams Collaboration to Safely Reduce Incident Clearance Times	
TSMO Focus Area	Recommended Processes
1. CMM TIM Survey	Analyze responses to the TIM Self-Assessment section of the CMM survey.
2. TIM Strategic Plan	Develop TIM strategic plan to address TIM Self-Assessment deficiencies.
3. Performance Measures	Identify performance measures and targets to track improvements.
4. Interagency Agreements	Develop and execute interagency agreements to strengthen partnerships.
5. Integrated Operations	Assess TMC/TIM integrated operations to improve their effectiveness.

**GOAL ALIGNMENT (Check appropriate areas)**

Safety: Yes                      Mobility: No  
Reliability: Yes                      Asset Uptime: No

**COST (Low, Medium, High)**

Initial: Low                      Recurring: Low

**TXDOT STAFF EFFORT (Low, Medium, High)**

Medium

**STAKEHOLDERS (Yes or No)**

Internal: Yes                      External: Yes

**TIMEFRAME (Near-term, Mid-term, Long-term)**

Near-term

**RETURN ON INVESTMENT (Low, Medium, High)**

High

**FOCUS AREA:  
COLLABORATION**

**STRATEGY NO. 35  
Develop Special Event Checklist to apply TSMO strategies.**

Special events provide an opportunity for agencies to plan, coordinate, share resources, deploy ITS technologies, and apply proven traffic management techniques to mitigate possible adverse impacts resulting from these events. Advanced planning and coordination allow agencies to develop and deploy the operational strategies, traffic control plans, protocols, procedures, and technologies needed to control traffic and share real-time information with other stakeholders on the day of the event.

A checklist should be developed to provide a structured approach to special event planning including traffic management, parking, roadblocks, security, and pedestrian traffic. The checklist should address the following as a minimum: (1) pre-approved traffic management plans and SOPs; (2) designation of a command center that is activated during these special events; (3) communication with the public before and during the event; (4) application of ITS and portable technologies; (5) parking management advisories to indicate available supply at various facilities; (6) modification in transit services; (7) preapproved signal timing plans used as part of traffic management plans; (8) security operations roles and responsibilities; (9) mobilization and deactivation of special event systems; and (10) performance measures to assess the effectiveness of special event plans resulting in continuous improvement. TSMO processes to develop special event checklist to apply TSMO strategies are presented in the table below.

TSMO Processes to Develop Special Event Checklist to Apply TSMO Strategies	
TSMO Focus Area	Recommended Processes
1. Working Committee	Create working committee to obtain input for components of the checklist.
2. Develop Checklist	Develop draft checklist for review by working committee.
3. Prepare SOPs	Develop SOP template addressing various types of special events.
4. ITS Technologies	Prepare ITS plan to monitor and manage transportation for special events.
5. Command Center	Designate command center to manage transportation for special events.
6. Parking Management	Coordinate with parking facilities to provide wayfinding using ITS technologies.
7. Transit Management	Coordinate with transit services providing access and egress for special events.
8. Signal Timings	Coordinate signal timings with maintaining agencies and monitor impacts.
9. Security	Coordinate with public safety to provide a coordinated response to security.
10. Pilot Test	Pilot test and refine checklist based on applying it for various special events.

**GOAL ALIGNMENT (Check appropriate areas)**

Safety: Yes                      Mobility: Yes  
Reliability: Yes                      Asset Uptime: No

**COST (Low, Medium, High)**

Initial: Low                      Recurring: Low

**TXDOT STAFF EFFORT (Low, Medium, High)**

Medium

**STAKEHOLDERS (Yes or No)**

Internal: Yes                      External: Yes

**TIMEFRAME (Near-term, Mid-term, Long-term)**

Mid-term

**RETURN ON INVESTMENT (Low, Medium, High)**

Medium

**FOCUS AREA:  
COLLABORATION**

**STRATEGY NO. 36**

**Maintain strong collaboration between TRF, ITD, and Strategy & Innovation Division to support TSMO.**

To ensure the success of TSMO deployment, operations, and maintenance, a strong collaborative relationship needs to be maintained between TRF, ITD, and the Strategy and Innovation (S&I) Division. This begins with a common understanding of the plan and status in modernizing the Traffic Network, TRF's needs and initiatives, as well as ITD's and the S&I's solutions. There should be more opportunities to engage with the districts and identify what TSMO will do for them as well as engagement with ITS America, Federal Affairs (Federal Highway Administration, National Operations Center of Excellence, National Highway Traffic Safety Administration). Other collaborative efforts may include the trucking industry (packaged deliveries) as they are having more of an impact on TxDOT's transportation systems and more collaboration with the American Association of State Highway & Transportation Officials to incorporate TMS technologies as part of roadway projects. TSMO processes to maintain strong collaboration between TRF, ITD, and the Strategy & Innovation Division are summarized in the table below.

TSMO Processes to Maintain Strong Collaboration between TRF, ITD and S&I to Support TSMO	
TSMO Focus Area	Recommended Processes
1. Review Statewide TSMO Plan	TRF to brief ITD and S&I on the Statewide TSMO Strategic Plan.
2. Review District TSMO Plans	TRF to brief ITD and S&I on District TSMO Program Plans.
3. Identify ITD Interfaces	Discuss and agree on key TSMO interfaces between TRF and ITD.
4. TSMO Partnering	Identify issues to be addressed for TSMO to be successful.
5. Resolve Issues or Concerns	Develop and implement action plans to resolve issues & concerns.
6. Strategy & Innovation (S&I)	Identify emerging technologies to support TSMO.
7. Engage with TSMO Innovators	Encourage technology vendors to demo their products and services.
8. Cybersecurity Concerns	Develop plan to address TSMO cybersecurity needs.
9. Engage with TxDOT Districts	Coordinate with TRF, ITD, and Districts to address their TSMO needs.
10. Develop IT Costs to Support TSMO	Prepare 5-year budget to address IT and traffic network needs.

**GOAL ALIGNMENT (Check appropriate areas)**

Safety: Yes                      Mobility: Yes  
Reliability: Yes                      Asset Uptime: Yes

**COST (Low, Medium, High)**

Initial: Low                      Recurring: Low

**TXDOT STAFF EFFORT (Low, Medium, High)**

Medium

**STAKEHOLDERS (Yes or No)**

Internal: Yes                      External: No

**TIMEFRAME (Near-term, Mid-term, Long-term)**

Mid-term

**RETURN ON INVESTMENT (Low, Medium, High)**

High

**FOCUS AREA:  
COLLABORATION**

**STRATEGY NO. 37**

**Develop stronger collaboration with first responders in better understanding and serving their needs.**

Effective traffic incident management improves the safety and reliability of the roadway by removing the vehicles involved in the incident in a safe and efficient manner. On average, every one-minute of traffic lane closure results in four minutes of traffic delays and queueing for each approaching vehicle. For every one-minute that an incident remains uncleared, the probability of a secondary crash increases by 2.8%. Stronger collaboration between TMCs, Texas Highway Patrol Dispatch Centers, and First Responders is needed to improve the efficiency of incident response and clearance. This collaboration should address what kind of information can be shared and is it helpful. There is also a need for better communications between first responders and more formalized Joint Operations Policies. For example, sharing of data and video will help first responders better plan for what resources are needed before arriving on the incident scene thereby saving critical minutes. TSMO processes to develop stronger collaboration with first responders are summarized in the table below.

TSMO Processes to Develop Stronger Collaboration with First Repsonders	
TSMO Focus Area	Recommended Processes
1. TIM Assessment Review	Review CMM TIM Team surveys to identify areas needing improvement.
2. Shadow DSP Dispatcher	Place TMC Operator at a Highway Patrol Dispatch Center on an interim basis.
3. Analyze Incident Timeline	Review the incident timeline to identify areas needing improvement.
4. Workshop(s)	Conduct workshop to identify how to respond to incidents more efficiently.
5. Identify Data/Video Needs	Identify First Responder needs to respond to incidents safer and faster.
6. Systems and Technology	Identify systems and technologies to improve communications among First Responders in the field and at TMCs and Highway Patrol Dispatch Centers.
7. SOPs	Review and modify SOPs for TMCs, Highway Patrol Dispatch Centers, and First Responders to reflect more efficient protocols and processes.
8. Training	Train First Responders on new technologies to optimize utilization.
9. Performance Measures	Define and apply KPMs for each of step on the incident timeline.
10. Operational Integration	Improve operational integration between TMCs, Highway Patrol Dispatch Centers, and First Responders via technology and process improvements.

**GOAL ALIGNMENT (Check appropriate areas)**

Safety: Yes                      Mobility: No  
Reliability: Yes                      Asset Uptime: No

**COST (Low, Medium, High)**

Initial: Low                      Recurring: Low

**TXDOT STAFF EFFORT (Low, Medium, High)**

Medium

**STAKEHOLDERS (Yes or No)**

Internal: Yes                      External: Yes

**TIMEFRAME (Near-term, Mid-term, Long-term)**

Mid-term

**RETURN ON INVESTMENT (Low, Medium, High)**

High

**FOCUS AREA:  
COLLABORATION**

**STRATEGY NO. 38  
Develop Rural Incident Management Plans for strategic corridors.**

Rural incident management is an important component of a comprehensive TSMO program. ITS deployments can help with safety/weather alerts, delay notifications, incident response, coordination of resources, infrastructure monitoring, work zone management and safety, weather information dissemination, real-time road condition monitoring, safety warnings for large vehicles, real-time traveler information, animal/vehicle collision avoidance, and other use cases. There is a need to develop Rural Incident Management Plans that depicts predefined alternate routes for strategic corridors and predefined first responder agencies and their role in the incident. This may include deployment of CCTV cameras with cell modem connectivity at busy interchanges in rural areas; road weather ice detection devices at locations of possible freezing pavement; wrong way driver detection systems on rural road connecting to interstate highways; and interagency agreements. TSMO processes to develop rural incident management plans for strategic corridors are summarized in the table below.

TSMO Processes to Develop Rural Incident Management Plans for Strategic Corridors	
TSMO Focus Area	Recommended Processes
1. Establish Rural ITS Vision	Identify challenges (e.g., weather, lack of diversion routes, slow emergency response, alignments, terrain, slow vehicles) and incident response goals.
2. Regional TIM Teams	Develop new, or enhance existing, regional TIM Teams to provide input and consensus on recommendations for Rural Incident Management Plans.
3. Operational Strategies	Apply CMM process in conducting a gap analysis for incident management.
4. Identify Market Packages	Select applicable market packages such as safety, traveler information, infrastructure maintenance, emergency services, freight operations, other.
5. Develop ITS Concepts	Review TSMO Program Plans and ITS Master Plans for applicable concepts.
6. Functional Requirements	Follow the systems engineering process to define functional requirements.
7. Rural ITS Deployment	Prioritize investments in technology based on adopted ITS Master Plans.
8. Performance Measures	Define/apply KPMs to measure incident response/clearance effectiveness.
9. Joint Operating Policies	Formalize policies between TIM stakeholders and neighboring districts.
10. Rural ITS Best Practices	Apply national and state best practices to continually improve the program.

**GOAL ALIGNMENT (Check appropriate areas)**

Safety: Yes                      Mobility: Yes  
Reliability: Yes                Asset Uptime: No

**COST (Low, Medium, High)**

Initial: Medium                Recurring: Low

**TXDOT STAFF EFFORT (Low, Medium, High)**

Medium

**STAKEHOLDERS (Yes or No)**

Internal: Yes                      External: Yes

**TIMEFRAME (Near-term, Mid-term, Long-term)**

Mid-term

**RETURN ON INVESTMENT (Low, Medium, High)**

High

## Appendix B: List of Stakeholders

Agency / Division	Name	Title
<b>Texas Department of Transportation</b>		
Traffic Safety Division	Michael Chacon	Director
Traffic Safety Division	George Villarreal	Assistant Director
Traffic Safety Division	Joe Hunt	TRF – TM Director
Traffic Safety Division	Barbara Russell	TRF - TM
Communications Division	Beth Hallmark	Director
Design Division	Camille Thomason	Director
Maintenance Division	Daniel Stacks	Director
Public Transportation Division	Eric Gleason	Director
Research and Technology Implementation Division	Kevin Pete	Director
Strategic Planning Division	TBD	Director
Transportation Planning and Programming Division	Peter Smith	Director
Freight, Trade and Connectivity Section (TPP Division)	Caroline Mays	Director
Toll Operations Division	Richard Nelson	Director
Information Technology Management	Ann Selissen	Chief Info Officer
Construction Division	Gina Gallegos	Director
Human Resources Division	David McMillan	Director
Houston District	Valarie Taylor	Director, TM Systems
Dallas District	Christopher Bain	Director, Traffic Ops
Fort Worth District	Theresa Poer	Director, Traffic Ops
San Antonio District	Dale Picha	Manager, Traffic Ops
El Paso District	Eduardo Perales	District Traffic Engineer
Odessa District	Kelli Williams	District Traffic Engineer
Amarillo District	Blair Johnson	District TP&D Office
<b>Federal Agencies</b>		
Federal Highway Administration – Texas Division	Al Alonzi	Division Administrator
<b>Regional Mobility Authorities / Toll Authorities</b>		
International Bridge, Tunnel and Turnpike Association	Julia Monso	Director
<b>Transit Authorities</b>		
Texas Transit Association	Meredith Greene	Executive Director
<b>Metropolitan Planning Organizations</b>		
Association Texas Metropolitan Planning Organizations	Chris Evilla	Executive Director
<b>Law Enforcement / Emergency Response</b>		
Texas Department of Public Safety	Chris Nordloh	Major

Texas Division of Emergency Management	W. Nim Kidd	Chief
USDOT - PHMSA Hazardous Materials Safety, SW Region	Matt Ripley	Director
<b>Private Industry</b>		
Texas Trucking Association	Gregory Price	Chairman
<b>Traffic Generators</b>		
Texas A&M University Athletics	Kevin Hurley	Senior Associate
University of Texas Athletics	Brian Womack	Assistant Director



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