Transportation Systems Management and Operations

Pharr District Program Plan

CSJ: 0915-00-187

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ACRONYMS AND ABBREVIATIONS

ARC-IT	Architecture Reference for Cooperative and Intelligent Transportation
ATMS	Advanced Traffic Management System
ATSPM	Automated Traffic Signal Performance Measures
B/C Ratios	Benefit-to-Cost Ratios
CAV	Connected and Automated Vehicle
CCTV	Closed-Circuit Television
CMF	Capability Maturity Framework
CMM	Capability Maturity Model
Con-Ops	Concept of Operations
CRIS	Crash Records Information System
DCC	Design Concept Conference
DE	District Engineer
DMS	Dynamic Message Sign
DOTs	Departments of Transportation
DSRT	District Safety Review Team
FHWA	Federal Highway Administration
FTA	Federal Transit Administration
ITS	Intelligent Transportation Systems
PDO	Property Damage Only
PDP	Project Development Process
PHR	Pharr District
PS&E	Plans, Specifications, & Estimates
PTI	Planning Time Index
RGVMPO	Rio Grande Valley Metropolitan Planning Organization
SEA	Systems Engineering Analysis
SHRP2	Second Strategic Highway Research Program
SWZ	Smart Work Zone
TAC	Technical Advisory Committee
TIM	Traffic Incident Management
TM	Traffic Management
TMC	Traffic Management Center
TMS	Traffic Management Systems
TP&D	Transportation Planning & Development
TRF	Traffic Safety Division
TSM	Traffic Signal Management
TSMO	Transportation Systems Management and Operations
TTI	Texas Transportation Institute
TxDOT	Texas Department of Transportation

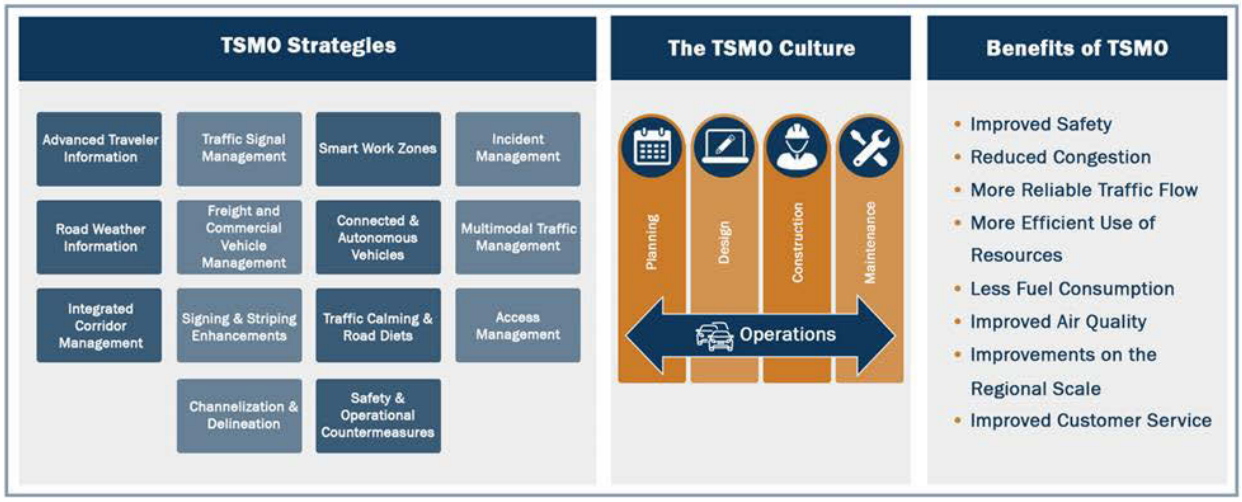
UTP	Unified Transportation Program
WZ	Work Zone
WZM	Work Zone Management

EXECUTIVE SUMMARY

What is TSMO?

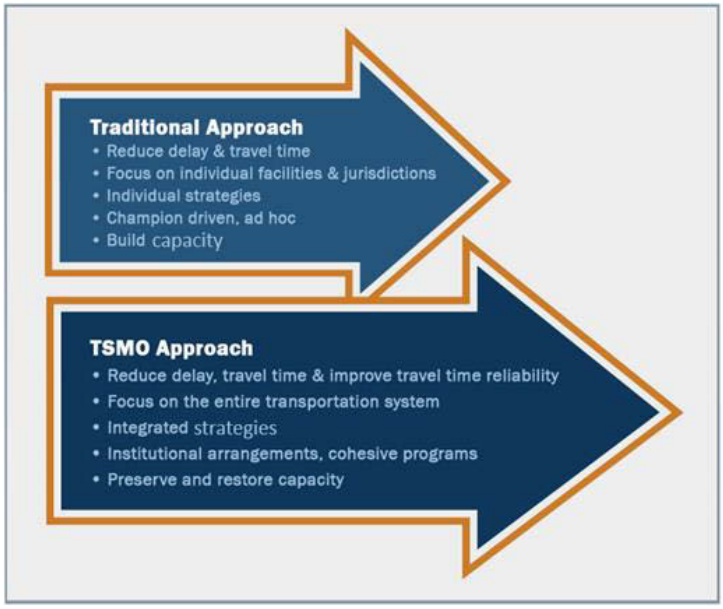
Transportation Systems Management and Operations, also known as TSMO, is a set of strategies that focus on operational improvements that can maintain and even restore the performance of the existing transportation system before additional capacity is needed. The goal of TSMO is to get the most performance out of the existing transportation system, allowing departments of transportation to stretch their funding to benefit more areas and customers.

Successful TSMO programs have adopted TSMO as a core function of the transportation agency and developed institutional arrangements and processes that promote inclusion of TSMO strategies throughout the project lifecycle of planning, design, construction, and maintenance.



The TSMO Difference

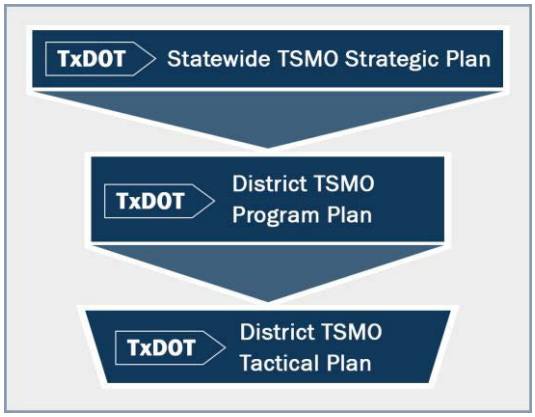
Texas Department of Transportation (TxDOT) Pharr District (PHR; District) implements several of the above-listed TSMO solutions. However, TSMO is more than implementations of isolated, champion-driven Intelligent Transportation Systems (ITS) solutions. TSMO involves a mindset change to determine the best way to optimize the safety, mobility, and reliability of the existing transportation system with limited resources. This graphic highlights the



paradigm shift that will sustain and grow TSMO within TxDOT-PHR.

TxDOT TSMO Planning Initiative

To begin the statewide TSMO initiative, TxDOT's Traffic Safety Division (TRF) developed a three-stage approach to TSMO adoption across the state. As part of the first stage, TRF rolled out the Statewide TSMO Strategic Plan in 2017. As part of the second stage, all TxDOT districts, including TxDOT-PHR, are developing TSMO program plans. Subsequently, the districts will develop TSMO tactical plans, as necessary, to address specific operational needs within each district.



In June 2022, TxDOT Executive Director Marc Williams issued a policy highlighting the importance of Traffic Management Systems (TMS) as cost-effective and efficient means to address safety, mobility, connectivity, maintenance, and emergency response across the state. Excerpts from the policy are provided below.

"…it is imperative that Traffic Management Systems (TMS) and operational improvements complement construction and maintenance program efforts. This includes ensuring that TMS is considered throughout the project lifecycle from inception through construction…"

Marc Williams, June 29, 2022

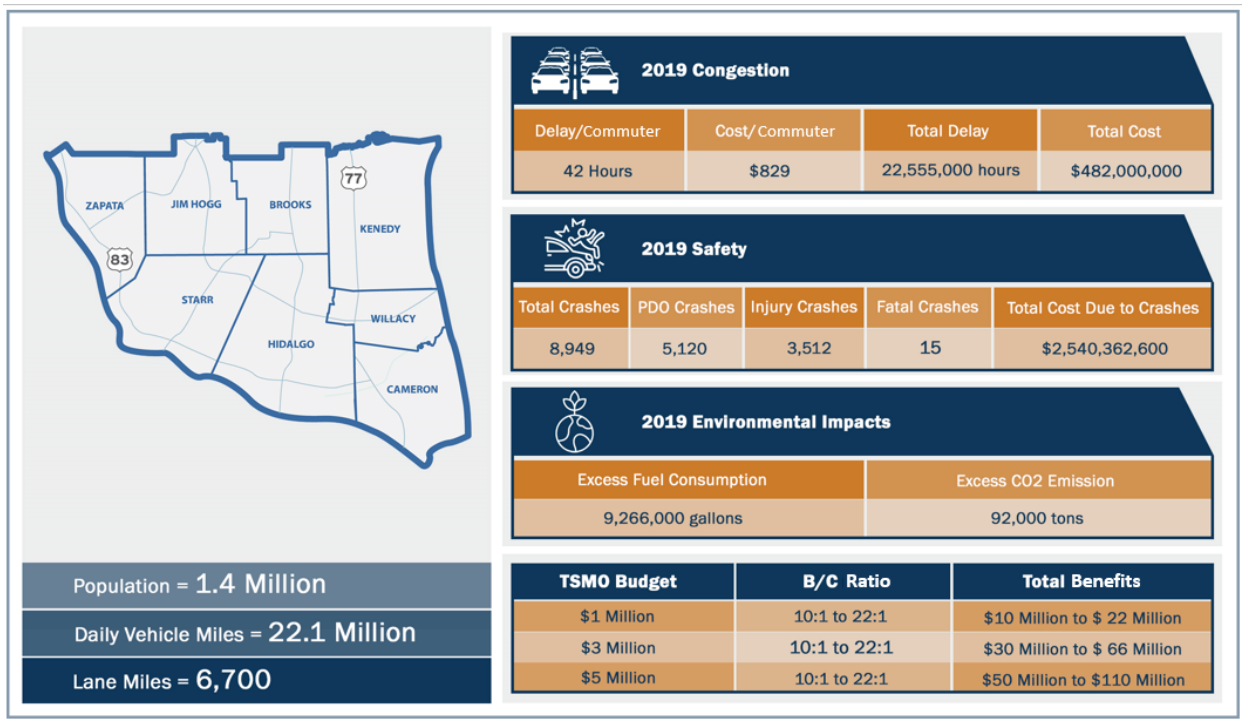
"Each district will be expected to (1) ensure TMS is included in each project's planning, development, design, construction, maintenance and operation, and (2) provide specific TMS projects where gaps exist between typical road and bridge projects."

Marc Williams, June 29, 2022

The TSMO planning documents, as well as the TMS policy, will guide TxDOT districts in TSMO adoption and mainstreaming across district projects and programs.

Business Case For TSMO

Studies around the country have shown that TSMO deployments provide benefit-to-cost ratios (B/C Ratios) between 10:1 to 22:1. The business case summary presented here illustrates the impacts and costs associated with congestion, safety, and environment within the Rio Grande Valley region and highlights the potential benefits from TSMO deployments. The graphic on the following page highlights how hypothetical TSMO investments of $1 million to $5 million would result in benefits to congestion and safety of $10 million to $110 million.



TSMO Implementation

The process illustrated below was utilized to develop the TSMO program-level and operational-area-level (program-area-level) actions. The four program areas selected by the District for development of TSMO actions included traffic signal management, traffic incident management (TIM), traffic management, and work zone management (WZM). The process, beginning with the District Engineer's (DE's) endorsement, included extensive engagement with the district leadership, partner agencies, and project steering committee to obtain input on existing TSMO practices, complete Capability Maturity Model (CMM) and Capability Maturity Framework (CMF) assessments, develop District-specific TSMO goals and objectives, and cocreate the TSMO actions included in this Program Plan.

The key program-level and program-area-level actions are summarized below.

Action	Lead	Support
Program Level Actions		
<u>Consider proven TSMO/ITS strategies during planning:</u> - Consider including ITS/TSMO as part of access management studies. - Include ITS/TSMO during schematic development to provide better estimates of construction costs. - Develop checklists/a toolbox to include ITS/TSMO strategies.	Transportation Planning & Development (TP&D)	Operations
<u>Include TSMO activities as part of existing meetings/processes instead of adding to the number of meetings/processes.</u> - Discuss topics such as ITS needs, WZ analysis, smart WZ needs and technologies, safety and operational performance measures and traffic control funding during DSRT (Construction), Design Review and DCC (TP&D) meetings.	Construction	TP&D
<u>TSMO planning and programming:</u> - Identify priorities and estimated costs for TSMO projects that can be added to the UTP over the next 10 years. - Identify ways to incorporate stand-alone TSMO projects within the District's annual budget. - Include the discussion of ITS Master Plan projects during project planning and programming.	TP&D	Operations
<u>Track complaints/issues from initial documentation to resolution:</u> - Institutionalize the use of TxDOT ticketing system (TxDOTNow) for tracking issues, discussions, resolutions, and turnaround time.	Maintenance	Operations, TP&D
Identify ways to embed TSMO in the District's culture, e.g., discuss TSMO lessons learned during the Directors' meetings, involve all District staff in TSMO activities, recognize staff for bringing TSMO ideas to projects, and establish TSMO roles and responsibilities.	Deputy DE	All Sections
<u>Collect and analyze mobility (from probe data) and safety data such as speeds, travel times and crashes to develop mobility and safety-based performance measures. Display performance measures on a shareable dashboard:</u> - Identify bottlenecks/hotspots and develop and prioritize projects. - Utilize performance measures to enhance operations during construction by better planning for traffic control and detours.	TP&D	Operations
Establish through the Rio Grande Valley Metropolitan Planning Organization's (RGVMPO's) Technical Advisory Committee a TSMO sub-committee that meets quarterly to discuss district-wide TSMO efforts, partnership opportunities, and lessons learned.	TP&D	RGVMPO
Emphasize need for TSMO focus, similar to Safety, within the existing organization structure. Example: TSMO function similar to Safety under Asst. DE; TSMO Liaisons within each section.	Deputy DE	All Sections

Action	Lead	Support
Program Level Actions		
Formalize the process of collaboration with partner agencies including the RGVMPO.	TP&D/ Operations	RGVMPO, Cities of Brownsville, Edinburg, Harlingen, McAllen, Mission, and Pharr
Formalize and improve collaboration between the TP&D, Operations, Maintenance, Construction, and Area Offices. E.g., Discuss funding allocation, project selection and prioritization, and design review comments.	TP&D	All Sections

Action	Lead	Support
Traffic Signal Management Actions		
Provide communications to 100 percent signals and include communication as part of every new signal design and construction.	Operations	TRF
Expand traffic signal central system license to provide connectivity to 100 percent of District signals.	Operations	Operations
Utilize crowdsourced data (e.g., INRIX) to identify corridors to retime and to compare performance measures before/after signal timing studies.	Operations	TP&D
Develop ATSPM/probe data-based reporting for regionally significant corridors, and track performance measures monthly for continuous improvement of signal operations and maintenance.	Operations	Operations
Identify ways to communicate benefits, outcomes, and needs to various internal and external stakeholders, including policy makers, the media, and others. - Share benefits from signal timing at Directors' and supervisors' meetings. - Leverage social media to share information.	Operations	Operations
Assess required staffing levels based on data-driven needs of signal management as well as TxDOT's goals and objectives.	Operations	Operations

Action	Lead	Support
Identify training needs of existing staff based on new technology and training needs for new employees.	Operations	Operations
Share traffic-signal-related data upon request from partner agencies.	Operations	Partner Agencies
Traffic Incident Management Actions		
Consider addressing TIM impacts prior to the final design/construction of significant roadway projects.	Operations	TP&D, Construction
Evaluate the use of video analytics and probe data to automatically detect incidents and alert operations staff.	Operations	TRF
Evaluate the need for staffing and technology to support TIM while developing the District's TMC.	Operations	TRF
Share lessons learned, benefits, and outcomes from traffic incident response with stakeholders and TxDOT leadership.	Operations	TIM Stakeholders
Establish recurring, consistent, and evolving TIM training for all stakeholders. - To train new staff and develop redundancy in existing staff. - For multidisciplinary TIM program participants to understand the incident command structure, role of involved agencies, and applicable standards (e.g., Texas Manual on Uniform Traffic Control Devices). - To improve TIM practices based on lessons learned.	Operations	TIM Stakeholders
Collaborate with all TIM partners to develop data-sharing policies, including access to CCTV cameras.	Operations	TIM Stakeholders
Traffic Management Actions		
Evaluate whether ITS Master Plan projects can be incorporated within project planning activities initiated by TP&D.	Operations	TP&D
Develop a data-driven, needs-based operations and maintenance budgeting process to maintain or replace TSMO (ITS/signals) assets. The process will utilize TSMO asset inventory, asset cost, information on completed/needed maintenance, and assigned asset level of service to determine the operations and maintenance budget.	Operations	Operations
Evaluate the need for a performance-driven preventative maintenance and inspection program that would complement the statewide ITS/signals network monitoring contract and the multi-district preventative and response to facilitate needs-based maintenance.	Operations	TRF
Develop TxDOT TMC Concept of Operations to develop the operational scenarios, system requirements, and stakeholder needs.	Operations	TIM Stakeholders

Action	Lead	Support
Explore the use of technology to address issues determined in the District Safety Plan.	Operations	Operations
Evaluate continuously analysis of mobility and safety data to develop mobility- and safety-based performance (e.g., incident, roadway clearance times, average speed, travel-time index). Display performance measures on a TMC dashboard. - Identify areas to focus traffic management activities on (e.g., traveler information, signal timing adjustments, incident response). - Utilize performance measures to plan for and enhance operations (e.g., work zones, special events, weather events, holidays).	Operations	Operations
Continuously track asset performance (e.g., percentage uptime, asset reliability, asset age vs. service life, work-order tracking) against goals.	Operations	Operations
Document and share lessons learned from TSMO projects district-wide and throughout the region.	Operations	Partner Agencies
Evaluate training and development of existing staff and new staff to continue to leverage data and technology in traffic management activities.	Operations	Operations
Identify ways to collaborate with partner agencies from the inception of a project. - Include the discussion of TSMO during MPO TAC meetings.	Operations	Partner Agencies
Work Zone Management Actions		
For significant projects, evaluate the use of planning-level traffic analysis (e.g., FREEVAL, QuickZone, VISSIM, DynusT) and predictive safety analysis tools to configure WZs (duration, extent, and number of WZ-taken lanes).	TP&D	Construction
For significant projects, evaluate the need for and type of WZ ITS based on the TxDOT SWZ Guidelines and Go/No-Go Decision Tool (LINK).	Operations	Construction
Develop a process to coordinate lane closures among multiple projects and agencies to achieve work zone management objectives.	Operations	Construction
For significant projects, evaluate integration of incident management through work zones	Operations	Operations
Pilot test SWZ technologies to identify use cases and mainstream SWZ deployments.	Operations	Construction

Action	Lead	Support
Define safety- and mobility-based goals and performance measures to inform continuous improvements within WZs.	TP&D	Operations
On significant projects, collect real-time and historical performance measures on travel speed, travel time, traffic volumes, queue lengths, and crashes: - Utilize performance measures to monitor WZ performance and to develop safety and mobility countermeasures. - Utilize performance measures from multiple projects to continually evaluate and improve WZ policies and procedures. - Utilize historical WZ performance measures and planning-level analyses to develop WZM funding needs for upcoming projects.	TP&D	Operations
Discuss Work Zone safety and lessons learned in Supervisors' and Construction meetings.	Construction	Operations
Identify ways to enhance collaboration with law enforcement during WZ activities (e.g., use of CAD data, WZ enforcement, incident response).	Operations	Construction
Collaborate with partner agencies on coordination of construction projects and sharing data that may help address construction impacts.	Operations	Construction
Identify ways to enhance collaboration with the private sector and stakeholders during WZ activities: - Collaborate with fleet operators to provide information on road closures. - Provide regular construction updates via social media platforms/project websites.	Operations	Construction

1 INTRODUCTION

Historically, state and local departments of transportation (DOTs) were created to deliver infrastructure capacity for the movement of people and goods. As a result, DOTs have traditionally focused their efforts and resources on the planning, design, construction, and maintenance of capital projects. This focus on delivery of capital projects has generally resulted in limited resources for the management and operations of transportation systems. Further, with capacity building lagging traffic growth in most urban areas and available funding lagging DOT funding needs, DOTs are often required to do more with less. To overcome these challenges, many DOTs are starting to embrace Transportation Systems Management and Operations (TSMO), a strategic approach that provides near-term and cost-effective solutions to improve mobility and safety while addressing customer needs.

1.1 What is TSMO?

In simple terms, TSMO is a set of strategies that focus on operational improvements that can maintain and even restore the performance of the existing transportation system before additional capacity is needed. The goal of TSMO is to get the most performance out of our existing transportation system, allowing DOTs to stretch their funding to benefit more areas and customers.

Successful TSMO programs have adopted TSMO as a core function of the transportation agency and developed institutional arrangements and processes that promote inclusion of TSMO strategies throughout the project lifecycle of planning, design, construction, and maintenance. Figure 1 summarizes the concept of TSMO.

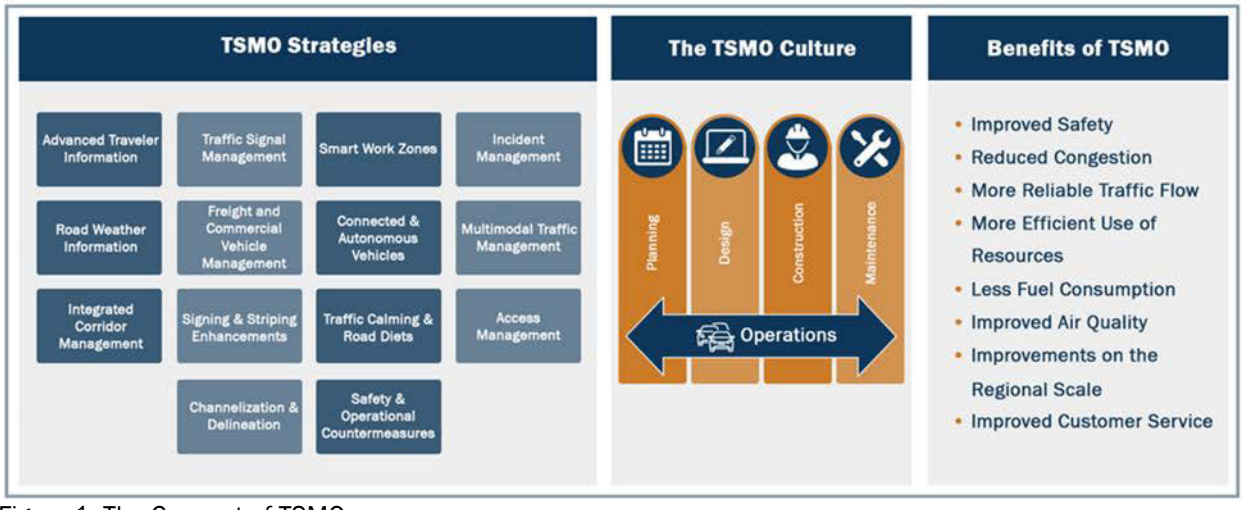


Figure 1: The Concept of TSMO

1.2 Aren't We Already Doing TSMO?

Texas Department of Transportation (TxDOT) Pharr District (PHR; District) implements several of the TSMO solutions listed on Figure 1. However, TSMO is more than the implementations of isolated, champion-driven

Intelligent Transportation Systems (ITS) solutions. TSMO involves a mindset change to determine the best way to optimize the safety, mobility, and reliability of the existing transportation system with limited resources.

Figure 2 highlights the paradigm shift that will sustain and grow TSMO within TxDOT-PHR.

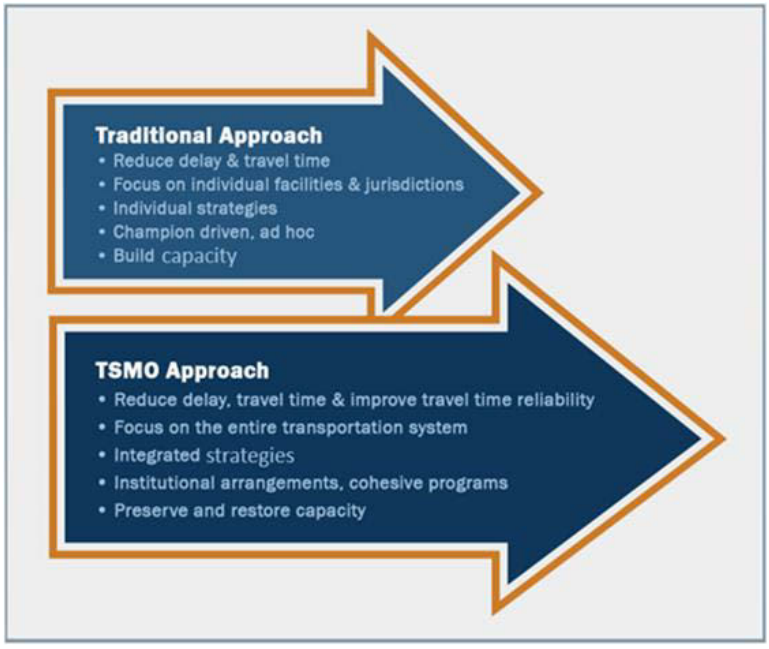


Figure 2: The TSMO Difference

1.3 Need for TSMO Planning

Research conducted as part of the Federal Highway Administration's (FHWA's) Second Strategic Highway Research Program (SHRP2) found that in most agencies, TSMO planning and budgeting have been largely limited to specific projects or initiatives and initiatives have been limited based on availability of funding and a champion to drive those initiatives. The research determined that agencies with the most effective TSMO activities were differentiated not by budgets or technical skills alone but by the existence of critical processes and institutional arrangements focused on TSMO applications. The research identified development of a TSMO Program Plan as a key action to guide organizations in advancing the institutional focus on TSMO.

1.3.1 TxDOT Division TSMO Initiative

To begin the statewide TSMO initiative, TxDOT's TRF developed a three-stage approach (Figure 3) to TSMO adoption across the state. As part of the first stage, TRF rolled out the Statewide TSMO Strategic Plan in 2017.

The strategic plan provided the framework and guidelines to mainstream TSMO throughout the state and recommended that each district develop a TSMO program focused on their unique needs. As part of the second stage, the Austin District in 2018 formalized its TSMO program by developing a TSMO Program Plan. In 2019 and 2020, the remaining TxDOT districts began developing their own TSMO program plans. As part of the third stage, the districts may develop tactical plans with specific operational focus, such as plans for work zone management (WZM), traffic incident management (TIM), traffic signal management (TSM), regional traffic management (TM), or ITS implementation.

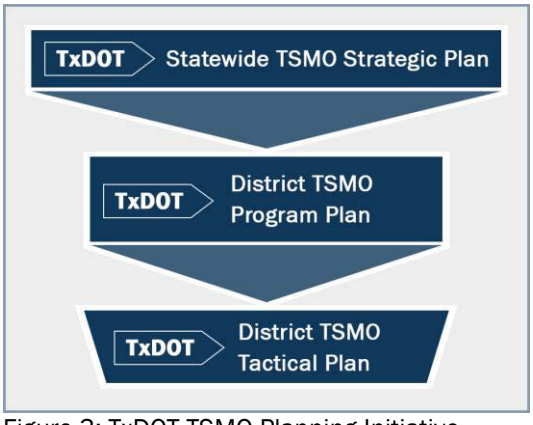


Figure 3: TxDOT TSMO Planning Initiative

In June 2022, TxDOT Executive Director Marc Williams issued a policy highlighting the importance of Traffic Management Systems (TMS) as cost-effective and efficient means to address safety, mobility, connectivity, maintenance, and emergency response across the state. Excerpts from the policy are provided below.

> *"…it is imperative that Traffic Management Systems (TMS) and operational improvements complement construction and maintenance program efforts. This includes ensuring that TMS is considered throughout the project lifecycle from inception through construction…"*
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> Marc Williams, June 29, 2022

> *"Each district will be expected to (1) ensure TMS is included in each project's planning, development, design, construction, maintenance and operation, and (2) provide specific TMS projects where gaps exist between typical road and bridge projects."*
>
> Marc Williams, June 29, 2022

The TSMO planning documents as well as the TMS policy will guide the TxDOT Districts in TSMO adoption and mainstreaming across the District projects and programs.

1.3.2 TxDOT-PHR TSMO Initiative

In alignment with the statewide TSMO initiative, TxDOT-PHR began developing the District TSMO Program Plan in September 2020. Program Plan development began with an endorsement from the District Engineer (DE), paving the way to formalize the District's TSMO program. Subsequently, the leadership and key leads within TxDOT and partner agencies were engaged to seek input on regional operational challenges, capabilities, and ideas for improvements. Leadership engagement within TxDOT focused on gathering input from the DE and Deputy DE, the Directors and leads representing Transportation Operations, Maintenance, Transportation Planning & Development (TP&D), Construction, and Area Engineers. Partner agency engagement focused on gathering input from leadership within the Cities of Brownsville, Edinburg, Harlingen, McAllen, Mission, Pharr, and the Rio Grande Valley Metropolitan Planning Organization (RGVMPO). A TxDOT steering committee was also established to seek technical input and buy-in at various stages of the project. Appendix A provides a list of TxDOT and partner agency members that participated during the various engagement efforts. The same TxDOT and partner agency members were also engaged to conduct the Capability Maturity Model (CMM) and Capability Maturity Framework (CMF) self-assessments for the District. The input received during the leadership engagement and self-assessment stages was combined to develop draft TSMO actions to be included in the District TSMO Program Plan. This District TSMO Program Plan summarizes the District-specific TSMO goals and objectives, institutional arrangements, responsibilities, processes, and implementable action items that were developed collaboratively with the District and partner agency groups. Figure 4 summarizes the process that was utilized to develop the TxDOT-PHR TSMO Program Plan.

Figure 4: TxDOT-PHR TSMO Planning Process

1.3.3 Program Plan Format

The Program Plan document format follows a process similar to the one utilized to develop TSMO actions for the District and is as follows:

- Introduction: Introduces the concept of TSMO and discusses the need for TSMO planning.
- Business Case for TMSO: Establishes a data-driven business case to support sustained investment in TSMO strategies.
- TSMO Vision, Mission, Goals, & Objectives: Shares the TSMO vision and mission developed as part of the Statewide TSMO Strategic Plan and the District-specific TSMO goals and objectives developed in collaboration with District leadership.
- CMM and CMF: Discusses the six dimensions of CMM, how TxDOT and partner agencies assessed their capability across each dimension, and opportunities to improve within each dimension. Discussion also includes a summary of CMF assessment across four program areas: TIM, WZM, TSM, and TM.
- Five-Year TSMO Implementation Plan: Summarizes TSMO actions developed based on input from District leadership, an understanding of the District's TSMO state of practice, and a review of CMM and CMF self-assessments and provides an implementation time frame.
- TSMO Tactical Plan Assessment: Evaluates the need for tactical plans, with specific operational focus such as plans for WZM, TIM, TSM, regional TM, and ITS implementation.

2 BUSINESS CASE FOR TSMO

Figure 5 summarizes the business case for TSMO within TxDOT-PHR. The figure provides impacts and costs associated with congestion, safety, and environment within the Rio Grande Valley region and highlights potential benefits from TSMO deployments. Studies around the country have shown that TSMO deployments provide benefit-to-cost ratios (B/C Ratios) between 10:1 to 22:1. The figure highlights how hypothetical TSMO investments of $1 million to $5 million would result in benefits to congestion and safety of $10 million to $110 million. A more detailed discussion on the TSMO business case is provided in the paragraphs that follow.

Figure 5: TxDOT-PHR TSMO Business Case Summary*

* Data sources: TxDOT District Profile, TTI Urban Mobility Report, and TxDOT CRIS

2.1 Funding

2.1.1 Challenge

Texas population grew by 16 percent between 2010 and 2020 and is projected to grow by 60 percent between 2020 and 2050. While the state's population continues to grow rapidly, the available transportation system capacity continues to decrease. Additionally, many of the state's congested corridors are fully built out, and the funding necessary to expand the system capacity continues to be constrained. The left side of Figure 6 shows the funding deficit at the statewide level based on Texas Transportation Plan 2040. The right side of Figure 6 shows the funding deficit at district level based on TxDOT's 2023 Unified Transportation Program (UTP). It should be noted that the funding gap at the district level could be larger outside of the constrained UTP.

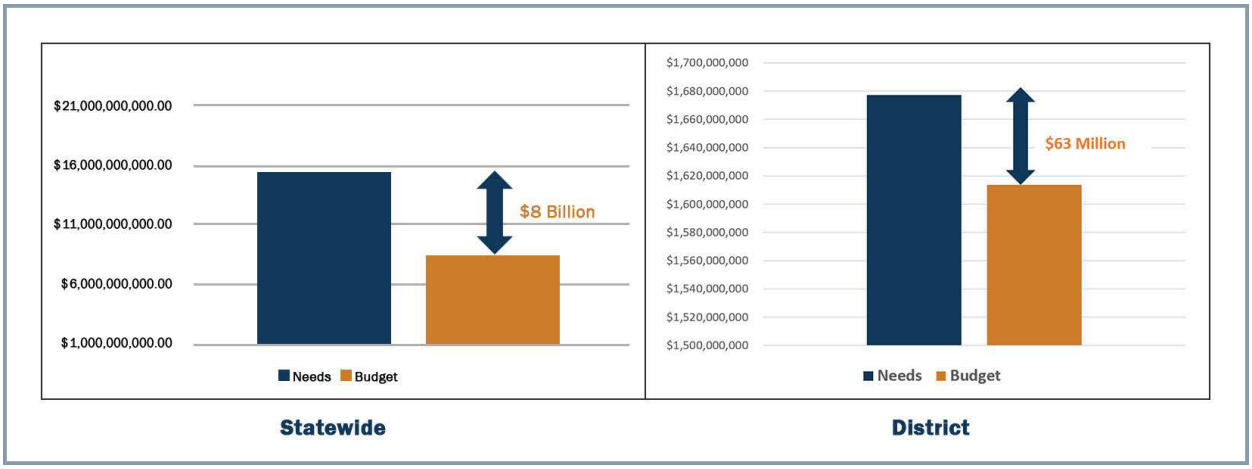

Figure 6: TxDOT Statewide and District-Level Funding Needs vs. Budget

2.1.2 How TSMO Can Help

To address the growing capacity and funding constraints, TRF recommends transitioning a portion of funding and resources from the more expensive, long-range capacity expansion projects to cheaper, near-term TSMO deployments that focus on the management and operation of the existing transportation system. This new TSMO approach also leverages resources among regional partner agencies and the private sector to improve regional mobility at a higher Benefit-to-Cost ratio compared to capacity improvement projects.

Placing importance on TSMO strategies in long-range planning, project development, and system operations and maintenance creates a strong basis for devoting funding to these strategies. Applying a TSMO approach in the early stages of project development can help establish procedures that lead to efficient and cost-effective implementation of TSMO strategies. TSMO program planning helps develop institutional arrangements to reserve funds for system management during construction, asset management techniques, upgrades to existing ITS and signal infrastructure, workforce development, and other operational strategies.

2.2 Congestion

2.2.1 Challenge

According to TxDOT's performance dashboard, an average driver experienced more than 31 hours of delay while traveling on Texas roadways in 2019. In the same year, an average urban driver in Texas had to account for 51 percent more travel time to be 95 percent confident in reaching their destination on time.

Figure 7 summarizes the congestion statistics for the Rio Grande Valley region based on the Texas Transportation Institute's (TTI's) Urban Mobility Report. Per the report, an average driver traveling in the region experienced more than 42 hours of delay in 2019. In the delay distribution table for the entire week as shown in figure 7, magnitude of delay is indicated by color and color intensity from dark blue representing least amount of delays to dark orange representing highest amount of delays. The region also recorded a Planning

Time Index (PTI) of 1.29, indicating that an average driver had to account for 29 percent more travel time during peak periods to reach their destination on time. The monetary cost of congestion was almost $829 per commuter and $482 million overall. Of the overall delay, 64 percent occurred on freeways and 36 percent on arterials.

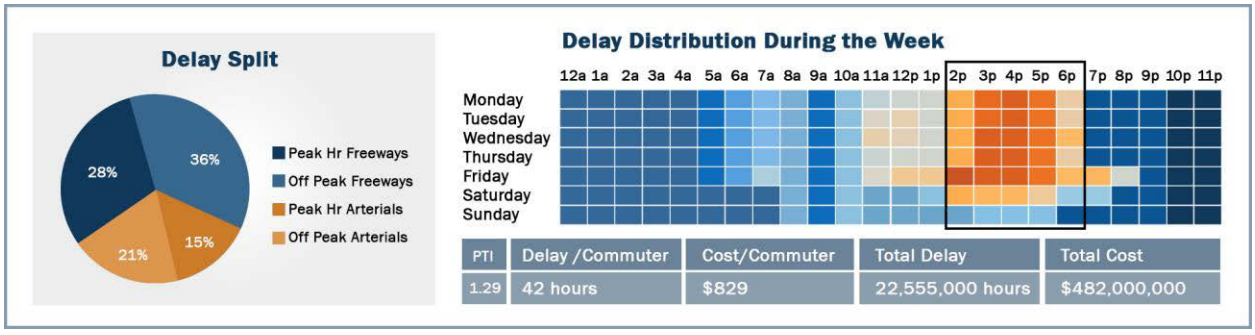

Figure 7: TxDOT-PHR 2019 Congestion Statistics *

* Data source: TTI's Urban Mobility Report

2.2.2 How TSMO Can Help

As seen in the delay split pie chart above (Figure 7), 36 percent of the regional delay occurred during off-peak conditions on freeways and 21 percent of the regional delay occurred during off-peak conditions on arterials. This indicates that the capacity improvement projects, which mainly address peak-period congestion, do not specifically target approximately 57 percent of the delay occurring in the Rio Grande Valley region. As seen on Figure 8, FHWA estimates that approximately 40 percent of national congestion is attributable to recurring congestion (bottlenecks), while 60 percent is attributable to non-recurring congestion (e.g., traffic incidents, work zones [WZs], special events). TSMO provides robust and near-term strategies such as TIM, WZM, TSM, active TM, and road weather management to address the recurring and non-recurring congestion at a fraction of the cost of capacity expansion projects.

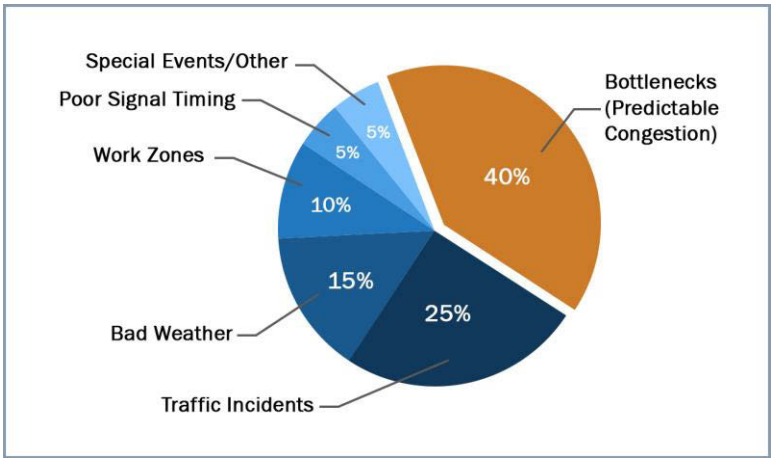

Figure 8: National Causes of Congestion by FHWA

Oftentimes existing practices can be reoriented to a TSMO perspective in order to continuously mitigate the effects of congestion. The Delaware Valley Regional Planning Commission in Pennsylvania has developed a Congestion Management Process similar to the one being developed by the RGVMPO and has, over time,

begun to integrate it more and more into their transportation planning process. This includes tracking the progress of long-range goals using performance indicators and using this information to prioritize projects in different areas of the region. Planned future enhancements to its process include increased focus on systems management and operations to better measure reliability and strengthening its use of performance measures.

2.3 Safety

2.3.1 Challenge

According to TxDOT's performance dashboard, there were 3,622 fatalities and 15,851 serious injuries on Texas roadways in 2019. According to TxDOT's Crash Records Information System (CRIS), the Rio Grande Valley region experienced over 16 traffic-related fatalities, 3,512 injury crashes, and 5,120 property-damage-only (PDO) crashes in 2019 (Figure 9). Of the fatal and injury crashes, almost 969 crashes occurred at intersections and 196 occurred within WZs. Of the overall crashes, 33 percent occurred on freeways and 67 percent on arterials. The total cost of crashes was more than $2.5 billion.

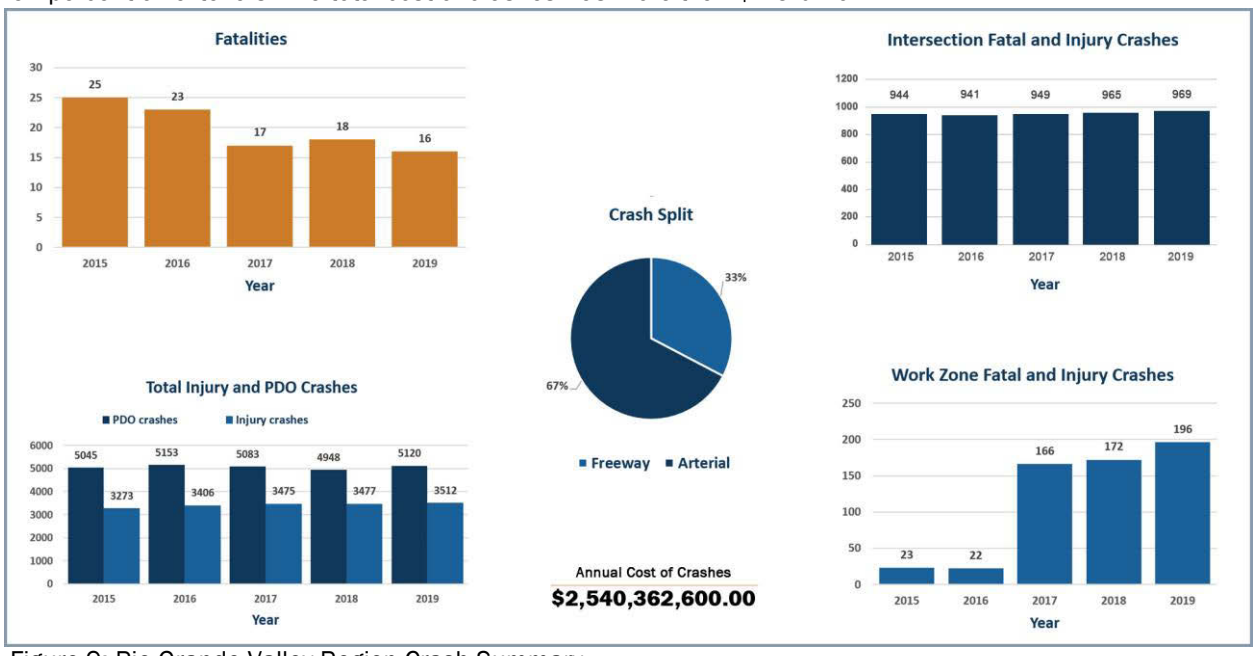

Figure 9: Rio Grande Valley Region Crash Summary

2.3.2 How TSMO Can Help

Integrating TSMO principles throughout the project development process (PDP) ensures a collaborative and data-driven approach, consideration of cost-effective and multimodal alternatives (e.g., conflict reduction, innovative intersections, ITS, multimodal facilities), evaluation of network-wide opportunities, and inclusion of operational elements during and after construction. This holistic approach to project development ensures that solutions to improve safety are evaluated and implemented throughout the project lifecycle and across the transportation network. TSMO strategies aimed at reducing non-recurring congestion and improving traveler

information can improve driver expectancy and improve driver awareness of hazardous conditions. Finally, TSMO strategies can help protect those who spend time working in the roadway, including TxDOT employees and contractors, public safety officers, and emergency responders.

2.4 Mainstreaming TSMO

FHWA research has shown that agencies with the most effective TSMO activities are differentiated not by budgets or technical skills alone but by the existence of critical processes and institutional arrangements focused on TSMO applications. Therefore, mainstreaming TSMO through the modification of existing business and technical processes is an important step toward building a sustainable TSMO program within the District.

TxDOT-PHR currently implements numerous processes, projects, and programs with a TSMO flavor, including Traveler Information, WZM, TSM, 4-year safety planning, and 4-year-maintenance planning. However, sometimes in the past, TSMO strategies were taken out of new projects due to funding constraints or due to being considered too late during project development. Also, sometimes TSMO strategies are not considered as standalone projects due to lack of understanding of TSMO strategies and their benefits. Such projects miss out on the safety and mobility benefits provided by TSMO.

Mainstreaming TSMO through integration within the PDP (Figure 10), creation of institutional arrangements, and documentation of critical processes will ensure that TSMO is fully adopted within the District. Taking full advantage of TSMO will require the following:

Figure 10: Integrating TSMO within PDP

1. A commitment from the DE and Deputy DE to integrate the TSMO mission and vision within the District's project development and business processes.
2. A commitment from District leadership (DE, Deputy DE, and Directors) to embrace a TSMO mindset, where processes are formalized and programs and projects are developed in a data-driven, collaborative, and cost-effective manner.
3. A performance-based approach to budgeting, project selection, assessing project/program performance, and tracking and enhancing system performance.
4. Consistent funding, staffing, and training to sustain the TSMO program.
5. Utilization of a systems engineering process during the TMS project planning and deployment.
6. Leveraging existing touchpoints with partner agencies to collaborate on regionally significant TSMO implementation opportunities.

The institutional commitment to TSMO—including reorganization, staffing, and changes in processes to accommodate TSMO—is outside the control of the staff who manage TSMO functions. Implementing these changes will require the DE and Deputy DE's support and authorization. There will need to be high-level

direction to all staff that the changes needed to deploy and implement TSMO strategies are necessary and that these strategies should apply across all sections of the District.

3 TSMO VISION, MISSION, GOALS, AND OBJECTIVES

The Pharr District has adopted the statewide TSMO vision, mission, and goals and has developed specific objectives to address District-specific mobility and safety challenges.

3.1 Statewide TSMO Vision

The statewide TSMO vision is as follows: Improve safety and mobility for all modes of transportation by integrating planning, design, operations, construction, and maintenance activities and acknowledging all opportunities for innovation.

3.2 Statewide TSMO Mission

The statewide TSMO mission is as follows: Through innovation, collaboration, and performance-based decision-making, transportation facilities are developed, constructed, maintained, and operated cost-effectively with the end user in mind.

3.3 District-Specific TSMO Goals and Objectives

TxDOT-PHR has adopted each of the six statewide TSMO goals of safety, reliability, efficiency, customer service, collaboration, and integration and included technology and innovation as an additional goal specific to the District. For each of these goals, the District has developed objectives in order to monitor the District's progress toward implementing the TSMO Program Plan. Measurable objectives have been set where baseline data are available to track performance. Non-measurable objectives for which baseline data are not available should be revisited with future Program Plan updates once the District has established more performance metrics. TxDOT-PHR TSMO goals and objectives are listed in Table 1.

Table 1: TxDOT-PHR TSMO Goals & Objectives

Goal	TxDOT Statewide TSMO Objectives	TxDOT PHR TSMO Objectives
Safety 	• Reduce crashes and fatalities through continuous improvement of TMS and procedures.	• Continually develop and track safety performance measures for the transportation system. • Utilize safety performance measures to document benefits of TSMO deployments and prioritize projects. • Periodically review safety data to develop systemwide safety improvements and package the improvements for implementation. • Reduce WZ-related crashes. • Accurately track and reduce secondary crashes.

Goal	TxDOT Statewide TSMO Objectives	TxDOT PHR TSMO Objectives
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.	• Continually measure travel times for on-system roadways and develop travel-time-reliability-related performance measures (travel-time index, planning-time index). • Improve travel-time reliability for on-system roadways by deploying TSMO strategies. • Reduce delay caused by WZs. • Reduce incident clearance times for on-system roadways. • Maintain above 90 percent TMS asset operational uptime.
Efficiency 	• Implement projects that optimize existing transportation system capacity and vehicular throughput.	• Periodically review operational data to develop systemwide operational improvements and package the improvements for implementation. • Continually review traffic signal performance for operations and maintenance deficiencies, and proactively address the deficiencies for improved customer service. • Consider the use of systems and technology-based solutions over capacity building to improve system performance. • Consider all modes of transportation in the PDP.
Customer Service 	• Provide timely and accurate travel information to customers so they can make informed mobility decisions.	• Deliver traveler information related to incident detection and recovery to the public more efficiently and through multiple media. • Deliver traveler information related to closures/alternate routes to the public through multiple media. • Identify opportunities for third-party partnerships to enhance traveler information services. • Accommodate needs of all road users, including pedestrians, bicyclists, transit, and commercial vehicles.
Collaboration 	• Proactively manage and operate an integrated transportation system through multi-jurisdictional coordination, internal collaboration, and cooperation between various transportation disciplines and partner agencies.	• Develop a regional TSMO committee to facilitate quarterly collaboration on TSMO initiatives. • Discuss TxDOT TSMO initiatives and collaboration opportunities during District Director's meetings. • Promote data sharing across TxDOT sections and TSMO stakeholders.
Integration 	• Prioritize TSMO as a core objective in the agency's planning, design, construction, operations, and maintenance activities.	• Integrate TSMO within existing District policies, plans, and procedures. • Discuss TSMO opportunities during Design Concept Conference, Design Review, and District Traffic Safety Review Team meetings. • Leverage regional stakeholder partnerships, including with the RGVMPO, to identify funding opportunities for TSMO. • Deploy TMS assets as part of new construction projects. • Achieve 100 percent monitoring capabilities for all existing and proposed TMS deployments. • Conduct joint TSMO training exercises in the region.

Goal	TxDOT Statewide TSMO Objectives	TxDOT PHR TSMO Objectives
Technology & Innovation	• Leverage technology and innovation to get the most out of the existing transportation system.	• Encourage initial deployment or implementation of emerging technology that can provide safety and mobility benefits. • Continuously assess and address gaps in TMS coverage. • Proactively identify and evaluate emerging or innovative technology to address mobility and safety. • Refer to the ITS Master Plan during the PDP. • Update the ITS Master Plan every 4 years.

4 CAPABILITY MATURITY MODEL AND FRAMEWORKS

4.1 Capability Maturity Model

CMM is a concept adopted from the information technology industry during the FHWA's SHRP2 research. The goal of CMM assessment is to allow agencies to identify, build consensus around, and prioritize institutional and process improvements that further TSMO objectives within the agency and region. The CMM framework, laid out as a matrix, consists of six improvement areas (often referred to as the CMM dimensions) that are evaluated across four levels of capability (Level 1 being the lowest and Level 4 being the highest). Illustrated on Figure 11 are the six CMM dimensions, the four levels of capability, and the FHWA-recommended process of CMM assessment. The CMM assessment is not meant to be a scorecard. Its purpose is to identify opportunities for improvement and support setting goals that are achievable.

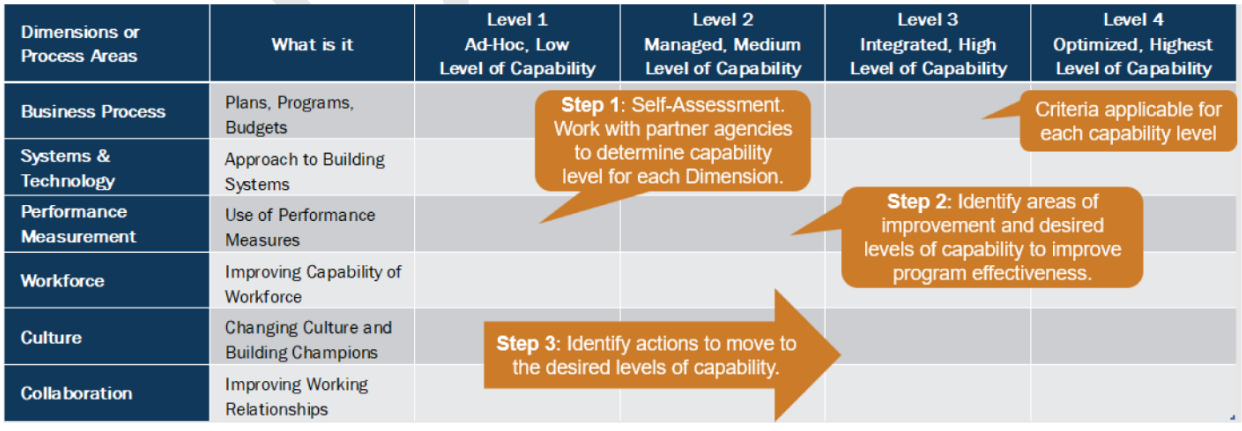

Figure 11: CMM Assessment Process

TxDOT-PHR conducted a CMM assessment workshop to identify TSMO-related gaps and needs for TxDOT-PHR and the region. Partner agency attendees included the Cities of Brownsville, Edinburg, McAllen, Mission, and Pharr. The RGVMPO and the City of Harlingen were not able to attend. CMM assessment results from the workshop are discussed below.

4.1.1 Business Process

Business Process dimension relates to the planning, programming, budgeting, and implementation of TSMO programs. Table 2 summarizes the FHWA-provided criteria for each Business Process capability level.

Table 2: Capability-Level Descriptions for Business Process

Dimension				Level 4
Business Process (planning, programming, budgeting, implementation)				**Processes streamlined** and subject to **continuous improvement**

Figure 12 summarizes the results of the capability assessment for the Business Process dimension. As seen in the figure, all agencies that voted in the region rated themselves between 1.5 and 2.1, with the City of Mission and City of Edinburg at 1.5, TxDOT at 2.1, and other partner agencies in between. The weighted average score of all agencies that voted is 1.9. The results indicate TxDOT and partner agencies' desire for a shift from an ad hoc implementation of TSMO projects or programs toward institutionalizing TSMO as a core function of the District through the development of a TSMO program plan, which will outline the strategic, programmatic, and tactical visions for TSMO and the steps needed to achieve them.

The following needs related to Business Process were discussed during the CMM workshop:

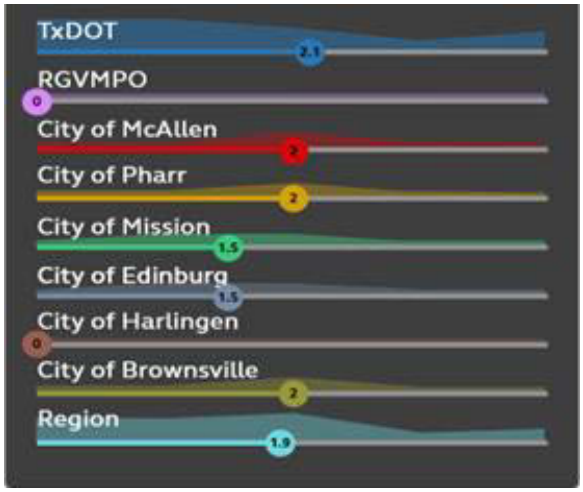

Figure 12: Business Process Assessment Results

Revised Project Delivery Process:

The PDP at TxDOT-PHR comprises six steps: Planning, Programming, Design, Construction, Operations, and Maintenance. While this process has successfully been used to develop capital projects over the years, the process also supports development of new or retrofit TSMO projects. During the workshop, TxDOT identified the opportunity to integrate operations or technology-oriented strategies throughout the existing PDP. This can be accomplished by enhancing Design Concept Conference (DCC), Design Review Meetings, and District Safety Review Team (DSRT) meeting agendas to include broader TSMO topics.

TSMO Planning:

TxDOT-PHR currently develops several multi-year plans that address TSMO aspects. These plans include the ITS Master Plan, Maintenance Plan (e.g., striping, seal coat, pavement rehabilitation), and Safety Plan. The TxDOT team discussed that these plans can be further enhanced through interdepartmental data sharing to include data-driven analysis and project prioritization and map-based dashboards for performance measurement and tracking. Additionally, improving the understanding of TSMO across sections and developing

a TSMO strategy toolbox will allow for incorporation of TSMO strategies at the project schematic stage and through long-range planning.

Programming, Budgeting, and Funding:

Figure 13 shows the TxDOT-PHR funding allocations based on the 2023 UTP. Although there is no dedicated funding for TSMO, the projects in Categories 1, 2, 4, 7, and 12 can be good candidates in which to incorporate TSMO strategies. Adding cost-effective and near-term TSMO strategies to projects in these categories presents an opportunity to address the TxDOT-PHR funding deficit shown on Figure 6.

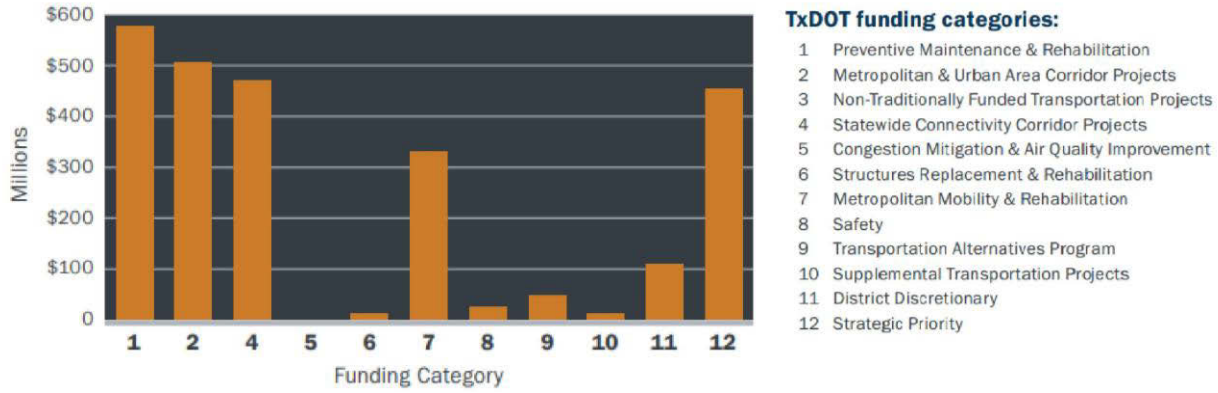

Figure 13: TxDOT-PHR Funding Allocations from 2023 UTP

During the workshop, attendees discussed creation of a dedicated and sustainable source of funding for TSMO. Attendees expressed interest in leveraging available RGVMPO funding (Categories 2 and 7) and interagency collaboration to pursue federal funding for regional TSMO deployments.

Continuous Improvement:

TxDOT's top statewide TSMO objective is to "reduce crashes and fatalities through continuous improvement of TM systems and procedures." Formalizing collaboration on TSMO initiatives through the RGVMPO Technical Advisory Committee (TAC) and through regularly scheduled meetings could help improve the adoption of TSMO. Additionally, revisiting the TSMO Program Plan and CMM assessments every couple of years for minor updates and revisiting them every 5 years for major updates will ensure that TSMO is well integrated and on a path to continuous improvement within TxDOT.

4.1.2 Systems and Technology

Systems and Technology dimension relates to the use of systems engineering, systems architecture standards, interoperability, and standardization in TSMO activities. Table 3 summarizes the FHWA-provided criteria for each Systems and Technology capability level. Figure 14 summarizes the results of the capability assessment for the Systems & Technology dimension. As seen in the figure, all agencies that voted in the region rated themselves between 1 and 3, with the City of Pharr at 1, TxDOT at 1.6, and other partner agencies in between.

Table 3: Capability-Level Descriptions for Systems and Technology

Dimension				Level 4
Systems and Technology (systems engineering, ITS standards, technology interoperability)				**Systems and technology routinely upgraded** and utilized to improve efficiency performance

The weighted average score of all agencies that voted is 1.7. The results indicate TxDOT and partner agencies' desire for more consistent use of systems engineering and regional ITS architecture in developing TSMO/ITS projects to ensure that systems being designed, developed, or procured address project and stakeholder needs, are cost-effective, and assess the need for standardization and interoperability between agencies. The following needs related to Systems and Technology were discussed during the CMM workshop:

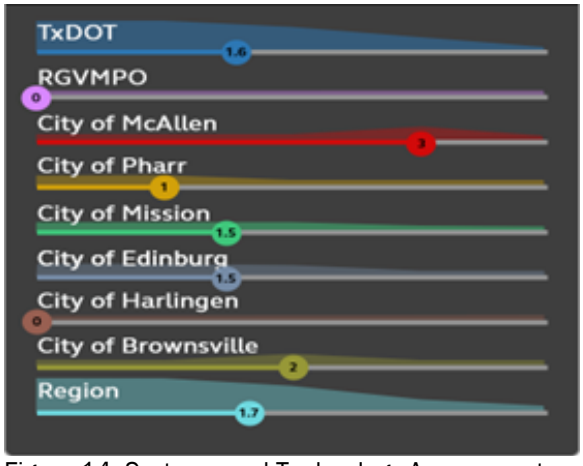

Figure 14: Systems and Technology Assessment Results

Systems Engineering Analysis Process

Systems Engineering Analysis (SEA) provides a systematic method for ITS and operations project developers to design their systems to achieve the desired operations objectives while also providing an assessment of alternative physical solutions. SEA allows developers to establish the concept of operations (con-ops) and perform alternatives analysis, cost analysis, technical risks analysis, and effectiveness analysis. SEA is required for all ITS projects using federal funds per Title 23 Code of Federal Regulations 940.11. All projects, not necessarily limited to federally funded projects, borrow components from the systems engineering process shown on Figure 15. This figure also highlights the key stages of TxDOT PDP and how they relate to the systems engineering process.

TxDOT projects apply a few components from the systems engineering process but generally begin with high-level system requirements and go straight to the Plans, Specifications, & Estimates (PS&E) stage. TxDOT engineers have an idea of the system requirements, but the requirements are generally not documented in con-ops and ITS architecture is seldom referenced during project development. Factors such as critical timelines to spend available funding cause engineers to expedite project design and advertise the project for construction. As a result, the SEA is often omitted during the PDP.

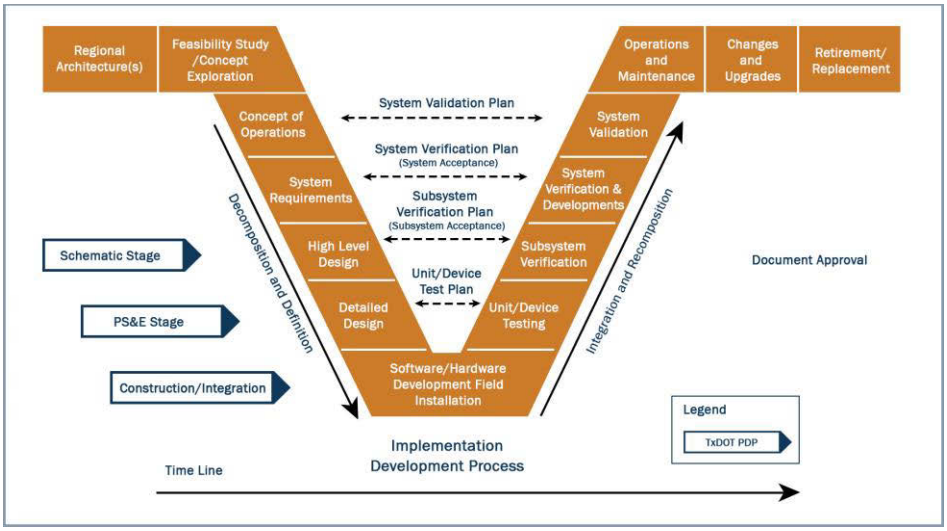

Figure 15: Systems Engineering Process

TSMO, which incorporates the "Plan to Operate" concept, encourages integration of the "Feasibility Study/Concept Exploration" phase (SEA) shown on Figure 15 within the PDP. This ensures consideration of a range of alternatives, incorporation of stakeholder needs, incorporation of operations and maintenance costs within planning-level costs, and selection of an alternative that addresses most system needs.

Innovative Technology Vetting Process

The transportation industry is currently going through a phase of rapid innovation. New types of detection, communication, software, and connected-vehicle technology as well as probe-based data are becoming available each day, putting the onus of vetting and accepting the technologies on DOT staff. Vendors market products based on case studies that are limited in scope, and many of these technologies employ "black box" algorithms that are challenging to validate. It also becomes challenging to compare multiple technology products with similar features due to the absence of technical specifications for those applications. To mitigate these challenges, the District, in collaboration with TRF, should develop a technology vetting process and apply it in conjunction with an SEA to evaluate a range of options and select the technology application that most closely and cost effectively meets the system requirements.

Regional ITS Architecture

The Lower Rio Grande Valley Regional ITS Architecture developed in 2003, systematically identified transportation needs for the region through stakeholder interviews. Regional ITS Architecture provides a framework to support project planning and the systems engineering process reflecting the regional transportation priorities and needs. It provides a systematic approach to integrate TMS and ITS in project planning. The architecture fosters stakeholder coordination and reflects the current state of ITS for the region.

It ensures that the region is in conformation with Architecture Reference for Cooperative and Intelligent Transportation (ARC-IT) and meets FHWA Final Rule 940 and Federal Transit Administration (FTA) Final Policy on ITS Architecture and Standards. ITS Architecture also supports initial identification and scoping of an ITS project—the initial steps of the systems engineering process represented by the "V" model. Regional ITS Architecture identifies many agency interfaces, information exchanges, and formal agreements among the associated stakeholders in addition to the roles and responsibilities of stakeholders needed to provide ITS services for the region.

The National ITS Architecture was integrated with Connected Vehicle Reference Implementation Architecture in 2017, and the resulting expanded reference framework became ARC-IT Version 8.0. ARC-IT allows transportation organizations to explore how connected and automated vehicle (CAV) services could be integrated with traditional and ITS projects. In September 2022, the ARC-IT updated to Version 9.1 with significantly enhanced service packages including maintenance and construction vehicle signal priority, remote access, and electric charging stations management. In November 2023, the ARC-IT updated to Version 9.2 with focuses on improvements that support Multimodal Accessible Travel (MAT), the Management of Electronic Traffic Regulations (METR) and other new concepts and refinements.

It is recommended that the Lower Rio Grande Valley Regional ITS Architecture be updated to conform to ARC-IT Version 9.2 first and then be updated periodically every 5 years to accommodate changes in technology, to reflect the region's ITS status as new projects are being deployed, and to ensure that TxDOT-PHR's operational needs are met. ITS projects to support TxDOT-PHR TSMO strategy action item implementation should be referenced in the TxDOT-PHR Regional ITS Architecture and meet FHWA Final Rule 940 and/or FTA Final Policy on ITS Architecture and Standards if the Highway Trust Fund is used for their deployment.

Existing and Planned Tools

All sections within TxDOT-PHR utilize some level of technology to assist staff with their daily work activities. TxDOT's Lonestar Advanced Traffic Management System (ATMS) is the foundational platform from which applications are launched, including accessing closed-circuit television (CCTV) camera video, and providing dynamic message sign (DMS) messages. TxDOT utilizes ATMS.now central systems to remotely monitor and control traffic signal operations and is planning to adopt Automated Traffic Signal Performance Measures (ATSPM) to improve the maintenance and operations of traffic signals. Additionally, TxDOT currently utilizes an asset and network management tool, TxDOTNow, to track assets (e.g., CCTV, DMS), monitor traffic along the communication network, and identify locations where the network is bogged down. TxDOT has also instituted cybersecurity measures to combat unauthorized access to the network. A project is currently in construction to add communications to all signalized intersections to enable monitoring and control of the signals.

During leadership engagement, various TxDOT sections expressed interest in sharing tools and data across groups and utilizing them to improve technical and business processes. To streamline work, sections expressed interest in reducing the number of programs used. Table 4 summarizes the tools and data utilized by TxDOT sections that could be of interest to other groups. Partner agencies and TxDOT expressed the desire

to share data such as camera feeds, signal operations data, traffic counts, public concerns, lane closures, and performance measures.

Table 4: Tools and Data Used by TxDOT-PHR

Tool or Data	Purpose
Probe Data (e.g., INRIX, Streetlight)	Traffic analysis (travel time, speed, origin-destination)
Traffic Counts	Traffic analysis (capacity analysis, prioritization)
Performance Measures (delay, travel time)	System performance tracking
Travel Demand Models	Traffic projections
Lonestar ATMS	Active traffic management
TxDOTNow	Ticketing, network monitoring, and asset management
Signing and Pavement Marking Retroreflectivity	Identify and prioritize maintenance locations
Pavement Analyst (PMIS Ratings, visual condition, ride data, maps)	Identify pavement segments in need of maintenance/rehabilitation and prioritize them
TxTAP and TxMAP	Evaluate traffic control devices and determine needs and maintenance priorities
TxDOTCONNECT	Portfolio management, project development, letting management, project execution
Project data in spreadsheets	Countermeasure development, cost estimation
GIS Apps and Dashboards	Identify hotspots, develop countermeasures, prioritize projects, budgeting
Compass Maintenance Management System	Maintenance costs, maintenance plan
Tablet/Phone	Field documentation
SiteManager	Information on project (work diary, payment, measurements)
Primavera P6	Scheduling
ProjectWise	File storage
OneDrive and SharePoint	File storage and sharing
Skyline	Track performance of ITS systems
Claris System	Provide a web-based video sharing system for traffic incident management
CRIS Crash Data	Assess crash issues monthly
TxDOT ITS public website	View CCTV cameras and DMS status for traffic management activities

4.1.3 Performance Measurement

Performance Measurement dimension relates to the identification of performance measures, consistent use of (big) data and analytics, and use of performance measures throughout a project lifecycle for decision-making. Table 5 summarizes the FHWA-provided criteria for each Performance Measurement capability level.

Table 5: Capability-Level Descriptions for Performance Measurement

Dimension				Level 4
Performance Measurement (measures, data and analytics, and utilization)				**Mission-related outputs data routinely utilized** for management, reported internally and externally, and archived

Figure 16 summarizes the results of the capability assessment for the Performance Measurement dimension. As seen in the figure, all agencies that voted in the region rated themselves between 1 and 2, with the City of Pharr, City of Mission, and City of Edinburg at 1, and TxDOT, the City of McAllen, and City of Brownsville at 2. The weighted average score of all agencies that voted is 1.7. The results indicate TxDOT and partner agencies' desire for greater use of data and data-driven insights throughout the project lifecycle, as well as enhanced data sharing, both within and between agencies.

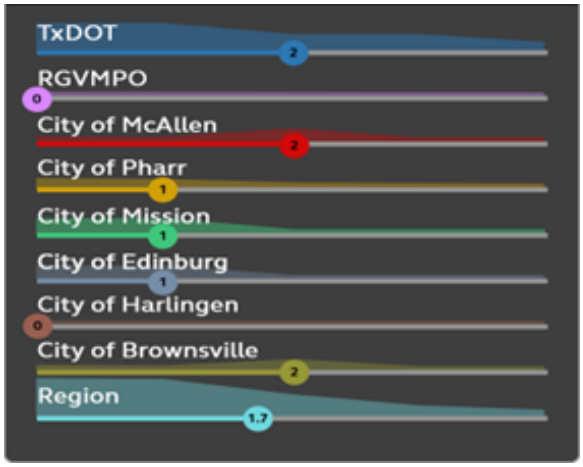

Figure 16: Performance Measurement Assessment Results

Agency Performance-Based Initiatives

TxDOT's Performance Dashboard (Link) provides insights to the public on how TxDOT is doing in relation to its seven strategic goals. Table 6 summarizes the TxDOT strategic goals and performance measures available on the statewide dashboard. TxDOT has also adopted a statewide "Road to Zero" initiative to reduce fatalities on all Texas roadways by half by 2035 and to zero by 2050. The TxDOT strategic goals and Performance Dashboard serve as a guide for districts to develop their own performance measures to track projects and assets starting from planning through operations and maintenance.

Table 6: TxDOT Strategic Goals and Statewide Performance Measures

TxDOT Strategic Goal	Performance Measures
Promote Safety	Annual fatalities and fatality rate, annual serious injuries and serious-injury rate, fatality emphasis areas (e.g., run off road, DUI, intersections, pedestrians, bicyclists).
Optimize System Performance	Congestion and reliability indices (urban, rural, and truck), vehicle miles traveled, delay per person.
Preserve Our Assets	Bridge condition scores (statewide, national highways, non-national highways), percentage of lane miles in good or better condition.
Deliver the Right Projects	Percentage of construction contracts completed on time and on budget, savings due to innovative contracting usage (e.g., A+B bidding).
Focus on the Customer	Customer complaints closed on time, complaint type, customer service through social media.
Foster Stewardship	Transportation expenditures, Disadvantaged Business Enterprise/DBE and Historically Underutilized Business/HUB goal attainment.
Value Our Employees	Employee engagement score.

District-Wide Performance Measures

The June 2022 TxDOT TMS Policy places an emphasis on utilizing performance measures to track and improve transportation system performance. All districts are required to submit their TMS status with an implementation plan for the next 12 months to TRF semiannually. As a result, TxDOT-PHR began developing quarterly TMS Status Reports with the documentation of performance measures such as asset operation uptime and TMS system coverage. Although it is not included in the report, the District does utilize probe-based travel-time data to display travel-time information to the traveling public.

Additionally, TP&D develops project-specific planning-level performance measures related to traffic operations and safety (e.g., delay, volume-to-capacity ratio, level of service, travel time, queue length, crash rate) that are used to develop transportation system improvements. The data used to develop these performance measures are usually collected on a single day during the school year. Usually, no follow-up studies (before vs. after) are conducted after the improvements are constructed to validate the planning-level performance measures.

During the CMM workshop, TxDOT participants recognized that a lot of data are being collected across sections in an ad-hoc manner. Streamlining data collection and sharing data and performance measures across sections will improve system efficiency and save data collection costs. Also, many types of operational, safety, and maintenance data (e.g., probe data, CRIS data, Lonestar data, Pavement Analyst, lane closures) are available at all times. These data can be brought into a single, GIS-based platform and overlayed to provide insights that could improve various TxDOT processes, including project analyses, selection, prioritization, and TM. Workshop participants, including partner agencies recognized the need to report TSMO performance measures and quantify benefits and costs associated with TSMO projects. Doing so will allow TSMO projects to compete well with capacity improvement projects. All agencies recognize that sharing of data and performance measures across agencies will contribute to overall system performance.

4.1.4 Organization and Workforce

Organization and Workforce dimension relates to the programmatic status, organizational structure, staff development, and recruitment and retention related to TSMO. Table 7 summarizes the FHWA-provided criteria for each Organization and Workforce capability level.

Table 7: Capability-Level Descriptions for Organization and Workforce

Dimension				Level 4
Organization and Workforce (organizational structure and workforce capability development)				**Professionalization and certification of operations** core capacity positions including performance incentives

Figure 17 summarizes the results of the capability assessment for the Organization & Workforce dimension. As seen in the figure, all agencies that voted in the region rated themselves between 1 and 2, with the City of Pharr, City of Mission, and City of Edinburg at 1, TxDOT at 1.7, and the City of McAllen and City of Brownsville at 2. The weighted average score of all agencies that voted is 1.5. The results indicate TxDOT and partner agencies' desire to evaluate staff capabilities and roles, and responsibilities in relation to TSMO.

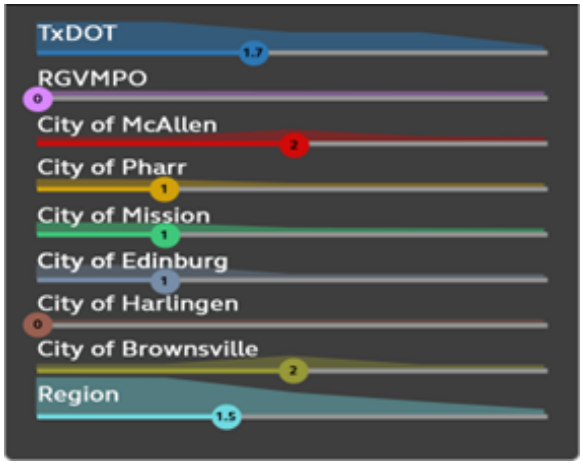

Figure 17: Organization and Workforce Assessment Results

Organization Structure to Accommodate TSMO

During TxDOT leadership engagement meetings and the CMM workshop, TxDOT leadership was supportive of integrating TSMO within their organizational structure.

Although District leadership recognizes the benefits of having TSMO as part of their organizational structure, current resource constraints make it challenging to have existing staff take on additional responsibilities to focus on integrating TSMO within the district. As a result, the TxDOT Pharr District is planning to incorporate new positions including a TSMO Champion, a TSMO Coordinator, and several TSMO Liaisons to lead district's TSMO integration activities in the future. Figure 18 below describes where these new TSMO positions (highlighted in orange) would fit into the existing organizational structure and collaborate with the other existing staff positions (highlighted in blue) to implement TSMO integration. It is also important to note that the existing organizational roles/staff positions are expected to assist/support the dedicated TSMO personnel for TSMO integration activities in their respective roles such as planning, construction, operations, etc.

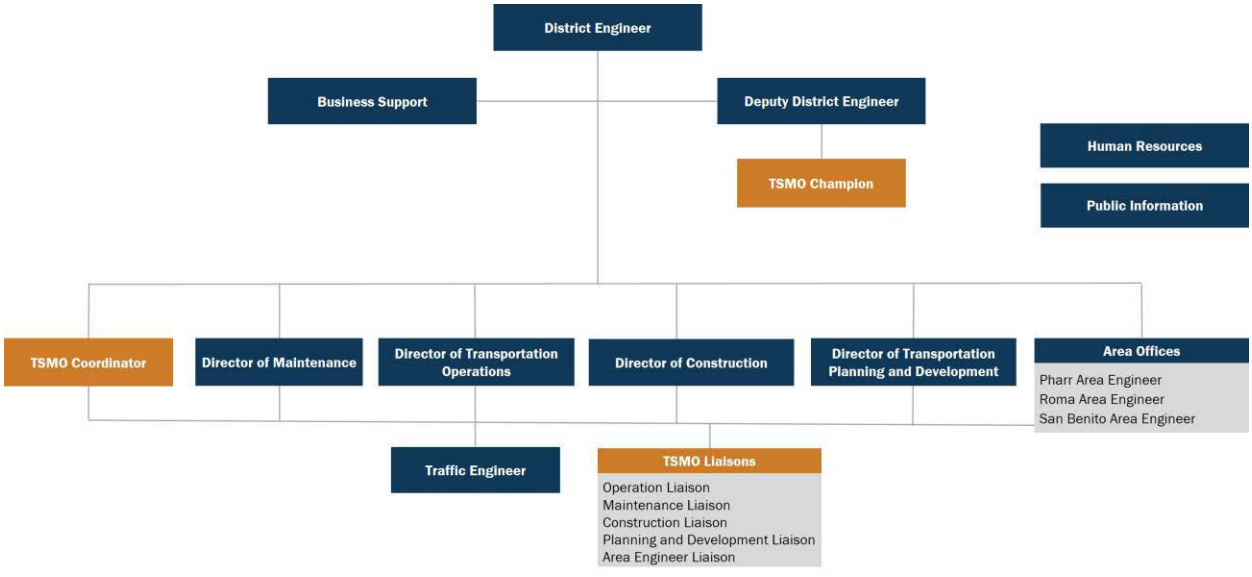

Figure 18: Organization Structure with TSMO Integration

Key TSMO Roles

As TSMO matures within the organization, key TSMO roles will need to be formalized to ensure continuous implementation of TSMO. This section describes how key roles in the region could support TSMO:

TSMO Champion:

This designation will be held by the Director of Transportation Operations. Key responsibilities will include:

- Representing TSMO activities during leadership meetings.
- Advocating for funding and resources.
- Promoting the value of TSMO activities and the high-benefit cost.

TSMO Coordinator:

This designation will be held by the District Traffic Engineer. Key responsibilities will include:

- Acting as the point of contact for TSMO questions and activities internally and among partner agencies.
- Managing the development and continuous improvement of the TSMO Program Plan.

TSMO Liaisons:

This designation will be held by a key lead from each section and a lead representing all area offices. Key responsibilities will include:

- Embracing a TSMO mindset and identify TSMO-related opportunities while performing functions critical to their department.
- Collaborating with the TSMO Coordinator and liaisons from other sections to advance TSMO ideas to actionable strategies.

Staffing Plan for Recruitment and Retention

The transportation industry is evolving rapidly. As a result, many agencies are having difficulties recruiting and retaining qualified personnel. Having trained staff to carry out critical TMS, traffic engineering, and planning functions is critical to the success of TSMO within the District. Therefore, a staffing plan detailing strategies to fill immediate needs in the workforce such as positions carrying out critical TSMO functions becomes necessary. The plan should consider how TSMO can help prepare the District for technology advancement. Additionally, the staffing plan should consider the following strategies:

- Cross-train employees to ensure staff can transition into TSMO roles quicker.
- Provide professional development opportunities related to TSMO.
- Establish a TSMO career path, with established training requirements and goals.

4.1.5 Culture

Culture dimension relates to the technical understanding, leadership, outreach, and program-level authority related to TSMO. Table 8 summarizes the FHWA-provided criteria for each Culture capability level.

Table 8: Capability-Level Descriptions for Culture

Dimension				Level 4
Culture (technical understanding, leadership, outreach, program authority)				**Explicit agency commitment to TSMO** as key strategy to achieve full range of mobility, safety, and livability

Figure 19 summarizes the results of the capability assessment for the Culture dimension. As seen in the figure, all agencies that voted in the region rated themselves between 1 and 3, with the City of Pharr, City of Mission, City of Edinburg, and City of Brownsville at 1, TxDOT at 1.8, and the City of McAllen at 3. The weighted average score of all agencies that voted is 1.5. The results indicate TxDOT and partner agencies' desire to improve technical understanding of TSMO and agency-wide appreciation of the role TSMO can play in improving regional traffic mobility and safety.

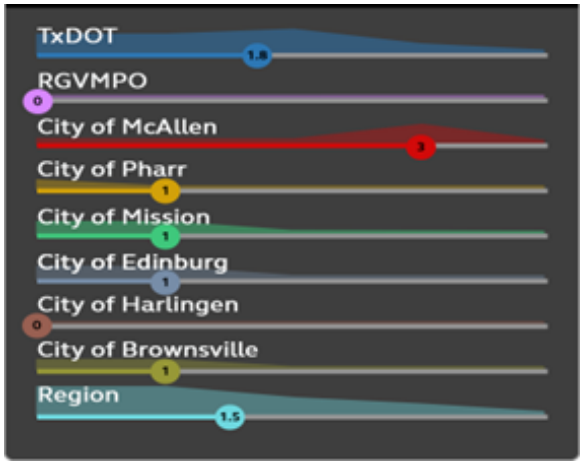

Figure 19: Culture Assessment Results

TSMO culture within the District can be enhanced in a similar way to how the District has enhanced the safety culture. The TSMO program within the District is endorsed by the DE and is being led by the Director of Transportation Operations (TSMO Champion) and the District Traffic Engineer (TSMO Coordinator). These leaders can encourage every District staff member to review the TSMO Program Plan and attend TSMO outreach events within the District and at TxDOT-sponsored conferences to improve their understanding of TSMO.

The District leadership and staff can consider the following strategies to enhance TSMO culture within the District:

- Share TSMO opportunities, accomplishments, and lessons learned within meetings.
- Include TSMO discussions within existing Director's, DCC, Design Review, and DSRT meetings.
- Continue distribution of the monthly TSMO Voice newsletter with TSMO case studies.
- Develop an annual report, sharing advancement of TSMO within the District and highlighting key staff members for their TSMO-related successes.

4.1.6 *Collaboration*

Collaboration dimension relates to the working relationships and partnerships between TxDOT and partner agencies, public safety agencies, and the private sector in relation to TSMO. Table 9 summarizes the FHWA-provided criteria for each Collaboration capability level.

Table 9: Capability-Level Descriptions for Collaboration

Dimension				Level 4
Collaboration (partnerships among levels of government and with public safety agencies and private sector)				High level of operations **coordination institutionalized among key players**—public and private

Figure 20 summarizes the results of the capability assessment for the Collaboration dimension. As seen in the figure, all agencies that voted in the region rated themselves between 1 and 2, with the City of McAllen, City of Pharr, and City of Edinburg at 1, TxDOT and City of Mission at 1.5, and City of Brownsville at 2. The weighted average score of all agencies that voted is 1.4. The results indicate TxDOT and partner agencies' desire to collaborate with each other regularly at the regional level.

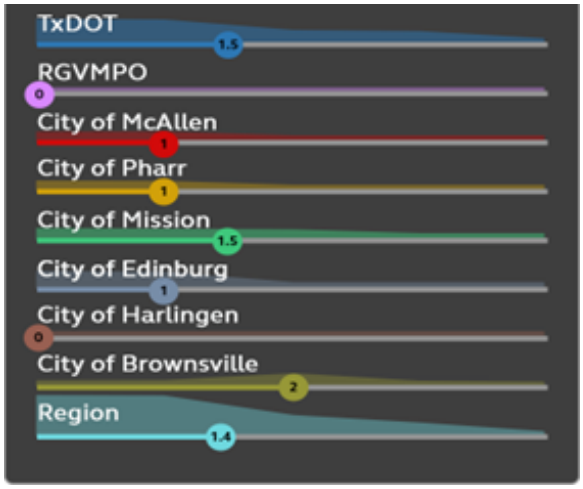

Figure 20: Collaboration Assessment Results

Internal Partnerships

Many of the senior leadership within TxDOT-PHR, such as the Deputy DE, and section directors have been with the District long term and have established strong working relationships with one another. These relationships, along with some institutionalized activities such as monthly Director's meetings and DCC, Design Review, and DSRT meetings, form the basis for strong collaboration throughout traditional project development. However, sometimes, the District resources are constrained and opportunities for TSMO integration are not realized. Additionally, most of the collaboration beyond the project development, including collaboration within the sections, occurs on an ad-hoc basis.

Some opportunities to formalize the internal collaboration in the TSMO context include:

- Add a discussion of TSMO opportunities to the existing Director's, DCC, Design Review, and DSRT meetings.
- Obtain input from traffic operations staff during planning, design, construction, and maintenance phases to ensure TSMO opportunities are considered.
- Through collaboration between Operations and TP&D groups, develop performance measures for TSMO projects to allow them to compete with traditional project types during project selection.

- Through collaboration within the Operations and Maintenance groups, explore the use of technology to make the maintenance process more effective and efficient.
- Through collaboration between Operations and Construction groups, ensure the consideration of appropriate smart work zone (SWZ) technology and detour signal timing within regionally significant projects.
- Through collaboration within the Operations group, establish funding needs for proactive management of traffic signals through a data-driven process.

External Partnerships

Similar to TxDOT-PHR, many of the senior leadership within partner agencies have been working in a similar capacity in the Rio Grande Valley region long term and have established strong working relationships with one another. Collaboration across agencies typically occurs in an ad-hoc manner. Some examples of interagency collaboration include collaboration between TxDOT, Cities of Brownsville, Harlingen, Mission, McAllen, Pharr, and Edinburg on Highway Safety Improvement Program projects to improve roadways and signals. Some opportunities to formalize the internal collaboration in the TSMO context include:

- Formalizing the process of interagency collaboration through the RGVMPO TAC meeting.
- Formalizing the process of collaboration during day-to-day TM activities.

4.2 Capability Maturity Framework

Based on the success of CMM across the country, the FHWA adapted the CMM approach to develop specific CMFs for individual TSMO applications (also called program areas), including TIM, TSM, WZM, planned special events, TM, and road weather management. Tailored capability frameworks allow agencies and stakeholders to focus on specific capability improvement needs within each program area.

TxDOT-PHR determined the four program areas discussed in paragraphs below to be the most critical for regional mobility and safety. Discussed below is the existing state of practice for TxDOT-PHR in these program areas and case studies that were discussed in conjunction with CMF self-assessments to develop actions for the program areas. The actions are detailed in the Five-Year TSMO Implementation Plan section (Section 5).

4.2.1 Traffic Signal Management

TSM involves the planning, design, integration, maintenance, and proactive operation of a traffic signal system. It is one of the most cost-effective TSMO strategies to improve movement of people and goods while making our streets safer and trips more reliable.

TxDOT-PHR currently operates approximately 374 traffic signals, and these signals are mostly located along freeway frontage roads and in the outskirts of the cities. About 27 (representing 7 percent) of these signals currently have communications via a combination of cell modems and wireless ethernet radios. The District uses ATMS.now traffic signal central system software programs and Trafficware controllers to control the

signalized intersections and a mix of inductive loops, radar, video and magnetometers to detect vehicles. Four major corridors currently run coordinated plans: SH 100 in Port Isabel, SH 48 to Garcia St.; FM 88 in Weslaco, from Ballard St. to BUS 83; SH 345 in San Benito, from IH 69E to BUS 77; US 83 in Rio Grande City, from Redwood to Flores St. TxDOT does not currently operate traffic responsive or adaptive signal operation and does not collect performance measures such as ATSPM. Signal timing adjustments or equipment repairs are conducted once the issue is observed in the field, or a request is received from the public. There currently are no corridors in the Rio Grande Valley region that operate Transit Signal Priority.

TxDOT-PHR is in the process of modernizing the signal system by implementing cabinet upgrades (cabinet locks), and communications at all signals as part of the Districtwide traffic signal project. The District also plans to increase the number of signals connected to ATMS.now and adopt ATSPM to proactively maintain and operate signals. Table 10 provides examples of how agencies across the country have utilized TSMO principles to enhance traffic signal/arterial management. These examples, along with CMF assessment results and discussions with TxDOT leadership, were utilized to develop the TSM program-area recommendations presented in Table 15.

Table 10: TSMO Applications for Traffic Signal Management

Case Study 1: Denver Regional Council of Government's (DRCOG) Traffic Operations Program (LINK) **Extent:** 3500 traffic signals across 32 jurisdictions in Denver Metro **Program Components:** 1. Capital improvement program: providing signal and communications equipment 2. Traffic signal timing program: Implementing signal timing improvements to demonstrate the benefits of the capital improvements. **Funding:** CMAQ **Benefits:** 7.0
Case Study 2: FDOT (District 4) and Palm Beach County Active Arterial Management (LINK) **Extent:** 76 traffic signals across three corridors **Project Components:** 1. Actively monitor, manage, and improve arterial operations utilizing 38 CCTVs, 30 BlueTOAD devices and remote command of traffic signals. 2. Deploy signal timing plans in response to incidents along I-95. 3. Develop performance measures while accounting for costs of equipment/devices, operations and maintenance, Traffic Management Center operators, central signal software, and INRIX subscription. Benefits calculations accounted for cost of travel-time savings, crash reductions, and energy savings. **Funding:** FDOT and Palm Beach County **Benefits:** Benefit-Cost Ratio of 10.0
Case Study 3: Traffic Signal Retiming Program, North Central Texas Council of Governments (LINK) **Extent:** 400+ signals retimed as part of Phase 1 **Project Components:** 1. Collect and analyze traffic data, develop and optimize traffic models, create signal timing plans, and field deploy the signal timing plans 2. Collect and report before-after performance measures. **Funding:** CMAQ **Benefits:** 7.3 percent reduction in travel time, 31.1 percent reduction in number of stops, 14.3 percent reduction in fuel consumption, and 4.9 percent reduction in emissions; approximately $25.7 million in annual savings.

4.2.2 *Traffic Incident Management*

TIM is a planned and coordinated program to detect, respond to, and remove traffic incidents and restore traffic capacity as safely and quickly as possible. TIM reduces travel delay and non-recurring congestion and improves responder and traveler safety. Effective incident management helps address approximately 25 percent of all traffic congestion and reduces secondary incidents, which account for approximately 20 percent of all incidents.

TxDOT-PHR generally conducts TIM activities on an ad-hoc basis as no formal TIM program exists within the District. The District's Area and Maintenance offices handle all incident management-related processes. There's limited coordination between the Area and Maintenance offices and the Transportation Operations group at the District Office, outside of major events (special or weather-related events), which have well-defined processes through the emergency management administration by the District maintenance office. The District has previously participated in the TIM training organized by TRF and should continue to identify these training opportunities to stay involved so as to share information about best practices and lessons learned with the TRF and other TxDOT districts.

TIM is currently considered in planning for special events or weather-related events but not for construction and WZs on major projects. Contractors are typically required to report incidents to TxDOT and adjust traffic control to facilitate clearing of the incident. District staff use the incident report from the contractor to publish traveler information on DMSs and ensure that the contractor implements appropriate actions at the scene of the incident.

The Claris system, which will provide a valuable online website video sharing system, has been deployed in the District with all existing cameras available to view. This system will help District staff, traffic operations staff, and incident responders to respond to events quicker.

TxDOT and stakeholders recognize the importance of a coordinated response to traffic incidents and therefore plan to implement a formal TIM program and develop a TIM plan. As part of the program, a TIM Task Force that will include representatives from all stakeholders will be established to discuss TIM collaboration needs and conduct after-action reviews and lessons learned. Table 11 provides examples of how agencies across the country have utilized TSMO principles to enhance TIM. These examples, along with CMF assessment results and discussions with TxDOT leadership, were utilized to develop the TIM program-area recommendations presented in Table 15.

Table 11: TSMO Applications for Traffic Incident Management

Case Study 1: Waycare Incident Management Platform Deployment at Southern Nevada Traffic Management Center (TMC) (LINK) **Extent:** Southern Nevada region **Project Components:**

1. Real-time sharing of incident information across four agencies housed at the TMC and to the public. The incident information, now available through the Waycare Platform, used to be siloed across various software platforms used by the agencies.
2. Live map showing active incidents, congestion, queues, construction zones, road closures, location of highway patrol, service patrol, and maintenance drivers.
3. Incident alerts on all devices, including incident location, a 20-second looped GIF, geofenced CCTV footage, insights on current road conditions, as well as relevant notes.

Benefits: 12-minute reduction in incident response time; greater context of incident details prior to arriving on the scene; reduction in secondary crashes.

Case Study 2: TMC-based Active Incident Monitoring and Management, Denver, CO (LINK)

Extent: Metro Denver area including Colorado Department of Transportation (CDOT) roadways

Project Components:

1. The City uses "live" travel time and vehicular volume data and CCTV cameras to detect and verify incidents as well as bottlenecks, queuing, and diversion routes.
2. The City and CDOT work together to activate incident-related messaging on DMS signs and deploy signal timing changes to address congestion and travel-time increase due to congestion.
3. The City and CDOT actively monitor and manage the incident through the TMC, which includes use of cameras and travel-time/volume data to iteratively adjust signal timing on diversion routes.

Benefits: 67 percent reduction in travel time on diversion routes.

Case Study 3: Real-Time Incident Management Dashboard, Bellevue, Washington (LINK)

Extent: City of Bellevue

Project Components:

1. The City developed a map-based dashboard integrating real-time 911 dispatch data (incident location, type, time) and CCTV cameras at traffic signals.
2. The dashboard map displays incident alerts near traffic signals, allows filtering of calls and viewing and archiving of CCTV footage.
3. The engineers utilize the dashboard to verify, monitor, and respond to incidents. Incident response includes signal timing adjustments, public notifications, incident analysis, and countermeasures development.

Benefits: 10-15 minutes saved in incident investigations; up to 50 percent reduction in incident clearance time; reduced travel delays and improved safety of traveling public and responders.

4.2.3 Traffic Management

TM is the efficient management of traffic by application of the appropriate policies, strategies, and actions to mitigate any potential impacts resulting from the intensity, timing, and/or location of travel and to enhance mobility on transportation facilities. Effective TM reduces travel delay, reduces recurring and non-recurring congestion, and improves safety.

TxDOT conducts regional TM activities through District staff workstations and there is currently no continuous traffic monitoring. CCTV camera feeds are passed through Lonestar servers and then posted to the public website for viewing. TxDOT-PHR utilizes the TxDOT-SAT to post messages (Alert – AMBER, silver, blue, etc.) on its DMSs during off-peak hours (nights and weekends).

The Lower Rio Grande Valley Regional ITS Architecture was developed in 2003 with no updates to date. TxDOT-PHR plans to update the Lower Rio Grande Valley Regional ITS Architecture to be compliant with ARC-IT v9.2.

TxDOT-PHR recently developed its ITS Master Plan (completed in 2022), providing a 5-year roadmap for developing the on-system ITS for major corridors within the Rio Grande Valley region. The ITS Master Plan was developed using ARC-IT v9.0. Infrastructure-Based Traffic Surveillance, Traffic Information Dissemination, ITS Communications, Traffic Signal Control, Performance Monitoring, and Traffic Incident Management System are among the service packages recommended in the plan. The District plans to develop a Con-Ops for implementation of a District TMC. The Con-Ops will document the TMC's stakeholder needs, operational concept, and operational scenarios.

As part of the network monitoring initiative from TRF, TxDOT-PHR prepares quarterly TMS Reports that describe the existing ITS, gaps and needs, and implementation plans to address those gaps. Table 12 provides examples of how agencies across the country have utilized TSMO principles to enhance TM. These examples, along with CMF assessment results and discussions with TxDOT leadership, were utilized to develop the TM program-area recommendations presented in Table 15.

Table 12: TSMO Applications for Traffic Management

Case Study 1: FDOT District 5 Integrated Corridor Management (LINK) **Extent:** Florida Department of Transportation District 5 **Project Components:** 1. FDOT District 5 freeway personnel and Active Arterial Management personnel work side by side to ensure an integrated approach to operations throughout the region. 2. ICM includes a wide variety of strategies such as traffic signal management through remote control and ATSPM, signal preemption and priority, ramp metering, traveler information (511, DMS, WAZE), incident management, dynamic shoulder running, information management, etc. **Benefits:** up to 10:1.
Case Study 2: Arizona DOT Needs-Based Maintenance Budget (LINK) **Extent:** All of ADOT **Project Components:** 1. Determination of TSMO (e.g., CCTV, DMS, signals, lighting, ITS, signing, striping) maintenance needs based on a data-driven, performance-centered approach as opposed to one based on historical perspective (budget allocation based on what was accomplished last year). 2. ADOT staff collects inventories, assigns level-of-service grades, and enters data into a Needs-Based Budget model for analysis and budget allocation. 3. Real-time Tableau-based performance measures and dashboards are available to make decisions based on the most recent data and to track progress toward targets. **Benefits:** Limited maintenance funds are allocated more efficiently.
Case Study 3: Georgia DOT Connected-Data Platform (LINK) **Extent:** All GDOT **Project Components:** 1. The project will build a platform that aggregates data from multiple departments and eliminates the need to use multiple software. 2. The map-based platform will aggregate, quality check, and develop performance measures for data such as crashes, incidents, ITS/signal devices, traffic, weather, fleet, etc. 3. The platform will provide automated alerts, on-screen monitoring, performance measure dashboards, and reports. **Benefits:** Improve decision-making accuracy and efficiency.

4.2.4 *Work Zone Management* 

WZM entails the management of traffic during construction to minimize traffic delays, maintain motorist and worker safety, complete construction in a timely manner, and maintain access for businesses and residents. WZM is necessary to ensure construction projects progress without adversely affecting the safety and mobility of construction workers and the traveling public.

The District Construction Office, along with the Area Offices, oversees and manages construction activities (freeway/arterial construction, signal construction, landscaping, rehabilitation) throughout the District for on-system roadways. TxDOT Design Guidebook includes construction-related design requirements, including requirements for ITS and WZs. TxDOT also has Special Specifications (6000 series) that apply to ITS items. Currently, the WZ details developed during the project do not include SWZ elements due to the limited knowledge on appropriate SWZ technologies. The District is, however, interested in implementing SWZ technology on projects. There are currently no performance measures pertaining to traffic operations being collected for WZs. On large projects where mobility and safety concerns are raised, TxDOT plans to engage TTI to monitor performance measures and to develop countermeasures.

Frontage roads and on-system roadways generally serve as alternate routes during construction. Signal timing changes to accommodate the needs of detour traffic are generally not developed or maintained by TxDOT over the duration of construction. Contractors usually adjust and manage traffic signal timing changes under Item 681 (Temporary Traffic Signals), but District Signal Shop technicians also assist whenever needed.

Table 13 provides examples of how agencies across the country have utilized TSMO principles to enhance WZM. These examples, along with CMF assessment results and discussions with TxDOT leadership, were utilized to develop the WZM program-area recommendations presented in Table 15.

Table 13: TSMO Applications for Work Zone Management

Case Study 1: My35 Waco Construction Work Zone (LINK) **Extent:** TxDOT I-35 Waco **Project Components:** 1. ITS such as CCTVs, end-of-queue warning systems, comparative travel-time signs. 2. Project website with a map displaying real-time traffic conditions, incidents, delays, pedestrian crossing locations, and CCTV streams **Benefits:** Surrounding Waco community and traveling public benefit from comprehensive approach to traveler information.
Case Study 2: AZTech Smarter Work Zone (LINK) **Extent:** Phoenix Metro **Project Components:** Arizona DOT, Maricopa County DOT, and Maricopa Metropolitan Planning Organization partnered to deploy three technology and data-driven solutions to address WZ mobility and safety: 1. Deployed SWZ applications such as queue warning, traveler information (travel times, detours), and speed-limit compliance across the state on both freeways and arterials. 2. Developed a database that collects and processes construction data from multiple agencies and disseminates the information through AZ 511.

3. Developed an in-vehicle connected-vehicle app that utilizes 5.9-gigahertz wireless communications to provide freight vehicles WZ-related alerts and warnings.

Benefits: Reduced travel times, increased speed compliance, and no fatalities or worker safety issues during SWZ deployment.

Case Study 3: Comprehensive Work Zone Management Program (LINK)

Extent: All of Iowa DOT

Project Components:

1. To determine which highway projects require additional WZM attention, developed the Traffic Critical Projects process and added it within the Design Manual.
2. Added countermeasures such as traffic operations treatments, SWZ equipment, and WZ TIM plans to the Design Manual.
3. Partnered with Iowa State University on real-time performance monitoring, developed a database to store WZ data, disseminated situational data to engineers and law enforcement, and developed a specification for requiring smart arrow boards (GPS + modem) on construction projects.

Benefits: Advanced Iowa DOT's TSMO capability maturity through the development of policy and procedures.

5 FIVE-YEAR TSMO IMPLEMENTATION PLAN

This section includes a prioritized implementation plan for advancing TSMO in the Pharr District over the next 5 years. The action items included in Tables 14 and 15 are the outcome of the comprehensive TxDOT and partner agency engagement process discussed earlier in which the leadership and key leads from TxDOT and partner agencies were engaged multiple times over the course of the project to co-create TSMO actions. This approach ensures that the action items listed below are properly vetted and that there is TxDOT support for them, making the actions implementable. Table 14 provides program-level, CMM-based TSMO actions, and Table 15 provides program-area-level, CMF-based TSMO actions. These tables provide the following information for each action item.

- **ID:** An identifier for each recommended action item, organized by CMM capability dimension: Business Processes (BP), Systems & Technology (ST), Performance Measurement (PM), Culture (CU), Organization & Workforce (OW), and Collaboration (CO).
- **Action:** Brief description of the action and associated steps.
- **Lead:** Identification of the department or agency that will take ownership of the action and lead its implementation.
- **Support:** Identification of the department or agency that will support the implementation of the action.
- **Cost:** An estimate of the level of fiscal resources TxDOT would need to commit to implement the action.
- **Impact:** An estimate of the magnitude of improvement as a result of implementing the action.
- **Time Frame:** The time frame in which an action is likely to be implemented.
- **Measure of Success:** Identification of how the progress and completion of an action will be tracked.

While all action items listed below could potentially be implemented within the next 5 years, no funding is currently allocated for any of these action items unless otherwise specifically stated in this plan. Action items will be implemented as District resources permit.

Table 14: TxDOT-PHR Program-Level TSMO Action Items

ID	Action	Lead	Support	Cost	Impact	Time Frame	Measure of Success
Year 1 - 2 Actions							
BP-01	Consider proven TSMO/ITS Strategies during planning: - Consider including ITS/TSMO as part of access management studies. - Include ITS/TSMO during schematic development to provide better estimates of construction costs. - Develop checklists/a toolbox to include ITS/TSMO strategies.	TP&D	Operations	$	★★★★	1-2 years	Yes/No
BP-02	Include TSMO activities as part of existing meetings/processes instead of adding to the number of meetings/processes - Discuss topics such as ITS needs, WZ analysis, smart WZ needs and technologies, safety and operational performance measures and traffic control funding during DSRT (Construction), Design Review and DCC (TP&D) meetings.	Construction	TP&D	$	★★★	1-2 years	Yes/No
BP-03	TSMO planning and programming: - Identify priorities and estimated costs for TSMO projects that can be added to the UTP over the next 10 years. - Identify ways to incorporate stand-alone TSMO projects within the District's annual budget. - Include the discussion of ITS Master Plan projects during project planning and programming.	TP&D	Operations	$$	★★★★	1-2 years	% Complete
ST-01	Track complaints/issues from initial documentation to resolution: - Institutionalize the use of TxDOT ticketing system (TxDOTNow) for tracking issues, discussions, resolutions, and turnaround time.	Maintenance	Operations, TP&D	$	★★★★	1-2 years	% Complete
CU-01	Identify ways to embed TSMO in the District's culture, e.g., discuss TSMO lessons learned during the Directors' meetings, involve all District staff in TSMO activities, recognize staff for bringing TSMO ideas to projects, and establish TSMO roles and responsibilities.	Deputy DE	All Sections	$	★★★★	1-2 years	Yes/No
PM-02	Collect and analyze mobility (from probe data) and safety data such as speeds, travel times and crashes to develop mobility and safety-based performance measures. Display performance measures on a shareable dashboard: - Identify bottlenecks/hotspots and develop and prioritize projects. - Utilize performance measures to enhance operations during construction by better planning for traffic control and detours.	TP&D	Operations	$$	★★★★	1-2 years	% Complete
OW-01	Emphasize need for TSMO focus, similar to Safety, within the existing organization structure. Example: TSMO function similar to Safety under Asst. DE; TSMO Liaisons within each section.	Deputy DE	All Sections	$$	★★★★	1-2 years	Yes/No
CO-01	Formalize the process of collaboration with partner agencies including the RGVMPO.	TP&D/Operations	RGVMPO, Cities of Brownsville, Edinburg, Harlingen, McAllen, Mission, and Pharr	$$	★★★★	1-2 years	Yes/No
CO-02	Formalize and improve collaboration between the TP&D, Operations, Maintenance, Construction, and Area Offices. E.g., Discuss funding allocation, project selection and prioritization, and design review comments.	TP&D	All Sections	$$	★★★★	1-2 years	Yes/No
Year 3 - 5 Actions							
BP-04	Develop a data-driven, needs-based process to better plan for, prioritize and budget maintenance, and track maintenance activities and performance.	Maintenance Division	Maintenance	$$$	★★★★	3-5 years	% Complete
BP-05	Develop a data-driven process for project selection, prioritization, and identification of funding needs. - Develop a process of collaboration between TP&D, Construction, Operations and Maintenance.	TP&D	All Sections	$$$	★★★★	3-5 years	% Complete
BP-06	Institutionalize the use of Regional ITS Architecture and Systems Engineering processes during planning of ITS/TSMO projects to ensure that systems being designed, developed or procured address project and stakeholder needs, are cost effective, and assess need for standardization and interoperability between agencies.	Operations	TP&D	$$	★★★	3-5 years	Yes/No
BP-07	Review the TSMO Program Plan and CMM/CMF assessments for minor updates every 2 years.	Operations	All Sections	$	★★	3-5 years	Yes/No
ST-02	Identify a way to reduce the number of tools/software being used and improve information/data sharing between tools/software.	IMD	TP&D, Operations	$$	★★★★	3-5 years	Yes/No

ID	Action	Lead	Support	Cost	Impact	Time Frame	Measure of Success
PM-01	Document benefits and costs associated with TSMO projects. - Track performance measures during project planning and after project completion to assess performance against expected benefits	TP&D	Operations	$$	★★★	3-5 years	Yes/No
CU-02	Establish through the Rio Grande Valley Metropolitan Planning Organization's (RGVMPO's) Technical Advisory Committee a TSMO sub-committee that meets quarterly to discuss district-wide TSMO efforts, partnership opportunities, and lessons learned.	TP&D	RGVMPO	$	★★★	3-5 years	Yes/No
OW-02	Evaluate training and development of existing staff/retention of staff (data scientists, software developers or technology experts) to continue to leverage data and technology to enhance DOT Business Processes. E.g., Develop the training and education of traffic and ITS technicians by leveraging South Texas universities and community colleges.	Deputy DE	All Sections	$$	★★★★	3-5 years	% Complete
OW-03	Update staff position descriptions/duties to reflect TSMO skills and capabilities.	District HR	All Sections	$$	★★★★	3-5 years	Yes/No

Table 15: TxDOT-PHR Program-Area-Level TSMO Action Items

ID	Action	Lead	Support	Cost	Impact	Timeframe	Measure of Success
Traffic Signal Management							
Year 1 - 2 Actions							
ST-01	Provide communications to 100 percent signals and include communication as part of every new signal design and construction.	Operations	TRF	$	★★★★	1-2 years	Yes/No
ST-02	Expand traffic signal central system license to provide connectivity to 100 percent of District signals.	Operations	Operations	$$	★★★★	1-2 years	% Complete
PM-01	Utilize crowdsourced data (e.g., INRIX) to identify corridors to retime and to compare performance measures before/after signal timing studies.	Operations	TP&D	$$	★★★	1-2 years	Yes/No
PM-02	Develop ATSPM/probe data-based reporting for regionally significant corridors, and track performance measures monthly for continuous improvement of signal operations and maintenance.	Operations	Operations	$$	★★★	1-2 years	% Complete
CU-01	Identify ways to communicate benefits, outcomes, and needs to various internal and external stakeholders, including policy makers, the media, and others. - Share benefits from signal timing at Directors' and supervisors' meetings. - Leverage social media to share information.	Operations	Operations	$	★★★	1-2 years	Yes/No
OW-01	Assess required staffing levels based on data-driven needs of signal management as well as TxDOT's goals and objectives.	Operations	Operations	$	★★★	1-2 years	Yes/No
OW-02	Identify training needs of existing staff based on new technology and training needs for new employees.	Operations	Operations	$$	★★★	1-2 years	Yes/No
CO-01	Share traffic-signal-related data upon request from partner agencies.	Operations	Partner Agencies	$	★★★	1-2 years	Yes/No
Year 3 - 5 Actions							
BP-01	Develop a performance-based and objectives-driven traffic signal timing program in alignment with TxDOT goals and objectives.	Operations	Operations	$	★★★	3-5 years	% Complete
BP-02	Develop a performance-based and objectives-driven traffic signal maintenance program in alignment with TxDOT goals and objectives.	Operations	Operations	$$	★★★	3-5 years	% Complete
ST-03	Begin Districtwide Deployment of ATSPM: - Evaluate traffic controllers to ensure high-resolution data capability (to collect ATSPMs). - Deploy ATSPMs pilots to evaluate a districtwide deployment. - Develop guidance for detection layout to enable ATSPMs.	Operations	TRF	$$$	★★★	3-5 years	% Complete
ST-04	Deploy an asset management system for traffic signals.	Operations	TRF	$$$	★★★★	3-5 years	Yes/No

ID	Action	Lead	Support	Cost	Impact	Timeframe	Measure of Success
OW-03	Evaluate the need for traffic signal technician training by leveraging regional community colleges and trade schools.	Operations	Operations	$	★★★	3-5 years	Yes/No
CO-02	Collaborate with partner agencies to optimize regional signal corridors on a periodic basis to achieve regional operational objectives.	Operations	Partner Agencies	$$	★★★★	3-5 years	Yes/No
Traffic Incident Management							
Year 1 - 2 Actions							
BP-01	Consider addressing TIM impacts prior to the final design/construction of significant roadway projects.	Operations	TP&D, Construction	$	★★★	1-2 years	Yes/No
ST-01	Evaluate the use of video analytics and probe data to automatically detect incidents and alert operations staff.	Operations	TRF	$$	★★★	1-2 years	Yes/No
ST-02	Evaluate the need for staffing and technology to support TIM while developing the District's TMC.	Operations	TRF	$$	★★★	1-2 years	Yes/No
CU-01	Share lessons learned, benefits, and outcomes from traffic incident response with stakeholders and TxDOT leadership.	Operations	TIM Stakeholders	$	★★★	1-2 years	Yes/No
OW-01	Establish recurring, consistent, and evolving TIM training for all stakeholders. - To train new staff and develop redundancy in existing staff. - For multidisciplinary TIM program participants to understand the incident command structure, role of involved agencies, and applicable standards (e.g., Texas Manual on Uniform Traffic Control Devices). - To improve TIM practices based on lessons learned.	Operations	TIM Stakeholders	$$	★★★	1-2 years	% Complete
CO-01	Collaborate with all TIM partners to develop data-sharing policies, including access to CCTV cameras.	Operations	TIM Stakeholders	$$	★★★★	1-2 years	Yes/No
Year 3 - 5 Actions							
BP-02	Review any existing interagency agreements and determine need for updates or additional agreements.	Operations	TP&D	$	★★★	3-5 years	Yes/No
BP-03	Develop a TIM plan. - Document how the TIM program should function. - Identify agencies and stakeholders, and roles and responsibilities of each party.	Operations	TIM Stakeholders	$$	★★★★	3-5 years	Yes/No
BP-04	Establish a formal TIM program. - Establish TIM Task Force that includes representatives from stakeholders to discuss TIM collaboration needs, conduct after-action reviews and lessons learned. - Evaluate establishing freeway safety service patrol along major routes.	Operations	TIM Stakeholders	$$$	★★★★	3-5 years	Yes/No
0W-02	Establish roles and responsibilities within TxDOT and TIM stakeholders to carry out TIM functions.	Operations	TIM Stakeholders	$$	★★★	3-5 years	Yes/No
ST-03	Consider establishing a connection between police dispatch and TxDOT to provide real-time CAD data to TxDOT.	Operations	TRF	$$	★★★	3-5 years	Yes/No
PM-01	Utilize probe data sources (such as RITIS/INRIX) for incident detection, tracking, and reporting.	TRF	Operations	$$	★★★	3-5 years	Yes/No
PM-02	Establish continuous tracking performance measures such as roadway clearance time, incident clearance time, and secondary crashes.	Operations	Operations	$$	★★★	3-5 years	Yes/No
Traffic Management							
Year 1 - 2 Actions							
BP-01	Evaluate whether ITS Master Plan projects can be incorporated within project planning activities initiated by TP&D.	Operations	TP&D	$	★★★	1-2 years	Yes/No
BP-02	Develop a data-driven, needs-based operations and maintenance budgeting process to maintain or replace TSMO (ITS/signals) assets. The process will utilize TSMO asset inventory, asset cost, information on completed/needed maintenance, and assigned asset level of service to determine the operations and maintenance budget.	Operations	Operations	$$$	★★★★	1-2 years	% Complete

ID	Action	Lead	Support	Cost	Impact	Timeframe	Measure of Success
BP-03	Evaluate the need for a performance-driven preventative maintenance and inspection program that would complement the statewide ITS/signals network monitoring contract and the multi-district preventative and response to facilitate needs-based maintenance.	Operations	TRF	$$	★★★	1-2 years	Yes/No
ST-01	Develop TxDOT TMC Concept of Operations to develop the operational scenarios, system requirements, and stakeholder needs.	Operations	TIM Stakeholders	$$	★★★★	1-2 years	Yes/No
ST-02	Explore the use of technology to address issues determined in the District Safety Plan.	Operations	Operations	$$	★★★	1-2 years	Yes/No
PM-01	Evaluate continuously analysis of mobility and safety data to develop mobility- and safety-based performance (e.g., incident, roadway clearance times, average speed, travel-time index). Display performance measures on a TMC dashboard. - Identify areas to focus traffic management activities on (e.g., traveler information, signal timing adjustments, incident response). - Utilize performance measures to plan for and enhance operations (e.g., work zones, special events, weather events, holidays).	Operations	Operations	$$	★★★	1-2 years	% Complete
PM-02	Continuously track asset performance (e.g., percentage uptime, asset reliability, asset age vs. service life, work-order tracking) against goals.	Operations	Operations	$$	★★★	1-2 years	% Complete
CU-01	Document and share lessons learned from TSMO projects district-wide and throughout the region.	Operations	Partner Agencies	$	★★★	1-2 years	Yes/No
0W-01	Evaluate training and development of existing staff and new staff to continue to leverage data and technology in traffic management activities.	Operations	Operations	$$	★★★	1-2 years	% Complete
CO-01	Identify ways to collaborate with partner agencies from the inception of a project. - Include the discussion of TSMO during MPO TAC meetings.	Operations	Partner Agencies	$	★★★	1-2 years	Yes/No
Year 3 - 5 Actions							
ST-03	Update the existing Lower Rio Grande Valley (Pharr) Regional ITS Architecture documents to be ARC-IT 9.2 compliant. - Conduct multi-agency training on ITS Architecture to ensure all stakeholder agencies are developing TSMO/ITS projects in compliance with the Architecture. - Evaluate a web-based, interactive and user-friendly version of the Regional ITS Architecture that is easy to reference and update.	Operations	Partner Agencies	$$	★★★	3-5 years	Yes/No
CO-02	Explore partnerships with private application developers to share traveler information data with them (e.g., share construction data with Google/Waze).	TRF	Operations	$$	★★★	3-5 years	Yes/No
Work Zone Management							
Year 1 - 2 Actions							
BP-01	For significant projects, evaluate the use of planning-level traffic analysis (e.g., FREEVAL, QuickZone, VISSIM, DynusT) and predictive safety analysis tools to configure WZs (duration, extent, and number of WZ-taken lanes).	TP&D	Construction	$$	★★★	1-2 years	Yes/No
BP-02	For significant projects, evaluate the need for and type of WZ ITS based on the TxDOT SWZ Guidelines and Go/No-Go Decision Tool (LINK).	Operations	Construction	$	★★★	1-2 years	Yes/No
BP-03	Develop a process to coordinate lane closures among multiple projects and agencies to achieve work zone management objectives.	Operations	Construction	$$	★★★	1-2 years	Yes/No
BP-04	For significant projects, evaluate integration of incident management through work zones	Operations	Operations	$	★★★	1-2 years	Yes/No
ST-01	Pilot test SWZ technologies to identify use cases and mainstream SWZ deployments.	Operations	Construction	$$	★★★	1-2 years	Yes/No
PM-01	Define safety- and mobility-based goals and performance measures to inform continuous improvements within WZs.	TP&D	Operations	$$	★★★	1-2 years	Yes/No
CU-01	Discuss Work Zone safety and lessons learned in Supervisors' and Construction meetings.	Construction	Operations	$	★★★	1-2 years	Yes/No
CU-02	For significant projects, document and share with relevant staff/stakeholders the WZM successes and improvement opportunities to develop actions for future projects.	Construction	Operations	$	★★★	1-2 years	Yes/No

ID	Action	Lead	Support	Cost	Impact	Timeframe	Measure of Success
CO-01	Identify ways to enhance collaboration with law enforcement during WZ activities (e.g., use of CAD data, WZ enforcement, incident response).	Operations	Construction	$$	★★★	1-2 years	Yes/No
CO-02	Collaborate with partner agencies on coordination of construction projects and sharing data that may help address construction impacts.	Operations	Construction	$$	★★★	1-2 years	Yes/No
CO-03	Identify ways to enhance collaboration with the private sector and stakeholders during WZ activities: - Collaborate with fleet operators to provide information on road closures. - Provide regular construction updates via social media platforms/project websites.	Operations	Construction	$$	★★★	1-2 years	% Complete
Year 3 - 5 Actions							
BP-05	Develop a Transportation Management Plan for significant project WZs, and document safety and mobility performance measures and TSMO elements: - Utilize WZM strategies listed under Table 4.1 of FHWA's "Developing and Implementing Transportation Management Plans for Work Zones." (LINK) - Document how ITS/SWZ elements are evaluated to improve WZ mobility, safety, and monitoring capabilities - Document how social media, crowdsourcing, and connected-vehicle technology are evaluated to improve traveler information.	Operations	Construction	$$	★★★	3-5 years	Yes/No
ST-02	Assess whether the application of existing and/or new technologies to manage traffic and measure system performance would enhance WZ operations and safety.	TP&D	Operations	$$	★★★	3-5 years	Yes/No
PM-02	On significant projects, collect real-time and historical performance measures on travel speed, travel time, traffic volumes, queue lengths, and crashes: - Utilize performance measures to monitor WZ performance and to develop safety and mobility countermeasures. - Utilize performance measures from multiple projects to continually evaluate and improve WZ policies and procedures. - Utilize historical WZ performance measures and planning-level analyses to develop WZM funding needs for upcoming projects.	TP&D	Operations	$$	★★★	3-5 years	% Complete
OW-01	Establish periodic WZM training to: - Regularly update WZM knowledge and skills to incorporate latest industry advances within the TxDOT practice. - Cross-train staff to improve understanding of all aspects of WZM. - Capture, share, and refine institutional WZ knowledge within TxDOT.	Construction	Operations	$$	★★★	3-5 years	% Complete

6 TSMO TACTICAL PLAN ASSESSMENT

Tactical plans build upon the higher-level recommendations provided in a TSMO Program Plan related to specific services, projects, and programs and provide more detailed recommendations and actions to operationalize them. Tactical plans include discussion and analysis of existing conditions, needs and gaps, opportunities and challenges, recommendations including responsibilities and staffing, and a more detailed cost estimate for implementation. Examples of tactical plans created by TxDOT-PHR include the 2003 Lower Rio Grande Valley Regional ITS Architecture (LINK), and the 2022 ITS Master Plan.

6.1 Tactical Plan Criteria

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

- Alignment with TxDOT-PHR TSMO goals.
- Stakeholder partnerships necessary for implementation.
- Anticipated initial and ongoing costs.
- Level of district-staff effort.
- Expected return on investment.

6.2 Tactical Plan Components

The following components will be included in each tactical plan:

- Documentation, discussion, and analysis of existing conditions, including existing processes, systems, roles, and responsibilities.
- Identification of gaps and development of needs based on tactical plan objectives.
- Discussion of institutional and technical challenges in addition to opportunities to support TSMO advancement developed in conjunction with stakeholders.
- Recommendations related to enhancement of activities or addition of new activities to advance TSMO elements.
- Budgetary requirements and schedule for implementation.
- Performance measures to track progress of the proposed activities.

6.3 Recommended Tactical Plans

TSMO tactical plans recommended for TxDOT-PHR are summarized in Table 16.

Table 16: TxDOT-PHR TSMO Tactical Plan Recommendations

Tactical Plan	Supported District TSMO Goals						Lead	Support	Cost	Impact
	Safety	Reliability	Efficiency	Customer Service	Collaboration	Integration				
Traffic Management Center Concept of Operations	X	X	X	X	X	X	Operations	First Responders, City of Brownsville, City of Edinburg, City of Harlingen, City of McAllen, City of Mission, City of Pharr, Webb County, RGVMPO	$$	★★★★
Regional ITS Architecture Update					X	X	Operations	First Responders, City of Brownsville, City of Edinburg, City of Harlingen, City of McAllen, City of Mission, City of Pharr, Webb County, RGVMPO	$$	★★★
Traffic Incident Management Plan	X	X	X	X	X		Operations	First Responders, City of Brownsville, City of Edinburg, City of Harlingen, City of McAllen, City of Mission, City of Pharr, Webb County, RGVMPO	$$	★★★★
Traffic Signal Management Plan	X	X	X	X	X	X	Operations	First Responders, City of Brownsville, City of Edinburg, City of Harlingen, City of McAllen, City of Mission, City of Pharr, Webb County, RGVMPO	$$	★★★

7 REFERENCES

- Texas Transportation Plan 2050.
- TxDOT Transportation Systems Management & Operations.
- TxDOT (2018) Transportation Systems Management and Operations (TSMO) Statewide Strategic Plan.
- TxDOT Performance Dashboard. Accessed June 2022.
- TxDOT (2023) Unified Transportation Program
- Lower Rio Grande Valley (2003) Regional ITS Architecture
- TTI's Urban Mobility Report – Congestion Data for Your City
- TxDOT-PHR District (2022) ITS Master Plan
- Federal Highway Administration (2017) Developing and Sustaining a Transportation Systems Management & Operations Mission for Your Organization: A Primer for Program Planning (FHWA-HOP-17-017).
- FHWA (2020) Capability Maturity Frameworks Overview
- US DOT (2021) Architecture Reference for Cooperative and Intelligent Transportation (ARC-IT)
- FHWA (2015) Transportation Systems Management and Operations Benefit-Cost Analysis Compendium.
- FHWA (2005) Developing and Implementing Transportation Management Plans for Work Zones

APPENDIX A

List of TxDOT and Partner Agency Members

TxDOT Pharr TSMO Leadership Engagement and Outreach Plan - Contact List

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TxDOT Pharr TSMO Leadership Engagement and Outreach Plan - Contact List

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