TxDOT Statewide TSMO Policies and Procedures

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Prepared By

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DOCUMENT CONTROL		
Date	Version	Description
1-15-21	1.0	Traffic Safety Division Review (Prepared by AECOM)
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List of Acronyms

Acronym	Definition
CE	Categorical Exclusion
CMAQ	Congestion Mitigation and Air Quality
DCC	Design Concept Conference
DCIS	Design and Construction Information System
DMS	Dynamic Message Sign
DSR	Design Summary Report
FAHP	Federal Aid Highway Program
FHWA	Federal Highway Administration
FONSI	Finding of No Significant Impact
ITS	Intelligent Transportation Systems
MPO	Metropolitan Planning Organization
MPPM	Modernize Portfolio and Project Management
NEPA	National Environmental Policy Act
NHS	National Highway System
PS&E	Plans, Specifications and Estimate
ROD	Record of Decision
SWZ	Smart Work Zone
TIM	Traffic Incident Management
TMC	Transportation Management Center
TSMO	Transportation Systems Management & Operations
TTP	Texas Transportation Plan
TxDOT	Texas Department of Transportation
USMCA	United States-Mexico-Canada Agreement

1.0 Introduction

Texas roads are busier than ever, and more drivers on the roadways increases the potential for crashes and congestion. The Texas Department of Transportation (TxDOT) is addressing these issues through the implementation of Transportation Systems Management & Operations (TSMO) and has developed a Statewide TSMO Strategic Plan. TSMO is a strategic approach to proactively improve mobility for all modes of transportation by integrating planning and design with operations and maintenance to holistically manage the transportation network and optimize the existing infrastructure.

This technical report analyses relevant processes in TxDOT's "Project Development Plan" from a TSMO perspective. It is recommended that TSMO be considered early in the project development process and adopted TSMO strategies advanced through the schematic, design, construction, operations, and maintenance phases.

What is Transportation Systems Management and Operations (TSMO)?

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

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

TxDOT TSMO Vision and Mission Statement

TxDOT has adopted a TSMO vision and mission statement as presented below.

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

In support of the above TSMO vision and mission statements, the initial TxDOT "Statewide TSMO Strategic Plan" was issued on August 21, 2017 then updated during May 2020.

How can TSMO Policies and Procedures enhance Project Delivery?

TSMO includes efforts to operate the multimodal transportation system and activities to manage travel demand crossing over political, modal, and jurisdictional boundaries. TSMO expands beyond just roads. It emphasizes the door-to-door experience, regardless of the modes of travel. TSMO requires agencies to look beyond a project or a corridor and consider the impacts of the entire transportation system. This involves coordination and collaboration among multiple stakeholders, such as federal, state, and local agencies, the first responder community, and the private sector to achieve seamless interoperability.

TSMO analyzes performance from a systems perspective, not just one strategy, project or corridor. This means that these strategies are coordinated with others across multiple jurisdictions, agencies, and modes. Integration views the surface transportation network as a unified whole, making the various transportation modes and facilities work together and ultimately perform better. TSMO not only provides public agencies with a growing toolbox of individual solutions but encourages combining them to achieve greater performance on the entire system. Integration can happen on multiple levels:

- **System** – Implementing and combining strategies as a corridor or region matures in needs.
- **Technical** – Developing a framework used to support information sharing between technology deployed on the system.
- **Cultural** – Developing a workforce that values and prioritizes the use of TSMO solutions across multiple disciplines.
- **Operational** – Coordinating day-to-day operational strategies so that corridor, region, or system-wide objectives are achieved.
- **Institutional** – Incorporating TSMO policies and processes into an agency's normal way of doing business. This step includes TSMO integration with various disciplines, such as planning, program management and design, to support long-term goals for the transportation system. This can be applied both internally and externally.

Consideration and formal adoption of TSMO strategies early in the project development phase and carrying these strategies through the schematic, design, construction, operations, and maintenance phases can enhance mobility and safety of the traveling public.

2.0 TSMO Benefits in the Project Development Process

2.1 TSMO and Planning

As cooperative automated transportation and other emerging technologies begin to change the dynamics of our transportation systems, including TSMO in the early planning phase is critical to embrace these technologies and operating strategies. This will provide travelers flexibility in selecting routes, schedules, and modes during their trip planning to help balance transportation supply and demand. This will result in improving mobility, safety, and congestion relief for moving people and goods.

Planners collect data from relevant sources that are available; analyze it and input the data into travel demand forecasting models to predict future traffic conditions and identify bottlenecks; and test mitigation measures. TSMO strategies should be considered as a complementary (or separate) mitigation measure in addressing existing or forecasted congestion. It is recommended that planners and system operators discuss TSMO strategies early in the planning phase and identify appropriate measures of effectiveness to improve system reliability and performance.

TxDOT and MPOs should work together in mainstreaming TSMO to address short and long-term transportation objectives that drive state, metropolitan, corridor, and subarea planning and operations. Working together, planners and operators can develop innovative institutional arrangements that share resources, provide mutual assistance, agree on interoperability standards, and share real-time and archived data.
The discussions and analysis required by the Congestion Management Process offer an opportunity to include a wider variety of operators and planners in discussions about non-recurring congestion and travel time reliability.

2.2 TSMO and Environment

TSMO strategies typically contribute to more effectively managing congestion resulting in environmental benefits such as reduced emissions and fuel consumption. TSMO strategies related to traffic incident management contributes to faster and safer clean-up of incidents involving hazardous materials.
Applying TSMO travel demand management strategies results in the efficient movement of people and goods and prioritizes environmentally friendly modes such as walking, cycling, ridesharing, public transit, and telework. The congestion management process conducted by MPOs provides an important connection between air quality and TSMO, especially in transportation management areas designated as ozone or carbon monoxide non-attainment areas.

The Congestion Mitigation and Air Quality Improvement (CMAQ) Program, provides funding to surface transportation projects and other related efforts that contribute air quality improvements and provide congestion relief. Surface transportation projects with TSMO strategies can reduce emissions rates in many situations and can be eligible for CMAQ funding. For example, adjusting traffic signal timing, or applying traffic adaptive systems, may reduce fuel consumption by 7%.

2.3 TSMO and Design

TSMO is a cost-effective approach to improving transportation safety and reliability. TSMO can be an alternative to adding new capacity or reducing additional capacity needed. TSMO and technology needs can be incorporated into a traditional design to preserve capacity and extend the functional life of the facility. TSMO strategies can help resolve or mitigate substandard or problematic geometrics and be applied as a useful performance-based design tool.

TSMO strategies can be implemented at each point of the design process to improve project outcomes and long-term operational efficiency. Agencies benefit from developing formal policies and procedures for including TSMO strategies and making operational considerations throughout the design process.

The initial step is to identify the problem that needs to be resolved and the potential application of TSMO strategies. During this phase, consideration should be afforded to defining how the design will influence operations and maintenance decisions and whether interagency agreements are needed.

Designing with TSMO in mind results in several benefits, including:

- A safer and more operationally efficient facility design for all users (motorized and non-motorized), emergency responders, maintenance staff, and other operators.
- Lower costs for future operational and intelligent transportation systems (ITS) deployments, as foundational ITS infrastructure can be included in highway designs during construction.
- Less congestion and greater travel time reliability from the implementation of TSMO strategies.

2.4 TSMO and Construction

TSMO is integral to effective work zone management. TSMO strategies can encourage travelers to use alternate routes during construction, reduce congestion, and enhance the safety of construction crews as well as motorists approaching the work zone. TSMO strategies in construction can provide road users with up to date information about planned work while offering mobility alternatives. TSMO strategies may involve public information officers to coordinate with the media and share information on alternate routes and forecasted travel times in and around work zones. TSMO strategies need to be discussed with construction staff during design to determine the most appropriate strategies and how existing or temporary ITS can be deployed to monitor and manage traffic.

In addition to work zone management, TSMO offers several important benefits to construction stakeholders. TSMO strategies support accelerated construction methods that reduce construction time. For example, full closures (in one or both directions) can lead to more efficient project delivery while minimizing extended disruptions to the public. TSMO analytical tools can help assess the feasibility of full closures and evaluate alternate routing.

TSMO can increase the available capacity of transportation facilities though better management of demand and flow disruptions. Timely and accurate traveler information is a primary function of TSMO programs.

Including Transportation Management Centers (TMC) and Public Information Office staff is critical for the success of TSMO construction strategies.

TSMO strategies should include monitoring of roadway closures and construction activities by the TMC. TMC operators can quickly and efficiently address incidents or other issues on the roadway. Alternate routes can benefit from adjusted signal timing during construction to reduce impacts to automobiles, pedestrians, and bicyclists. TSMO strategies can include incident management plan for work zones that may include Highway Emergency Response Operators, pre-positioned tow and recovery vehicles, and rapid response to incidents near or in the work zone. Incident plans can include TSMO strategies to safely and quickly clear incidents and return traffic to its normal flow, reducing congestion and the risks of secondary incidents.
TSMO strategies should consider applicable Smart Work Zone strategies such as the following:

- Temporary Queue Detection System
- Temporary Speed Monitoring System
- Temporary Construction Equipment Alert System
- Temporary Travel Time System
- Temporary Incident Detection and Surveillance System
- Temporary Over-Height Warning System

In 2018, TxDOT developed “Smart Work Zone (SWZ) Guidelines”. This document presents the basic guidelines for the consistent and uniform application of SWZs in Texas and should be used in the design and implementation phases of a construction project, as applicable. The Guidelines includes the following information:

- Description of each SWZ system
- Identification of data needs
- Conceptual layout drawings for each system
- Criteria and selection process for determining feasibility
- Design guidelines, metrics

The timeline showing the TxDOT construction process and SWZ life cycle is shown in Figure 1.

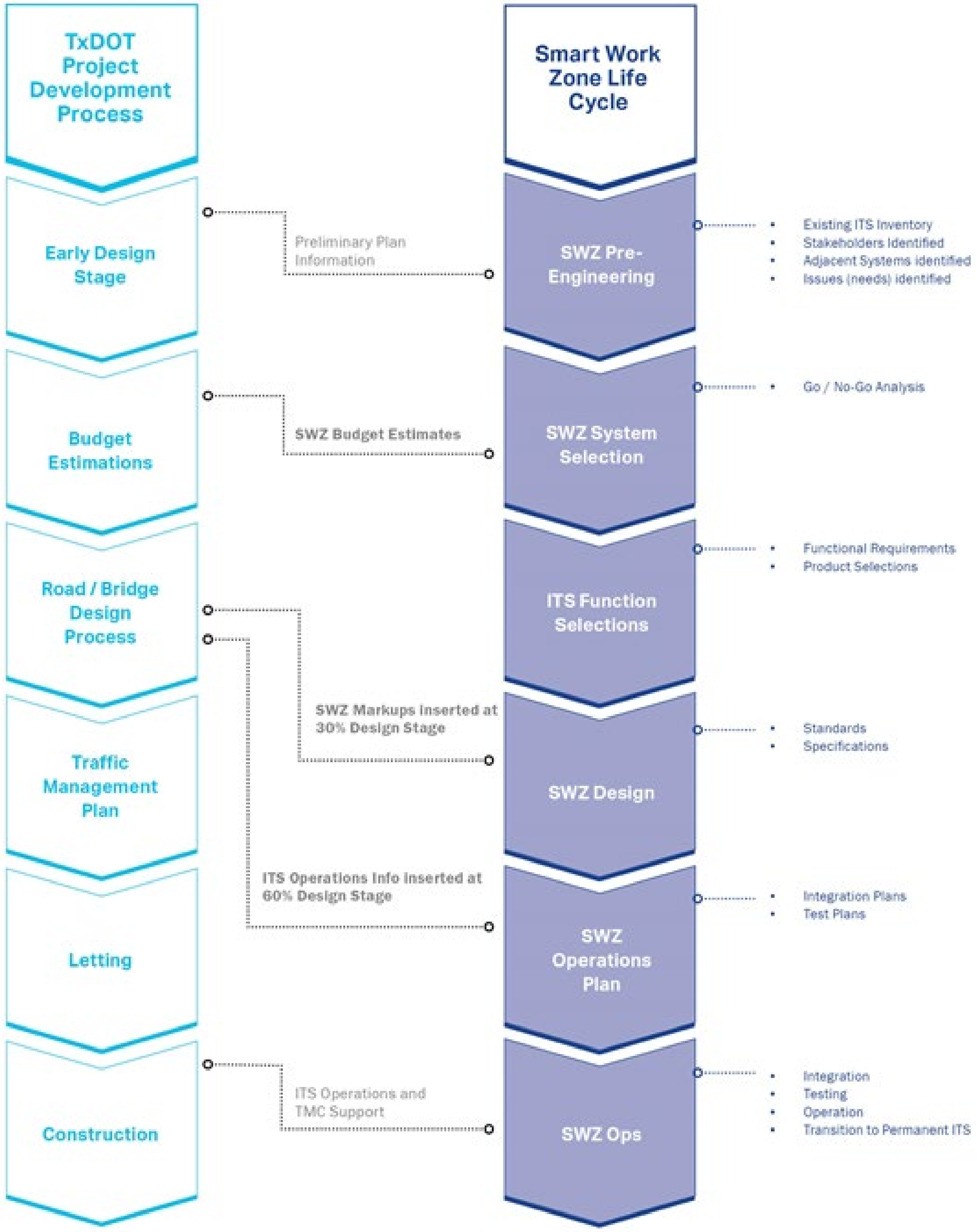

Figure 1: Timeline showing the TxDOT Construction Process and Smart Work Zone Life Cycle

3.0 TxDOT's Project Development Process

TxDOT's Project Development Process Manual is a document that guides engineers through the process of developing a roadway project. TxDOT developed this manual that provides direction on Planning and Programming, Preliminary Design, Environmental, Right-of-Way, Utilities, Plans, Specifications & Estimates (PS&E), and Construction Letting. This section provides an overview on how the project development process relates to TSMO strategies and how the process can improve by implementing TSMO.

3.1 Planning and Programming

Chapter 1 of the Project Development Manual discusses the tasks of identifying and documenting the need for a project. The need for a project may be identified in many ways, including suggestions from maintenance supervisors, area engineers, district staff, planning organizations, local elected officials, developers, and the society served by transportation planning and programming. Once a project is identified, research should be conducted to prioritize the need for one project relative to others competing for limited funds. This process includes the following tasks:

Identify Project Need and Scope

Many factors are considered in determining project need including crash frequency and severity, pavement condition, bridge condition, conformance with current geometric standards, security, trends, issues associated with demand for moving people and goods, resiliency, and the Texas Transportation Plan (TTP) goals and objectives.

Recommendations: *Projects need to be analyzed from a TSMO perspective beginning by fully understanding the problem that needs to be solved. Is it safety? Is it congestion? Is it traffic signal timing progression? Once a problem is identified, its solution needs to be analyzed from a systems perspective to determine how partner agencies could support the proposed improvements and to coordinate with other projects where there may be overlapping (or conflicting) impacts.*

Perform Site Visit

Site visits should be performed to properly assess project needs to adequately design a project. Although maps, satellite imagery, or aerial photography may provide an overview of a project area, a site visit is essential to obtain a complete understanding of the project area. The purpose of the visit is to identify needed improvements and physical or environmental constraints. Planning stage site analysis of land, location, and possible environmental impacts can improve scope development and reduce key features oversight. Documents and media files gathered during a site visit by subject matter experts can aid preliminary design and project estimate development.

Recommendations: *Site visits provide a better understanding of the issues. Reviewing tire marks on the pavement, existing signage and how traffic reacts to certain conditions can provide an enhanced perspective of the situation. Site visits can also provide a better visual to understand traffic congestion. Research has shown that while some congestion may be caused by typical morning and evening rush hours, a significant amount of congestion may result from non-recurring events, such as crashes, breakdowns, work zones, bad* *weather, and special events. In many cases, roadway capacity is not lost due to bottlenecks or limited capacity, but due to these unexpected events. There may be opportunities to quickly apply low-cost TSMO improvements that are targeted toward these specific causes to reduce their impacts. Low-cost TSMO strategies could be as simple as signalization, channelization or traffic calming, or traffic incident management strategies.*

Public Safety Planning

Given Texas' geographic location and impact on state and national economies, it is essential to consider security for the Texas transportation network which serves public mobility, economic development, and productivity. Texas has an international border, a long coastline attracting visitors and accommodating a mega-region bound by several Interstates, as well as more than two dozen ports and ferry services. The United States-Mexico-Canada Agreement (USMCA) has increased the amount of regional and national freight traffic passing through the Texas Triangle. Texas ports serve military and multinational commercial business and will serve deep-water post-Panamax ships carrying freight distributed by truck, air, and rail. Having a long coastline places megapolitan areas at risk to natural disasters. Texas is also a significant national and international supplier of energy products with refineries and distribution infrastructure near the Texas transportation network.

Recommendations: *At the inception of any project, develop a TSMO team and consider strategies that could make a roadway safer from all perspectives, particularly the motorists by proposing ITS technologies. Such technologies may include wrong way detection systems, dynamic message signs, lane management systems, and cooperative automated transportation applications.*

It is recommended that a TSMO team composed of transportation engineers and first responders develop a plan to detour traffic around an incident keeping traffic flowing as much as possible. TSMO and Traffic Incident Management (TIM) teams should consider and take advantage of the latest technologies to communicate to the driver, as well as among each other, to reduce delays and incident clearance timelines.

TSMO teams should consider locating ITS devices so as to not require lane or shoulder closures impacting traffic flow during maintenance. ITS devices should be located in an accessible area behind metal beam guard fence or barrier to address safety of maintenance staff. In addition, a concrete platform should be provided for maintenance personnel to be able to park their vehicles safely.

Two of the most congested areas in the United States are in Texas - Houston and Dallas-Fort Worth. Houston truck congestion cost is $522 million annually, 96 million gallons of fuel wasted per year. Reducing congestion by implementing TSMO strategies can greatly improve the economy of the region.

3.2 Preliminary Design

Chapter 2 in the Project Development Manual describes preliminary activities to define the general project location, design concepts, and activities to establish parameters for final design.

The Preliminary Design Concept Conference is a meeting of key individuals for establishing fundamental aspects of a project. The conference facilitates agreement to basic project features by concerned parties and enhances relationships among those parties. Preliminary design activities undertaken prior to environmental clearance should not materially undermine consideration of project alternatives. This process includes the following tasks:

Conduct a Preliminary Design Concept Conference

A Preliminary Design Concept Conference (DCC) is a meeting to establish and agree on fundamental aspects, concepts, and preliminary design criteria of a project. Supporting documents constitute an understanding of basic features of the project by Federal Highway Administration (FHWA), TxDOT divisions, TxDOT district office, and local government agencies.

The Design Summary Report (DSR) is a dynamic document. It contains the record of project development and design. Used as a preliminary DCC guide, the DSR will help ensure that the project team does not overlook potentially critical issues. While all items will not be applicable to all projects, overlooking any item may significantly delay the project. Although the project is in a preliminary phase and fundamental aspects have not reached detailed development, the DSR should be updated with known data; information detail can be added as the project progresses to the detailed PS&E level of development. The DSR remains with the project records from creation to eventual archival or destruction.

Recommendations: *During the DCC a TSMO team should considers and analyze TSMO strategies to improve mobility, capacity and safety of this project. If the project is located in a multi-jurisdictional area, improvements should be considered in coordination with other agencies. For example, if ITS is deployed along the corridor with a single fiber duct bank it may be shared between agencies. In this example, traffic signals could be operated and maintained by a city while CCTV cameras and DMS could be operated by the State.*

Each district or region develops their own TSMO checklist identifying low cost and technology solutions to maximize the mobility and safety of a corridor. In addition to the DSR, it is recommended the TSMO team fills out this TSMO checklist and confirms all strategies are considered and analyzed for the corridor.

Analysis of Environmental Impacts and Mitigation

TxDOT has review responsibilities for the National Environmental Policy Act (NEPA) assignment for projects funded by the Federal Aid Highway Program (FAHP) and any other Federal environmental law with respect to transportation projects. Environmental review responsibilities should be started as early as possible during the project to avoid future delays. This comprehensive assessment of potential and existing human and natural environmental risks for a proposed federal action starts with a defined needs and objectives of the project and alternatives. The completed NEPA document is a detailed single source of information for project decision makers.

The NEPA decision occurs when a Categorical Exclusion (CE), Finding of No Significant Impacts (FONSI), or Record of Decision (ROD) is issued. Final design activities may not be advanced until a NEPA decision has been issued.

Recommendations: *Although in most cases TSMO does not have direct impacts on the NEPA process, the implementation of TSMO strategies can indirectly provide benefits to the environment.*

Right-of-Way Determination
Right-of-way is a function of project development. The project team needs a method to incorporate and control factors affecting right of way determination. During a Preliminary Design Concept Conference, proposed project limits, impacts, and physical and financial constraints should be studied.

Recommendations: *Right-of-way acquisition can be a lengthy process that delays implementation of roadway improvements allowing for further deterioration of traffic conditions. TSMO strategies should be considered as an alternative to addressing safety and congestion relief as an alternative to right-of-way acquisition.*

3.3 Environmental

A sustainable highway approach provides decision makers with balanced choices among environmental, economic, and social values that will benefit current and future road users. In early project development, it is vital to identify the environmental, economic, and social concerns regarding a project. Identifying a project's environmental variables should be conducted concurrently with developing the preliminary schematics and determining utility and right of way ownership.

Recommendations: *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 extra capacity is needed. Implementation of TSMO strategies can benefit economic and social values of the current and future road users. The environmental benefits associated with TSMO include the following:*

- Improved quality of life
- Smoother and more reliable traffic flow
- Improved safety
- Reduced congestion
- Less wasted fuel
- Cleaner air
- Increased economic vitality

3.4 PS&E Development

The PS&E development process includes the following tasks:

3.4.1 Design Conference

The design conference provides the opportunity for key staff to review basic design criteria and parameters, accept or change them, and formally endorse decisions. These decisions provide a foundation for the design team to commence detailed design work for PS&E production.

During the Preliminary Design Concept Conference, a Design Summary Report (DSR) is created. This document should be updated as the project progresses and activities are performed. The DSR is an auditable record of project development, which should be stored in the project File of Record. It is recommended that the TSMO team fills out the TSMO checklist and confirms all strategies were considered and analyzed for the corridor.

3.4.2 Begin Detail Design

This period of project development requires a substantial amount of the project manager's experience and attention. Decisions made during this time will directly affect the project schedule and quality. Input from the project manager's peers and supervisor should be sought for quality assurance of the project development process. The design field survey, stream crossing hydraulics, and pavement design should be completed before detailed plan development. Additionally, Design Division approval of geometric schematics for new location or added capacity projects should be obtained before beginning detailed design. Traffic control and permits/agreements may delay the project, if not handled properly at the beginning of detailed design.

Section 3.4.3 includes the following groups of tasks which may be performed concurrently:

3.4.3 Operational Design

Operational design involves subsections of Illumination, ITS, Signals, and Signing/Striping. Construction plans result from each of the tasks within this section. **This is where TSMO strategies are identified and put into action.** Strategies that advance from the Design Concept Conference will be converted to ITS devices and operational strategies. This includes the following groups of tasks which may be performed concurrently.

- Design illumination
- Design ITS
- Design signalization plan
- Design signing and pavement markings

- Operational Strategies may include:
    1) Work Zone Management,
    2) Road Weather Management,
    3) Traveler Information,
    4) Traffic Incident Management,
    5) Rural Emergency Response,
    6) Traffic Signal Coordination,

7) Commercial Vehicle Operations,

8) Ramp Management,

9) Active Traffic Management,

10) Integrated Corridor Management,

11) Managed Lanes.

- Channelization - can be used to restrict or direct traffic flow or to change a roadway's type. It can allow motorists to move at different speeds and in conflicting directions as well as provide areas for pedestrians. Channelization can be created with pavement markings, islands or curbs.
- Delineation - refers to methods used to define vehicular travel paths for drivers. Delineation can include one or a combination of devices used on and adjacent to the roadway, such as painted, thermoplastic, or other durable pavement markings (e.g., chevrons), light retroreflecting guideposts and post-mounted delineators, raised pavement markers and rumble strips. Delineation is often part of channelization.
- Low-cost safety enhancements - are a collection of minor operational roadway improvements that allow TxDOT to increase safety without expending major resources or without a major planning or design effort. Some examples of low-cost safety enhancements include (1) adding clear zones at the side of the road to provide a clear, traversable area in which a vehicle can recover if it runs off the roadway; (2) additional signing and stripping, (3) traffic calming features, (4) installing new rumble strips or altering existing ones, to reduce the risk of run-off-the-road crashes.
- Signage - regulates the flow of traffic and provides information, guidance, and warnings to drivers and other roadway network users, such as pedestrians and bicyclists. TxDOT publications such as the Texas Manual on Uniform Traffic Control Devices provides standards and guidance for roadway signage. Installing signage is often a low-cost TSMO solution. Linking signs with message boards or flashing lights to detectors can create smart signs.
- Traffic calming - relies on physical design and other measures to slow vehicle speeds and reduce traffic volumes by obstructing traffic flow and by increasing the cognitive load of drivers. The goals of traffic calming include altering driver behavior, improving conditions for non-motorized street users and reducing the impacts of motor vehicle use. Furthermore, technologies such as variable message signs posting driver’s speed may be considered.

3.4.4 Traffic Control Plan

A Traffic Control Plan consists of the following elements:

- Sequencing of construction staging and phasing plan
- Detour plan (when required)
- Temporary signing, striping and pavement marking plan

Traffic control plans should clearly show provisions to efficiently move road users through or around a work zone with minimal delay and minimize potential hazards to motorists in the vicinity of a work zone and to people within the work zone exposed to traffic. Coordination of work zone impacts may extend beyond the physical location of the work zone and to all modes of transportation, workers, and/or the regional transportation network. The scope of the plan procedures should be based on the project characteristics to provide optimal development of the project Traffic Control Plan.

Recommendations: *Traffic control plans can benefit from inclusion of TSMO strategies. Transportation engineers and first responders should meet and discuss approaches to TSMO that may be implemented in traffic control plans. Strategies that can be deployed in work zone areas include Smart Work Zones, temporary and portable CCTV cameras, message boards. These systems can be deployed along the construction zones as well as alternate routes.*

Traffic signals along the corridor should have special timing plans developed for use during construction.

The use of big data providers such as Inrix, Google, WAZE as well as data collected by field devices could be used to develop a work zone monitoring dashboard that can monitor the health of a corridor and evaluate performance metrics. Furthermore, this dashboard could be shared with project stakeholders and agencies within the project's jurisdiction.

4.0 Modernize Portfolio and Project Management

The goal of the Modernize Portfolio and Project Management (MPPM) initiative is to automate the delivery of TxDOT's transportation programs including portfolio management, project management, contract management, asset management, and letting management. The vision of the MPPM initiative is presented in Figure 2.

System capabilities	Organizational capabilities	Process design	Decision support/analytics
Single source of truth for project data	Develop cross-functional teaming	Create phase gates, process controls	Facilitate data-driven decision making
Eliminate dual entry and automate low-value, manual tasks	Automate, enhance communication	Streamline workflows	Provide what-if scenario forecasting
Deliver intuitive, simple functionality	Ease information-sharing	Share best practices	Incorporate historical & forecasted data analytics in decisions
Increase visibility to public	Drive accountability for project outcomes	Reduce re-work	Implement common performance metrics
Move to reliable supportable software (from complex legacy)	Reduce employee on-boarding time	Standardize data & reporting formats	Track cost drivers, budget, payout, & earned value

Figure 2: Modernize Portfolio and Project Management Vision

The MPPM initiative has since transformed into TxDOTCONNECT. The first release of TxDOTCONNECT (April 2019) focused on construction projects and consolidated Design and Construction Information System (DCIS) functionality. It introduced a web-based, user-friendly system with geo-spatial mapping, new reporting capabilities and automated workflows to assign resources to projects. The next release (October 2019) enabled TxDOT staff and external partners to create and manage the Engineer's Estimate in TxDOTCONNECT. The most recent release (June 2020) of system functionality consolidates Right of Way and Utilities project information in TxDOTCONNECT, eliminating dual data entry in multiple systems and spreadsheets, and improving collaboration among TxDOT staff and external partners. Key benefits of TxDOTCONNECT are:

- Modern, web-based, user-friendly, and custom system;
- Standardizes data and reporting formats;
- Automates workflow between stakeholders;
- Provides a single source for project data;
- Introduces geospatial mapping functions;
- Makes information easier to access and share; and
- Consolidates the functionality of up to 40 legacy systems with an enterprise-wide system to plan, manage and measure transportation programs.

Recommendations: Continue implementing system enhancements to introduce new functionalities and consolidate legacy systems. In addition, document lessons learned and apply applicable enhancements as part of a continuous improvement process.

5.0 Recommendations

It is recommended that TSMO strategies be included early in the project development phase and advance the selected strategies through the schematic, design, construction, operations, and maintenance phases. Specifically, the recommendations include the following:

- Include TSMO in the early **planning** phase is critical to incorporate emerging technologies and innovative TSMO strategies.
- Consider TSMO strategies to help mitigate **environment** impacts by reducing emissions rates which can be eligible for CMAQ funding in nonattainment areas.
- Consider TSMO strategies and technology during the **design** phase to provide an alternative to adding new capacity to existing facilities.
- Consider TSMO strategies during the **construction** phase to encourage travelers to use alternate routes, reduce congestion, and enhance the safety of construction crews as well as motorists approaching the work zone.
- Develop a TSMO **champion working group** that can help TSMO initiatives gain momentum at the Division and District levels.
- Incorporate TSMO **strategies and requirements** into the Project Development Process and Manuals.
- Provide regular TSMO **training** sessions to TxDOT and regional stakeholders.

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