ITS AND TSMO STRATEGIC PLAN

October 2023

Statewide

OKLAHOMA Transportation

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List of Acronyms

ACOG Association of Central Oklahoma Governments
ADAS Advanced Driver Assistance Systems
ASCT Adaptive System Control Technology
API Application Programmer Interface
ATMA Autonomous Trailer-mounted Attenuators
ATMS Advanced Traffic Management System
ATR Automatic Traffic Recorder
AV Automated Vehicles
CAD Computer–aided Dispatch
CATT Center for Advanced Transportation Technology
CAV Connected and Automated Vehicles
CMM Capability and Maturity Model
CVISN Commercial Vehicle Information Systems
DOT Department of Transportation
DMS Dynamic Message Signs
DPS Department of Public Safety
EMS Emergency Medical Services
eVTOL Electric Vertical Take-Off and Landing
FCC Federal Communications Commission
FEMA Federal Emergency Management Agency
FHWA Federal Highway Administration
GIS Geographic Information System
GPS Global Positioning System
HAR Highway Advisory Radio
HOT High Occupancy Toll
ICM Integrated Corridor Management
ICS Incident Command System
IMO Integrating Mobile Observations
INCOG Indian Nations Council of Governments
IT Information Technology
ITE Institute of Transportation Engineers
ITS Intelligent Transportation Systems
lidar Light Detection and Ranging
JPO Joint Program Office
LMR Land Mobile Radio
MOE Measures of Effectiveness
NCHRP National Cooperative Highway Research Program
NHS National Highway System
ODOT Oklahoma Department of Transportation
OTA Oklahoma Turnpike Authority
OU Oklahoma University
PTZ Pan-tilt-Zoom
RITIS Regional Integrated Transportation Information System
ROLF Regional Operations Leadership Forum
RTKS Real-time Kinematics Systems
RWIS Roadway Weather Information System
RWM Road Weather Management
SSO State Safety Oversight
STIP Statewide Transportation Improvement Plan
SWZ Smart Work Zone
TI Traveler information
TIM Traffic Incident Management
TM Traffic Management
TOC Traffic Operations Center
TRPS Traffic-responsive Plan Selection
TSM Traffic Signal Management
TSMO Transportation Systems Management and Operations
UAV Unmanned Aerial Vehicle
USDOT U.S. Department of Transportation
VOT Value of Time
VMT Vehicle-miles Travelled
VSL Variable Speed Limit
WZDX Work Zone Data Exchange
WZM Work Zone Management

1 Executive Summary

This strategic plan details Oklahoma Department of Transportation's (ODOT's) approach to Intelligent Transportation Systems (ITS) and Transportation Systems Management and Operations (TSMO). TSMO consists of strategies and technologies that improve the safety and operations of the transportation system. TSMO includes but is much broader than ITS, which primarily comprises devices, systems, and technologies.

The need for operational improvements in Oklahoma is well documented. Oklahomans experienced an estimated 5.8 million vehicle-hours of delay in 2019, approximately 60 percent of which was from nonrecurring sources such as impacts from weather, incidents, traffic signals, special events, construction, and maintenance. TSMO strategies often provide operational and safety benefits at a much lower cost than traditional capacity improvements, and many of the strategies address nonrecurring congestion. The strategic implementation of ITS and TSMO and traditional solutions will help ODOT meet its goals of safety and security, infrastructure preservation, mobility and accessibility, economic vitality, environmental responsibility, efficient intermodal system, management and operation, and fiscal responsibility.

The recommendations of this strategic plan were developed through a combination of stakeholder outreach and Federal Highway Administration (FHWA) guidance. Key ODOT stakeholders were engaged to provide background about existing efforts and to identify and prioritize current needs and future direction. This information was supplemented by guidance from FHWA, primarily from published information for the Capability Maturity Model (CMM) for TSMO.

The plan is structured around six existing program areas – (1) Work Zone Management (WZM), (2) Road Weather Management (RWM), (3) Traffic Incident Management (TIM), (4) Traffic Management (TM), (5) Traveler Information (TI), and (6) Traffic Signal Management (TSM) – and six new program areas – (1) Freight Management, (2) Special Event Management, (3) Transit Management, (4) Congestion Pricing, (5) Integrated Corridor Management (ICM), and (6) Connected and Automated Vehicles (CAV). Existing systems are summarized, and proposed action items for each program area are provided. Business processes and resources are also addressed because they are the foundation of TSMO and ITS integration into ODOT's organization. Addressed topics include workforce development; programming and budget; communications, marketing, and outreach; data management; leadership and organization; and performance measurement and management.

To implement this plan and advance the impact of TSMO within the organization, it is recommended that additional organizational support be provided through either centralized or distributed implementation support teams. These teams will be responsible to define and prioritize actions further in each program area, including estimating needed resources and funding. After actions are prioritized, an implementation schedule can be created, assigning tasks accordingly and establishing a robust reporting and accountability process.

2 `Business Case

This strategic plan provides the business case for Transportation Systems Management and Operations (TSMO) in Oklahoma and details the program that Oklahoma Department of Transportation (ODOT) is committed to moving forward to advance operations on the state's roadway network.

2.1 Oklahoma Challenges

The transportation challenges that Oklahoma road users face are numerous and addressed broadly in the Long-Range Transportation Plan goals and objectives shown in in Table 1. At a high level, challenges can be rolled into one of several categories. Safety and mobility are typically the largest challenges that departments of transportation (DOTs) must address; these challenges affect the DOTs' related economic and environmental achievements. This report does not examine the environmental impacts, such as emissions, fuel consumption, etc., that are the result of congestion caused by challenges to mobility.

The challenges discussed in this section focus on these external challenges, and the less obvious internal challenges that are present in every organization. Examples of such internal challenges cited by stakeholders engaged for this project include references to organizational silos and other concerns regarding intra-ODOT collaboration, lack of staff and funding resources, and so forth. This TSMO plan will address those internal challenges in sections 6 and 7.

Table 1. ODOT 2045 Long Range Transportation Plan Goals.[1]

Goal Area	Goal
Safety and Security	Ensure a safe and secure transportation system for all users.
Infrastructure Preservation	Preserve and maintain the condition of Oklahoma's multimodal transportation system in a state of good repair through risk-based, data-driven decision-making processes.
Mobility and Accessibility	Facilitate the movement of people and goods, improve connectivity between regions and activity centers, and increase travel mode choices.
Economic Vitality	Provide a reliable multimodal transportation system for people and goods that coordinates with land development patterns, strengthens communities, and supports a healthy and competitive Oklahoma economy.
Environmental Responsibility	Minimize and mitigate transportation-related impacts to the natural and human environment.
Efficient Intermodal System Management and Operation	Maximize system performance and operations.
Fiscal Responsibility	Sustainably fund and efficiently deliver quality transportation projects while continuing to leverage additional resources in coordination with ODOT's partners.

[1] Source: Oklahoma Long Range Transportation Plan 2020 - 2045 Final Plan, August 2020 (https://www.oklongrangeplan.org/)

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2.1.1 Safety

Challenges related to highway safety were investigated briefly by reviewing available crash data, which resulted in identifying some interesting trends over the past several decades. Figure 1 illustrates Oklahoma's statewide history of severe crashes (injury and fatal) and vehicle-miles travelled (VMT). Although VMT have generally increased in most of the recorded history, injury crash frequencies have generally declined, and fatal crashes have remained relatively constant since the beginning of the 21st century[2]. The crash data includes the year 2020, which saw significant disruption to the travel experienced in the nation because of the worldwide Covid-19 pandemic declared on March 11, 2020[3]. In addition to the pandemic-related decrease, Figure 1 also shows an approximate 8 percent and 10 percent decrease in overall state VMT because the methodology for determining the VMT numbers in Oklahoma was updated in 2019 and 2020[4].

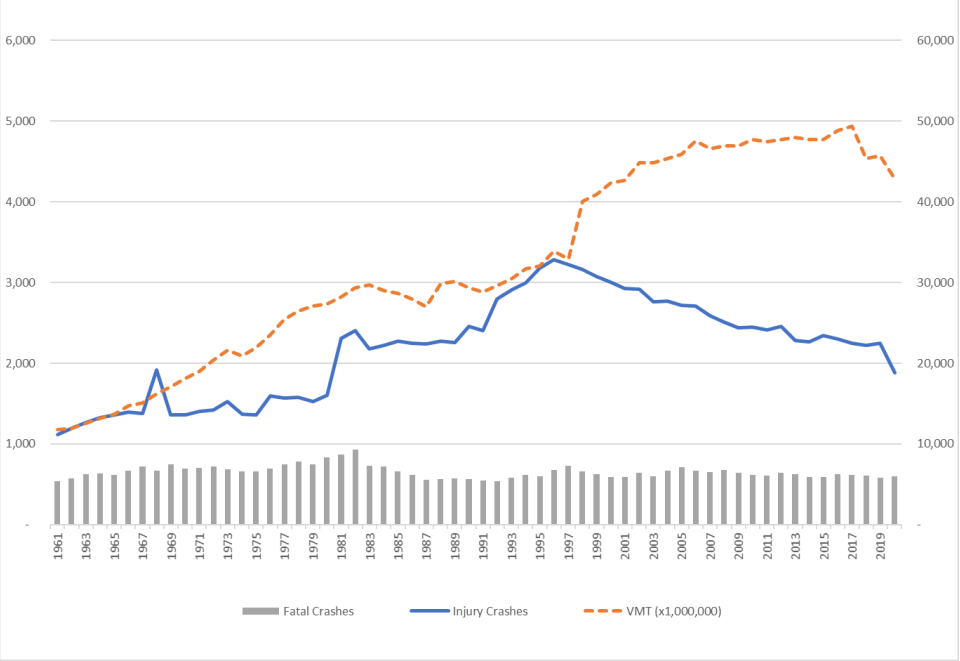

Figure 1. Oklahoma Statewide Severe Crash Data and Vehicle-miles Traveled (VMT) (1961-2020).[4]

[2] The COVID-19 public health emergency resulted in reduced VMT in 2020, yet fatal crash frequencies were relatively unchanged.

[3] Source: https://www.who.int/director-general/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19---11-march-2020

[4] Source: Historical Traffic Statistics from https://ohso.ok.gov/sites/g/files/gmc751/f/2020_s1_summarybackground.pdf downloaded 11/9/21 from https://ohso.ok.gov/crash-data2

Figure 2 depicts the breakdown of highway miles in Oklahoma and Figure 3 illustrates the distribution of crash frequencies of various characteristics from the most recently available one year of crash data (2020). Both figures show the rural/urban designations of the respective data. The data is not normalized for volume data along specific segments; however, some high-level comparisons can be made. For example, Oklahoma's urban highways represent only an approximate 15 percent of highway miles but account for 62 percent of the severe crashes in 2020. This indicates that a disproportionate distribution of severe crashes per highway-mile occur in urban areas, as can be expected because of the areas' higher traffic volumes.

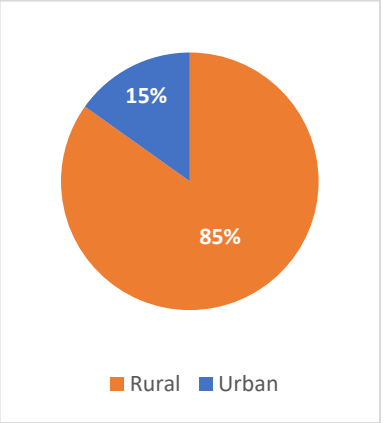

Figure 2. Statewide Highway Mileage (Rural vs. Urban).

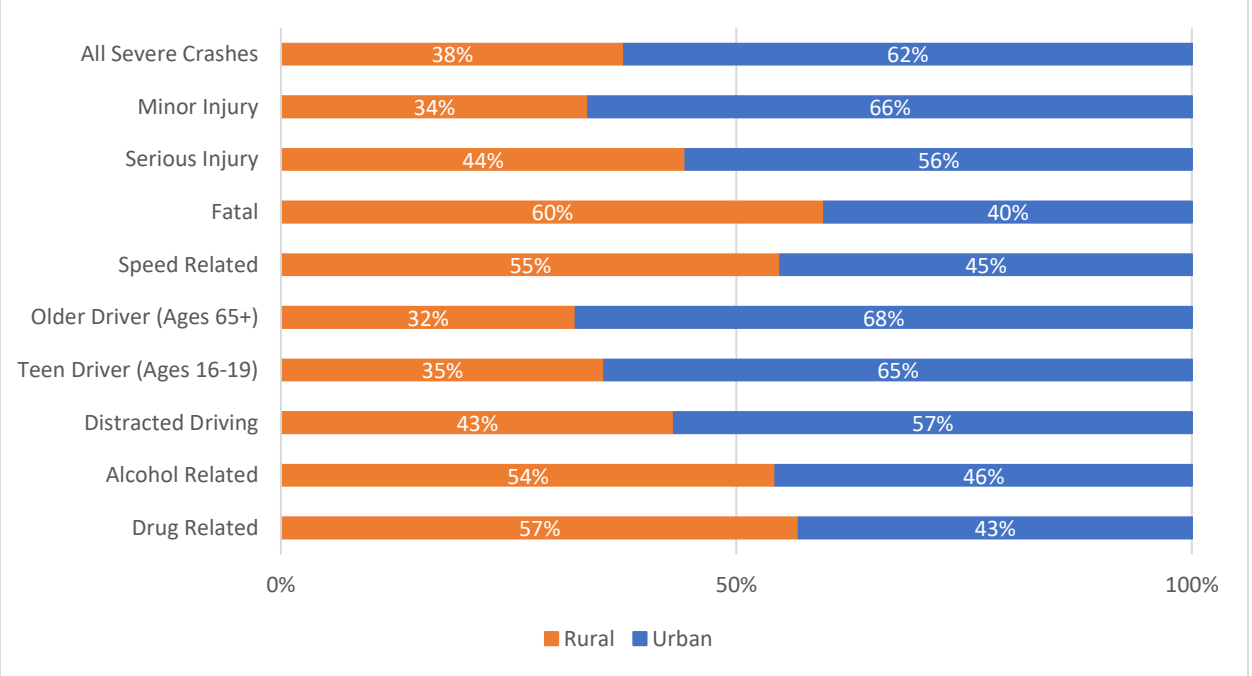

Figure 3. Oklahoma Statewide 2020 Severe Crash Data Summary (Rural vs. Urban).[5]

[5] Source: Oklahoma Interactive Crash Maps, https://ohso.ok.gov/crash-data2, summarized November 9, 2021.

2.1.2 Mobility

Challenges to mobility in Oklahoma that ODOT can address are caused by both recurring and nonrecurring congestion experienced by all road users.

Recurring congestion is caused by events that are repetitive and predictable, such as heavy congestion during morning and evening commuting periods, known bottlenecks, etc. As a result, roadway users tend to be less surprised by recurring congestion, and therefore, their travel during those periods tends to be less disrupted because they can plan their trips accordingly.

Oklahomans experienced an estimated 5.8 million vehicle-hours of delay in 2019, 59% of which was caused by nonrecurring sources.

In contrast, nonrecurring congestion is caused by events that do not occur on a regular or predictable basis. Nonrecurring congestion causes can include the impacts of road blockages because of crashes and disabled vehicles and variable disruptions caused by work zone traffic control, adverse weather, and planned special events. The unpredictable nature of nonrecurring congestion causes the most impact on travel time reliability with significant economic and safety impacts.

At a national level, it has been estimated that 55 percent of congestion is caused by nonrecurring events[6], but congestion at the state level had not been estimated. As shown in Table 2, based on more recent analyses, it is now estimated that of the nearly 5.8M vehicle-hours of delay experienced by Oklahoma motorists in 2019, 59 percent of that congestion was nonrecurring.

Figure 4 shows a different view of the data, illustrating recurring and nonrecurring incidents in rural and urban areas[7]. This analysis revealed that the urban areas experience the majority of both recurring and nonrecurring congestion in Oklahoma (24 percent and 36 percent of all congestion, respectively).

[6] Source: https://ops.fhwa.dot.gov/aboutus/opstory.htm
[7] Rural and urban proportions were estimated from designations within ODOT GIS data for Oklahoma roadways.

Table 2. Oklahoma Congestion by Source (2019).

Source of Congestion	Estimated Vehicle-hours of Delay[8]	% of Total
Recurring	**2,350,000**	**41**
Holiday	120,000	2
Recurrent	675,000	12
Signals	639,000	11
Unclassified	916,000	16
Nonrecurring	**3,453,000**	**59**
Incident	929,000	16
Incident & Weather	185,000	3
Incident & Work Zone	285,000	5
Other Multiple Causes	551,000	9
Recurrent & Incident	137,000	2
Signal & Weather	48,000	1
Unclassified	916,000	16
Weather	209,000	4
Work Zone	193,000	3
Total	**5,803,000**	**100**

Figure 4. Oklahoma's Approximate Congestion Sources (Rural vs. Urban; 2019).

[8] Source: RITIS, Congestion Causes for the National Highway System (NHS), www.ritis.org/archive/congestion, accessed January 18, 2022.) (The similar 2019 estimate of congestion nationwide is 1.75 billion vehicle-hours of delay.)

2.1.3 Cost

To identify the monetary impact of congestion to Oklahoma roadway users, the cost of the Oklahoma congestion in Table 2 above was estimated by applying an average value of time (VOT) to road users. Figure 5 depicts Oklahoma's cost of congestion, totaling an estimated $140M annually. An estimated VOT of $25 per hour for passenger vehicles and $35 per hour for commercial vehicles[9] was used and truck traffic percentages of 23 percent (rural) and 6 percent (urban)[10].

Oklahoma's Annual Cost of Congestion is estimated at $140M

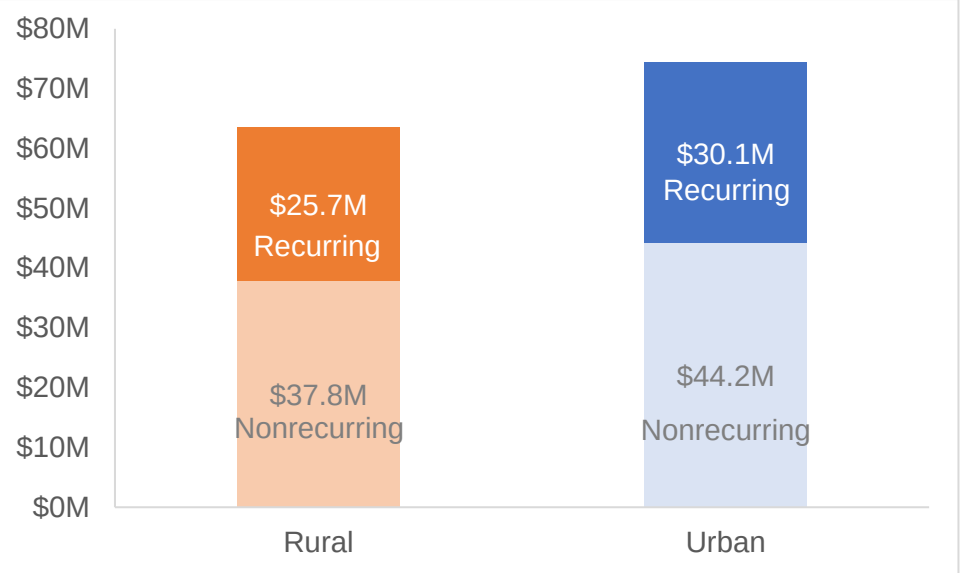

Figure 5. Estimated Annual Cost of Congestion (Oklahoma 2019).

ODOT's eight-year project plan represents planned investments of more than $8.4 billion across 1,745 projects budgeted for 2021 to 2028[11]. Each of these projects represents an opportunity to incorporate TSMO strategies.

Recurring congestion often requires heavy investments into infrastructure to address congestion caused by capacity constraints that occur during peak period surges. The majority of investments will be made on traditional bridge and roadway projects. The plan also includes a total of $5M annually for ODOT's

[9] Based on an estimated 2 percent/year annual inflation to arrive at 2019 VOT, applied to values of time used by TX in 2014, as reported in https://static.tti.tamu.edu/tti.tamu.edu/documents/PRC-2016-4.pdf
[10] https://www.fhwa.dot.gov/policyinformation/statistics.cfm
[11] Source: ODOT ESRI shapefile data downloaded September 2022 from the 2021-2028 Roads Work Plan, at https://oklahoma.gov/content/dam/ok/en/odot/project-management/cwp-8-year-plan/cwp-ffy2023-ffy2030/2023-2030%20CWP%20Book_.pdf

intelligent transportation system (ITS) infrastructure and other TSMO activities, as described in Section 5, and approximately $2M annually for Oklahoma Turnpike Authority (OTA) improvements. Federal funding obligations for all the projects average approximately $590M per year, but those obligations can range from $533M to $684M per year.

The majority of TSMO strategies are oriented to address nonrecurring congestion and are typically quite cost-effective in comparison to capital investments into infrastructure improvements (roadway widening). For example, roadway widening projects typically result in a benefit-cost ratio of approximately 2.7. On the other hand, TSMO-oriented strategies can realize a much higher return on investment, with benefit-cost ratios estimated to range from 6.6 to 25.0[12]. Figure 6 summarizes a range of improvement types, illustrating the benefits of several key TSMO-oriented strategies.

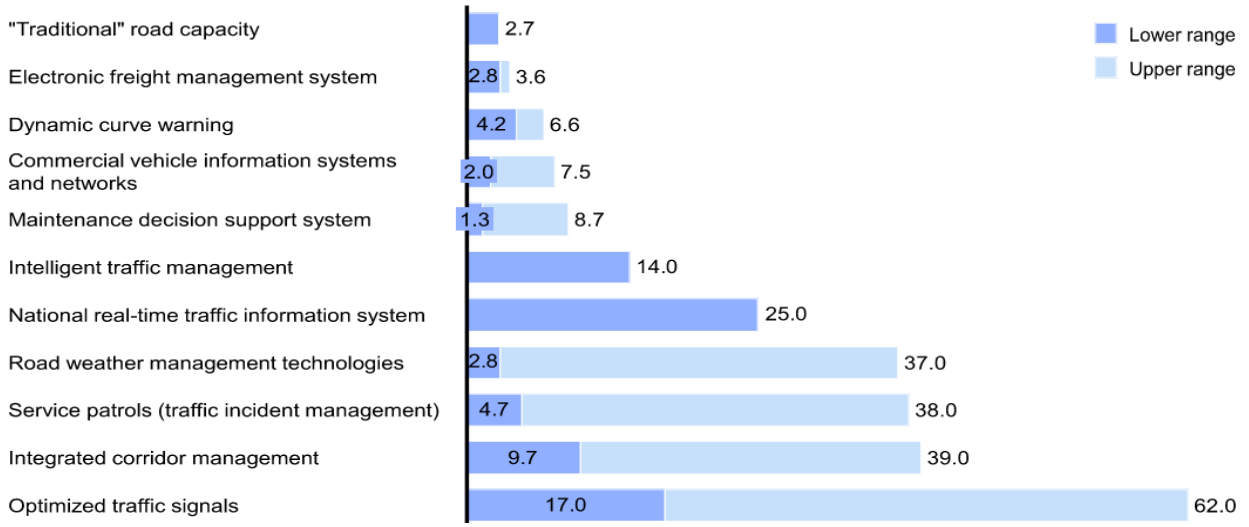

Figure 6. Comparison of Returns for Road Investments (Cost-benefit Ratios).[13]

[12] Source: https://sites.nationalacademies.org/cs/groups/pgasite/documents/webpage/pga_083856.pdf
[13] ITSs not addressed specifically in Figure *6*, include strategies that use cameras, Dynamic Message Signs (DMS), and other ITS devices assumed to be included within Intelligent Traffic Management.

2.2 How TSMO and ITS Can Help

ITS refers broadly to the application of technologies, processes, and communications to enhance transportation operations. TSMO is an integrated set of strategies that incorporate ITS and much more. TMSO program areas considered by ODOT are described in Table 3. Note that each of the programs listed below primarily addresses nonrecurring congestion, but also has positive impacts on recurring congestion.

Table 3. Common TSMO Program Areas.[14]

Example TSMO Program Areas	Program Area Description	ODOT Existing Program Areas	ODOT Future Program Areas
Active Transportation & Demand Management	The dynamic management, control, and influence of travel demand and traffic flow.		■
Arterial Management	The management of arterial streets that provides users with a safe, efficient, and reliable trip (e.g., access management, traffic signal timing).	■	
Bottleneck Mitigation	Strategies that focus on recurring bottlenecks (sections of roadway that are routinely over capacity).	■	
Congestion Pricing (OTA)	A strategy that varies toll price by time of day and level of congestion.		■
Integrated Corridor Management	An approach for collaborative management of all assets in a transportation corridor as a system (e.g., multiple roadways and transit facilities), rather than managing each asset individually to improve the overall operation of the corridor.		■
Emergency Transportation Operations	Providing users with a safe and efficient transportation system during an emergency situation.	■	
Freeway Management	The implementation of policies, strategies, and technologies to improve freeway performance by minimizing congestion (and its side effects), improving safety, and enhancing overall mobility.	■	
Freight Technology & Operations	The effective management of the transportation system for freight to move goods safely, efficiently, and reliably throughout the region.		■
Managed Lanes	Highway facilities or a set of lanes where operational strategies are proactively implemented and managed in response to changing conditions.		■

[14] https://ops.fhwa.dot.gov/plan4ops/focus_areas/integrating/operations_strategies.htm

Example TSMO Program Areas	Program Area Description	ODOT Existing Program Areas	ODOT Future Program Areas
Planned Special Events Traffic Management	Special event management to provide users with a safe and efficiently managed transportation system during a planned special event.		■
Road Weather Management	Systems and strategies focused on providing users with information before, and a safe and efficient transportation system during and after, weather events.	■	
Real-time Traveler Information	Information provided to travelers to help them choose the safest and most efficient mode and route of travel.	■	
Traffic Incident Management	Verifying, responding to, and clearing traffic incidents in a manner that provides transportation system users with the least disruption.	■	
Traffic Signal Management	Programs, processes, and systems for the effective monitoring and operation of traffic signals.	■	
Transit Management	Operation and management of a safe and efficient transit system.	■	
Travel Demand Management	Providing users with effective travel choices to shift or reduce the demand for travel in congested conditions.		■
Work Zone Management	Organizing and operating areas affected by road or rail construction to minimize traffic delays, maintain safety for workers and travelers, and accomplish the work efficiently.	■	

Many of the program areas listed above benefit from and rely on ITSs (e.g., Road Weather Information Systems [RWIS], dynamic message signs [DMS], cameras, traffic operations center, data collection devices, traffic signal management [TSM] systems, etc.). Some specific systems support multiple strategies (for example, RWIS support road weather management [RWM] and traveler information [TI] programs).

The collective network of these systems helps to provide operational awareness about the present state of ODOT's infrastructure and what is necessary to effectively implement the strategies above. By addressing the core issues of both recurring and nonrecurring congestion, these programs have tremendous returns on investment and improve mobility statewide.

2.3 TSMO Mission, Goals, and Objectives

The purpose of this strategic plan is to identify a vision for TSMO and guide ODOT with steps to advance toward that vision. This section defines TSMO's vision, mission, goals, and objectives and brings them into alignment with ODOT's vision, mission, and core values, which are defined as follows:

Vision: *ODOT is an innovative and responsive leader in the transportation field. We value our people for their individual and team contributions, empowering them to make decisions through productive partnerships. We are accountable for meeting the transportation needs of citizens, businesses, and industry in the safest, most proficient manner possible.*

Mission: *The mission of the ODOT is to provide a safe, economical, and effective transportation network for the people, commerce, and communities of Oklahoma.*

Core Values: *Improved Collaboration | Enhanced Innovation | Greater Coordination | Exceptional Customer Service | Increased Efficiency | Rapid Adaptability*

2.3.1 TSMO Mission

ODOT is driven by the desire to maintain a high-performing system of facilities that embrace the optimization of existing and planned facilities using integrated strategies of technological innovations and institutional and process innovations that positively affect Oklahomans and Oklahoma's other road users. The following summarizes the ODOT TSMO mission:

ODOT proactively applies integrated strategies to optimize the performance of existing and planned infrastructure, achieved through the implementation of systems, services, real-time information, and programs. These initiatives are specifically designed to improve the performance of ODOT's current and planned transportation systems.

2.3.2 TSMO Goals and Objectives

Table 4 presents the ODOT TSMO goals and objectives developed to guide ODOT's ITS and TSMO Strategic plan. Section 5 includes discussions about the current TSMO activities and recommendations that center around the goals and objectives listed here.

Because of the rapid development of new technologies, devices, and even practices that may have an impact on achieving ODOT's mission, it is important to be wary of the "shiny object" effect, yet also remain open to the possibility that innovations can revolutionize systems or subsystems. The goals and objectives listed below were developed to articulate the core needs of the system and will serve to provide ODOT the guiding principles against which bold claims can be tested.

Table 4. ODOT's TSMO Goals and Objectives.

Goals	Objectives
Safety – Reduce the frequency, severity, and clearance time of crashes	• Reduce the frequency of crashes related to work zones. • Reduce the frequency of crashes related to road weather conditions (e.g., snow, ice, fog, etc.). • Reduce incident clearance times safely in rural and urban Oklahoma to reduce the frequency of secondary crashes. • Embrace innovations within current and future systems to improve system safety. • Continuously seek out and test relevant innovations and embrace those that have positive direct or indirect effects on the safety performance of ODOT's highway network.
Mobility – Improve the mobility and efficiency of ODOT's transportation facilities	• Reduce congestion for all modes in urban areas throughout Oklahoma. • Reduce delays associated with work zone activities. • Optimize the operation of traffic signals through performance-based reviews. • Continuously seek out and test relevant innovations and embrace those that have positive direct or indirect effects on the mobility performance of ODOT's highway network.
Reliability – Improve the resilience and travel time reliability of ODOT's facilities	• Decrease the effects of nonrecurring congestion on travel in both urban and rural areas of Oklahoma. • Increase the availability of useful pre-trip and in-route Traveler Information (TI) for both urban and rural areas of Oklahoma, including recurring congestion, with a focus on nonrecurring congestion. • Continuously seek out and test relevant innovations and embrace those that have positive direct or indirect effects on the travel time reliability performance of ODOT's highway network. • Continuously maintain the physical and cybersecurity for Intelligent Transportation System (ITS) infrastructure based on known or reasonably foreseeable threats.
Institutional – Formalize the integration of TSMO principles into ODOT project life cycle and culture	• Weave TSMO strategies into the planning stages of projects and programs proactively rather than reactively. • Increase the application of TSMO strategies within projects statewide. • Include planning for operation principles in ODOT planning process documents. • Prepare standard details and specifications to facilitate inclusion of ITS and other TSMO-related elements in projects. • Provide new and supplement existing TSMO outreach, training, and recruitment resources for key ODOT staff and partners. • Identify, continuously collect data for, and regularly report TSMO performance measures. • Document progress toward meeting each goal and ODOT's stated tangible results.

For more information on these objectives, refer to **Table 5**.

3 Strategic Plan Development

Effective stakeholder engagement and discussion are essential to a successful strategic planning process. It provides all stakeholders with an opportunity to share technical, organizational, and institutional needs and builds a commitment to assist with the plan's execution. Eight organizations, listed in Section 3.1, were represented during the statewide stakeholder engagement. The responses and insights shared during this engagement have been integrated throughout this plan.

3.1 Outreach

ODOT district engineers and other key ODOT stakeholders listed below participated in the Oklahoma Statewide ITS planning process to identify needs and direction discussed in the next section.

- ODOT – District Engineers
- ODOT – Multimodal
- ODOT – Planning/GIS
- ODOT – Strategic Communications
- ODOT – Traffic Engineering
- Oklahoma Turnpike Authority (OTA)
- Federal Highway Administration (FHWA)
- ODOT – ITS Maintenance Division

The various organizations listed above were invited to identify existing ITS elements and discuss their needs and requirements and ongoing and planned ITS programs. The means of gathering this information included meetings, online surveys, live feedback sharing sessions, and take-home surveys.

3.2 Stakeholder Input

Stakeholder needs were elicited through the various stakeholder engagement meetings. As discussed in Section 3.1, each meeting was held virtually, except for the first meeting held with ODOT district engineers. Paper surveys were used in the in-person survey and online engagement tools were used to gather feedback during a presentation made to the stakeholders. Additionally, information about existing and proposed ITS elements was collected via a take-home worksheet sent to stakeholders following each of the virtual meetings.

3.3 ITS Architecture

To be eligible for federal funding for ITS, each region within the U.S. is required to establish and maintain a regional ITS architecture. This statewide ITS architecture must be updated and maintained to confirm projects and systems adhere to a common architecture. ODOT is preparing a statewide ITS architecture update in parallel to this strategic plan. For the sake of developing both the state's ITS Architecture and Strategic plans, the state's area is divided into three regions: (1) statewide, (2) the Oklahoma City region, and (3) the Tulsa region. Regional ITS architectures will also be prepared for the Oklahoma City and Tulsa urban regions.

3.4 Existing Plans

Several existing documents have guided ODOT in the past years. They are listed below.

- 2003 Oklahoma Commercial Vehicle Information Systems (CVISN) Program Plan and Top-level Design Document
- 2004 Oklahoma Statewide Intelligent Transportation Systems (ITS) Implementation Plan
- 2005 Oklahoma Statewide Intelligent Transportation Systems (ITS) Architecture
- 2005 Oklahoma Statewide Intelligent Transportation Systems (ITS) Strategic Plan
- 2023-2030 Oklahoma Freight Transportation Plan
- 2045 Oklahoma's Long Range Transportation Plan

3.5 Program Prioritization Method

Prioritization recommendations found in Section 5 were developed through a process of gathering ODOT's existing capabilities, needs, and desired priorities and recommendations and best practices from FHWA. This protocol resulted in the selection of six existing program areas and six potential future program areas.

Using the FHWA recommended Capability Maturity Model (CMM), stakeholders ranked existing program areas based on their assessment of the organizational maturity and effectiveness in six dimensions: business processes, systems and technology, performance measurement, workforce, culture, and collaboration. This ranking provides direction on which program areas need the greatest level of focus and investment. Stakeholders also ranked future program areas based on the need to initiate a new program area.

The development of recommended actions for existing and future programs consisted of a series of workshops with representatives of each TSMO program area for the state. The approach generally followed as described below.

1. *Research and Assessment* – Review of statewide needs inventory to identify possible ITS technology and operational preferences. Classify them into "program areas" for existing and proposed plans and procedures.
2. *Workshop* – Discussion of enhancements to the TSMO program areas, resulting in a set of key actions for each category to advance to the next level of program maturity. These discussions not only covered the existing programs, but also incorporated potential future priorities statewide.
3. *Recommendations for Existing Programs* – Outline of project-level recommendations for maintaining and expanding existing TSMO programs using ITS technologies.
4. *Recommendations for New Initiatives* – Review of new initiatives based on the current and potential future capabilities of the system.

4 Current Intelligent Transportation System Program

For more than 20 years, ODOT has used ITS to help improve operations for Oklahoma travelers. Over that time, ODOT has strategically and effectively developed, deployed, and operated a variety of ITSs and the software and communications infrastructure to support them. Many internal and external partnerships have been forged along the way, allowing the ITSs to support Oklahoma's transportation system in a holistic way. This section describes the current ITSs.

Much of ODOT's current ITS Program is based on the 2005 Oklahoma Statewide ITS Strategic Plan, with enhancements made as ITS technologies and TSMO strategies have evolved. In addition, ODOT and OTA have developed the following master plans for ITS assets located along the turnpike system:

- Fiber Optic Inventory
- Monitoring Cameras
- DMS

In 2019, ODOT formed a TSMO committee to help define and direct TSMO initiatives for the state. The committee included members from the following divisions:

- Traffic Engineering Division
- Project Delivery & Design
- Planning/GIS
- Multimodal
- Roadway
- OTA
- Field Construction
- Field Maintenance
- Maintenance, ITS

4.1 Existing ITSs

ODOT operates multiple ITSs in support of the broader TSMO programs that are described in Section 5.2. Though most of the systems are managed by the ITS Maintenance Division, some are managed by other ODOT groups, such as the Traffic Engineering Division. Table 5 provides a summary of the ITSs and devices and shows which TSMO programs they support.

Table 5. Summary of Current TSMO and ITS Programs.

ITS \ Section / TSMO Program	5.2.5 Traveler Information	5.2.4 Traffic Management	5.2.2 Road Weather Management	5.2.1 Work Zone Management	5.2.3 Traffic Incident Management	5.2.6 Traffic Signal Management
Cameras	•	•	•	•	•	
Road Weather Information Systems	•	•	•			
Dynamic Message Signs	•	•	•	•	•	
Snowplow Integrated Mobile Observations	•		•	•		
Traffic Data Collection	•	•		•	•	•
Variable Speed Limits	•			•		
Queue Warning System	•	•		•		
Drive OK (Mobile App-Public)	•		•	•	•	
Drive OK (Mobile App-Internal)	•			•	•	
Drive OK (Web)	•				•	
Traffic Signal Management System						•
Video Management Software	•	•	•	•	•	
Advanced Traffic Management		•				
Maintenance Tracker Workflow		•				
Asset Management	•	•		•	•	•
Traffic Operations Center	•	•	•	•	•	•
Communications Infrastructure	•	•	•	•	•	•
Fiber Optics	•	•	•	•	•	•
Wireless	•					•
Cellular	•	•	•	•	•	•
Network Hardware	•	•			•	

4.1.1 Field Devices

ODOT has invested in a significant deployment of both permanent and portable ITS infrastructure. This section provides an overview of the types of devices and systems ODOT has deployed, including several that are currently being piloted. In addition, a table of tactics that guide future deployments follows each system description.

Cameras

Cameras are used by ODOT across Oklahoma as shown in Figure *7*, Figure 8 and Figure 9. There are 729 existing cameras, including 116 pan-tilt-zoom (PTZ) cameras, 347 fixed-position cameras, 167 sensor cameras, and 99 security cameras. Most cameras are connected by fiber optics for real-time traffic monitoring capability, though a few remote cameras are connected through cell modems. Most cameras provide streaming video; however, a few only provide periodic still images because of bandwidth restrictions. A small portion of the infrastructure consists of outdated technology that is being replaced as devices fail or improved during infrastructure projects. Table 6 provides example tactics for the deployment of cameras.

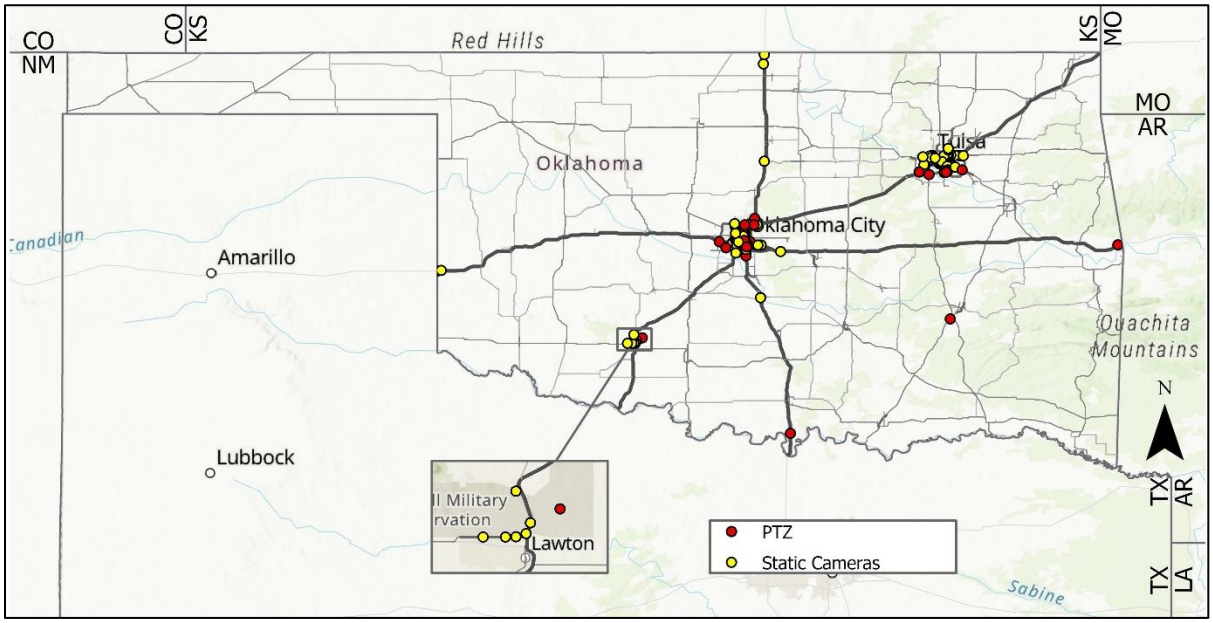

Figure 7 ODOT Cameras – Statewide.

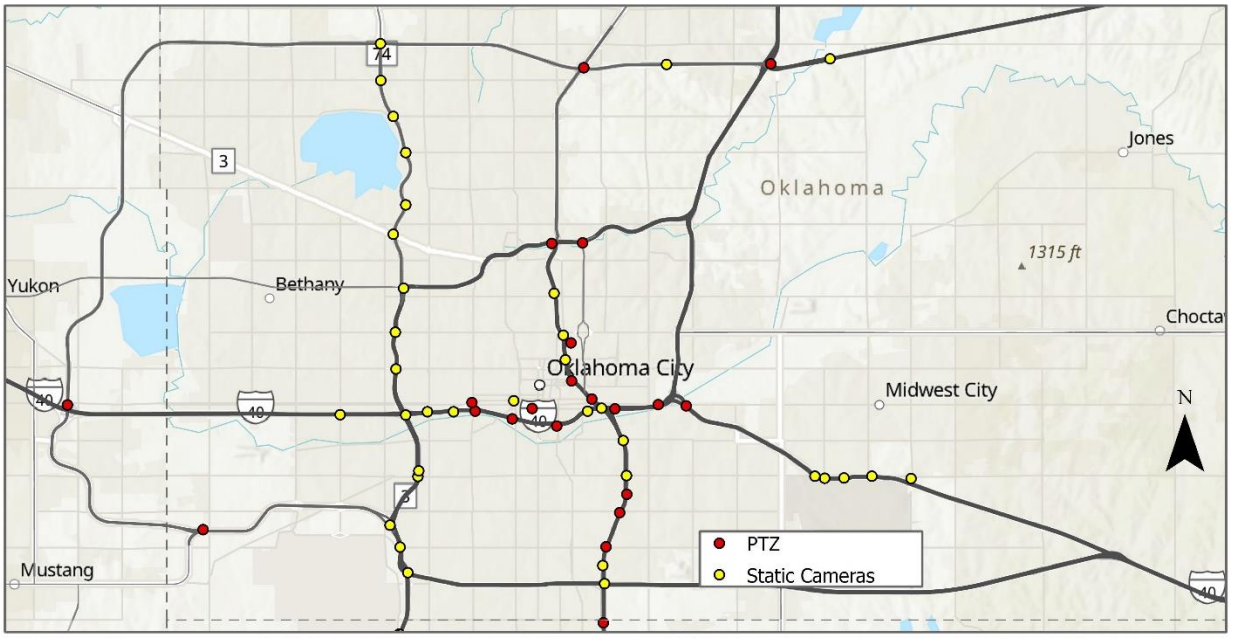

Figure 8. ODOT Cameras – Greater Oklahoma City Region.

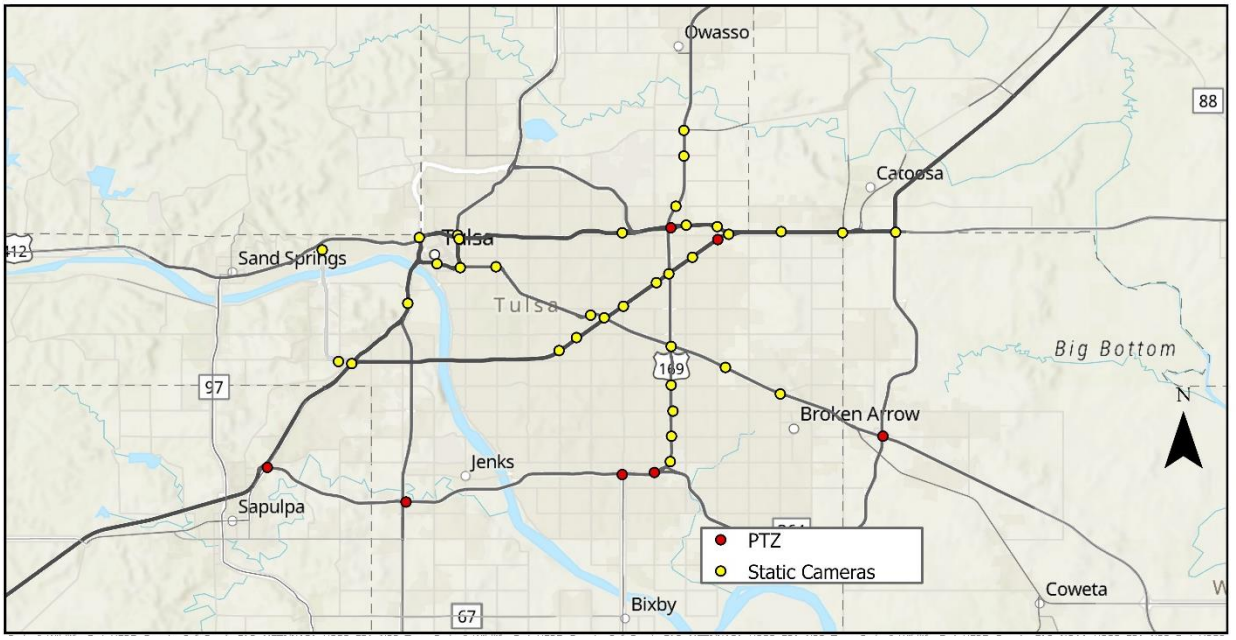

Figure 9. ODOT Cameras – Greater Tulsa Region.

Table 6. Camera Deployment Tactics.

Tactic	Description
High-priority Segments	○ Comprehensive camera coverage should be provided in areas of high volume and density, whereas less coverage may be provided along roadways with lower volume and density.
Interstates	○ Comprehensive camera coverage should be provided along interstates.
Key Locations	○ Some locations may have a greater need for cameras because of high crash rates, localized weather concerns, seasonal or event traffic, or routing decision points. ○ Cameras may be provided in certain areas because of access to power and communications capabilities and the opportunity to provide coverage of an area of interest.
Temporary Uses	○ Portable camera trailers can be used in areas with temporary needs, including the following: • Work zones • Special events • Accident investigation or other safety concerns • Observing a new traffic pattern or operational concerns • Design support (recorded or live as needed)

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Dynamic Message Signs (DMS)

ODOT has installed 71 permanent DMS across Oklahoma. These are primarily centered in the Oklahoma City and Tulsa metro areas, and at highway and interstate borders, with additional signs planned. Figure 10 shows an example of a permanent median mounted DMS, and Figure 11 illustrates the permanent DMS locations. ODOT also has 37 portable DMS which are used for construction, maintenance, emergency detour, special event, and other temporary uses.

Various portable trailer-mounted DMS are used to provide motorists with real-time and in-route TI or early warning of work zones, traffic incidents, and other nonrecurring congestion. Most portable DMS are connected to and operated by the Traffic Operations Center (TOC), but a few older units are unconnected and operated by the field divisions. A few of the older units are being replaced each year. These older units are stationed at maintenance facilities in each district. Additional portable DMS are used in Smart Work Zone (SWZ) apps, which are deployed, operated, and maintained by the SWZ contractor. Table 7 provides a summary of the tactics used to deploy DMS.

Figure 10. Example Dynamic Message Sign Installation.

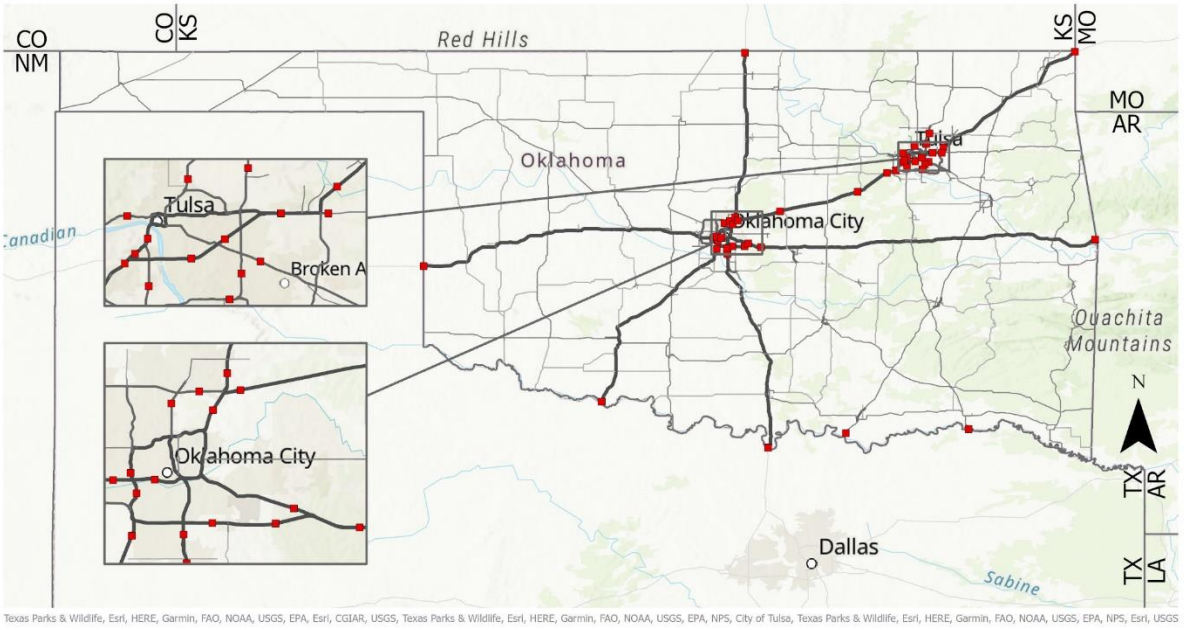

Figure 11. ODOT Permanent Dynamic Message Sign Locations.

Table 7. Dynamic Message Signs Deployment Tactics.

Tactics	Description
Travel Time Displays on Commuter Corridors	Corridors with high commuter volumes within urban areas greater than 12 miles or between two urban areas with a maximum distance of 50 miles.
Decision Points	In advance of interchanges and other locations of motorists' key route decisions, and for broadcasting Traveler Information (TI) at the right time and location to provide adequate information for motorists to make informed route selection.

Roadway Weather Information System (RWIS) Stations

ODOT has deployed 32 RWIS stations across the state. State-deployed RWISs supplement existing weather data sources, providing a more detailed understanding of the local conditions, including pavement conditions, road surface temperatures, and subsurface temperatures. This additional information gives valuable insights to maintenance crews about current and forecasted road conditions in advance of and during weather events, which helps crews plan and manage weather operations. Continued expansion of the network of RWIS sites will further improve the accuracy of the information, allowing winter operations to be optimized to provide greater safety for travelers and efficiency and cost management for maintenance crews.

An example an RWIS site is shown in Figure 12 and existing sites, mostly along Interstate 35 are illustrated in Figure 13. Not shown in Figure 13: RWIS sites are also planned along Interstate 40 between the Texas and Arkansas borders. Table 8 summarizes the tactics used to guide the deployment of RWIS.

Figure 12. Example Roadway Weather Information System (RWIS) Site.

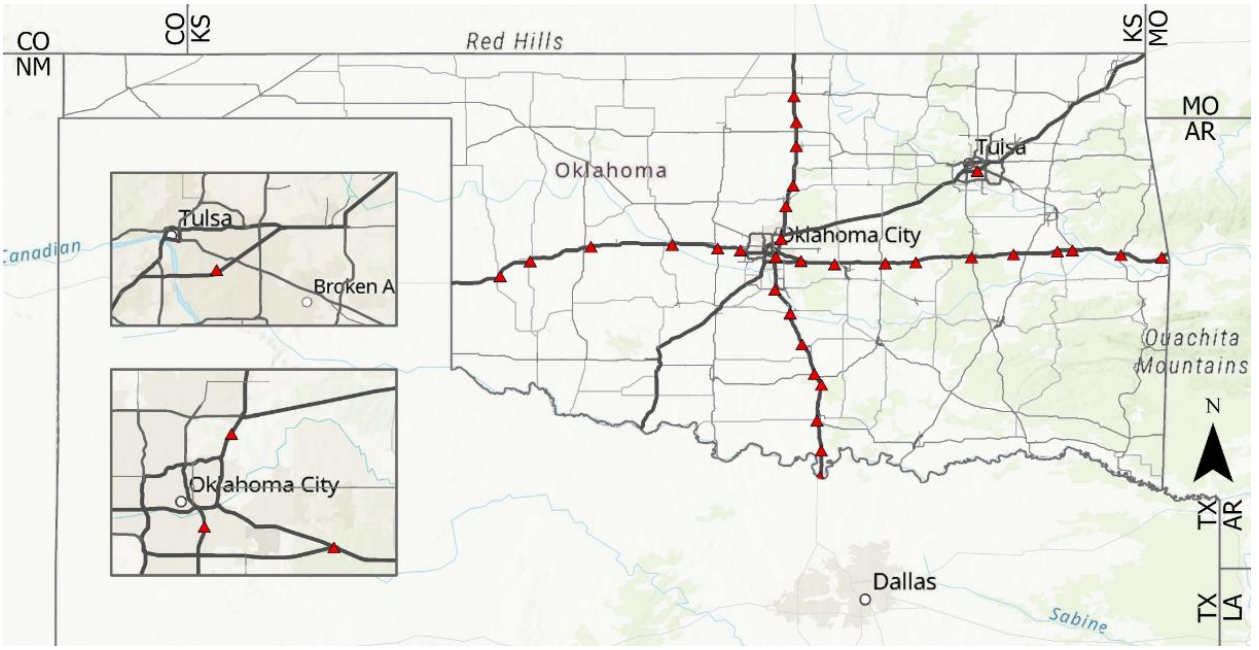

Figure 13. ODOT Roadway Weather Information System (RWIS) Locations.

Table 8. Roadway Weather Information System (RWIS) Deployment Tactics.

Tactic	Description
Representative Locations	○ Install RWIS in the largest gaps in the state where RWIS is currently not provided, at approximately 20-mile spacing.
Trouble Spots	○ Provide RWIS in trouble areas, such as the following: ○ Low-lying areas where fog and ice may be present ○ Wind-prone areas ○ Bridges where icing may be a factor
Colocation with Other Devices or Facilities	○ Consider installing RWIS to share communications, power, and poles and to minimize the cost of installation. ○ Work with neighboring states to share RWIS information that represents conditions on both sides of the state line.
Mobile RWIS / Connected Vehicle Data	○ Begin pilot program for mobile RWIS installed in Oklahoma Department of Transportation (ODOT) maintenance trucks.
Integrate Mobile Observations	○ Leverage the ability to integrate and disseminate mobile observations of roadway conditions through vehicles.

Traffic Data Collection

The ODOT Traffic Engineering Division operates and maintains approximately 162 Automatic Traffic Recorders (ATRs) for the purposes of collecting and monitoring traffic volume data along ODOT's highway network, shown in Figure 14. Most ATRs provide speed, classification, and volume data. Where possible, ATRs can also be deployed with cameras and RWIS technology to take advantage of available power and communications and provide still camera images and weather condition data. Most ATRs use radar vehicle detection, but they are also capable of using inductive loops. ODOT has a goal to deploy 30 additional ATR stations per year. ODOT Traffic Division regularly publishes ATR data for planning and other uses. The ODOT ITS Program also uses real-time data from the ATRs during winter events, incidents, and other events as needed. Table 9 provides tactics to guide the deployment for traffic data collection.

In addition to data collection field devices, ODOT also has access to statewide probe data from HERE Technologies through the Iteris ClearGuide product. The data from HERE provides travel times and other metrics based on GPS data from fleets, cell phone location data, and other sources. The Iteris ClearGuide product provides additional metrics and a user interface through which users can monitor and analyze congestion and other measures across the state. Because it is based on probe vehicles, the data is more reliable on higher-volume roads, leading to limitations on low-volume rural roads and low-volume city streets. The ITS group pulls data from both Iteris ClearGuide and Google Maps to help populate general travel conditions on its website and mobile app.

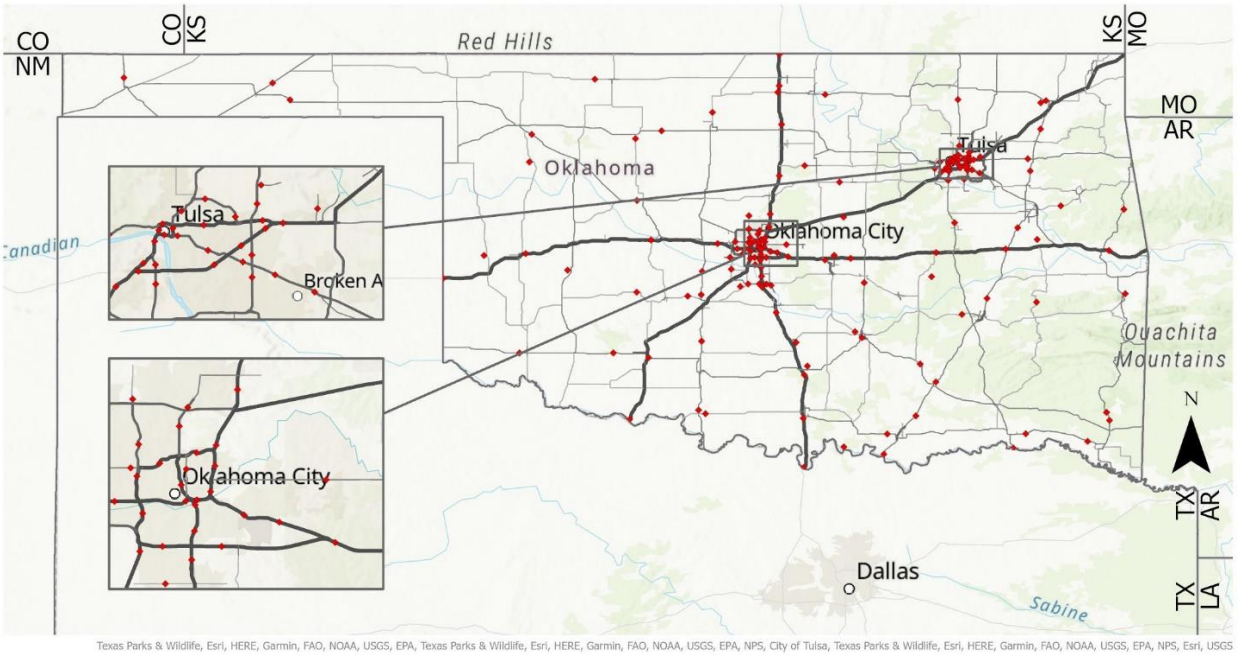

Figure 14. ODOT Automatic Traffic Recorder Locations.

Table 9. Traffic Data Collection Deployment Tactics.

Tactic	Description
General Travel Conditions	○ Probe and crowd-sourced data should be used on all interstate and major state highways.
Active Traffic Management	○ Some active traffic management strategies such as Smart Work Zone can leverage Automatic Traffic Recorder (ATR) data, so appropriate traffic sensors should be installed early to support these systems and strategies during construction.
Automatic Traffic Recorder Support	○ Wherever the ATRs are located, shared-use should be considered to supplement both planning and real-time information efforts.

Traffic Signals (Emerging)

Connectivity to traffic signals provides a means to monitor their operation and to allow multi-signal coordination along corridors. There are over 1,000 traffic signals in Oklahoma, including state and US highways, and ODOT installs new signalized intersections annually. ODOT has historically developed agreements with local agencies to manage the operations and maintenance of the traffic signals, so ODOT itself has not traditionally provided communications to or maintenance of traffic signals. For many reasons, however, ODOT is beginning to take a stronger role in traffic signal operations. Future traffic signals will be equipped with communication capabilities so that ODOT Traffic Division may operate and maintain the traffic signals.

Queue Warning System (Pilot)

Queue warning systems alert drivers to the presence of slow or stopped traffic. These systems detect the presence of a queue, then alert drivers to its presence either by a message posted to DMS or the mobile app. These systems can be deployed in SWZs where queues are detected using portable sensors and messages are posted using portable DMS. These SWZ apps can either function as a standalone system or be connected and operated through the central traffic management system. In more permanent locations, queues are detected using probe data, and drivers are notified using the mobile app or nearby permanent DMS if applicable.

Variable Speed Limits (Pilot)

Variable Speed Limits (VSLs) consist of a set of portable devices to create a system that changes speed limits dynamically in accordance with current safe speeds. ODOT is deploying a pilot project to test the effectiveness of a variable work zone speed limit during heavy congestion times along an Interstate 35 work zone.

Highway Advisory Radio (Retired)

Highway Advisory Radio (HAR) transmitters and related infrastructure are no longer in use, and the hardware is being retired as it ages out of operation. Radio frequency consumption, especially in the AM bands, are not as widely used or understood as a result of widespread use of in-vehicle audio streaming and other modern digital media for consumption of entertainment and news content.

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4.1.2 Applications

ODOT uses various apps to support its ITS programs. Some of these tools consist of websites or mobile apps developed and published by ODOT and others commercial apps. Table 10 summarizes these apps, and the following subsections provide additional descriptions.

Table 10. Summary of ODOT's ITS Apps.

Branded Name	Purpose	Website	Mobile App	Publicly Accessible	Auth User Access
OK First	Weather Conditions Broadcast	•		•	•
OK Roads	Road Conditions Broadcast	•		•	
OK Traffic	Traveler Information Broadcast	•		•	•
Drive Oklahoma	Mobile Traveler Information Broadcast		•	•	•
OK Trucks	Snowplow Performance Tracking Site	•			•
Construction Mobile App	Work Zone Management		•		•
Snowplow Integrated Mobile Observations	Real-time Image Sharing (Snowplow Dash Camera)	•		•	•
Advanced Traffic Management System (ATMS)	Field Device Control, Management, Configuration		•		•
Maintenance Tracker	Workflow Management				•
Asset Management	Asset Management				•
Traffic Signal Management System	Traffic Signal Management	•			•
Video Streaming	Camera Video Management				•

OK First

OK First is an outreach program of the Oklahoma Mesonet group (a weather-focused organization). The website, https://www.mesonet.org/index.php, provides the Oklahoma community with weather education and access to real-time weather information data. The data shared through this web-based app includes all types of weather events. OK First offers online and in-person courses and certification programs for emergency medical services (EMS), ODOT, law enforcement, and other public safety officials.

OK Roads

The OK Roads road condition map includes current weather-related highway conditions and closures. This website, https://okroads.org/, is used as the primary road condition information dissemination site with real-time imagery that consists of static cameras and mobile dash cameras from active snowplow vehicles. Most of the imagery is derived from mobile sources. The tool also serves as a data entry site carried by ODOT personnel, county field crews, and maintenance engineers who are trained accordingly. ODOT staff is expected to update the data every 4-6 hours or as changing conditions warrant during inclement weather events.

OK Traffic

ODOT uses its traveler information website, https://oktraffic.org/ (branded as OK Traffic), to broadcast traveler information to the public (see Figure 15). The site provides users with current traffic and weather conditions on an interactive map with access to live camera streams, DMS messages, electric vehicle charging stations, temperature, work zones, and wind gust conditions. The interactive map allows users to select the information shown through a simple layer management pane. The site also provides users with links to other travel-related resources.

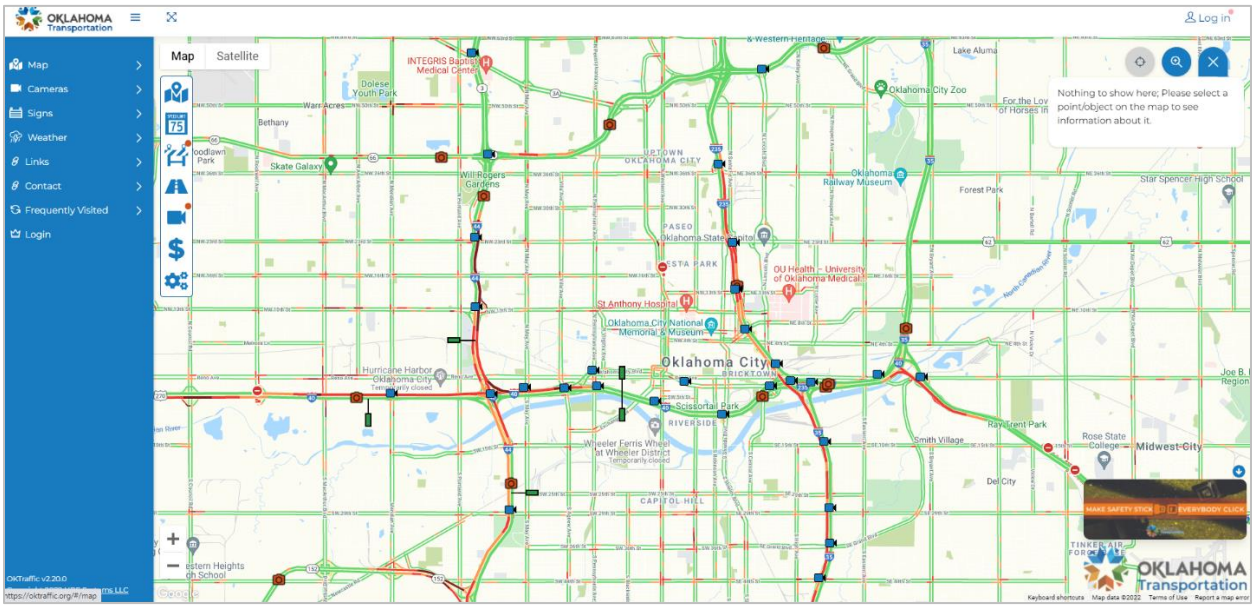

Figure 15. ODOT's Traveler Information Site (OKTraffic.org).

Drive OK

A companion, strictly mobile app (branded as *Drive Oklahoma*) is also available for free to the public, offering traveler information via connected Android and iOS mobile devices (see Figure 16). The app provides the same information as OK Traffic website, but it also leverages the user's location to limit information offerings to only those that are most relevant.

Similar to the OK Traffic website, the Drive Oklahoma mobile app provides authorized users at ODOT with secure access to additional features (see Figure 17). Those additional features include the ability to review more detailed real-time ITS device information, update DMS messages, enter current road conditions, review more detailed snowplow activity data, and access Maintenance Tracker (ODOT's workflow app for maintenance activities). Authorized users with administrative privileges can review user activity and other metrics.

Figure 16. Drive Oklahoma App (Public-facing).[15]

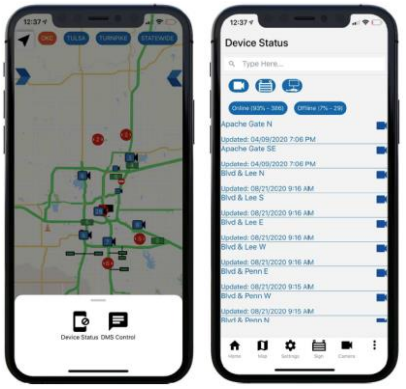

Figure 17. Drive Oklahoma App (Internal to ODOT – Login Required).[16]

[15] Image source: ODOT
[16] Image source: ODOT

OK Trucks

OK Trucks is a website that provides fleet management capability to ODOT and OTA superintendents. IT was designed for ODOT and OTA and provides video from a camera in the cab of the trucks. The website https://oktrucks.org/ is not publicly accessible. It tracks rates of material disbursement (salt or anti-icing material from winter maintenance vehicles) and includes dashboards that display other relevant information. The system involves approximately 330 equipped ODOT trucks and 43 OTA trucks.

Construction Mobile App

ODOT has developed an internally accessible mobile app to help collect and maintain accurate work zone location information for internal records and to inform the public. The app is used by workers to mark the GPS locations of the beginning and ending of the work zone and the lane changes throughout the work zone. From video devices mounted to the dashboard, the app can record video and take pictures of the work zone. The collected data not only provides current information to the traveling public via the mobile app and the website, but it is also used for work zone audits. Because the construction mobile app is used with large video files, it is managed on its own server so that it does not interfere with the operation of the DriveOK app.

Snowplow Integrated Mobile Observations (IMO)

The IMO app makes video from snowplow dashboards available over an internally accessible website, Maintenance Activity Truck Tracking (oktrucks.org). ODOT is working on the deployment of Samsara, an integrated platform, to help support these efforts. This imagery aids supervisors when prioritizing critical plowing activities. Approximately 75 percent of ODOT's nearly 500 snowplow trucks and over 40 of OTA's snowplows are outfitted with IMO capabilities. See Figure 18 for an example image retrieved periodically from the vehicle-mounted cameras. Because of the temporary relevance of the images available on the website, the images expire from the website after two hours but remain accessible to ODOT personnel.

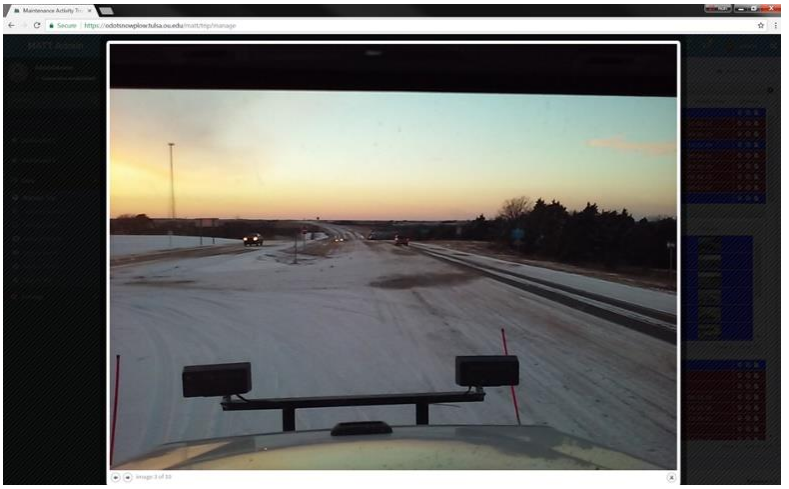

Figure 18. Integrating Mobile Observations Example Image from In-vehicle Camera.[17]

Advanced Traffic Management System (ATMS)

ODOT has developed an ATMS as an updated version of the legacy ITS console that has been in use for many years (oktraffic.org). The web-based app provides authorized users with cameras and DMS control and the ability to review more detailed information about field devices. User-level security also grants access to key staff to configure new devices added to the ODOT ITS private network.

The OK Traffic site discussed above also provides the secure login option to the ATMS software, enabling remote access from any browser for authorized users.

Maintenance Tracker

ODOT uses the Maintenance Tracker app to manage its operations and maintenance work orders. Maintenance Tracker pings all ITS devices to confirm device power and communications. Failed pings are summarized into reports used by maintenance personnel to generate work order tickets and track historical asset performance.

Authorized users can remotely access the Maintenance Tracker app through a secure login option provided by the Maintenance Tracker website (maintracker.its.ou.edu). This option can be accessed from any browser.

Asset Management

ODOT uses a combination of Environmental Systems Research Institute (ESRI) geographic information systems (GIS) databases and spreadsheets and other applications to document the locations and attributes of assets. OTA is also in the process of developing a fiber asset management system. This

[17] Image source: ODOT

application is only accessible through a private network, using an Access database paired with a VB GUI. Public access to this system is not available.

Traffic Signal Management System

ODOT's Traffic Division uses a cloud-based management system to manage its field controllers. The system's management features give authorized users the ability to view and modify timing parameters remotely, among other real-time control functions that provide ODOT Traffic Division staff with a current awareness of operational conditions. Traffic signal system status is not currently shared with local agencies.

Video Streaming

ODOT leverages the Wowza Streaming Engine to live stream camera video imagery to the web. This service helps inform travelers, partner agencies, and the media about traffic conditions. It's important to note that this is a private network and doesn't provide public access.

4.1.3 Support Infrastructure

ODOT has heavily invested in additional infrastructure to support the various ITS initiatives. Support-oriented systems are described below.

Traffic Operations Center (TOC)

ODOT's TOC is used to monitor ODOT's highway conditions and perform management and coordination. ODOT monitors highways for traffic incidents, weather, work zones, congestion, and planned special events. Staff also coordinates with transportation and emergency management partners, posts DMS messages, configures field devices, and observes device maintenance status. The TOC is staffed by 2-4 individuals during business hours, and staff are on-call outside of office hours. Figure 19 shows the TOC, which is located on the first floor of the ODOT headquarters building. The land mobile radio (LMR) system is also accessible from the TOC. ODOT's legacy ITS console software is also available exclusively from the TOC.

Figure 19. Image of ODOT Traffic Operations Center.

Communications Infrastructure

A reliable communications network is the backbone that enables TSMO strategies by linking people, systems, and devices. Providing a reliable and secure communications system is not only a strategy for transportation operations, but also strengthens operational ties with partner agencies. Through many years of work, ODOT has built a fiber-optic network of over 3,600 miles consisting of both fiber available from public and private partners and fiber that ODOT built, owns, and maintains. Maps of this infrastructure are provided to show this fiber infrastructure statewide in Figure 20 and for Oklahoma City in Figure 21 and 22 and for Tulsa in Figure 23.

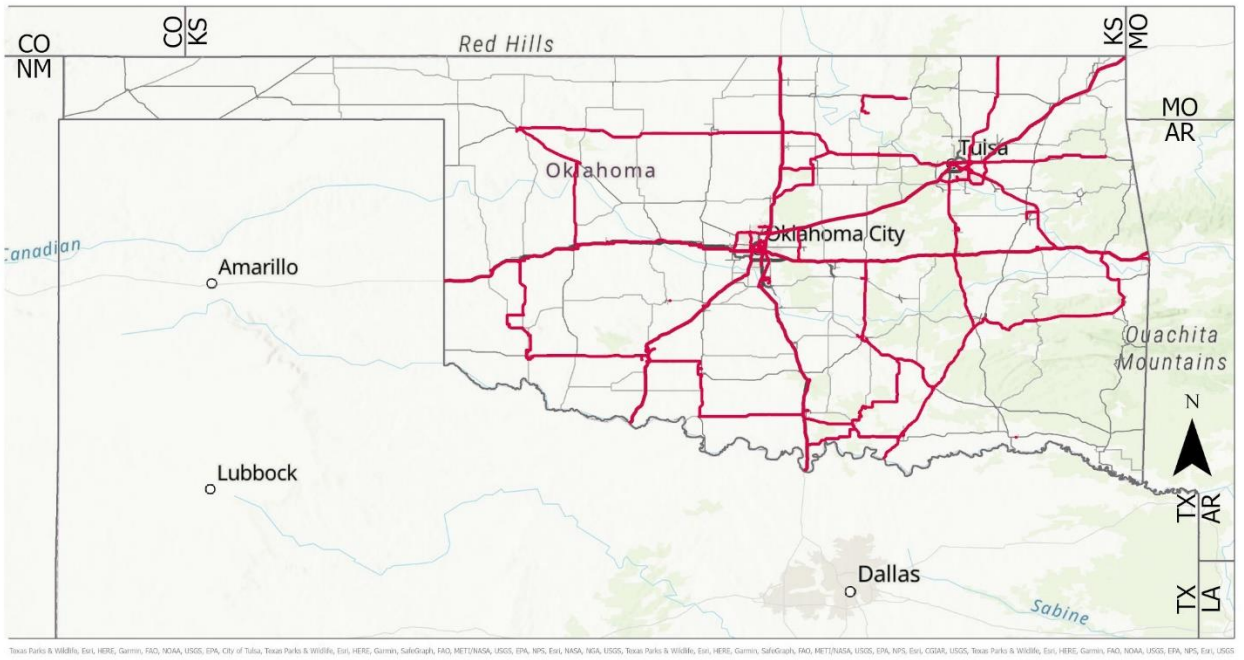

Figure 20. ODOT ITS Fiber-optic Infrastructure – Statewide.

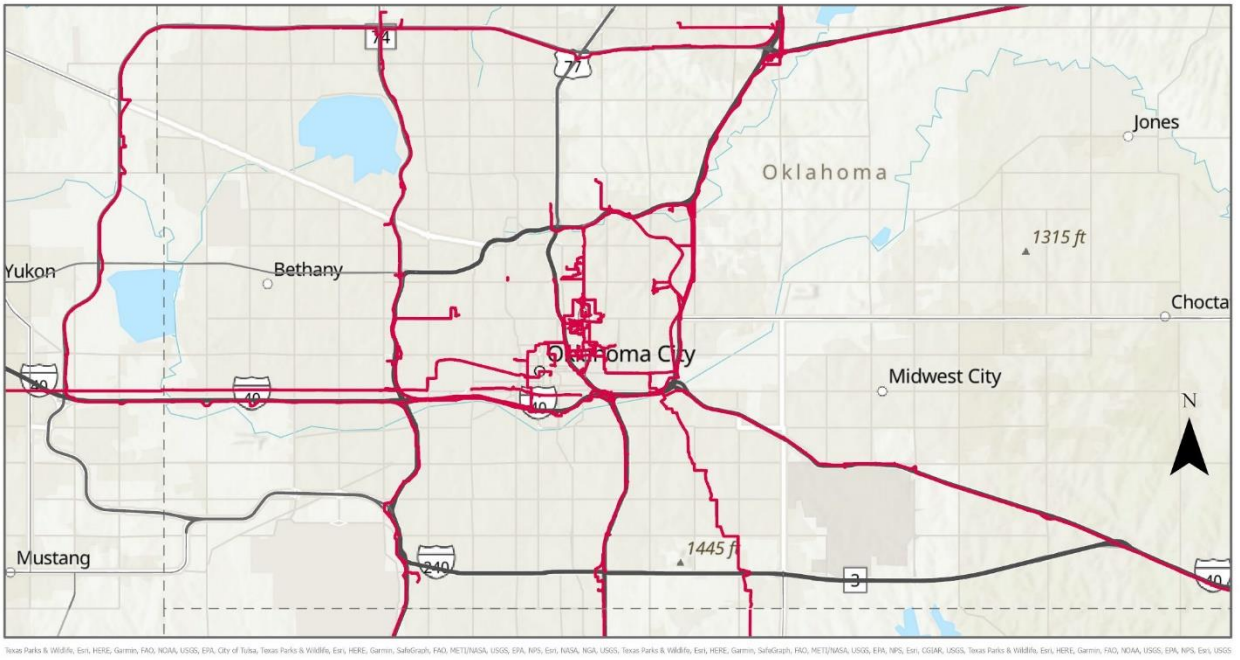

Figure 21. ODOT ITS Fiber-optic Infrastructure – Greater Oklahoma City Region.

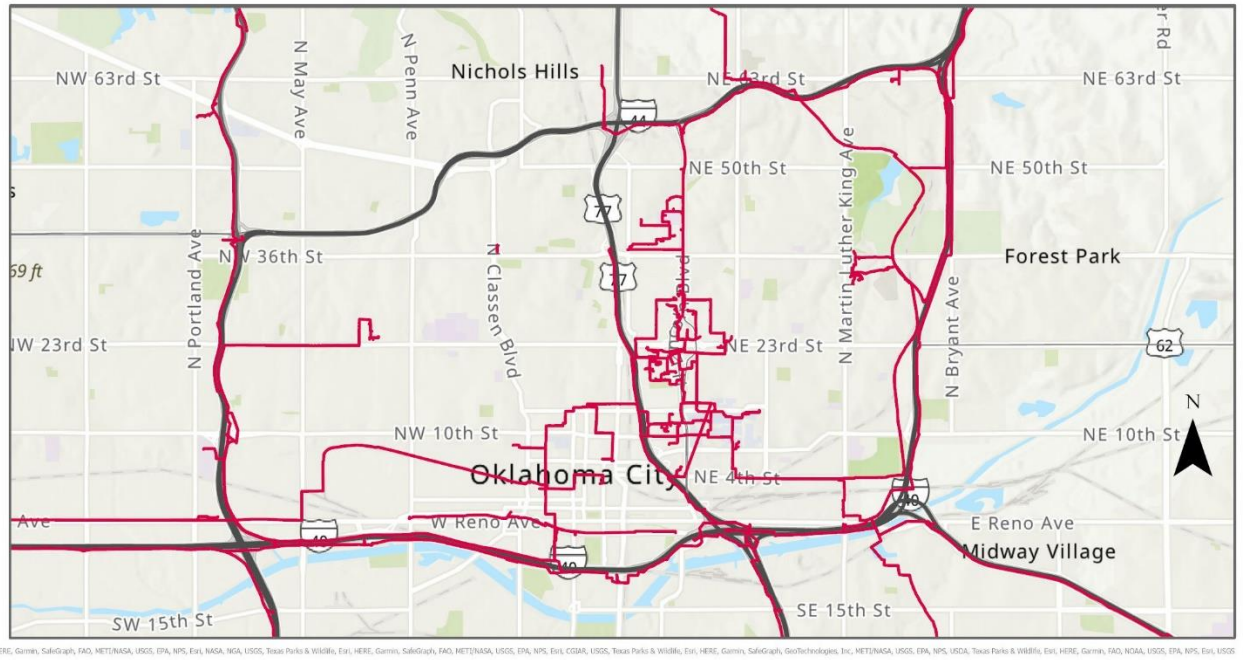

Figure 22. ODOT ITS Fiber-optic Infrastructure – Oklahoma City Urban Area.

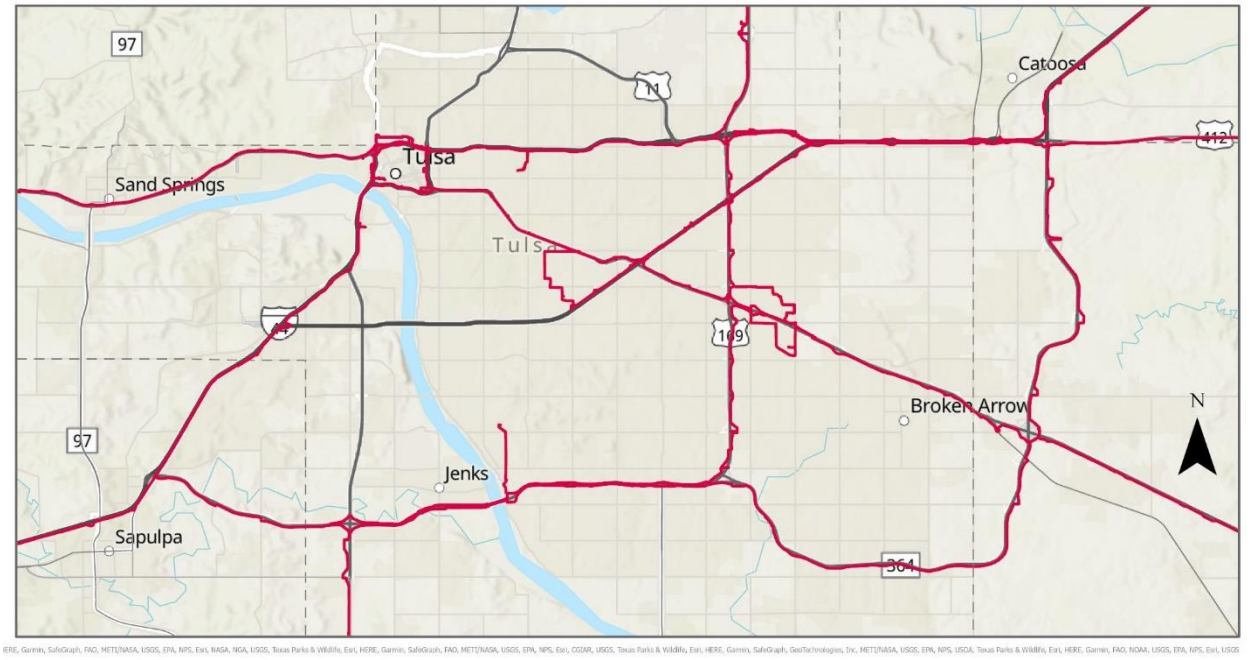

Figure 23. ODOT ITS Fiber-optic Infrastructure – Tulsa.

In addition to fiber-optic cable, ODOT uses wireless or cellular communications as a "last mile" connection to some end devices. All network communications hardware, such as routers, switches, and firewalls, are also managed by ODOT to provide a secure and reliable network. The field communications network enables the reliable flow of real-time data from field ITS assets to a centralized traffic management center.

Because of this extensive experience with fiber optics, the ITS manager is also the designated broadband coordinator for ODOT. In this role, the ITS manager coordinates with a designated representative from the Oklahoma State Regents for Higher Education to coordinate broadband initiatives across the state.

Because of its importance to effective operations, ODOT will continue to improve the reach, reliability, and security of its communications system through the tactics listed in Table 11.

Table 11. Communications Infrastructure Tactics.

Tactic	Description
Highest-priority Corridors	Because of the importance of interstate corridors, use fiber optics to connect devices to monitor and manage transportation along all Oklahoma interstates.
Statewide Backbone	Use fiber optics to establish a statewide backbone in a redundant path configuration around the state, where possible, to maximize reliability.
Urban Area Backbone	When possible, use fiber optics as a backbone in a redundant path configuration for communications throughout each urban area for facility and device connections.
Interfacility Connections	When possible, use fiber optics to provide connectivity between staffed ODOT facilities. Use fiber optics to provide connectivity between Oklahoma Department of Transportation (ODOT) and transportation partner networks.
Visual Monitoring	When possible, use fiber optics to connect to interstate and major highway cameras.
Improving Reliability	Continue to place priority on improving the reliability of communications services throughout the state through redundancy and other network strategies.
Improving Security	Establish a process and budget for the continuous evaluation and implementation of physical and digital security measures.
Fiber Ownership	Most fiber is owned and maintained by private companies through partnerships with ODOT. These companies install, own, and maintain the fiber and end equipment and manage the connections. This is advantageous for ODOT and will be the model moving forward.
Funding	Continue to pursue grants and other funding sources available to assist with the expansion of the fiber-optic network.
Dig Once Policy	ODOT is reviewing the feasibility of a “dig once” policy to allow junction boxes to be installed on all construction projects where ODOT disturbs the ground or builds a bridge – even if that conduit does not currently connect to anything.
Policies	A policy change is needed specifically for external bridge attachments. Specifically, the new policy should prevent multiple vendors from attaching to the same bridge.
Maintenance	As the amount of communications infrastructure increases and more agencies and partners rely on it for their operation, the number and skill level of maintenance staff should also be increased to effectively maintain it.

4.1.4 Support Services

Various support services are used to maintain various programs. Those services are discussed further below.

Freeway Service Patrol

A freeway service patrol (branded GoDOT) was started briefly in 2019 but was discontinued because of economic concerns. Because freeway service patrols have been effective at improving safety and incident response in many other states, the feasibility and operational model for this service in Oklahoma is likely to be reevaluated in the future.

ITS and Traffic Data Sharing

The ODOT ITS and Traffic groups understand the value of data for real-time traffic operations and to support planning decisions. For this reason, they share ITS and traffic-related data in various ways. A few examples include the following:

- General operational data is shared with the public via the traveler information website and the mobile app. Data incudes streaming video from cameras, vehicle speeds, active DMS messages, winter road conditions, work zone locations and lane closures, and others.
- Some agency partners have more direct access to some data. Examples include streaming video for Oklahoma Highway Patrol, communications tower security data for Oklahoma Department of Public Safety (DPS), etc.
- ODOT has provided direct access to its central management system through the ITS console with various partners in and around the Oklahoma City and Tulsa regions and other federal partners.
- ODOT also partners with public and private organizations both as a source of data for ODOT's operations and to distribute real-time traveler information to the widest possible audience. Such public organizations include the National Weather Service, the National Oceanic and Atmospheric Administration, and the University of Oklahoma's weather service. Private organizations include Waze (both providing data to and pulling data from Waze) and Google (pulling data from Google).
- ODOT has also supported federal data exchange initiatives such as providing work zone data to the Work Zone Data Exchange (WZDX) operated by the U.S. Department of Transportation's (USDOT's) Joint Program Office (JPO).
- ODOT is also actively looking at new ways of leveraging emerging technology to extract additional value from its existing data assets. For example, camera images are currently being shared with V3 Imaging, which is working on a system that will provide counts and traffic data directly from these video streams. Data is also being provided to the University of Oklahoma, which is currently developing an application programming interface (API) to allow others to access additional traffic operations data.

4.2 Key Relationships

ODOT partners with several key organizations to help meet its goals. Those organizations are listed below.

- Local transportation partners statewide and in the Oklahoma and Tulsa metropolitan areas
- University of Oklahoma Center for Intelligent Transportation Systems (https://its.ou.edu/pages/)
- The University of Oklahoma, Tulsa
- The University of Oklahoma, Norman
- Waze (https://www.waze.com/live-map/)
- Media outlets
- Live probe data from HERE (https://www.here.com/) through Iteris Clearguide
- Regional Integrated Transportation Information System (RITIS) through the University of Maryland Center for Advanced Transportation Technology (CATT) Lab for historical data
- Association of Central Oklahoma Governments (ACOG)
- The Indian Nations Council of Governments (INCOG)

5 TSMO Program Area Prioritization and Roadmap

This section provides details on each current and future program area. First, it will describe the outcome of the stakeholder prioritization for existing and new program areas. Following this overview, each program area will be described with a roadmap of prioritized actions.

5.1 Needs and Priorities

Through the stakeholder engagement process, the project team gathered significant input from project stakeholders that described current challenges and future goals. This input helped determine overarching needs and priorities for the advancement of TSMO.

At the beginning of the first stakeholder workshop, the project team asked all stakeholders to provide feedback on what they see as the primary transportation challenges for Oklahoma and ODOT. These challenges were solicited at the very beginning of the workshop to minimize any bias participants may have picked up during the discussion of TSMO. Participants shared more than 30 major concerns, which have been grouped into the following categories. Each of these challenges was considered during the development of future suggested actions, listed in Section 5.3.

- Congestion management
- Equitable transportation
- Funding
- Human factors / distractions
- Infrastructure maintenance
- Intradepartmental coordination
- Multimodal/interagency coordination
- Outreach and education
- Rural operations
- System standardization
- Technology integration
- Work zone management
- Workforce challenges

5.1.1 Program Area Prioritization

Based on guidance from the FHWA office of operations, six existing and six future TSMO program areas have been identified as the most relevant for Oklahoma. These program areas are shown in Table *12*.

Table 12. Existing and Potential Future TSMO Program Areas.

Existing TSMO Program Areas	Potential Future TSMO Program Areas
A. Work Zone Management	G. Freight Management
B. Road Weather Management	H. Special Event Management
C. Traffic Incident Management	I. Transit Management
D. Traveler Information System	J. Congestion Pricing
E. Traffic Management	K. Integrated Corridor Management
F. Traffic Signal Management	L. Connected / Automated Vehicles

All stakeholders were presented with these categories and were asked to classify/score their current capabilities and future priorities for each. The results are shown for two specific workshops – the first workshop included all district engineers and senior management and the second included representatives from many ODOT departments.

The first meeting included senior management and district engineers. In this forum, the project team also provided information from the CMM (discussed in Section 3) and asked all participants to rank both their existing capability in each area and their suggested priority for each program area. The results of these surveys are shown in Figure 24.

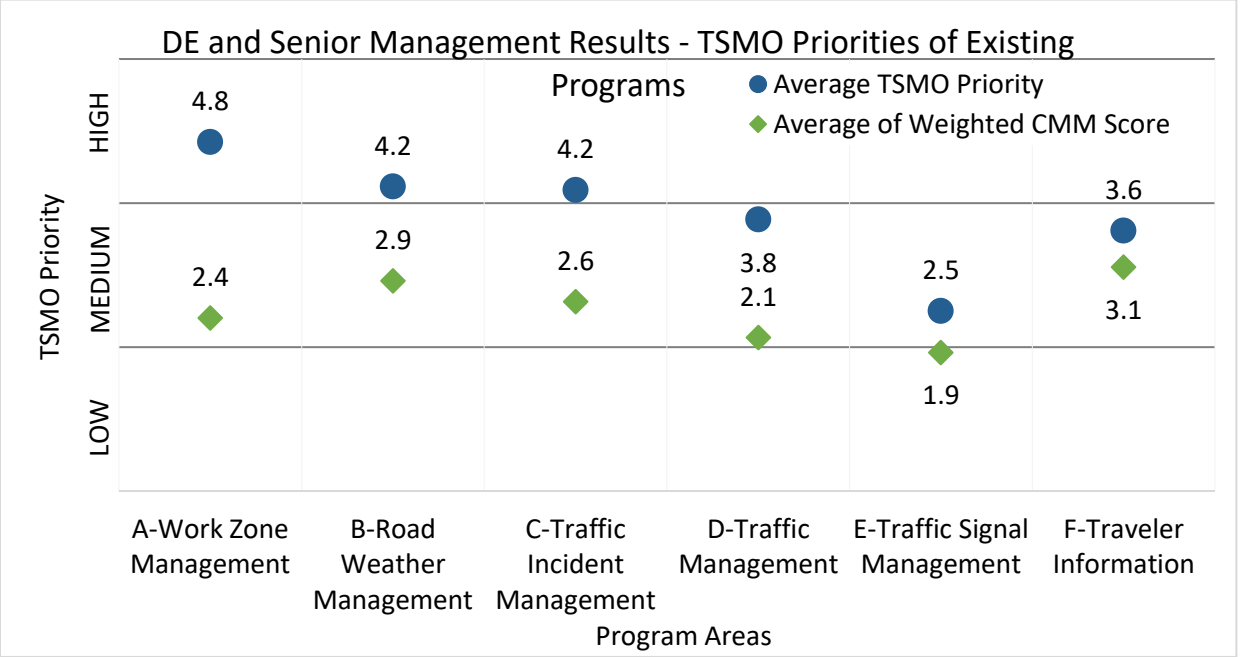

Figure 24. Capability Maturity Self-Assessment Results and Priorities for Existing TSMO Programs.

The second workshop included stakeholders from many ODOT departments. Though these participants were not asked about the current capability, they were asked to prioritize each program area moving forward. Overall, existing program areas fall in the medium to high TSMO priority level. Prioritization scores range from 1 to 5; 5 is the highest priority. The resulting future priority for senior management and ODOT departments is shown in Table 13.

Table 13. TSMO Priorities of Existing and Future Program Areas.

	Program Area\Stakeholder	Senior Management	ODOT Departments
Existing	A. Work Zone Management	4.8	4.3
	B. Road Weather Management	4.2	3.9
	C. Traffic Incident Management	4.2	4.3
	D. Traffic Management	3.8	4.2
	E. Traffic Signal Management	2.5	3.7
	F. Traveler Information	3.6	4.2
Future	G. Freight Management	3.0	3.8
	H. Special Event Management	1.9	3.0
	I. Transit Management	1.6	3.5
	J. Congestion Pricing	2.7	2.9
	K. Integrated Corridor Management	3.5	4.1
	L. Traveler Information	3.0	3.7

The stakeholders agreed that ODOT should continue to support and expand services in each of the existing program areas. This opinion is especially true with Work Zone Management (WZM) services, which were ranked highest by all stakeholder groups. Stakeholders scored the TSM program area lowest, primarily because ODOT manages few traffic signals, deferring this function to local agencies.

For future program areas, Integrated Corridor Management (ICM) scored highest, and the senior management and ODOT department staff group differed on the lowest scoring initiatives, which were Transit Management and Congestion Pricing, respectively. In both cases, these functions are managed by agencies other than ODOT, and ODOT will support local agency efforts in these areas at a regional level.

5.1.2 Program Area Needs

In addition to the workshops, the project team met with representatives from each of the ODOT departments to do an extended "deep dive" into each program area to understand the current services, challenges, and needs. Though the needs for each program area are many and varied, the outcome of these extended workshops is captured in sections 5.2 and 5.3 for existing and new program areas.

5.2 Existing Programs

As part of proposed directions for ODOT's TSMO programs moving forward, it is essential to understand the existing organizational structure, proposed future program areas, and roles and responsibilities. This section presents an overview of the current practices and procedures of ODOT's operational, technological, and administrative functions for implementing and managing TSMO programs in a manner that supports and complements the many operations and safety initiatives in place.

Advancing existing and new TSMO programs by leveraging technologies to cost-effectively address congestion is one of the main objectives of this plan. This section describes the existing program areas; first it outlines the prioritization process and structure of existing programs from the stakeholder's point of view. Then, it provides a list of actions to expand the existing programs, listing recommendations of the steps needed to accomplish each lead action and defining a set of new TSMO programs with recommended actions.

ODOT has built six TSMO program areas over the past several years. Though not currently branded as TSMO programs, they have many of the elements of their full TSMO counterparts. Each of the following sections describes these program areas in more detail.

Stakeholder priorities for each program area are shown in Figure 25.

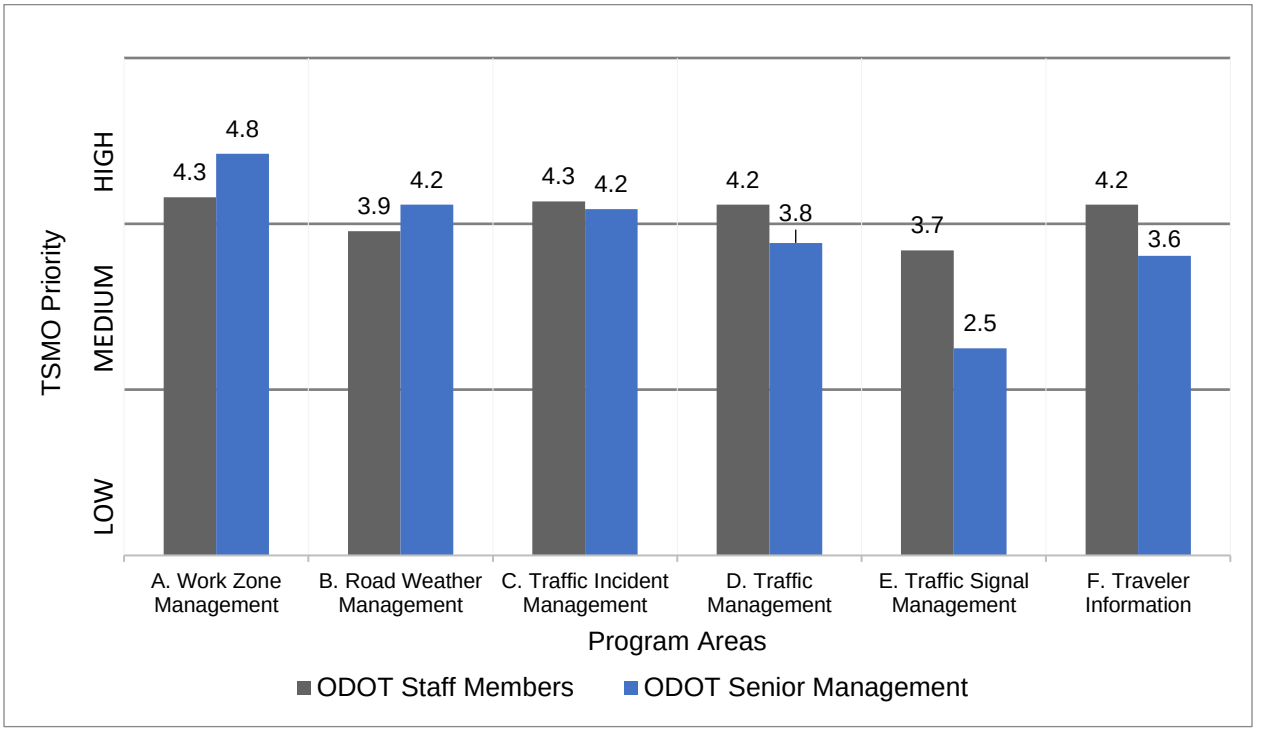

Figure 25. Existing Program Area Priorities.

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5.2.1 Work Zone Management (WZM)

WZM focuses on both the safety and operational efficiency of temporary construction and maintenance work areas. Under TSMO, agencies are looking to technology and other strategies to provide greater benefits to all who work in and travel through a work zone.

ODOT's ITS and Traffic staff have worked to incorporate technology into its work zones for many years; however, there is more work to do to vet and deploy new technologies and strategies and to mainstream their use into ODOT's regular statewide operation. An example of some efforts to date includes the following:

- Piloting strategies such as zipper merge, queue detection, and work zone travel times
- Working with law enforcement to understand the impacts of their presence
- Developing a Work Zone Inspection app to update the location and status of work zones for traveler information
- Developing standards for the use of portable sensors, cameras, and message boards
- Piloting the use of an outside vendor to deploy and manage SWZ implementations
- Working to effectively collect, manage, and distribute work zone data, including through FHWA's WZDX
- Variable speed limits
- Work zone alarms (alerting crews about imminent vehicle encroachment)
- Autonomous Trailer-Mounted Attenuators (ATMAs)

Recommended Actions

ODOT staff at all levels ranked improving WZM as the number one TSMO priority. The ODOT ITS and Traffic groups have collaborated to identify and prioritize numerous actions and areas that can further advance the implementation of WZM to improve traffic operations and increase safety for travelers and transportation workers. Top-ranked items are included in Table 14, and all actions are provided in the appendix.

Table 14. Recommended Actions – Work Zone Management.

Action	Initiative Status	Assigned to
Specifications and Special Provisions – Develop formal specifications or special provisions for each advanced work zone strategy.	Ongoing	Traffic
Work Zone Safety Education – Develop and implement a work zone safety education program plan for Oklahoma Department of Transportation (ODOT) staff and other transportation workers.	Ongoing	Chief Engineer/Traffic
Work Zone Safety Education for Public – Develop a work zone safety outreach program for the traveling public.	Ongoing	Chief Engineer
Work Zone Coordinator – Consider establishing a work zone coordinator position to support resident engineers. Responsibilities can include approval of traffic control plans and coordination of work zone audits and inspections.	Ongoing	Traffic
Strengthen Collaboration – Strengthen existing collaborative efforts between the Intelligent Transportation System (ITS) and Traffic groups to advance Work Zone Management (WZM).	Ongoing	ITS/Traffic
Coordinate Design and Construction – Establish tighter coordination between design and construction for WZM.	Ongoing	Traffic/ District Traffic Engineers/ Roadway
University Partnerships – Continue to rely on partnerships with the local universities to advance WZM activities, including research, software development, evaluation, performance measures, and studies.	Ongoing	ITS
Central WZM Performance Data Repository – Develop a process and system to collect and store WZM-related performance data in a central data repository.	New	ITS/Traffic
Develop Guidelines – Develop advanced WZM strategy guidelines that can be used to select and budget for the most appropriate strategies during planning.	Ongoing	Roadway/Traffic/Bridge Divisions
Work Zone Location Reporting – Enact policies to require reporting on work zone locations as changes occur for documentation, inspection, and information to the public.	Ongoing	ITS/Traffic

5.2.2 Road Weather Management (RWM)

RWM consists of systems, processes, and personnel working to actively monitor, manage, and communicate road conditions during weather events. RWM is needed not just during winter weather events, but also year-round for high winds, storms, floods, or other natural phenomena that affect the ability to drive on Oklahoma roadways. RWM is important because weather can not only cause travel delays, but it can also sometimes be deadly.

Through the RWM program, ODOT offers a series of websites to monitor local roadway and weather condition information. Continuous efforts to improve linkages between the RWM programs and other planning initiatives allow agencies to initiate processes to inform drivers of hazardous weather events. The following are a few examples of RWM processes:

- Deployed 32 RWIS stations, and have plans to deploy many more
- Developed a website for field personnel (maintenance and DPS) to input road condition data. This data is then shared through the OKTraffic, OKRoads, and other websites and data feeds.
- Deployed cameras and status monitoring equipment into snowplow vehicles and developed a website for maintenance superintendents to view them.
- TOC staff actively monitor and coordinate with field crews the road condition data and traveler information during a weather event.
- Actively support and participate with other weather groups such as the Oklahoma Mesonet and the National Weather Service.

Recommended Actions

A set of recommended actions was developed with input from the ODOT ITS and RWM groups and with recommendations from FHWA CMM resources. These recommendations have been prioritized based on their impact and feasibility. Top-ranked actions are shown in Table *15*, and all actions are provided in the appendix.

Table 15. Recommended Actions – Road Weather Management.

Action	Initiative Status	Assigned to
Web-based Management Tools – Enhance the dissemination of information presented on the website for internal use and as a management tool. For instance, include predictive analysis to foresee bridge freezing.	Ongoing	Intelligent Transportation System (ITS)
Improve User-Friendliness – Improve the user-friendliness of the tracking website for Oklahoma Department of Transportation (ODOT) staff. For example, make the site more responsive with content easy to skim and enter data to for later report.	Ongoing	ITS
Application Programming Interface (API) for Road Closure Logistics – Continue efforts to work on and improve API to push out on road closure logistics.	New	ITS
Deploy Additional Stream Gauges	Ongoing	University of Oklahoma
Deploy Road Weather Information System (RWIS) along Interstate 40 and Turnpike	Ongoing	ITS
Develop Rerouting Software – Pursue current efforts to develop a software capable of detecting debris and reroute/shut traffic down when needed.	New	University of Oklahoma
Flooding Research – Continue research to expand the study of identified flooding locations and the technologies required to detect and help mitigate the issue.	Ongoing	ITS
Reassess Sensor Locations – Reassess weather forecasting sensor locations through RWIS technologies to help identify a possible solution for hazardous weather-related conditions in the roadway. For example, develop a structured plan that details common weather-related trouble spots, and study the feasibility of installing a sensor at these locations for future weather forecast efforts.	Ongoing	ITS
Lidar Debris Detection – Implement lidar technologies for debris detection from flooding and bridges. There is a need to plan to deploy this technology at scale.	Ongoing	ITS

5.2.3 Traffic Incident Management (TIM)

TIM consists of multidisciplinary methods to plan and coordinate the process of rapid detection, verification, response, and safe clearance of traffic incidents. TIM is crucial to reducing nonrecurring congestion and reducing the risk of secondary incidents. Transportation and public safety agencies take on the responsibility of facilitating safe and rapid clearance of traffic incidents that affect the normal traffic flow while managing the affected traffic until normal traffic conditions are reinstated.

ODOT's roles in TIM responses are effective at increasing first responders' safety and reducing secondary incidents (for example, by verifying an incident using available real-time ITSs, establishing traffic control in advance of the incident, displaying DMS messages upstream, providing clean up support, enabling highway service patrol dispatch, etc.). ODOT recognizes the impact that roadway incidents have on the facilities' performance and the importance of having in place pertinent monitoring and rapid clearance programs. Additionally, Oklahoma has a strong TIM coalition in place to manage incidents along Oklahoma's interstate and state routes. ODOT personnel and first responders, local agencies including the Indian Nations Council of Governments (INCOG) and the Association of Central Oklahoma Governments (ACOG), FHWA, and other key partners are members of the coalition whose mission is to continuously improve on existing TIM strategies and identify new strategies that may be suitable to the Oklahoma TIM coalition. The following are some of the strategies used by the TIM coalition:

- Hold multidisciplinary coalition meetings monthly
- Provide regular first responder and trainer trainings (live and online)
- Support legislative changes needed to support TIM (e.g., move over law, good Samaritan law)
- Require wreckers demonstrate staff training as condition of licensing
- Prepare work zone specific TIM plans
- Track TIM performance metrics

Recommended Actions

Table 16 summarizes a series of actions that can improve the state of Oklahoma's existing TIM program.

Table 16. Recommended Actions – Traffic Incident Management (TIM).

Action	Initiative Status	Assigned to
Options for freeway service patrols study – Perform a study to investigate the feasibility, operational, and funding models for freeway service patrols in Oklahoma.	Not Started	Intelligent Transportation System (ITS) / Department of Public Safety (DPS)
Incorporate key incident data – Integrate DPS Computer-aided Dispatch (CAD) data into ODOT ITSs.	Pending	DPS
Integration of CAD – Continue to integrate CAD and reduce human intervention on the TIM data to increase data quality and make the system more efficient.	Pending	ITS & Partners
Involvement with TIM Coalition - Continue to work with the TIM Coalition group to provide training to field personnel and community members who are involved in traffic incidence response to ensure they are prepared for a quick and safe incident response.	Ongoing	ITS/DPS
TIM Reporting – Develop updated data collection, workflows, and reporting mechanism to automate the development and reporting of TIM performance metrics across all TIM stakeholders.	Ongoing	ITS/DPS
Standard Communication Protocol – Identify a standardized, on-scene communications protocol to aid in resource management during incidents. For example, the Federal Emergency Management Agency (FEMA) Incident Command System (ICS).	Ongoing	TIM Coalition
Comprehensive Response Planning – Adopt a planned and coordinated multidisciplinary process to detect, respond to, and clear traffic incidents rapidly and safely. For instance, the Oklahoma DPS unmanned aerial vehicles (UAV) program.	Desired	TIM Coalition
Common Platform for TIM Training – Provide a common platform (in-person and online) for training on TIM standards and practices among all responders.	Ongoing	TIM Coalition

5.2.4 Traffic Management (TM)

TM involves a broad range of strategies for actively monitoring and managing travel by implementing appropriate policies, systems, and actions to provide safe and efficient travel. Primary strategy categories are as follows:

- **Monitor** real-time traffic conditions.
- **Manage** traffic control systems and data.
- **Communicate** with all stakeholders, including field staff, management, partner agencies, emergency responders, the media, and the public.
- **Connect** systems, devices, and partners digitally through fiber-optic and wireless communications infrastructure.

Over the years, ODOT has developed and deployed several systems and forged operational partnerships with other agencies and organizations – all with the common goal of improving safety and mobility through the application of TM strategies. The implementation of all systems and strategies is coordinated and supported by staff within ODOT's central TOC infrastructure. There is a need for increasing resources, which includes staffing.

Operational performance is monitored, and decisions are supported by the significant amounts of data collected by these TM systems. Data analysis, management, security, data sharing, and performance measurement and management have also become a critical element of the TM program.

Recommended Actions

The ODOT ITS group and other stakeholders collaborated to identify and prioritize numerous actions and areas that can further advance the implementation of TM. Top-ranked items are included in Table 17, and all actions are provided in the appendix.

Table 17. Recommended Actions – Traffic Management (TM).

Action	Initiative Status	Assigned to
Increase camera coverage – For real-time operational awareness on priority routes, increase camera coverage.	Ongoing	ITS
Standard ITS Plans and Specifications – Develop ITS design standard plans and specifications promoting proactive incorporation of ITS into the planning, design, and construction process and workflow of Oklahoma Department of Transportation (ODOT) projects.	Ongoing	ITS
Annual Financial Plan – Include Transportation Systems Management and Operations (TSMO) initiatives in an annual financial plan and budget process.	New	ITS/Traffic
Include ODOT ITS Division in planning/design – Involve ODOT ITS division during the different phases of a project to account for ITS technology deployment, operations, and maintenance needs throughout the life span of the projects.	Ongoing	ITS/Traffic/Project Management
TM Decision-making Organization – Review and refine the organizational hierarchy that supports and empowers TM decision-making at the level that requires it.	Ongoing	ODOT Senior Management
Core Staffing – Establish a core group for TM that includes staff for key roles.	Ongoing	ITS/Traffic
Staff Training – Offer staff training courses to advance awareness, understanding, and application of planning operation concepts and approaches involving TSMO principles and their benefit. As a recommendation, propose a TSMO committee agenda item to identify a TSMO training program.	New	ITS/Traffic
Data Sharing – Ensure that data sharing capabilities extend to all TM systems.	Ongoing	ITS/Partner Divisions
Asset Management System – Develop an asset management system to manage the maintenance, replacement, and upgrade of ITS technologies.	New	ITS

5.2.5 Traveler Information (TI)

TI programs consist of gathering and disseminating information valuable to travelers so they can make more informed route decisions. As technology and data sources evolve, so does the TI program's ability to provide effective and timely information to road users.

ODOT's TI program includes information shared with the public. Dissemination of TI that provides robust, reliable, accurate, and timely information about roadway conditions to motorists and commercial vehicle operators (freight) allows them to make informed route decisions to save lives, time, and money. Additionally, sharing TI can increase customer satisfaction with the roadway network through timely awareness of upcoming delays, especially when provided in advance of available decision points toward alternate routes.

ODOT's TI consists of the following:

- Gathering TI data regarding travel conditions from field devices, ODOT fleet vehicles, and private transportation data providers, including imagery (still and streaming video), levels of congestion, roadway weather data, roadway conditions, snow removal status, snowplow locations
- Gathering information about work zone locations
- Gathering information about incidents from various calls or messages from trusted field personnel, computer-aided dispatch (CAD), ITS personnel working within TOC using video surveillance, crowd-sourced data
- Broadcasting TI data, incidents, and work zones with the traveling public via website, mobile apps, DMS
- Sharing relevant TI issues with adjacent state DOTs that may have major interstate impacts.

Recommended Actions

ODOT ITS and Traffic groups have collaborated to identify numerous actions and areas that can further advance the collection and dissemination of TI to improve traffic operations and increase safety for the public. Actions are generally divided into institutional and technology groups. A summary of the recommended actions to advance this program area are shown in Table 18.

Table 18. Recommended Actions – Traveler Information (TI).

Action	Initiative Status	Assigned to
Expand TI pilot projects – Grow TI pilot projects to automate Dynamic Message Signals (DMS) messaging from portable boards to permanent DMS mounts.	Ongoing	ITS
Integrate Waze data – Automate use of the incident data received from Waze.	Ongoing	ITS
Department of Public Safety (DPS) Computer-aided Dispatch (CAD) integration – Integrate data with Oklahoma Department of Transportation (ODOT) systems to support detection of incidents.	Planned	ITS/DPS
Joint TI Data Sharing – Establish an operating structure for joint TI data sharing across jurisdictional boundaries along adjoining transportation facilities.	New	ITS
Data Sharing Agreements – Formalize agreements for sharing data for TI programs.	Ongoing	ITS
TI Data Sources – Leverage the various types of emerging TI data sources including probe data, crowd-sourced data, and Department of Transportation (DOT) device data.	Ongoing	ITS
University Partnerships – Continue to leverage and optimize formal research partnerships with local universities and become involved in pooled-fund studies.	Ongoing	ITS
Eliminate Data Silos – Identify programs and data feeds still operating in stand-alone mode that should be considered in a multiagency sense to encourage stronger agency relationships. For instance, build stronger relationships with DPS.	Ongoing	ITS/DPS/Traffic
Interstate Coordination – Improve coordination of TI sharing with adjacent states. For example, share weather-related DMS alerts with Arkansas.	Ongoing	ITS/Maintenance
Traveler Information Plan – Develop a multiagency plan for combining and distributing all types of TI. The plan should address customized TI for groups such as freight and transit users.	Desired	ITS/DPS/Traffic/ Multimodal

5.2.6 Traffic Signal Management

TSM includes the planning and coordination of the personnel involved in the proactive management and operation of traffic signals. It comprises the planning, layout, integration, maintenance, and operation of an effective traffic signal system to meet the needs of motorists, traffic signal operators, transit agencies, emergency operations staff, and emergency personnel. Proactive and periodic assessments of the traffic signal system in the context of emerging technologies is important for maintaining and improving the safety and efficiency of signal operations.

ODOT has historically relied on local agencies to operate and maintain traffic signals through agreements with those agencies, except where specific support is requested by local agencies and clearly needed. Though these procedures have been in place for many years, ODOT is looking to take a more active role in ensuring that traffic signals along its highways are being managed well. Therefore, ODOT's Traffic Division staff require that selected projects installing a new signalized intersection also provide several years of cloud-based management software subscription for each traffic signal. This allows ODOT staff to monitor and manage the signals through field communications. Examples of key TSM activities ODOT performs where remote management capabilities exist are as follows:

- Ensuring the intended timing patterns are in effect as scheduled
- Modifying those patterns as needed during incidents
- Uploading and downloading new databases remotely to quickly verify and update timing patterns and other key parameters
- Configuring automatic alerts for equipment failures

ODOT is also considering other key ITS startegies and infrastructure that support signal operations, including adequate video surveillance and associated field communications infrastructure.

Recommended Actions

Recommended actions listed in Table 19 were designed to address many challenges to the institutional and technological systems of an agency.

Table 19. Recommended Actions – Traffic Signal Management (TSM).

Action	Initiative Status	Assigned to
Before/After Analysis of Optimization – Measure and report before/after assessments using appropriate measures of effectiveness (MOE) when traffic signal timings are reoptimized or other new traffic signal systems are deployed.	New	Traffic
Intelligent Transportation System (ITS) Strategy Recommendations – Identify a recommended set of ITS strategies needed to improve traffic signal operations at identified priority corridors. For example, the optimization of existing transportation system capacity to mitigate	New	Traffic

Action	Initiative Status	Assigned to
congestion and manage critical corridors to minimize travel time fluctuation.		
Integrate ITS deployments – Considering the operational benefits provided by ITS technology deployments, Oklahoma Department of Transportation (ODOT) can integrate this system into the design and planning process, which would allow ODOT to create a plan to allocate resources destined to traffic signals at local agencies.	New	Traffic/ITS
Remote Signal Monitoring – Expand capabilities to remotely monitor traffic signals daily to ensure correct configuration and identify any unintended changes.	Ongoing	Traffic/ITS
Match Signal Operations to Needs and Resources – As typical practice, provide the appropriate type of signal operation using available technical and financial resources. For instance, select conventional scheduled coordinated patterns, traffic-responsive plan selection (TRPS), or adaptive system control technology (ASCT) operation based on the traffic conditions.	New	Traffic
Accurate Inventory for Traffic Signals – Develop and maintain an accurate inventory of traffic signal assets.	Ongoing	Traffic
Traffic Signal Master Plan – Develop a comprehensive traffic signal master plan to identify infrastructure needs in priority corridors.	New	Traffic

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5.3 New Program Areas

The stakeholders prioritized several new program areas for ODOT to pursue. The following sections describe and briefly address the actions recommended to advance each of the programs.

Stakeholder priorities for each potential new area are shown in Figure *26*.

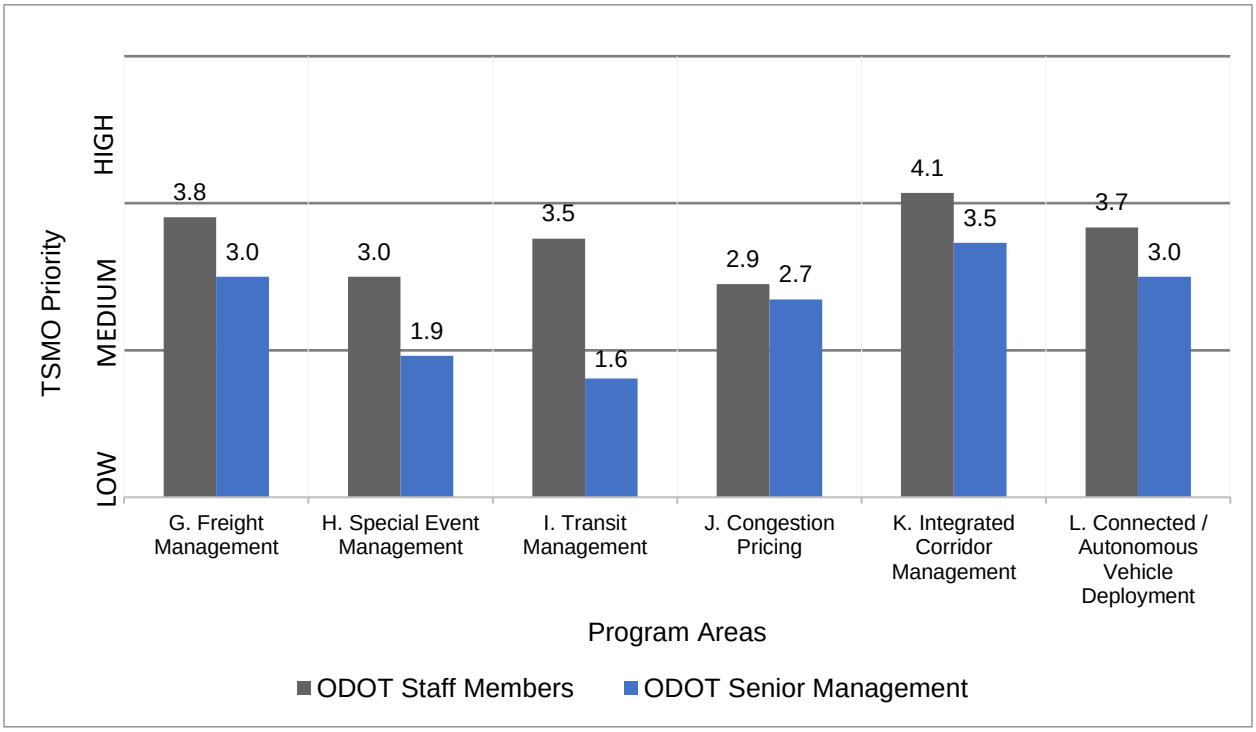

Figure 26. Potential Future Program Area Priorities.

5.3.1 Freight Management

Safe, reliable, and efficient freight transportation boosts exports, enhances commerce, and powers economic growth. A robust multimodal freight system in Oklahoma supports state and national economies by lowering costs to businesses and consumers and boosting the competitiveness of American goods abroad.

The safe and efficient movement of goods through the freight system is a top priority for ODOT. The goals of this program area include the following:

- **Safety** – Improve the safety, security, and resilience of the freight system in Oklahoma.
- **Infrastructure** – Modernize freight infrastructure and operations to grow the economy, increase competitiveness, and improve quality of life in Oklahoma.
- **Innovation** – Prepare for the future by supporting the development of data, technologies, and workforce capabilities that improve freight system performance within Oklahoma.

Recommended Actions

The ODOT ITS group and other stakeholders have prioritized various actions to advance a freight management program. Top priority items are summarized in Table 20, and all items are provided in the appendix.

Table 20. Recommended Actions – Freight Management.

Action	Initiative Status	Assigned to
Travel Time Reliability – Provide constant travel time reliability for freight movement (i.e., at-grade rail crossing delays). For example, with GPS navigation in use by truck drivers, add locations of hazards/delays into satellite navigation systems (i.e., Waze).	Ongoing	ITS/ Multimodal
Collaboration with Neighboring States – Consider collaboration with other states, and internally. For example, the 2015 rockslide that occurred on Interstate 35 needed to have a plan in place to communicate with the state of Texas and alert travelers of the hazardous conditions.	Ongoing	ITS/Multimodal
GPS RTKS Network – Apply GPS RTKS (Real-time Kinematics Systems) network for location accuracy enhancement (i.e., narrow medians to enhance precision and accuracy of positioning information).	Ongoing	ITS

5.3.2 Special Event Management

Planned special events include sporting events, concerts, festivals, and conventions occurring at permanent multiuse venues (e.g., arenas, stadiums, fairgrounds, amphitheaters, convention centers, etc.). They also include less frequent public events such as parades, firework displays, bicycle races, sporting games, motorcycle rallies, seasonal festivals, Olympic sporting events, and milestone celebrations at temporary venues. The term "planned special event" is used to describe these activities because of their known locations, scheduled times of occurrence, and associated operating characteristics. Emergencies, such as a severe weather event or other major catastrophe, represent special events that can induce extreme traffic demand under an evacuation condition. However, these events occur at random and with little or no advance warning, resulting in contrasting characteristics of planned special events.

A planned special event creates a typically intense and at times brief increase in travel demand and may require temporary traffic control measures to manage event traffic. Planned special events generate trips, thus affecting overall transportation system operations. This includes freeway operations, arterial and other street operations, transit operations, and pedestrian flow. Unlike roadway construction activities or traffic incidents that constrain travel within a single corridor, planned special events affect travel in all corridors serving the event venue. Planned special events pose a unique and diverse set of challenges to stakeholders charged with maintaining transportation system safety, mobility, and reliability. The following goals address the typical challenges:

- **Collaboration** – Work collaboratively with event holders to understand the anticipated impacts and develop appropriate solutions.
- **Safety** – Optimize the ingress and egress associated with large planned special events to minimize the risks to both event attendees and travelers.
- **Mobility** – Optimize the ingress and egress associated with large planned special events to minimize the delays to both event attendees and travelers.
- **Reliability** – Minimize the duration of impacts on the roadway network and travelers not attending planned special events.

Recommended Actions

Programmatically provide predictable, safe, and efficient travel around planned special events through intermodal and interagency collaboration. A list of recommended strategies is summarized in Table 21.

Table 21. Recommended Actions – Special Event Management.

Action	Initiative Status	Assigned to
Sharing Real-time Information – Continue sharing real-time data, with portable traffic management (TM) systems (cameras, detectors, changeable message signs), portable traffic signals, portable TM centers, etc.	Ongoing	ITS/Traffic

5.3.3 Transit Management

ODOT is the governor's designee for the administration of Oklahoma's state and federal public transportation financial assistance programs for areas under 50,000 population. Within ODOT, the Multimodal (Mobility and Public Transit) division is responsible for, "*the oversight and administration of Federal Transit Administration grants and resources and the State Management plan,*" according to Oklahoma Statute Title 69 Section 322, also known as House Bill 1365,[18] voted into law in 2019.

Recommended Actions

The statute requires that ODOT develop policies for pilot programs regarding microtransit and automated vehicles (AV).

The statute continues with the charge for the office to, "*ensure the mobility needs of all Oklahomans are met in a safe, affordable, reliable, consistent, and coordinated fashion.*"

Federal transit programs and grants that the Multimodal division currently administers are as follows:

- Federal transit programs and grants
  - Section 5307 Urban Public Transportation
  - Section 5310 Enhanced Mobility of Seniors and Individuals with Disabilities Program
  - Section 5311 Rural Public Transportation
  - Section 5329(e) State Safety Oversight (SSO) Program
  - Section 5339 Bus and Bus Facilities Program
- State of Oklahoma Programs
  - Oklahoma Public Transit Revolving Fund

Goals for this program area include facilitating federal and state funds for programs to achieve the following:

- Reliability – Ensure reliable, predictable, and on-time service to maintain a loyal customer base.
- System Efficiency – Minimize nonrevenue miles and adapt to user needs to maximize the efficient use of resources.
- Safety – Provide public transit users with a safe and secure system.
- Affordability – Ensure that services are priced affordably for their customer base.
- Accessibility – Optimize the types of transit services available and where stations are located to maximize how frequently transit is used. Provide accessible facilities for travelers with disabilities.

A list of recommended strategies is summarized in Table 22.

[18] https://oklahoma.gov/content/dam/ok/en/odot/documents/hb1365.pdf

Table 22. Recommended Actions – Transit Management.

Action	Initiative Status	Assigned to
Special Events/ Work Zones – Establish transit coordination for special events / work zones. For instance, implement additional services during periods of special events or highway construction.	New	Multimodal/EMBARK/Traffic
On-demand Mobility Service – Continue efforts to improve the on-demand mobility service transit program to Uber Pilot – Pick Transportation.	Ongoing	Multimodal/Rural Providers
Accurate Information – Investigate the use of General Transit Feed Specification (GTFS) to improve the accuracy of arrival/departure information to transit and rail passengers.	New	ITS /Multimodal/ All Providers
Ridesharing – Promote shared-ride services for efficiency.	Ongoing	Multimodal
Pilot programs for Connected and Automated Vehicles (CAV) and microtransit – Support the development of pilot projects for automated transit vehicles and microtransit	New	Multimodal

5.3.4 Congestion Pricing

Congestion pricing is a method of shifting traffic away from congested roadways by varying the tolling price along that route based on the current level of congestion. For example, the more congested the roadway, the higher the price, which will encourage travelers to take other routes or modes. This can be applied to entire roadways or to specifically designated lanes such as express lanes or high occupancy toll (HOT) lanes. The strategy takes advantage of the fact that most peak hour drivers on a typical urban highway are commuters. Removing a fraction (even as small as 5 percent) of the vehicles from a congested roadway enables the system to flow much more efficiently, allowing more vehicles to move through the same physical space. Similar variable charges have been successfully used in other industries – for example, airline tickets, cell phone rates, and electricity rates. There is a consensus among economists that congestion pricing represents the single most viable and sustainable approach to reducing traffic congestion.

Although drivers unfamiliar with the concept of congestion pricing initially have questions and concerns, surveys show that drivers more experienced with congestion pricing support it because it offers them a reliable trip time, which is very valuable, especially when they need to be somewhere on time. Goals of congestion pricing include the following:

- Influence Travel Mode Choices – Influence single-occupancy motor vehicle travel habits through incentives and pricing strategies to encourage alternate modes of travel (carpooling, transit, etc.).
- Influence When to Travel – Influence travel habits of motorists through incentives and pricing strategies to shift traffic demand to time periods outside of the peak travel periods.

Recommended Actions

Transit and ridesharing advocates appreciate the ability of congestion pricing to generate both funding and incentives to make transit and ridesharing more attractive. A list of recommended strategies is summarized in Table 23.

Table 23. Recommended Actions – Congestion Pricing.

Action	Initiative Status	Assigned to
Develop a feasibility study for congestion pricing in cooperation with the Oklahoma Turnpike Authority (OTA).	Not Active	OTA

5.3.5 Integrated Corridor Management

Transportation corridors often contain underused capacity in the form of parallel roadways, single-occupant vehicles, and transit services that could be better leveraged to improve person-throughput and reduce congestion. Facilities and services on a corridor are often independently operated, and efforts to date to reduce congestion have focused on the optimization of the performance of individual assets.

The vision of ICM is that transportation networks will realize significant improvements in the efficient movement of people and goods through institutional collaboration and aggressive, proactive integration of existing infrastructure along major corridors. Goals in this program area include the following:

- Being Proactive – Create an actively managed and integrated system that facilitates collaborative, multidisciplinary, and intermodal responses to address nonrecurring events on priority corridors.
- Continuous Advancement – Advance the level of active management and integration of each corridor and over time, increase the degree to which corridor issues are addressed.

Recommended Actions

Through an ICM approach, transportation professionals manage the corridor as a multimodal system and make operational decisions for the overall benefit of the corridor. A list of recommended strategies is summarized in Table 24.

Table 24. Recommended Actions – Integrated Corridor Management (ICM).

Action	Initiative Status	Assigned to
Cross-state Data Sharing – Strengthen data sharing for Dynamic Message Signs (DMS) control across states. There is a need of additional coordination with agencies and traffic signals.	Ongoing	ITS/Traffic
Identify Potential Corridors – Initiate a study to identify and prioritize corridors that would be good candidates for an ICM app.	New	Traffic/ITS

5.3.6 Connected/Automated Vehicles

ODOT has actively monitored the state of connected and automated vehicles (CAV) technologies. Efforts are focused on being proactive to both connected and automated vehicles benefit from the anticipated advantages of the technologies and mitigating impacts from the technology to infrastructure and operations.

Connected Vehicles

The USDOT's Connected Vehicle program is working with state and local transportation agencies, vehicle and device makers, and the public to test and evaluate technology that will enable cars, buses, trucks, trains, roads, and other infrastructure to "talk" to each other and to our smartphones and other devices. Cars on the highway, for example, would use short-range radio signals to communicate with each other so every vehicle on the road would be aware of other, nearby vehicles. Drivers would receive notifications and alerts of hazardous situations, such as someone about to run a red light, an oncoming car beyond a curve, or a vehicle swerving into their lane to avoid an object on the road.

In recent years, the specific frequency and technology that will be used for connected vehicle technology is in the process of being changed by the Federal Communications Commission (FCC), but these changes have not been finalized as of the writing of this report.

Automated Vehicles (AV)

AV technology allows vehicles to travel on roadways with some or no intervention from a human driver. Specific levels of automation range from basic Advanced Driver Assistance Systems (ADAS) such as dynamic cruise control and lane departure systems to full driverless automation. CAV are sometimes also referred to as autonomous vehicles; the term "automated" is generally preferred because it indicates that a vehicle will operate as part of a transportation system within the context of other vehicles, other road users, and the infrastructure, rather than in a purely autonomous fashion.

ODOT and the rest of the surface transportation industry is excited about the many anticipated benefits of AVs, with a primary focus on safety. This is because AVs have a reaction time measured in milliseconds, can sense in all directions simultaneously, and don't get drowsy or distracted. Though there is a significant amount of ongoing research and testing for AVs, there is much to be done from both a technological and regulatory standpoint before they are deployed at scale.

Multiple bills have been proposed through the Oklahoma State Legislature related to automated vehicles. Some bills relate specifically to the freight and trucking industry, while others are more general. Three bills are highlighted here:

- HB 1712 established a Road User Charge Task Force to study methods that may be used to record and report public road usage and alternatives to the current system of taxing highway use through motor vehicle fuel taxes.
- SB 1688 established the ODOT Advance Mobility Pilot Program, focusing on, "*both advanced ground transportation, such as autonomous ground vehicles, as well as advanced air mobility*

vehicles such as electric vertical take-off and landing (eVTOL) vehicles." The bill also requires the appointment of a nine-member council, the Advanced Mobility Program Advisory Council, by the Oklahoma Secretary of Transportation.

- SB 1541 allows the operation of fully AVs and provides a broad framework for regulation of those vehicles including registration, titling, insurance, vehicle types, governance, accident behavior and reporting, etc.

Recommended Actions

For the quickly evolving landscape of CAV, ODOT should continue to do the following:

- Monitor – Approach the rapidly evolving CAV technologies with caution.
- Achieve Equity – Support CAV deployments when the investment in CAV will result in clear and tangible benefits to a majority of road users in an equitable fashion.

A list of specific recommended strategies is summarized in Table 25.

Table 25. Recommended Actions – Connected and Automated Vehicles (CAV).

Action	Initiative Status	Assigned to
CAV Preparedness Plan – Develop a statewide CAV preparedness plan. The Oklahoma Advance Mobility Program is already in place and supported by broad stakeholders.	New Initiative	ITS/Traffic/Multimodal
CAV State Review – Prepare a study reviewing the current status of CAV for surrounding states.	New	ITS/Traffic/Multimodal

5.3.7 Regional Considerations

The Oklahoma TSMO & ITS Strategic Plan defines a short-term vision for the deployment of ITS technologies to support ITS operations and management goals, mission, and vision. The plan not only identifies the key actions that can be implemented statewide to address critical institutional and technical needs, but also identifies the needs that are inherent in a regional TSMO program.

In separate plans, the ODOT Regional Strategic Plans, regional policy guidance is provided. The ODOT Regional Strategic Plans convey a common vision of which ITS apps should be employed to the regional level to improve safety, mobility, accessibility, and reliability.

Current Activities

The ODOT ITS Regional Strategic Plan identifies a growing need for improved transportation management and operations in two regions - (1) Oklahoma City and (2) Tulsa. These regions cover a large amount of the state's ITS technology. Hence, the importance of making a coordinated effort to manage the statewide and regional transportation network. The ODOT Regional Strategic Plans include a concept of operation that supports the required functionality and infrastructure of the transportation system for each of the regions. The ODOT Regional Strategic Plans were developed in conjunction with the Oklahoma TSMO & ITS Statewide Strategic Plan.

6 Business Processes and Resources

The full benefit from a focus on TSMO can only be achieved if it is supported and facilitated by organizations, processes, and resources. Over the past two decades, ODOT has steadily increased its focus through continued investment in staffing, systems, and infrastructure. Over much of this time, ODOT has had some success fitting ITS and TSMO into ODOT's existing organization and business process structure. As a focus on operations continues to have a greater impact, ODOT may consider additional changes to encourage and facilitate its advancement. This section explores several of these organizational and business process areas.

6.1 Workforce Development

Currently, ODOT has an ITS group responsible for planning, development, operations, and maintenance of its ITS and program. The position and title of each member of this group is classified and compensated under ODOT's existing staffing and compensation structure. No recruitment efforts, training programs, or professional advancement paths exist specifically for staff working in ITS and TSMO.

Advancing TSMO and ITS requires a workforce with increasingly specialized skills and abilities different from traditional positions within ODOT. A concerted effort is needed to recruit, develop, staff the TOC, and retain this workforce. Various resources are available to help guide these efforts, including the National Cooperative Highway Research Program's (NCHRP's) *Transportation Systems Management and Operations (TSMO) Workforce Guidebook (NCHRP-20-07)*.

Staff Qualifications

Most personnel skills within ODOT are related to the design, construction, and maintenance of roads and bridges – and the administration to support these activities. Personnel skills and abilities are needed to support TSMO and ITS and include a combination of traffic engineering, information technology (IT), software, emergency management, data analytics, and electronics. ODOT should consider reviewing existing position descriptions, certifications, requirements, and pay structure related to staff members who have these specialized skills, including laying out a clear advancement path.

Staff Development

ODOT may consider identifying training needs and opportunities specific to its dedicated TSMO workforce. Training should include elements of ODOT- and Oklahoma-based systems, procedures, and technologies, such as those related to the design, construction, operation, management, and maintenance of systems and field devices used by ODOT and its regional partners. Training should also include broader externally provided training opportunities related to all aspects of TSMO and ITS operations. For example, detailed training and certifications are provided for fiber-optic design and installation through device manufacturers and software providers. Broader training is offered through many sources, including the Regional Operations Leadership Forum (ROLF), the Operations Academy Senior Management Program, developed jointly with FHWA, the Institute of Transportation Engineers (ITE), and various other partners. ODOT should continue to have staff participate in these training and

certification programs and may even consider requiring certain training or certifications for specific positions.

In addition to providing training for dedicated TSMO- and ITS-focused staff members, many DOTs are providing instruction on TSMO and ITS topics to their general workforce. Such education and outreach programs provide greater awareness of the benefits of TSMO to staff members in other related departments such as planning, design, construction, and maintenance. These training programs can be provided as part of new staff onboarding and as continuing education for existing personnel.

6.2 Programming and Budget

Throughout the years, ODOT has provided funding mechanisms for TSMO & ITS initiatives through the following four primary sources:

- Staffing: ODOT has assigned dedicated Full Time Equivalent (FTE)s to manage, maintain, and operate the ITS.
- Operations: Operations budget is allocated to operate and maintain the ITS network. Maintenance includes the repair and replacement of field devices and communications system elements. The current budget of $2M per year is sufficient for the operations and maintenance of the current system. This does not include the funding for Traffic Signal Management (TSM). TSM is currently funded within the Traffic Division's budget.
- ODOT Expansion: Historically, new ITS deployments were only associated with new construction and funded through those projects. In 2022, a construction budget of $5M per year was assigned to support the expansion of the ITS. As the system continues to grow, the maintenance budget must also be increased commensurate with the size of the system.
- OTA Expansion: An additional $2M per year has been budgeted and assigned for the expansion of ITS along roadways managed by OTA.

In addition to the dedicated funding, ODOT may consider looking at ways to allow larger ITS and TSMO initiatives to compete for funding through the Statewide Transportation Improvement Plan (STIP) process. This may require accommodations to show the value and benefit of TSMO projects in similar terms to more typical capacity improvement projects (i.e., comparing "apples to apples").

6.3 Communications, Marketing, and Outreach

Although many of the operational strategies covered under the umbrella of TSMO are by no means new, the concept of using them to extend the capacity of a roadway, or to use them in place of other capacity improvements, or even to rely on technology represents a true cultural change for many experienced transportation professionals. Others believe that TSMO is just another name for ITS, and that they are "already doing that." In some cases, even the acronym TSMO has a negative connotation – seemingly hard to define, or like a fad that will come and go. So, while the essence of TSMO is simply a management and operations focus, there is a need for education both inside and outside of the transportation community.

It is recommended that ODOT work with the ITS group, Traffic Division, and the STRATCOM group to continue to couple a strong communications, marketing, and outreach program with the advancement of TSMO in Oklahoma. The program should be documented in its own brief plan and should include the following elements:

- Education and outreach to stakeholders (including the public when appropriate) for new major initiatives
- Ongoing general education and training to the transportation community that includes communication of the definition of and benefits of TSMO and its component strategies
- Targeted education for senior management and elected officials on the benefits and advantages of operational strategies
- Social media postings and conferences

6.4 Data Management

Data storage, analytics, and management is an area that continues to evolve very quickly. For TSMO- and ITS-related data, ODOT has generally stored its data through a partnership with the University of Oklahoma in on-site databases that the University of Oklahoma manages while accessing procured data through available data feeds and APIs.

Some agencies have begun to move some data sets from on-site databases to off-site cloud-based systems. ODOT also has some of its systems data stored in the Amazon Web Services cloud. Such systems can provide much greater processing speed and power, storage capacity, and analytics tools – and they eliminate the need to manage and maintain local hardware. Cloud systems, however, also come with a recurring cost that varies based on size of storage need, usage, and access. Such systems may provide great benefits for large data sets such as vehicle detector data and future data sets that may come from connected vehicles. However, they are less helpful for smaller and frequently accessed data sets such as ITS device inventory.

As the data technology continues to develop, it is recommended that ODOT do the following:

- Periodically evaluate the benefits and drawbacks of evolving data management strategies for each of its data sets.
- Develop a data management plan, including policies for storage, aggregation, and retention.

6.5 Leadership and Organization

A successful TSMO program depends on an adequately trained and organized workforce, the support and sponsorship of senior leadership, and each management level between. This section describes each of these facets.

6.5.1 Senior Management Support

Few initiatives in any organization can be successful without the support of its leadership. ODOT has been fortunate to have the support of its senior leadership for much of the time. To be successful in the future, the program will continue to need champions at the executive level. Though not required, some states have recognized this fact and have identified TSMO directors at the senior leadership level to champion operations for their departments. At a minimum, it is recommended that ODOT add the advancement of operations and TSMO to the responsibilities of one of its executive leaders and as appropriate, to one or more positions at every organizational level.

6.5.2 ITS Group

ODOT currently has an ITS branch to administer, operate, and maintain its ITS and TSMO efforts. The ITS branch is currently organized under ODOT's Maintenance Division and is divided into two primary groups as follows:

- **ITS Management** – responsible for TOC operations, software system operations and development, and ITS planning, design, and engineering
- **ITS Field Operations** – responsible for maintenance of the field system, management of ITS deployments, and for monitoring, maintaining, and documenting the ITS communications network.

6.5.3 Collaboration with Other Organizations

Many TSMO strategies rely heavily on collaboration within ODOT and with outside partners. Such collaboration typically consists of simple verbal collaboration on projects such as designs, work zones, maintenance activities, incident and emergency management, etc. It also extends to the joint development of collaborative procedures or software applications, the real-time exchange of relevant operational data, and joint efforts to use multiple sources of data to drive better decision-making.

As mentioned in Section 4, ODOT has established a TSMO committee consisting of members from across the department. Prior to the COVID-19 pandemic, the group had been meeting quarterly; however, meetings have been more sporadic since that time. The group was originally formed because the various departments understood its value; however, it does not have a formal charter within the ODOT organization. It is therefore recommended that this committee be given a formal charter, that meets on a regular basis, and that establishes the mission of advancing TSMO and improving transportation operations throughout the department and on a statewide level. If desired, external statewide agency partners, such as DPS, may also be invited to facilitate fully integrated transportation system operations.

Externally, ODOT coordinates TSMO activities with some agencies, including DPS and OTA, and some local emergency response and law enforcement organizations. This work includes a statewide TIM coalition that meets monthly. The ITS group indicated that local interactions are limited in urban areas and often nonexistent in rural areas. It is recommended that ODOT assist in establishing and participate in regional TSMO committees within the Oklahoma City and Tulsa regions. If required, ODOT may consider taking the lead of those groups initially, but ODOT is encouraged to establish a regular rotation of group leadership and facilitation with all participating agencies.

Additionally, ODOT has had a long and productive relationship with the University of Oklahoma Center for Intelligent Transportation Systems (https://its.ou.edu/pages/) in support of its TSMO and ITS activities. This work has extended to two University of Oklahoma spin-off companies: (1) HBE Systems and (2) Innovative Traffic Systems and Solutions. The University of Oklahoma and these companies have served as an extension of ODOT staff in providing the bulk of required software development activities for ODOT. Applications include the primary ATMS software, the public TI website, and the TI mobile app; the university is currently working on a mobile work zone inspection app. It is highly recommended that ODOT continue to work with the University of Oklahoma in this capacity and possibly expand the university's services to include data analytics and other research efforts.

Though the current organization is working very well, it is anticipated that it will adapt and grow as the ITS continues to expand and as additional responsibilities are added. Some growth will come from new TSMO initiatives and some will come from added and changing responsibilities within existing initiatives. Its roles and responsibilities will also increase as collaboration with other divisions within ODOT and with external partners increases.

One additional consideration with TSMO organization is the potential to designate a TSMO representative within each district, in addition to the central ITS group. Many DOTs are moving to this model to facilitate communications, provide coordination, and facilitate the inclusion of operational considerations for all aspects of TSMO throughout the organization. Many DOTs have designated a full-time TSMO engineer in larger districts and have made it a part-time responsibility in less populated districts.

7 Performance Measurement and Management

Smarter management of the transportation system requires using data to produce performance measures. Using those performance measures to drive operational decisions that optimize system operations is known as Performance Management. ODOT has leveraged several TSMO-related data sources to monitor system operations. These efforts include data and performance measures related to both roadway operations and the ITS performance described in the following subsections.

Data and performance measures from the ITS can be obtained and analyzed in several ways. At a high level, a simple query tool is available through the OK Roads website, which allows users to run simple queries. Queried data can be presented on tables or visually through maps, charts, and graphs. More complex queries and analytics can be done through the University of Oklahoma partners.

Roadway Operations

ODOT's ITS infrastructure with multiple divisions within ODOT add significant depth and value to the traditional roadway operations data that ODOT already collects. This value comes from the many additional data sets that would not be available otherwise. In addition, ITS data is collected in real-time or near-real-time, which allows ODOT to detect and respond to changing conditions much more quickly than through traditional means. A few examples of ITS-based roadway operations data are as follows:

- Volume, occupancy, and classification – from permanent count stations
- Incident response times – from the ATMS software
- Speed, volume, and occupancy – from detector stations connected to the ATMS
- Travel times – from probe data
- Road-weather and atmospheric conditions – from RWIS stations

One specific example that shows how ITS data can be used is from the weather condition reports – a 2022 dashboard image is shown in Figure *27*. ODOT performed additional analytics on this geo-coded data to identify locations with recurring problems. These locations have been prioritized to improve drainage or raise the roadway level.

Figure 27. Weather Event Data from the OKRoads Dashboard.

ITS Performance

Another set of data and performance measures describes the operation and usage of the ITS infrastructure and systems. This data supports the ITS maintenance program by monitoring and identifying faulty devices, communications equipment, server resources, and other system elements. It also shows which components of the system are used most and which can help guide investments into additional needed features. ITS performance examples are as follows:

- Traveler Information Website unique visitors
- Traveler Information Mobile App downloads
- Number of incident responses – from the ATMS
- Field System uptime – from network monitoring software
- Maintenance response times – from the maintenance database

A specific example of this data is the tracking of maintenance activities. ODOT can display the number and type of maintenance tickets on a map, shown in Figure *28*. Showing the data in this way helps with the planning, staffing, and spare parts management of ITS maintenance.

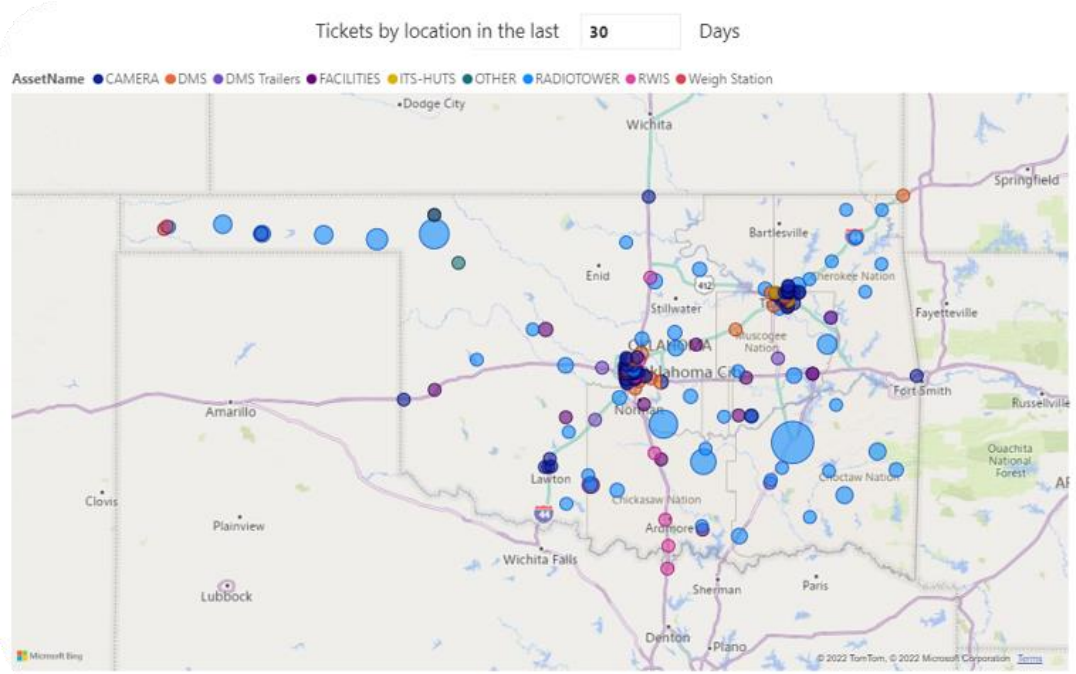

Figure 28. Intelligent Transportation System (ITS) Maintenance Activity Map.

Performance Management Actions

Section 5 identified several actions related to performance measures and performance management. In addition to the actions identified there, the following actions are recommended:

- As new data sources emerge, data analytics improve, and performance management techniques evolve, ODOT should continue to evaluate these new developments for applicability to ODOT's TSMO program.
- Evaluate the feasibility and benefits of a data repository and real-time data exchange system to improve data availability and encourage increased usage and applications.
- Develop a performance management plan to identify performance measures for regular monitoring and reporting. Measures should consist of a few indicators that tie to strategic goals and should be divided between strategic reporting to management and leadership and operational reporting for operations staff.

8 Plan Implementation

For transportation agencies like ODOT to capture the full benefits from TSMO and ITS, the focus on operations should be present in every corner of the organization. Achieving this end is a long-term challenge requiring a concerted effort. To do this effectively, there are three primary steps, which are described in this section.

1. Organize for implementation
2. Prioritize and execute tasks
3. Plan Maintenance

8.1 Organize for Implementation

Organizing for implementation means having employee positions that have responsibility for overseeing and executing TSMO functions and the accompanying reporting processes and structure. As mentioned in Section 4, ODOT has established a TSMO committee that has members from across the organization to accomplish this goal. As the TSMO program continues to become an integral part of ODOT's functions, *ODOT may consider modifying or expanding the functions and responsibilities of the TSMO committee to accommodate changing and future needs.*

ODOT's implementation of TSMO is centralized around an ITS group and the Divisions within ODOT with the TSMO committee providing direction and resources for implementation. This structure is similar to how many other DOTs have chosen to approach the integration of TSMO. The benefits of this method are that it allows for a focused point of accountability, expertise, and knowledge that members throughout the organization can rely on. The primary drawback of this method is that it can make the integration of TSMO/ITS considerations into all other divisions more challenging because these issues are viewed as the responsibility of the TSMO/ITS division. A byproduct of this drawback is that fewer staff members are familiar with TSMO concepts and ITSs, making workforce development and succession planning particularly challenging.

8.2 Prioritize and Execute Tasks

Section 5 of this plan includes many recommended actions to advance ODOT's operational capability in both existing and new program areas. There are many more recommended actions than an organization can take on at one time. Through the selected organization, ODOT can systematically incorporate these actions as part of a continual process, beginning with actions that provide the greatest benefit, considering the cost and budget available. *It is recommended that ODOT consider the following three-step process for implementation*:

Step 1: Task Prioritization: The ODOT TSMO committee should regularly review the potential tasks identified in Section 5 to further prioritize a few tasks based on the need and impact.

Step 2: Detailed Task Analysis: Once identified, the prioritized tasks should be investigated further to gain a better understanding of the benefits, costs, and resource requirements. It is important to

recognize that the benefits will vary by task type and may include direct traffic safety and mobility improvements, increased organizational efficiencies, improvements to standards and policies, increased education and outreach, stronger public and private partnerships, etc.

Step 3: Task Implementation: Once selected, the TSMO committee should identify and assign resources to carry out the selected tasks. The assignment should include a regular cadence for reporting and accountability and a plan for permanent integration into ODOT's organization.

8.3 Plan Maintenance

The field of TSMO has evolved steadily over the past 20 years, and technological advancements drive systems and solutions at an ever-increasing pace. As ODOT makes steady progress with its implementation, this plan, along with recommended implementation actions, should be reviewed and revised to reflect progress to date and new strategies and technologies that may have emerged since the plan was last reviewed. *It is advisable to conduct annual review of the recommended action, while the overall TSMO and ITS program plan can be reviewed at least every five years, or sooner if needed.*

9 Conclusion

Many benefits can be gained through the implementation of TSMO strategies and ITS technologies in helping ODOT achieve its mission and its safety and mobility goals. Achieving these goals requires that considerations for TSMO and ITS be reflected in all areas of ODOT's organization, policies, and procedures.

Achieving these goals has been challenging for transportation agencies across the country, primarily because they represent a cultural shift. For many years, transportation agency tasks have centered around road and bridge construction and maintenance projects and have minimized the role of operations, leaning on local agencies and law enforcement partners to provide support. Changing these mindsets takes a concerted effort for change management (or change leadership) led by senior management.

Successful implementation also relies on the right amount of emphasis. ODOT should focus on placing enough emphasis on ITS and TSMO to drive change while reiterating that they are valuable and cost-effective tools to be used and prioritized appropriately alongside all other strategies at the agency's disposal. As ODOT continues to implement ITS and TSMO at greater levels, the success stories will strengthen the case for operations and should be well publicized. Continued efforts to do publicize success stories will help ODOT move toward achieving its goals by saving the lives, time, and money of those who live, work, and travel through Oklahoma.

APPENDIX

List of Recommended Actions

Recommended Actions – Work Zone Management

Action	Initiative Status	Assigned to
Specifications and Special Provisions - Develop formal specifications or special provisions for each advanced work zone strategy.	Ongoing	Traffic
Work Zone Safety Education - Develop and implement a work zone safety education program plan for ODOT staff and other transportation workers.	Ongoing	Chief Engineer
Work Zone Safety Education for Public - Develop a work zone safety outreach program for the traveling public.	Ongoing	Chief Engineer
Work Zone Coordinator - Consider establishing a work zone coordinator position to support resident engineers. Responsibilities can include approval of traffic control plans and coordination of work zone audits and inspections.	New	Traffic
Strengthen Collaboration - Strengthen existing collaborative efforts between the ITS and Traffic groups to advance WZM.	Ongoing	ITS/Traffic
Coordinate Design and Construction - Establish tighter coordination between design and construction for WZM.	New	Traffic/ DTEs/ Roadway
University Partnerships - Continue to rely on partnerships with the local universities to advance WZM activities, including research, software development, evaluation, performance measures, and studies.	Ongoing	ITS
Central WZM Performance Data Repository - Develop a process and system to collect and store WZM related performance data in a central data repository.	New	
Develop Guidelines - Develop advanced WZM strategy guidelines that can be used to select and budget for the most appropriate strategies during planning.	Ongoing	Roadway
Work Zone Location Reporting - Enact policies to require reporting on work zone locations as changes occur for documentation, inspection, and information to the public.	Ongoing	ITS/Traffic

Future Considerations – Work Zone Management

Action
Continual Improvements - Set up a lessons-learned / continual improvement process to update and refine the methods, practices, and specifications for advanced strategies after each implementation.
Work Specific Incident Management - Include work zone-specific incident management response plans for high-risk and high-profile projects.
Work Zone Infraction Enforcement - Continue to support and strengthen existing programs (e.g. Operation Hard Hat, Operation Safety Vest).
Coordinate with Law Enforcement - Develop guidelines for when to include law enforcement as part of work zones, and guidance on how they should be deployed within the work zone. Develop and implement training on these guidelines.
Actionable Performance Measures - Implement and report on actionable performance measures based on WZM data that include safety, traffic operations, and quality.
Formal Work Zone Strategy - Formalize consideration of work zone strategies in the planning phase.
Work Zone Audit Mobile Application - Continue to develop and implement the existing work zone audit mobile application.
Work Zone TI Mobile Application - Continue to develop and implement the work zone TI mobile application to simplify and automate the distribution of TI to the public.
Advanced WZM Technologies - Continue to investigate and pilot new advanced WZM strategies and technologies, keeping track of their performance. Applications may include, but are not limited to: Work zone intrusion alarms GPS tracked work zone markers Use of probe data Support for ADAS enabled vehicles ATMA WZDX Other emerging technologies and strategies
Safety Audits - Build on existing work zone audit efforts to develop and adopt formal policies and procedures for work zone safety audits.
Adding to Contractor Rating - Add work zone safety audit data to the contractor rating system.

Recommended Actions – Road Weather Management

Action	Initiative Status	Assigned to
Web-based Management Tools - Enhance the dissemination of information presented on the website for internal use and as a management tool. For instance, inclusion of predictive analysis to foresee bridge freezing.	Ongoing	ITS
Improve User-Friendliness - Improve the user-friendliness of tracking website for ODOT staff. For example, make the site more responsive with content easy to skim and enter data for later report.	Ongoing	ITS
API for Road Closure Logistics - Continue efforts to work on and improve API to push out on road closure logistics.	New	
Deploy additional stream gauges	Ongoing	
Deploy RWIS along I-40 and Turnpike	Ongoing	ITS
Develop Re-Routing Software - Pursue current efforts to develop a software capable of detecting debris and re-route/shut traffic down when needed.	New	OU
Flooding Research - Continue research to expand the study of identified flooding locations and the technologies required to detect and help mitigate the issue.	Ongoing	ITS
Reassess Sensor Locations - Reassess weather forecasting sensor's locations through RWIS technologies to help identify possible solution for hazardous weather-related conditions in the roadway. For example, develop a structured plan that details common weather-related trouble-spots, and study the feasibility of installing a sensor at these locations for future weather forecast efforts.	Ongoing	ITS
Light Detection And Ranging (LIDAR) Debris Detection - Implementation of LIDAR technologies for debris detection from flooding and bridges. There is a need to plan to deploy this technology at scale.	Ongoing	ITS

Future Considerations – Road Weather Management

Action
Education and Outreach – E.g. develop a structured plan that details common weather-related trouble-spots, and study the feasibility of installing a sensor at these locations for future weather forecast efforts.
Weather Data from CAV - Study the likelihood of sharing transportation-related weather data related to connected vehicle applications. This action item will likely enhance current operational practices.

Recommended Actions – Traffic Incident Management

Action	Initiative Status	Assigned to
Study options for freeway service patrols – Perform a study to investigate the feasibility, operational, and funding models for freeway service patrols in Oklahoma.	Not Started	ITS/DPS
Incorporate key incident data from DPS Computer-Aided Dispatch (CAD) data into ODOT ITS systems.		DPS
Integrate CAD - Continue to integrate CAD and reduce human intervention on the TIM data to increase data quality and make the system more efficient.		ITS & Partners
Involvement with TIM Coalition - Continue their work and involvement with the Coalition TIM group to provide field personnel and the community involved in traffic incident response be trained and prepared for a quick and safe response.	Ongoing	
TIM Reporting - Develop updated data collection, workflows, and reporting mechanism to automate the development and reporting of TIM performance metrics across all TIM stakeholders.		ITS/DPS
Standard Communication Protocol - Identify a standardized, on-scene communications protocol to aid in resource management during incidents. For example, the Federal Emergency Management Agency (FEMA) Incident Command System (ICS).	Desired	TIM Coalition
Comprehensive Response Planning - Adopt a planned and coordinated multi-disciplinary process to detect, respond to, and clear traffic incidents rapidly and safely. For instance, the Oklahoma Department of Public Safety unmanned aerial vehicles (UAV) program.		
Common Platform for TIM Training - Provide a common platform for training on TIM standards and practices among all responders.		
Balance Online and In-Person Trainings – Use hybrid options to maximize training participation.		

Future Considerations – Traffic Incident Management

Action
Regular Oklahoma TIM Meetings – Conduct periodic Oklahoma TIM group meetings to improve and/or maintain agency relations and understanding/empathy of other stakeholders' TIM roles and responsibilities.
Incentivize Participation - Develop programs and incentives to maximize agency participation in the Oklahoma TIM group meetings.
Organizational Chart - Define respective roles and responsibilities by agencies. By doing this, commitment, and organization of common resources and facilities can be allocated.
TIM Performance Database Details - Expand on the level of details that are received in the TIM performance database.
Update ITS Deployment Processes - Advance and update the standard ITS Technology deployment process and standard traffic control requirements to enhance the system with the best practices of TIM technologies.
Annual TIM Conference - Hold annual conference with TIM stakeholders to de-brief on lessons learned, including keynote speaker to motivate, re-direct the TIM group, and provide informal touch points among stakeholders, similar to an annual snow & ice conferences.
Continuous Improvement - Analyze and use the TIM performance data about of the discrete elements of incident clearance to use data-driven decisions to prioritize objective and specific TIM strategies to continuously improve the effective safe and rapid clearance of traffic incidents. Data may be used helpful during OKTIM de-briefs following major incident responses.
Integrate Stakeholder Data - Prioritize the integration of systems to gather performance data from TIM stakeholders. Refer to NCHRP 07-20, for more information[2].
Relevance and Inclusion - Set agenda items to continuously maximize the breadth of participation in TIM training sessions across all stakeholder organization, and the depth of participation within each stakeholder organization, especially in context of staff turnover within stakeholder organizations.
Performance Measurement Development - Implement robust TIM performance measurement based on current guidance documents regarding the use and evaluation of performance measures to support TIM Programs. Refer to NCHRP 07-20, for more information[3].
Predictive Analytics - Develop predictive analytics based on historic incident and real-time travel conditions data to inform where and when key first-responders should be positioned to reduce incident response times.
Automate the TIM Broadcast - Automate the TIM related broadcast traveler information regarding presence of fleet vehicles with active HAAS Makeway system.
Debris Removeable - Implement tools to rapidly remove debris following incidents
Emergency Responder Presence Broadcasts - Investigate participation with the HAAS alert system.

Recommended Actions – Traffic Management

Action	Initiative Status	Assigned to
Increase CCTV coverage for real-time operational awareness on priority routes.	Ongoing	ITS
Standard ITS Plans and Specifications - Develop ITS design standard plans and specifications promoting proactive incorporation of ITS into the planning, design, and construction process and workflow of ODOT projects.	Ongoing	ITS
Annual Financial Plan - Include TSMO initiatives in an annual financial plan and budget process.	New	ITS
Include ODOT ITS Division in planning/design - Involve ODOT ITS division during the different phases of a project to account for ITS technology deployment, operations, and maintenance needs throughout the life span of the projects.	Ongoing	ITS/Traffic
TM Decision-Making Organization - Establish an organizational hierarchy that supports and empowers TM decision-making at the level that requires it.	Ongoing	
Core Staffing - Establish a core group for TM that includes staff for key roles.	Ongoing	
Staff Training - Offer staff training courses to advance awareness, understanding, and application of planning operation concepts and approaches involving TSMO principles and their benefit. As a recommendation, propose a TSMO committee agenda item to identify a TSMO training program.	New	ITS/Traffic
Data Sharing - Ensure that data sharing capabilities extend to all TM systems.	Ongoing	ITS/Partner Divisions
Asset Management System - Develop an asset management system to manage the maintenance, replacement, and upgrade of ITS technologies.	New	ITS

Additional Considerations – Traffic Management

Action
Prioritized Corridors - Consider prioritized corridors of significance and the operational implications in the system.
Using Real-Time and Historical Data - Develop and implement a system that automatically utilizes both real-time and historical data to provide predictive capabilities to support TM.
Expanding Systems Engineering - Extend the systems engineering process to not only design and integration but also testing, validation, operations, maintenance, and life-cycle approaches to replacements.
Joint Agreements - Establish joint procurement and contractual agreements among agencies to share/leverage available resources in deployment and TSMO of TM to allow for purchasing materials.
Statewide Traffic Operations Committee - Define and strengthen the role of the statewide traffic operation committee via the creation of a TSMO committee charter.
Target Operational Strategies - Identify operational strategies based on system performance to better allocate resources on systems, devices that meet these strategies.
Evaluate Novel TM Approaches - Develop a process whereby new TM approaches are evaluated to justify in new systems. To include in this plan the process of incorporating the participation of the ITS division for ITS technology deployment.
Regular Training - Promote regular training on systems engineering with staff and assess project-level milestones accomplished over time.
Life Cycle Cost Analysis - Develop a life-cycle cost analysis procedure to assess the benefits of operations. Current efforts include replacement as part of their operations and maintenance costs.
Goal Setting - Establish goals prior to starting projects and perform internal before/after studies to measure success.
Develop an OTA Traffic Operations Center
Regional Data Clearinghouse - Initiate efforts to develop a regional data clearinghouse of support with a variety of historical and current transportation data feasible for planning, design, and operation finalities.

Recommended Actions – Traveler Information

Action	Initiative Status	Assigned to
Expand TI pilot projects to automate DMS messaging from portable boards to permanent DMS	Ongoing	
Integrate Waze data - Automate use of the incident data received from Waze.	Ongoing	
DPS CAD integration - with ODOT Systems to support detection of incidents.	Planned	
Joint TI Data Sharing - Establish an operating structure for joint TI data sharing across jurisdictional boundaries along adjoining transportation facilities.	New	ITS
Data Sharing Agreements - Formalize agreements for sharing data for TI programs.	Ongoing	
TI Data Sources - Leverage the various types of emerging TI data sources including probe data, crowd-sourced data, and DOT device data.	Ongoing	ITS
University Partnerships - Continue to leverage and optimize formal research partnerships with local universities and become involved in pooled-fund studies.	Ongoing	ITS
Eliminate Data Silos - Identify programs and data feeds still operating in stand-alone mode that should be considered in a multi-agency sense to encourage stronger agencies relationships. For instance, build stronger relationships with DPS.	Ongoing	
Interstate Coordination – Improve coordination of TI sharing with adjacent states. For example, with Arkansas regarding weather-related DMS alerts.	Ongoing	

Future Considerations – Traveler Information

Action
Local Resources - Establish data-sharing agreements with locals. For example, building relationships with Mesonet as ITS technology deployment include the installation of CCTV for security features on LMR towers to share CCTV images and can also provide Mesonet better images, which can be used for weather purposes.
New Technology and Pilot Programs - Develop IT systems capability to access, analyze, and retain data from new technology/pilot deployments.
Data Validation Guidelines - Formalize data validation guidelines to have a better representation of changes in a graphing system.
Public Outreach Program - Generate a comprehensive outreach program that provides critical performance measure information across all audiences via diverse platforms for overall agency activities related to TI.
Identifying Target Traveler Groups - Implement a process for identifying the target traveler groups and related data collection needs. For instance, have a corridor-specific group to share targeted TI information (e.g., I-35, I-40 corridors).
Prioritization - Define ODOT's priorities for consistent implementation of TI. For example, en route updates for those who do not have access to a mobile.
Strategic Communications - Develop a focused communication plan with ODOT Strategic Communications based on information needs and recommendations.

Recommended Actions – Traffic Signal Management

Action	Initiative Status	Assigned to
Before/After Analysis of Optimization - Measure and report before-after assessments using appropriate measures of effectiveness (MOE) when traffic signal timings are re-optimized or other new traffic signal systems are deployed.	New	Traffic
ITS Strategy Recommendations - Identify a recommended set of ITS strategies needed to improve traffic signal operations at identified priority corridors. For example, the optimization of existing transportation system capacity to mitigate congestion, manage critical corridors to minimize travel time fluctuation.	New	Traffic
Integrate ITS system deployments - Considering the operational benefits provided by ITS technology deployments, ODOT can integrate this system into the design and planning process, which would allow ODOT to create a plan to allocate resources destined to Traffic Signals at local agencies.	New	Traffic/ITS
Remote Signal Monitoring - Expand capabilities to remotely monitor traffic signals daily to ensure correct configuration and identify any unintended changes.	Ongoing	Traffic/ITS
Match Signal Operations to Needs and Resources - As typical practice, provide the appropriate type of signal operation given available technical and financial resources. For instance, select conventional scheduled coordinated patterns, traffic-responsive plan selection (TRPS), or adaptive system control technology (ASCT) operation based on the traffic conditions.	New	Traffic
Accurate Inventory for Traffic Signals - Develop and maintain an accurate inventory of Traffic Signal assets.	Ongoing	Traffic
Traffic Signal Master Plan - Develop a comprehensive Traffic Signal Master Plan to identify infrastructure needs in priority corridors.	New	Traffic

Future Considerations – Traffic Signal Management

Action
Preventative Maintenance Plan - Establish and monitor preventative maintenance plan for all traffic signal equipment, to maximize equipment up-time and minimize emergency maintenance.
Periodic Assessment and Optimization - Establish a process to periodically assess each signalized corridor using continuously available data, and when deemed necessary, re-optimize corridor traffic signal operations.
Inclusion in Annual Budgets - Ensure annual budgets include funds to measure traffic signal performance and maintain optimized traffic signal timing.
Preserving Existing ITS Investments - Provide resources to maintain and preserve existing ITS investments including inspection of traffic signals during preventative maintenance visits, to detect potential hardware failures and ensure safe and efficient functioning of traffic signals.
MTBF Performance Measure - Measure and report average mean time between failure (MTBF) for traffic signal malfunctions, as well as preventative and emergency maintenance activity frequency, to demonstrate the value of increasing the ratio of preventative maintenance to emergency maintenance activities.
Self-Training - Support ODOT staff training to enable ODOT's statewide leadership regarding the implementation of appropriate emerging technologies.
Equipment Replacement - Periodically inspect and adequately budget for equipment replacement life cycle, including costly long-life assets such as steel traffic signal support structures.
Staff Resources - Equip staff with the appropriate resources to develop and implement optimized traffic signal timing plans.

Recommended Actions – Freight Management

Action	Initiative Status	Assigned to
Travel Time Reliability - Provide constant travel time reliability for freight movement (e.g., at-grade rail crossing delays). For example, With GPS navigation in use by truck drivers, add Locations of hazards/delays into satellite navigation system (e.g., Waze).	Ongoing	ITS/Planning
Collaboration with Neighboring States - Consider collaboration with other states, and internally. For example, the event of rockslide on I-35 needed to have a plan in place to communicate with the state of Texas in 2015 to alert travelers of the hazardous conditions.	Ongoing	ITS/Freight
GPS RTKS Network - Apply GPS RTKS (Real-Time Kinematics Systems) network for location accuracy enhancement. For instance, narrow medians.	Ongoing	ITS

Future Considerations – Freight Management

Action
Freight Safety Technologies - Support the development and adoption of automation, connectivity, and other freight safety technologies.
Modernization Efforts - Modernize safety oversight and security procedures.
Freight-Specific TI - Provide freight-specific TI. For instance, define restrictions and strategize on how to disseminate the information to travelers.
Multi-State Funding Coalitions - Consider multi-state program/coalition, and related funding opportunities. For example, consider commercial involvement to support such coalitions to help lessen load on ODOT to support such a program.

Recommended Actions – Special Event Management

Action	Initiative Status	Assigned to
Sharing Real-Time Information - Continue sharing real-time data, e.g., portable TM systems (closed-circuit television, detectors, changeable message signs), portable traffic signals, portable traffic management centers.	Ongoing	Traffic Management

Future Considerations – Special Event Management

Action
Committee for Special Event Planning - Create a committee on planned special events to monitor and plan travel management activities for all special events that occur within a region.
Standardize Special Event Operations - Follow an established event operations planning process. A valuable product from this committee is the ability to maintain a calendar for annual events and have better control of PCMS deployed and areas of potential delays.
Standard Special Event Routes - Develop standard street use event routes and traffic flow routes. For example, deploy messages to thru traffic that right lanes blocked, backing from off-ramps.

Recommended Actions – Transit Management

Action	Initiative Status	Assigned to
Special Events/ Work Zones - Transit coordination for special events / work zones. For instance, implementation of additional services during periods of special events or highway construction.	New	OMPT/ EMBARK
On-Demand Mobility Service - Continue efforts to improve the on-demand mobility service transit program to Uber Pilot – Pick Transportation.	Ongoing	OMPT/ Rural Providers
Accurate Information - Providing information to passengers to provide more accurate arrival/departure information for buses and/or rail.	New	OMPT/ All Providers
Ridesharing - Promote shared-ride service for efficiency.	Ongoing	
Pilot programs for Connected and Automated Vehicles (CAV) and micro-transit - Support the development of pilot projects for automated transit vehicles and micro-transit	New	OMPT

Future Considerations – Transit Management

Action
Transit Information Sharing - Adding technologies into cabs for drivers and information sharing to coordinate among the various bus and/or rail services within a region to reduce transfer times and enable more efficient transit connections.

Recommended Actions – Congestion Pricing

Action	Initiative Status	Assigned to
Develop a feasibility study for congestion pricing in cooperation with OTA.	Not Active	

Future Considerations – Congestion Pricing

Action
Pricing Partial Toll Facilities - Identify corridors that may benefit from pricing of partial facilities such as Express Toll Lanes and/or High Occupancy Toll (HOT) Lanes.
Pricing Entire Toll Facilities - Identify corridors that may benefit from pricing of entire roadway facilities.
Zone Based Pricing - Identify areas that may benefit from zone-based pricing.
Parking - Identify areas that may benefit from parking pricing.
Legal Framework for Pricing - Identify the legal framework required for potential congestion pricing strategies and policies.
Vehicle and Ridesharing - Identify areas that may benefit from priced vehicle sharing and dynamic ridesharing.

Recommended Actions – Integrated Corridor Management

Action	Initiative Status	Assigned to
Cross-State Data Sharing - Strengthen data sharing, DMS control across states. There is a need of additional coordination with agencies and traffic signals.		
Identify a Potential Corridor – Initiate a study to identify and prioritize corridors that would be good candidates for an ICM application.		

Future Considerations – Integrated Corridor Management

Action
Active Management of Integrated Corridors - Advance the level of active management and integration of each integrated corridor over time to increase the address corridor issues over time. Critical corridors at the statewide level to focus on include I-35 thru Oklahoma City, and I-40 from Texas to Arkansas.
Alternative Route Programs - Focus on alternative route programs (i.e., Driving Forward). These programs recognize the need and demands of the transportation system and provide strategies to achieve less congestion.
Traffic Signal Coordination - Improve traffic signal-level coordination, e.g., emails automations, Hotlines for phone calls to appropriate personnel at adjacent DOTs, auto-notification of inter-state closures, incidents.
Additional Funding Investments - Consider more funding investments. For instance, freeway closure scenario, incident management scenario on parallel arterials.

Recommended Actions – Connected and Automated Vehicles (CAV)

Action	Initiative Status	Assigned to
CAV Preparedness Plan - Develop a statewide CAV preparedness plan. Oklahoma Advance Mobility Program is already in place and supported by broad stakeholders.	New Initiative	ITS/Traffic/Multimodal

Future Considerations – Connected and Automated Vehicles (CAV)

Action
Support Work Zone Programs - Continue support of current work zone programs as technology is deployed. For instance, continue to engage teen drivers into work zone safety initiatives and training. Summer 2021 a program was launched where to-date around 900 students have participated.
Automated Freight - Focus on Automated freight technology. E.g., Safety driver + co-pilot reviewing code (de-bugging).
Public Engagement - Continue to engage with the public and commerce. For example, support initiatives that address real time strategies for work zone safety improvements.
Highway Infrastructure - Leverage highway infrastructure to Automated Vehicles (AV). Challenge may include the testing of these innovative products.