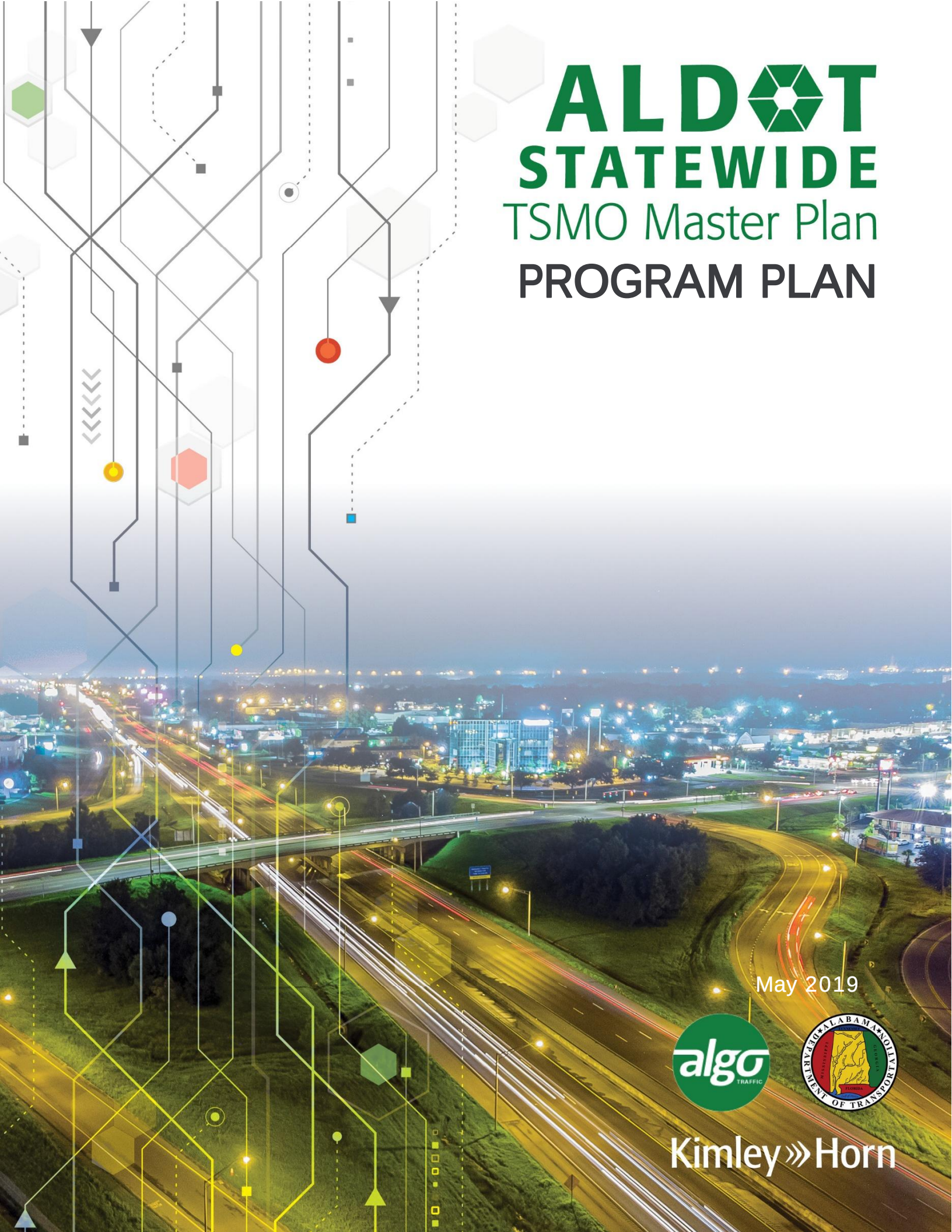
# ALDOT STATEWIDE TSMO Master Plan

# PROGRAM PLAN



May 2019

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May 22, 2019

To whom it may concern:

The enclosed State TSM&O Strategic Plan and accompanying TSM&O Program Plan address the challenges associated with operating the State Highway System in Alabama. These documents illustrate the business case for TSM&O; the return on investing in operations; and the balance between conventional programs and TSM&O. The outlined strategies focus on the performance improvements that can be realized to mobility, safety, and commerce by maximizing existing highway infrastructure. TSM&O provides a data driven, performance based solution to operate a reliable transportation system.

Congestion is categorized into Recurring (40%) and Non-Recurring (60%) categories nationally. Recurring congestion typically is attributed to bottlenecks or poor traffic signal operations, while Non-Recurring congestion is typically associated with work zones, crashes, adverse weather, or special events. This program provides nine service layers to address these challenges and provide a customer centric focus to investing in the transportation system.

All DOT programs require dedicated resources to accomplish their mission. This program outlines and provides tools to establish the monetary and personnel resources needed to realize the full benefit of TSM&O. Lastly, this program compares how other states are realizing the benefits of TSM&O and setting the stage for the future of the transportation industry.

Sincerely,

Kerry C. NeSmith
Deputy State Maintenance Engineer

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# 1 INTRODUCTION

The Alabama Department of Transportation (ALDOT) is responsible for the management and operations of the extensive transportation system throughout the state. This includes approximately 10,900 miles of roadways, ports, freight routes, bicycle and pedestrian routes, and support to transit. ALDOT has a stated commitment as follows:

> *To provide a safe, efficient, environmentally sound intermodal transportation system for all users, especially the taxpayers of Alabama. To also facilitate economic and social development and prosperity through the efficient movement of people and goods and to facilitate intermodal connections within Alabama. ALDOT must also demand excellence in transportation and be involved in promoting adequate funding to promote and maintain Alabama's transportation infrastructure. – ALDOT Mission Statement*

This commitment to excellence has led ALDOT to the creation of a Statewide Transportation Systems Management and Operations (TSMO) Master Plan which will establish the strategies and programmatic fundamentals necessary to further develop and provide direction to the Statewide TSMO Program. The Statewide TSMO Master Plan is organized in three parts: the Strategic Plan, the Program Plan, and the Service Layer Brochures. This document is the Strategic Plan and focuses on the high-level purpose and need for TSMO as well as the vision, goals, and objectives developed through this planning process. Additional information about the assembly of the Master Plan is provided at the end of this document.

# 2 TRANSPORTATION SYSTEMS MANAGEMENT AND OPERATIONS OVERVIEW

The Moving Ahead for Progress in the 21st Century (MAP-21) Act was the first federal initiative that recognized the importance of TSMO with an enhanced definition that includes innovative strategies and coordination especially at a regional scale.

The Fixing America's Surface Transportation (FAST) Act was later signed into law in December 2015 and further supports and recognizes the importance of TSMO initiatives. The FAST Act promotes an efficient and performance-based program designed to address the safety, mobility, and reliability challenges facing transportation systems and agencies across the nation. Some examples of potential outcomes of TSMO strategy implementation include: improved safety for the traveling public and first responders, full realization of the capacity of existing transportation infrastructure, increased travel time reliability for freight and motorists, improved information access for the public to assist in mobility choices, and agency readiness for adoption of innovative technology.

TSMO strategies focus on optimizing the existing transportation network to improve capacity, security, safety, and reliability.

http://www.aashtotsmoguidance.org/

This legislation is supported and integrated within the transportation community through national agencies such as the American Association of State Highway and Transportation Officials (AASHTO), the U.S. Department of Transportation Federal Highway Administration (FHWA), the Institue of Transporation Engineers (ITE), and the Intelligent Transporation Society of America (ITSA). In addition, AASHTO, ITE, and ITSA, with support from FHWA, have established the National Operations Center of Excellence (NOCoE) which offers resources to serve and promote the TSMO community. Together, these leading agencies encourage and guide states in using TSMO deployment strategies, practices, and programmatic approaches to optimize the efficiency of transportation networks.

The national transportation community recognizes the heightened need for a TSMO approach because of the continued increase in congestion and decreased space and funding for additional capacity. TSMO strategies leverage enhanced organizational techniques and performance measurement to promote program accountability throughout the transportation network. Examples of TSMO strategies used to improve safety, reduce congestion, and increase reliability include:

- Intelligent Transportation Systems (ITS) and Communications
- Advanced Traffic Signal Systems
- Traffic Management Centers (TMC)
- Real-time Traveler Information
- Traffic Incident Management (TIM)
- Emergency Transportation Operations
- Work Zone Management (WZM)
- Asset Management
- Road Weather Management
- Management and Operations Software Systems, including Decision Support Systems
- Performance Measures
- Special Event Management
- Emergency Management
- Connected/Automated Vehicles (CAV)
- Collaborative Business Practices
- Smart Cities

These strategies allow for more efficient, effective management and operations of transportation networks—this approach requires a cultural shift within most departments where the standard practice has been to plan, design, and construct roadways with only general maintenance requirements upon completion. A TSMO approach requires continued management and operations following implementation including improved communication, collaboration, and efficient use of resources among transportation partners. While TSMO strategies can address all modes of transportation, the focus for this plan has primarily been on vehicular and freight movements because the relative volume of these movements compared to that of pedestrian movements seemingly corresponds to a higher potential for positive impact. However, a mindset of actively seeking optimized efficiency in all modes of transportation is critical to the long-term success of the Department, and ALDOT is committed to integrating TSMO programming and practices as a way to increase safety, mobility, and reliability with efficacy and efficiency.

# 3 THE BUSINESS CASE FOR TSMO

Alabama has more than 102,000 miles of roadway in the state as identified by FHWA Highway Statistics and ALDOT's Highway Performance Monitoring System (HPMS); out of which 10,900 centerline roadway miles are maintained by the State (FHWA, 2018) (ALDOT, 2017). While roadways maintained by ALDOT consist of only 10% of the total centerline miles in Alabama, the state-maintained roads carry significantly more traffic and freight than local roads and represent the critical connections between communities—what happens on these roads substantially impacts the quality of life for Alabamians throughout the state.

## 3.1 SAFETY AND MOBILITY CONCERNS

Safety and mobility are independently necessary concerns within any transportation system, however, the inherent relationship between safety and mobility places added importance and complexity to isolating and solving these concerns. Alabamians experience a variety of safety and mobility challenges every day—from an increased commute time due to a fender bender; to a road closure due to an overturned tractor trailer; to a traffic fatality.

### *3.1.1 Safety*

Source: The Anniston Star

Traffic incidents such as stalled vehicles, major and minor crashes, and spilled freight loads account for one-fourth of all delays on the highway system in Alabama (ALDOT, 2018). Each minute a lane is blocked can lead to four minutes of delay which can mean a 30-minute lane blockage resulting in a potential two-hour distribution in traffic (FHWA, 2010) (SHRP 2, 2014). Importantly, for each minute that a primary incident continues, the likelihood of a secondary crash increases by 2.8% (FHWA, 2010). The United States Department of Transportation (USDOT) estimates that secondary crashes represent more than 20% of all crashes on freeways and 18% of fatalities on interstates (FHWA, 2010). Fewer incidents and quicker clearance of incidents help to reduce congestion, allowing the transportation system to operate more safely and efficiently.

There were 157,094 people involved in crashes in 2017 in Alabama with 15,003 non-capacitating injuries and 119,470 people involved in property damage only crashes as illustrated in Figure 1. In 2017, crashes in Alabama resulted in 860 fatalities and 6,413 incapacitating injuries (ADVANCE, 2018).

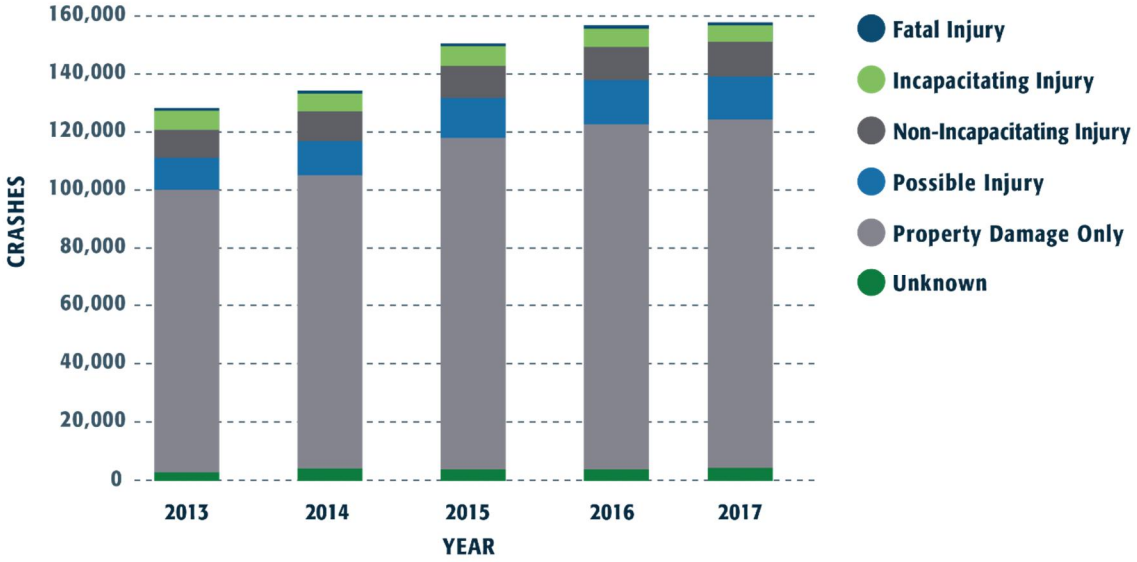



Figure 1: Alabama Crash Severity, 2013 – 2017 (ADVANCE, 2018)

In 2016, Alabama had double the national average for traffic fatalities. Alabama had 22.28 traffic fatality deaths per 100,000 population while there were 11.69 deaths per 100,000 population nationally. Alabama ranks second highest in the nation traffic fatalities per capita. Roads and highways in Alabama had a fatality rate of 1.56 fatalities per 100 million vehicle miles traveled (VMT) versus a national average of 1.19 in 2016 (BTS, 2016) (FHWA, 2018) (NHTSA, 2016). This trend is consistent, as shown in Figure 2 below.

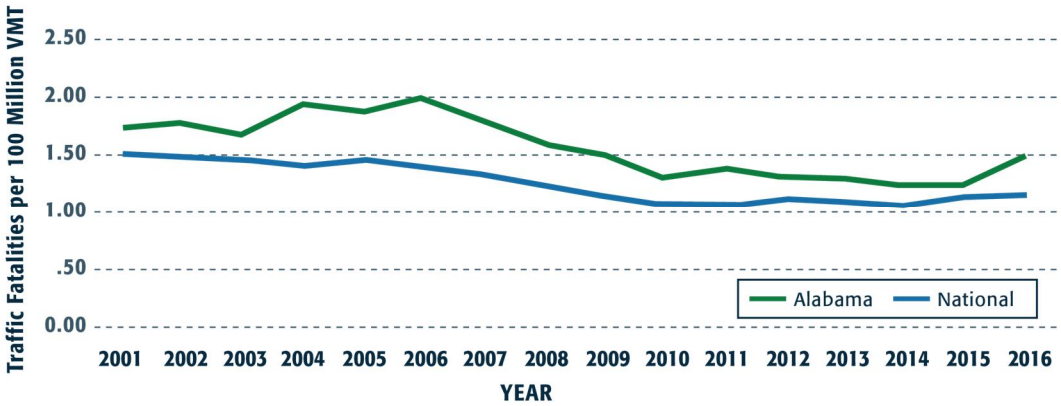



Figure 2: Alabama and National Traffic Fatalities per 100 Million VMT (2001 – 2016) (ADVANCE, 2018) (FHWA, 2018)

Crashes on Alabama roadways resulted in 860 fatalities in 2017—Alabama ranked second highest nationally for traffic fatalities per capita in 2016. Alabamians have a serious challenge.

### *3.1.2 Mobility and Reliability*

Alabama's mobility challenges impact freight movement, commuting workers, the delivery of goods and services, and the general public. Congestion is impacted by both recurring and non-recurring events. Recurring congestion accounts for more than half of congestion nationally and typically occurs during peak travel periods due to demand exceeding capacity (FHWA, 2017). Non-recurring events account for the remaining contributors to congestion and include disruptions such as severe weather, traffic incidents, and work zones. Nationally, the three main causes of non-recurring congestion are traffic incidents (25% of total congestion), work zones (10% of total congestion), and weather (15% of total congestion) as illustrated in Figure 3 (FHWA, 2017).

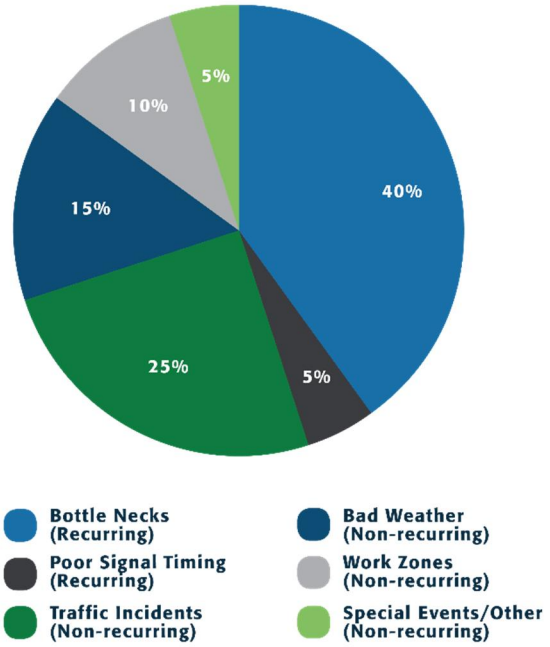



Figure 3: National Sources of Congestion *(FHWA, 2017)*

Congestion continues to increase annually as the increase in vehicle miles traveled (VMT) outpaces the growth of public road mileage (TTI, 2015). VMT in Alabama is increasing at a greater rate than public road mileage length for the state. Travel demand is outstripping the supply despite a focus on increasing capacity through infrastructure projects. In Alabama over the last sixteen years, VMT has grown 23% while public road mileage has only grown by 8%.

Birmingham, Huntsville, Mobile, and Montgomery commuters spend an average of 34, 23, 30, and 24 hours per year, stuck in traffic.

Congestion on roadways costs commuters, freight drivers, service providers, and the public time and money. In 2014, congestion cost Americans $160 billion (TTI, 2015). Studies indicate that drivers in the urban areas of Birmingham, Huntsville, Mobile, and Montgomery spend 34, 23, 30, and 24 hours per year, stuck in traffic, respectively (TTI, 2015). Nationally, congestion caused an extra 6.9 billion hours of travel in 2014 which resulted in a cost of $960 to the average commuter in 2014 (TTI, 2015).

Likewise, congestion is a significant problem for freight industry nationally and specifically, Alabama. The value of freight flow in Alabama was 386.6 billion in 2013 with 531.5 million tons of freight flow and 189.9 billion miles of freight flow (BTS, 2015). Alabama has two major water ports, Guntersville and Mobile, which includes ports ranked in the top 150 ports by tonnage in 2013 and has nine major airports (BTS, 2015). National truck operations experienced 18% (or $28 billion cost) of the congestion delay in 2014 (TTI, 2015). Not surprisingly, a goal of the 2017 Alabama Statewide Freight Plan is to reduce congestion

and improve reliability on the National Multimodal Freight Network (NMFN) to improve safety and economic competitiveness (ALDOT, 2017).

In addition to the financial costs related to mobility concerns, research has shown a direct correlation between physical and mental wellbeing and congestion. Higher commute times have been linked to decreased energy, increased stress, and higher illness-related work absence. And those that experience congested driving have increased stress and frustration. Simply stated, safety and mobility have significant financial and wellness costs to the citizens of Alabama.

Congestion on roadways creates significant costs to commuters, freight drivers, service providers, and the public in the form of time, money, and wellness deterioration—Alabamians have a serious challenge.

### *3.1.3 Transportation Funding*

As noted in ALDOT's 2017 Statewide Transportation Plan, annual revenues for transportation improvements averaged approximately $1.5 billion. In Alabama, roughly one-third of transportation revenues ($490 million) come from state sources, with the remaining two-thirds from Federal Aid, highway bonds, and other sources; gas excise and motor fuel taxes generate 70% ($341 million) of state revenues.

The Gas Excise and Motor Fuel tax makes up a considerable amount of the state's portion of transportation funds; however, Alabama is among the lowest in state gas taxes for both conventional and diesel fuels. As of July 2018, Alabama's gas tax was 20.91 cents per gallon, compared to the national average of 30.54 cents. The State has not increased the gas tax since 1992, with the most recent referendum this year not passing. However, this issue has gained momentum and is being considered during the 2019 legislative session. (Note: as of 3/12/2019, the State of Alabama legislature passed an increase in the gas tax by 10 cents per gallon by 2021).

There has been a steady decline in Motor Fuel Tax Revenues over the last two decades, made more dramatic if adjusting for inflation. While there has been a decline in revenues to support transportation infrastructure, there also have been dramatic increases in the use of this infrastructure. For example, between 1990 and 2015, the usage of Alabama's roads increased by more than 25 billion VMTs.

Low tax revenue on gas is only one part of the funding issue. Cars also are rapidly becoming more fuel efficient, decreasing the need for fuel. Beyond stagnant gas taxes in Alabama, the decreased dependence on motor fuels due to increased fuel efficiencies has decreased revenues despite increasing costs and congestion. So, at the same time we're witnessing greater usage of infrastructure while the gas tax has not increased, vehicles are becoming more efficient at how they use fuel, furthering the gap between revenue and need.

Many predictions forecast an imminent change in how DOTs approach funding transportation infrastructure improvements, with a total move away from gas taxes in as soon as a decade. A major focus in the transportation funding world now is collaboration and funding partnerships, which are some of the core components of TSMO strategies.

## 3.2 OPPORTUNITY FOR IMPROVEMENT

Transportation agencies have historically focused on increasing roadway capacity through capital projects and ongoing infrastructure maintenance. The mindset has been to build our way out of congestion; to construct additional roads or lanes to accommodate growth. This approach is becoming more difficult as space becomes limited in the most congested areas and costs rise as funding decreases. With limited money to continue to build and maintain infrastructure, DOTs are turning to TSMO strategies to do more with less.

A TSMO approach has demonstrated fruitful return on investment (ROI) via a range of different strategies. TSMO investments offer DOTs the opportunity to realize better returns on investments than traditional roadway investment methods, such as adding more lanes. Some of the most beneficial strategies include coordinating our traffic signals and providing real-time traffic information. Table 1 provides some examples of benefit-to-cost ratios that have been demonstrated TSMO strategies.

| TSMO Strategy | Benefit-to-Cost Ratio and Other Metrics |
|---|---|
| Traffic Incident Management | Incident duration reduced 30-40% |
| Safety Service Patrols | 2:1 to 42:1 |
| Surveillance/Detection | 6:1 |
| Traveler Information/Dynamic Message Signs | 3% decreases in crashes |
| Road Weather Information Systems | 2:1 to 10:1 |
| Work Zone Management Systems | 2:1 to 42:1 |
| Ramp Metering Systems | 15:1; up to 15% reduction in delay |
| Traffic Signal Optimization/Retiming | 17:1 to 62:1; up to 2-3% reduction in delay |
| Traffic Adaptive Signal Control | Improved travel time 6-11% |
| Electronic Toll Systems | 2:1 to 3:1 |
| Commercial Vehicle Information Systems | 3:1 to 5:1 |
| Bus Rapid Transit | 2:1 to 10:1 |
| Transit Signal Priority | Improved travel time 2-16% |
| Parking Management Systems | Increase in transit mode share up to 6% |
| Transit Automated Vehicle Locator/Computer-aided Dispatch | AVL improves on-time bus performance 9-58%<br>CAD improves on-time bus performance up to 9% |
| High Occupancy Toll Facilities | 59% would pay $2 to save 20 minutes |

Table 1: Impacts of Current TSMO Best Practices (US Department of Transportation, Intelligent Transportation Systems Joint Program Office, 2009)

Alabama is dependent upon the gas tax for transportation funding. Alabama has not increased the gas tax since 1992. Vehicles are rapidly becoming more fuel efficient. Alabamians have a serious challenge.

The transportation industry has taken note of these returns; comprehensive TSMO programs are being initiated and expanded in transportation agencies throughout the nation to address increasing safety and congestion concerns in a time when financial resources continue to shrink. TSMO programs provide significant benefits in safety and mobility of the transportation system. The mission of DOTs is shifting from traditional capacity expansion through capital roadway widening or new location projects and infrastructure maintenance to increasing the efficiency and capacity of existing infrastructure through a focus on optimized operations. This new focus can be accomplished with a TSMO program that enables targeted use of innovative technology, agency collaboration across disciplines and jurisdictional boundaries, and focused solutions to congestions causes.

The Alabama TSMO program works to optimize the use of existing facilities, maximize performance of the system, target solutions to congestion causes, and complement capacity projects. These innovative and technology-based approaches are essential in a time when national VMT continue to increase annually resulting in higher demand, while lane miles of the nation's surface transportation system expand at a lower rate due to limited funds and geographic constraints. The Alabama Statewide TSMO Master Plan will accelerate the TSMO program, processes, and deployments.

Alabamians have a serious challenge—TSMO is a critical part of the solution.

# 4 TSMO MASTER PLAN DEVELOPMENT

The Alabama Department of Transportation has invested significant time, effort, and resources into developing a TSMO program and recognizes the benefits of pursuing strategies and processes supported by a TSMO approach. ALDOT completed a capability maturity model (CMM) assessment in 2018 which identified the key areas for growth. In addition, TSMO regional plans were developed which focus on region-specific TSMO recommendations and ITS project deployment recommendations.

The ALDOT Statewide TSMO Master Plan builds upon the CMM assessment and regional TSMO plans, as well as established ALDOT multi-modal plans and current initiatives, to consider and create a coordinated effort statewide to enhance transportation systems management and operations. The Plan recommends a TSMO program that supports the goals and core values of ALDOT and reflects the Alabama TSMO Program's priorities as articulated in workshops, interviews, and project management team meetings with ALDOT staff and partner organizations.

## 4.1 CAPABILITY MATURITY MODEL ASSESSMENT

The CMM Assessment promotes a process-driven approach to assessing and improving TSMO programs and focuses on the role of agencies and other institutions to improve the business processes and management of programs and projects. The CMM Assessment framework allows for a common understanding and improvement of institutional issues that an agency faces on a continual and consistent basis and promotes the adoption and success of TSMO programs. The CMM Assessment is a methodology developed by FHWA to assist agencies in the self-evaluation of effectiveness in six key areas:


- Business Processes - formal scoping, planning, programming, and budgeting
- Collaboration - working relationships with public and private sector agencies
- Culture - technical understanding, leadership, outreach, and program legal authority
- Organization/Staffing – programmatic status, organizational structure, and staff development, recruitment, and retention
- Systems Technology - use of systems engineering, architecture standards, interoperability, and standardization
- Performance Measures - use of performance measures including measure definition, data acquisition, and utilization (benchmarking and dashboards)

By conducting and using a CMM Assessment, agencies can: develop consensus around needed agency improvements; identify their immediate priorities for improvements; and identify concrete actions to continuously improve capabilities to plan, design, implement TSMO (FHWA, Capability Maturity Frameworks Overview, 2017). ALDOT has self-assessed that there are opportunities for advancing capabilities within all of the six dimensions, particularly those assessed slightly lower. Key dimensions that were identified as areas needing immediate focus include: Business Processes, Performance Measurement, and Organization/Workforce Development. For more details on ALDOT's CMM self-assessment, please see the ALDOT Statewide TSMO Master Plan Strategic Plan.

## 4.2 TSMO SURVEY

As part of the Alabama Statewide TSMO Master Plan development process, a survey was distributed to ALDOT staff and partner agencies, such as metropolitan and rural planning organizations (MPO and RPO). The survey was focused on statewide transportation priorities, existing conditions, challenges, and opportunities. The most significant needs identified by the survey respondents were:

- Limited fiscal resources – demand for transportation services exceeding available funds
- Aging infrastructure – maintaining and replacing aging infrastructure

- Collaboration – Internal collaboration across regions and jurisdictions and collaboration with external partners
- Changing technology – staying current with advances in technology including adequate funding and training
- Staffing – hiring and retaining staff with TSMO skill sets
- Culture – marketing the benefits of TSMO to the public and decision-makers

Results from the survey and information gathered from stakeholder interviews and the statewide TSMO workshop provided both technical input and personal experiences which informed the development of the Plan. For more details on the TSMO stakeholder survey results, please see the ALDOT Statewide TSMO Master Plan – Strategic Plan.

## 4.3 TSMO WORKSHOPS

Workshops are used to reach larger groups of stakeholders and solicit feedback to guide development of a plan. Several workshops were held to guide this Plan:

- A Statewide TSMO Kickoff Workshop was widely attended by internal and external stakeholders.
- A Statewide TSMO Vision Workshop was held with a subset of core stakeholders representing each of the ALDOT Regions.
- Regional workshops were held in each region to discuss the Statewide TSMO Program vision, goals, and objectives as well as solicit feedback about challenges and opportunities.
- The Statewide TSMO Vision Refinement, Needs, and Recommendations Workshop was with representatives from each region focused on defining the TSMO program vision, further refining needs, and beginning to develop TSMO recommendations.
- The Statewide TSMO Program Recommendations Workshop was held in conjunction with a Statewide TSMO Roundtable meeting and the draft high-level recommendations were refined through stakeholder input.
- A second Statewide TSMO Program Recommendations Workshop was in conjunction with a Statewide TSMO Roundtable meeting and focused on the refined programmatic recommendations, implementation plan, and program cycle.
- The Statewide TSMO Master Plan Presentation was held May 15, 2019.

## 4.4 TSMO VISION, GOALS, AND OBJECTIVES

The information and guidance provided by the survey, workshops, and stakeholder discussions steered the development of the ALDOT TSMO vision. The ALDOT Statewide TSMO vision defines the future of TSMO in Alabama:

> *Manage and operate a safe, reliable, optimized transportation system for all users through the collaborative efforts of stakeholders, technology-based solutions, and innovative strategies.*

This vision has been used to guide the development of objectives for the TSMO program. In addition, review of regional TSMO plans, statewide transportation plans, and information gathered through extensive engagement with ALDOT leadership and stakeholders through a survey, strategic interviews, and workshops were used to develop the TSMO strategic goals and objectives. The goals and objectives are illustrated in Table 2 and have been broken into three categories: move, manage, and motivate.

| GOAL | | OBJECTIVE |
|---|---|---|
| MOVE | SAFETY | Reduce the number of overall crashes (including secondary) as well as severity |
| | | Reduce work zone-related crashes |
| | | Increase the resiliency of the transportation system to extreme weather events |
| | | Enhance and expand TIM program |
| | | Increase safety of freight corridors |
| | MOBILITY | Improve travel time reliability |
| | | Provide timely information and mobility choices to the public |
| | | Reduce congestion and bottlenecks |
| | | Work with partners to actively manage traffic during large-scale special events |
| | | Enhance freight route mobility |
| MANAGE | ACCOUNTABILITY | Demonstrate fiscal responsibility |
| | | Increase sustainability and minimize environmental impacts |
| | | Integrate TSMO solutions into ALDOT policies, plans, and procedures |
| | | Create and implement project prioritization methodology based on data-driven decisions |
| | | Develop performance measures to make the TSMO business case |
| MOTIVATE | COLLABORATION | Develop system standards to promote data sharing, coordination, and integration |
| | | Elevate TSMO through leadership buy-in of the benefits and innovative technology |
| | | Identify where to engage with conventional silos to promote collaboration |
| | | Create a forward-thinking environment with continuous quality improvement practices |
| | | Establish formal career paths to encourage retention and develop workforce |
| | | Increase efficiency by seeking internal and external partnership opportunities |
| | | Realize opportunities with P3 (public-private partnerships) |
| | INNOVATION | Provide training and foster growth and sharing of knowledge |
| | | Seek strategic pilot project deployment opportunities |
| | | Integrate consideration of innovative solutions for all modes |

Table 2: Alabama TSMO Master Plan Strategic Goals and Objectives

The goals provide the direction and priorities for the Statewide TSMO Program and the development of the Statewide Master Plan, the objectives define strategies to attain the identified goals. The Program Plan of the ALDOT Statewide TSMO Master Plan is the primary instrument to guide implementation the objectives and to achieve the outlined goals. The Program Plan outlines the proposed program activities, policies, and procedures recommended to work towards achieving the ALDOT TSMO vision. The following sections define recommendations provided to achieve the stated TSMO goals and objectives.

# 5 TSMO PROGRAM RECOMMENDATIONS

The transportation industry recognizes the importance and need to shift to a mindset of leveraging technology, relationships, and opportunities to maximize the effectiveness and efficiencies of current and future systems. This is evident by the support and emphasis that has been placed on TSMO by national legislation and agencies such as FHWA and AASHTO.

The following program recommendations have been developed based on current national best practices, ALDOT stakeholder and partner agencies' input, and data analysis. These recommendations support the ALDOT TSMO vision and goals; to guide ALDOT into the future of transportation and accomplish the mission of providing *a safe, efficient, environmentally sound intermodal transportation system for all users.*

The recommendations are programmatic in nature and are structured in three main topic areas: Program Structure, Programmatic Processes, and Continuous TSMO Program Success. A table of recommendations is provided at the end of each sub-section and summarizes the key recommendations and associated goal that is supported: Safety, Mobility, Accountability, Collaboration, and Innovation.

## 5.1 PROGRAM STRUCTURE

### *5.1.1 TSMO Integration*

To support ALDOT as it develops and refines its TSMO program structure and overall mindset toward TSMO technologies and capabilities, it is important to remember that TSMO strategies are tools within a larger toolkit that the department can leverage, but they are not the only available options. For example, FHWA has stated that TSMO may in some cases replace the traditional option of adding capacity to a roadway to mitigate congestion, but there may be instances in where capacity building is still the best solution, which is why TSMO considerations should be made early in the project development process such as the concept development stage:

> *TSMO can serve as an alternative to adding capacity for some areas by increasing the mobility and reliability of the existing system enough to meet current and projected needs, and do so more quickly. Other times TSMO may improve conditions enough to delay when a road expansion project is needed, enabling the agency to stretch their limited funding to more areas. There will, however, always be a need to increase capacity and add new infrastructure throughout the transportation system. In some cases, that is the best solution given the circumstances. TSMO strategies can be added to these capital projects and serve as a complement to extend the performance life of the new corridor.* —FHWA, *What is TSMO?*[1]

Additionally, FHWA notes that TSMO strategies complement more traditional solutions and that TSMO is a suite of options that typically approach performance from a systems-level perspective. Because of the complementary nature and systems-level perspective of TSMO, TSMO strategies generally require coordination between and within multiple jurisdictions, agencies and modes. To facilitate this

[1] FHWA, What is TSMO?, https://ops.fhwa.dot.gov/tsmo/index.htm#q6

coordination, it is important that TSMO be viewed as an "integrated set of strategies," per FHWA, that can be combined to achieve greater performance for the system as a whole.

The integration of TSMO can occur at multiple levels, as defined by FHWA:

- System – Implementing and combining strategies as a corridor or region matures in needs.
- Technical – Developing a framework used to support information sharing between technology deployed on the system.
- Cultural – Developing a workforce that values and prioritizes the use of TSMO solutions across multiple disciplines.
- Operational – Coordinating day-to-day operational strategies so that corridor, region, or systemwide objectives are achieved.
- Institutional – Incorporating TSMO policies and processes into an agency's normal way of doing business. This step includes TSMO integration with various disciplines, such as planning, program management and design, to support long-term goals for the transportation system. This can be applied both internally and externally.[1]

This integration will require a multipronged approach across all levels of ALDOT and ALDOT decision-making processes. The regional and statewide stakeholders who provided input for this plan overwhelmingly stated the need for better integration and collaboration. There were many discussions about the loss of opportunities and efficiencies because the right people were not involved with a task early enough or at the correct stages. The need for TSMO to be integrated throughout process driven decision making is critical, such that inclusion is not dependent upon champions, but rather supported and encouraged by the Department. Specific concerns were discussed relative to ALDOT's current construction process and that early involvement of regional TSMO representation is recommended.

In addition to internal-facing integration, ALDOT must also seek to integrate TSMO strategies through partnerships with Metropolitan Planning Organizations (MPOs), Rural Planning Organizations (RPOs), local jurisdictions or municipalities, private businesses, or other stakeholders to ensure coordinated plans and deployments. Another critical element of TSMO integration will be for ALDOT representatives to begin to build external TSMO awareness by presenting TSMO-related topics and information at ALDOT-sponsored and professional organization events. This external communication and integration effort should include events that are both TSMO and non-TSMO focused meetings to further promote TSMO complementary nature to more traditional solutions as well as presentations to elected officials the state legislature to foster their support and understanding of TSMO and its benefits.

The following actionable recommendations are provided to integrate TSMO into current procedures and processes.

Table 3: Strategies for TSMO Integration

| TSMO Integration | | Goal |
|---|---|---|
| 1 | Encourage statewide TSMO representative participation in existing safety, management, operations, and maintenance considerations; as well as budgeting and ways and means committee meetings. | S, M, A, C |
| 2 | Revise Guide for Development of Construction Plans (GDCP) to include Regional TSMO Engineer at preliminary project scoping meetings and throughout project planning, design, and construction. | S, M, A, C |
| 3 | Integrate TSMO into Statewide Transportation Improvement Program (STIP) planning procedures and processes. | S, M, A, C |
| 4 | Encourage Metropolitan Planning Organizations (MPOs), Rural Planning Organizations (RPOs), local jurisdictions or municipalities, private businesses, or other stakeholders to incorporate TSMO into their planning processes. | S, M, C |
| 5 | Present TSMO related topics at ALDOT and professional organizational conferences, including non-TSMO focused meetings such as maintenance, design, and construction meetings and summits as well as presentations to elected officials in the state legislature to foster their support and understanding of TSMO and its benefits. | C |
| S=Safety M=Mobility A=Accountability C=Collaboration I=Innovation | | |

### *5.1.2 Leadership and Organization*

An important aspect of the ALDOT TSMO program will be its leadership and organization structure to support TSMO. FHWA has focused on the importance of having a defined leadership and organizational structure for TSMO programs, recognizing that the structure will help to advance the TSMO culture and strategies within a DOT or agency. The organizational structure defines the roles and responsibilities within the program and helps to formalize the interactions and connections between divisions or offices.

In addition to FHWA's guidance on leadership and organization, AASHTO has also recently made committee reorganization decisions to support elevating the importance of TSMO in the transportation industry. In 2018, AASHTO elevated operations-based topics and discussions to an independent committee that includes several subcommittees and working groups: Transportation Systems Operations. Previously these topics were housed in a subcommittee on system management and operations. This elevation reinforces the importance that TSMO strategies are playing in the transportation industry as well as highlights the need to integrate TSMO practices to better support optimization and efficiency.

Based on FHWA, AASHTO, and observed successes throughout the nation, it is recommended that ALDOT seek to elevate and integrate TSMO within the organization through coordinated integration efforts and leadership/organizational structure definition. To advance the ALDOT TSMO program, the following statewide and regional leadership and organizational structures are recommended. These structural recommendations reflect national best practices as well as input received during plan development. These recommendations also emphasize the inclusion of TSMO across the ALDOT organization to promote integrating the TSMO culture at a statewide level. The integration of TSMO practices will support the optimization of programs, processes, and systems.

*Creation of State TSMO Engineer*

DOTs across the country with established TSMO programs have redefined the organizational structure and leadership of the department to include a TSMO Director/Engineer type position. The TSMO leadership role serves as a way to support and encourage the proactive management, optimization, and improvement of safety and mobility within the existing surface transportation system; leading to better use of limited resources realizing increased returns on investments. The figure below identifies the DOTs across the country that have taken this approach and have defined senior leadership positions with a focus on operations and TSMO strategies.

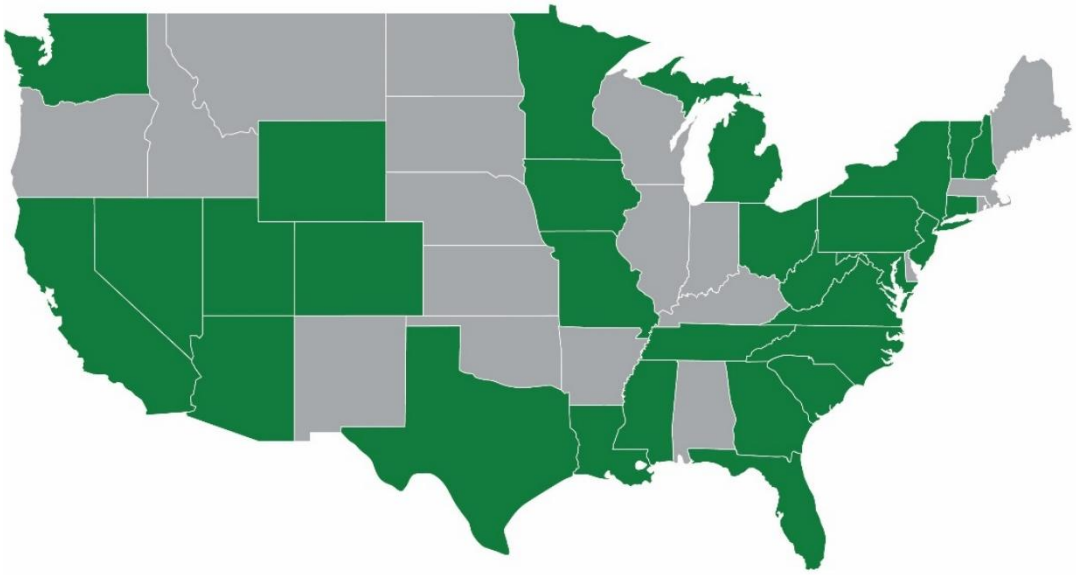


Figure 4: States with TSMO Senior Leadership Positions

These senior leadership positions allow states to better integrate TSMO programs into the culture and mindset of the department – encouraging efficiency and optimization of practice and infrastructure. In some cases, the leadership position titles may not specifically reference 'TSMO,' however, their support of a culture of collaboration and focus on management and operations to optimize the existing transportation network is apparent. Examples of several state TSMO leadership position titles include:

- Florida DOT – State TSM&O Program Engineer
- Iowa DOT – Director of Traffic Operations
- New Jersey DOT – Assistant Commissioner, Transportation Systems Management

Under the current ALDOT leadership structure, the TSMO organization currently falls under the State Maintenance Engineer and lacks dedicated funding. There is not a State TSMO Engineer at the same level of influence, decision-making responsibility, or accountability similar to other peer DOT organizations around the country.

To elevate TSMO within ALDOT and integrate its principles and practices within the Department, it is critical to have a State TSMO Engineer position assigned at the same level of organizational responsibility as shared by capital projects and maintenance as depicted in Figure 5. Similar to peer roles at this level,

this role would report to the ALDOT Deputy Director of Operations, who reports to the ALDOT Transportation Director (Section B of below organizational chart to be discussed in the following section). This position will allow the Deputy Director and the Director to get a different perspective on solving surface transportation challenges with a focus on utilizing strategies to promote optimization and efficiency, typically lower-cost solutions as compared to traditional expansion projects.

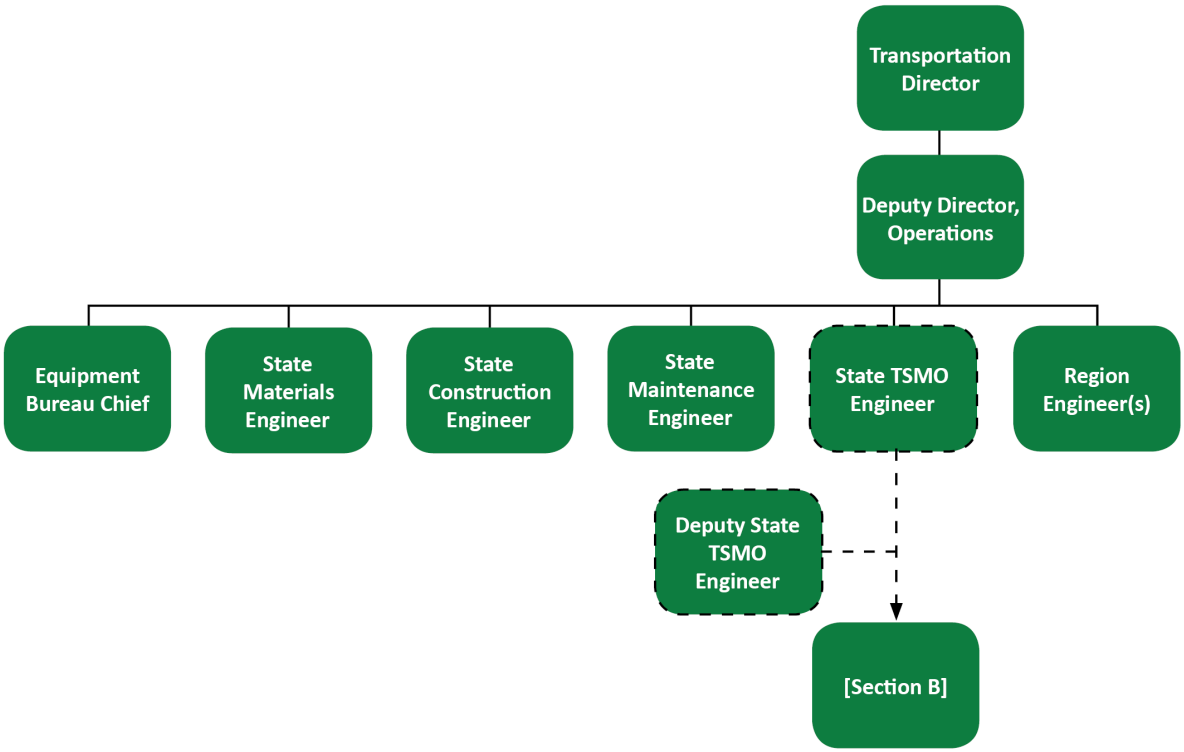



Figure 5: ALDOT Senior Leadership with the Addition of a State TSMO Engineer (Section A)

*Refinement of State TSMO Organization*

With the addition of a new senior leader role (State TSMO Engineer), there is a need to further define functional roles and responsibilities to support the senior leadership level within the recommended State TSMO organization. It is recommended that the state TSMO organization be divided into five functional departments led by the State TSMO Engineer: Programs, Engineering, Operations, Systems, and Emerging Technologies. It is envisioned that these departments will be serve the functional roles identified in Table 5 and will provide support to the regions within their respective roles. In some cases, a functional role may be delegated to a single position; however, it is not expected that all functional roles will be accomplished by a single dedicated staff position, but rather the responsibilities will be delegated based on staff experience, expertise, and need (i.e. one staff person may be able to accomplish the responsibilities of data collection and data analysis).

The Programs Department consists of several functional roles such as TSMO Program Planning Supervisor, Safety Supervisor, and Funding Supervisor. Within each section, supporting functional roles have been

defined (as applicable) to further support section and department goals and objectives. For instance, the TSMO Program Planning Supervisor is envisioned to be supported by data collection and data analysis functional roles. This may be a single staff position or multiple depending on the departments need and staff allocations. It should be noted that recognizing limited funding availability within ALDOT, some of these roles may not be staffed as ALDOT employees and may instead be contracted to specialty consultants or services. The following tables provide a list of functional roles and associated responsibilities as well as an indication if the role is currently being served. In addition, the anticipated resource discipline most likely to serve this role has been indicated. It is anticipated that there are other disciplines or skill sets that can meet the needs of the role, however, the most common discipline has been provided.

Table 4: Conceptual ALDOT State TSMO Organization – Program Department (Section B)

| Program Department | | | |
|---|---|---|---|
| Functional Role | Responsibilities | Resource | Discipline |
| TSMO Program Planning Supervisor | Lead development and updates of Statewide TSMO Program:<br>Capability Maturity Model Assessments<br>Goals and objectives<br>Performance objectives<br>Project priorities based on historical and current data | Met (TSMO) | Civil Engineer or Planner |
| Data Collection | Manage and coordinate existing data collection platforms and strategies. | Unmet (Other DOT) | Data Scientist |
| Data Analysis | Analyze and interpret performance measures data.<br>Provide data in a usable format to support data driven decisions. | Unmet (Other DOT) | Data Scientist |
| Safety Supervisor | Define Statewide TSMO Program safety goals and objectives.<br>Lead support for safety planning, design, operations, systems, and emerging technology departments.<br>Support data driven determination of safety project priorities. | Met (Other DOT) | Civil / Traffic Engineer |
| Safety | Analyze and interpret safety performance measures data.<br>Define Statewide TSMO safety standards and best practices based on existing national standards and guidelines. | Met (Other DOT) | Civil / Traffic Engineer |
| Traffic Safety and Operations | Liaison and support to Operations Department.<br>Define and manage performance metrics for signalized intersections. | Unmet (TSMO) | Civil / Traffic Engineer |
| Funding Supervisor | Manage annual budget allocation and TSMO Programming resources. | Unmet (TSMO) | Contract and Procurement Specialist |

Table 5: Conceptual ALDOT State TSMO Organization – Engineering Department (Section B)

| Engineering Department | | | |
|---|---|---|---|
| Functional Role | Responsibilities | Need | Discipline |
| Design Supervisor | Ensure a consistent approach to TSMO deployment designs.<br>Lead statewide traffic signal and ITS design standards, quality products list (QPL), and special provisions. | Met (Other DOT) | Civil / Traffic Engineer |
| ITS | Manage Statewide led ITS infrastructure design.<br>Support Regional ITS infrastructure design. | Unmet (TSMO) | Civil / Traffic Engineer |
| Traffic Signal | Manage Statewide led signal design.<br>Support Regional signal design. | Met (Other DOT) | Civil / Traffic Engineer |
| Freight | Manage Statewide led freight management focused strategies.<br>Support Regional freight system design. | Unmet (Contractor) | Freight Operations Engineer |
| Lighting Professional | Manage Statewide LED lighting design.<br>Support Regional lighting design. | Met (Other DOT) | Electrical Technician |
| Construction Supervisor | Ensure a consistent approach to TSMO deployment and construction.<br>Lead support on Statewide integration efforts. | Unmet (Other DOT) | Construction Manager |
| Contract Management | Assist with the letting of TSMO contracts.<br>TSMO construction contract support. | Unmet (Other DOT) | Contract and Procurement Specialist |
| Field Liaison and Integration | Ensure that TSMO construction and design standards are being applied to TSMO projects.<br>Support Statewide and Regional integration efforts. | Unmet (Other DOT) | Construction Manager |
| Maintenance Supervisor | Supervise maintenance activities on TSMO operations throughout the state.<br>Manage inventory of TSMO hardware to maintain operational efficiency throughout the state. | Met (TSMO) | Signal / Electrical Technician |
| Signal Shop | Perform maintenance tasks on TSMO hardware across the state. | Met (TSMO) | Signal / Electrical Technician |

Table 6: Conceptual ALDOT State TSMO Organization – Operations Department (Section B)

| Operations Department | | | |
|---|---|---|---|
| Functional Role | Responsibilities | Need | Discipline |
| Traffic Incident Management Supervisor | Lead development and implementation of Statewide TIM policies and procedures.<br>Manage TIM training program (coordinated with ETO training program).<br>Lead liaison to emergency management. | Met (TSMO) | Civil / Traffic Engineer |
| RTMC Operations | Monitor and support RTMC operations.<br>Develop standard operating procedures to meet TIM operational objectives. | Met (TSMO) | Dispatching Professional |
| Alabama Service and Assistance Patrol (A.S.A.P.) | Manage A.S.A.P. performance metrics.<br>Lead A.S.A.P. expansion. | Met (TSMO) | Safety Service Patrol Professional |
| Emergency Transportation Operations Supervisor | Lead development and implementation of Statewide ETO policies and procedures.<br>Manage ETO training program (coordinated with TIM training program).<br>Lead liaison to TIM. | Met (TSMO) | Civil / Traffic Engineer |
| Special Events | Develop, implement, and support active standard operating procedures, policies, and decision support systems to manage special event operations. | Unmet (Contractor) | Civil / Traffic Engineer |
| Weather | Develop, implement, and support active standard operating procedures, policies, and decision support systems to support inclement weather or evacuation operations. | Unmet (TSMO) | Civil / Traffic Engineer |
| Mobility Supervisor | Lead development and implementation of Statewide mobility policies and procedures.<br>Support Regional mobility initiatives.<br>Lead liaison to partner departments for collaboration. | Unmet (TSMO) | Civil / Traffic Engineer |
| Work Zone Management | Lead development and implementation of Statewide work zone management (including smart work zone) policies and procedures.<br>Support Regional coordination of work zone management of large-scale construction.<br>Lead liaison for traveler information integration. | Unmet (Other DOT) | Road Safety Professional |
| Traffic Engineering | Develop, implement, train, and support active standard operating procedures and policies for consistent traffic signal timing. Manage re-timing program. | Met (TSMO) | Civil / Traffic Engineer |
| Regional Traffic Operations Program (RTOP) | Support RTOP deployments throughout the State.<br>Track operational benefits and opportunity for improvement. | Unmet (Contractor) | Civil / Traffic Engineer |
| Traveler Information Supervisor | Manage traveler information systems and integration.<br>Support Regional traveler information initiatives.<br>Lead liaison to partner departments for collaboration. | Met (TSMO) | Public Relations and Communications Professional |

Table 7: Conceptual ALDOT State TSMO Organization – Systems Department (Section B)

| Systems Department | | | |
|---|---|---|---|
| Functional Role | Responsibilities | Need | Discipline |
| Network Communications | Support in development of quality products list (QPL) and special provisions for network equipment.<br>Develop SOPs, standard configurations, and change practices.<br>Lead development and implementation of Statewide Communications Plan.<br>Support Regional technical needs.<br>Liaison with IT for integration and security adherence. | Unmet (Other DOT) | Information Technology Professional |
| Data | Manage data governance and guidance.<br>Support performance measure objectives and data driven processes. Manage user groups and training resources. | Unmet (Contractor) | Statistician / Data Scientist |
| Hardware | Ensure that TSMO hardware meets statewide specifications.<br>Support procurement of new technology to ensure security and system requirements adherence. | Unmet (TSMO) | Electrical Engineer |
| Software | Collaborate with partners to understand software needs and support efficient integration.<br>Identify where software consolidation can provide efficiency. | Unmet (Other DOT) | Computer Scientist |

Table 8: Conceptual ALDOT State TSMO Organization – Emerging Technologies Department (Section B)

| Emerging Technologies Department | | | |
|---|---|---|---|
| Functional Role | Responsibilities | Need | Discipline |
| Connected Automated Vehicle (CAV) Specialist | Technical specialist.<br>Stay abreast of national practices and advances.<br>Liaison to elected officials to support CAV deployment.<br>Develop CAV policies and standards on a statewide level. | Unmet (TSMO) | Civil / Traffic Engineer or Other |
| Infrastructure Impacts Specialist | Evaluate impacts and benefits of TSMO Program deployments and initiatives.<br>Support to Regional partners for evaluation. | Unmet (Contractor) | Data Scientist |

*Refinement of Regional TSMO Organizations – Senior Leadership (C1)*

Beyond definition and refinement of a statewide TSMO organization, the ALDOT Regional TSMO organizational structure should also be refined to support the goals and objectives of the Statewide TSMO Program. This refinement will provide a consistent organizational framework for TSMO regional departments to enable peer-to-peer collaboration between regions for the benefit of statewide operations. In addition, it will ensure that regional TSMO organizations have the right blend of staff focus areas to manage and maintain successful TSMO operations.

Figure 6 depicts the recommended regional framework, consistent with Figure 5, *Leadership and Organizational Structure Section A*. The Region TSMO Engineer will report to the Assistant Region Engineer(s), who reports to the Region Engineer. The Region TSMO Engineer role currently exists as a function within the ALDOT organization, but it may not be a formalized role in all regional organizations – it is recommended that this role be formalized.

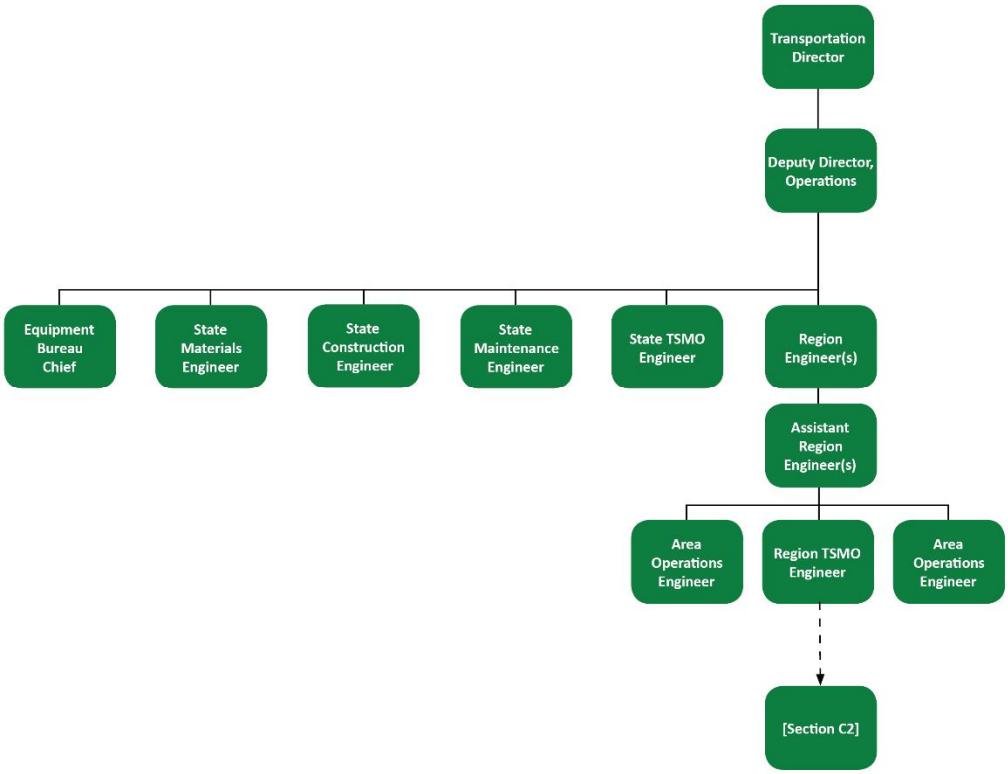



Figure 6: Conceptual ALDOT Regional TSMO Organization – Senior Leadership (Section C1)

### *Refinement of Regional TSMO Organizations – Supporting Staff*

Similar to the state TSMO organization, the regional TSMO organizations are envisioned to be comprised of a formalized Region TSMO Engineer who is supported by department-specific managers for the following departments: Programs, Engineering, Operations, Emerging Technologies, and Systems. Also similar to the state TSMO organization, each of these departments is further supported by section staff in roles relevant to the department. For instance, the Programs Department consists of a Planning Supervisor, Safety Supervisor, and Funding Supervisor—these roles are considered section supervisor managers. Within each regional section, functional roles have been defined (as applicable) to further support regional section and department goals and objectives. In addition, the regional organization includes Regional Traffic Management Center (RTMC) and Alabama Service and Assistance Patrol (A.S.A.P.) operational support which is recommended to be varied by need.

Because each region's TSMO maturity and needs are unique, the organizational structure at the regional level must be scalable and flexible (regarding the number of people in each defined position as well as the potential to consolidate multiple roles into a single professional's responsibilities) to be leveraged across all 5 regions. For example, the West Central Region is currently the only region with a Regional Traffic

Operation Program (RTOP). However, as the benefits and efficiency of this program are realized, it is recommended and expected that future RTOPs be implemented across the state.

It should be noted that recognizing limited funding availability within ALDOT, all these roles may not be staffed as ALDOT employees and may instead be contracted to quality professionals and consultants (as indicated with navy blue boxes).

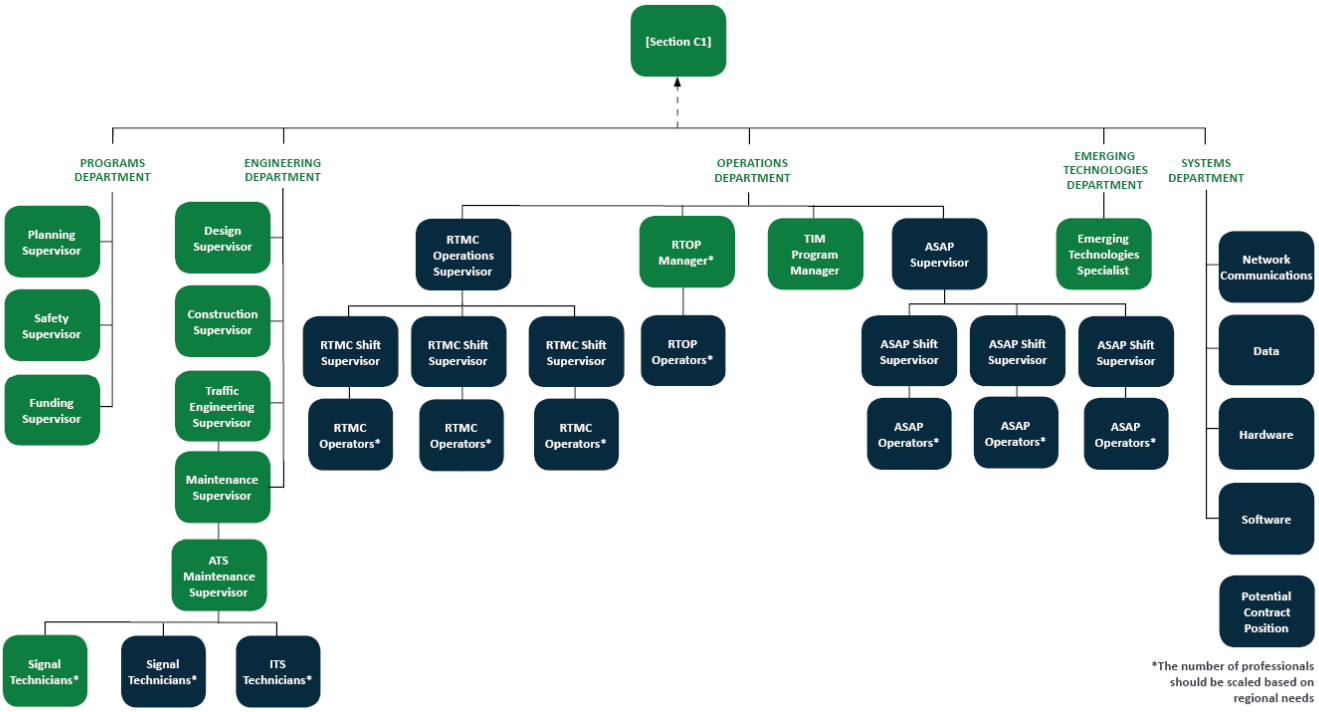



Figure 7: Conceptual ALDOT Regional TSMO Organization – Supporting Staff (Section C2)

### *Additional Leadership and Organization Recommendations*

In addition to leadership and organizational structure recommendations for the ALDOT state and regional departments, the following high-level recommendations also have been identified during the development of the Statewide TSMO Master Plan.

The TSMO departments, sections, and supporting staff will need to be adequately trained to perform their respective roles. To ensure that staff is well-equipped to perform the various functions needed at all levels of organization, ALDOT should develop and implement an ongoing TSMO training program. As discussed in a later section, this training program should be conducted formally at least quarterly, with topics covering:

- Signal Timing
- Signal Hardware
- Performance Management
- Traffic Incident Management

- Work Zone Management
- Evacuation Management
- Emergency Weather Response and Management
- New and emerging technologies, including CAV
- Data tools to support operations
- Advanced corridor management and operations
- Other identified training needs

In addition to training targeted at specific roles and functions, it is critical to cross-train TSMO staff in each of the above subject areas. Cross-training promotes TSMO integration and helps to ensure that knowledge-base is retained despite individual staff turnover. Furthermore, it is recommended that succession planning be elevated in importance with increased focus on documenting standard operating procedures (SOP), key contacts, lessons learned, etc.

To minimize staff turnover, it will be essential to the ALDOT TSMO program to focus on technical career path mobility because TSMO roles and functions are typically more highly specialized which can create challenges within a traditional agency promotional structure. Clearly defined roles and responsibilities, as outlined with the recommended leadership and organization structure, can help support technical staff promotion by reinforcing the important role each staff member plays in the TSMO program as well as help provide clarity on the influence and dependencies related to the technical skills being provided.

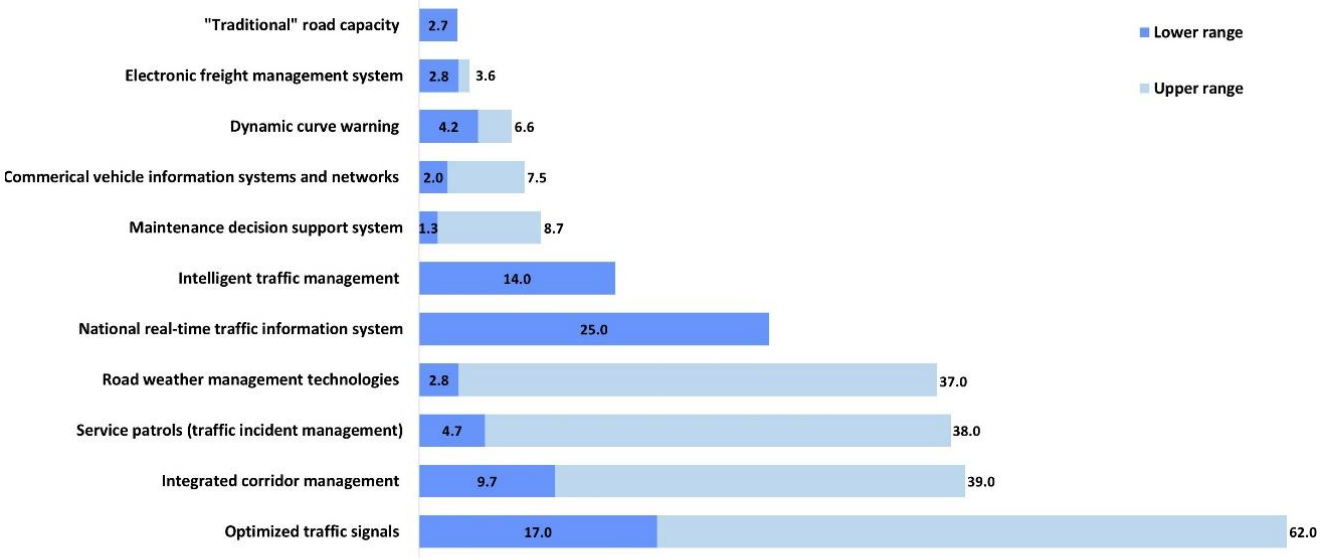
Clear expectations of the knowledge, skills, and abilities needed to perform each role can help ensure the right person is placed in the most appropriate role within the organization. Similarly, by establishing expectations for the knowledge, skills, and abilities for each role, the ALDOT TSMO program can work toward defining pay scales commensurate with these expectations. Appropriate pay scales are another important element to ensuring staff retention.

Table 9: Leadership and Organization

| Leadership and Organization | | Goal |
|---|---|---|
| 6 | Reorganize statewide work chart structure to increase the opportunity for TSMO collaboration by the State TSMO Engineer and supporting organizational structure. | A, C |
| 7 | Develop and implement an ongoing TSMO training program. Topics to include: signal timing, signal hardware, performance management, incident management, work zone management, evacuation management, and others as required. | S, M, A, C |
| 8 | Encourage technical staff retention: Clearly define roles and responsibilities; Identify and create job titles with appropriate knowledge, skills, and ability; Provide pay commensurate with knowledge, skills, and ability. | S, M, A |
| - | Clearly define roles and responsibilities. | S, M, A |
| - | Identify and create job titles with appropriate knowledge, skills, and ability. | S, M, A |
| - | Provide pay commensurate with knowledge, skills, and ability. | S, M, A |
| 9 | Cross-train critical positions to better secure knowledge and functionality for staff changes. | S, M, A |
| S=Safety M=Mobility A=Accountability C=Collaboration I=Innovation | | |

### *5.1.3 TSMO Program Support*

TSMO programs and deployment strategies have demonstrated performance success in making safer and more efficient use of existing infrastructure and doing more with less financial investment. Traditional capacity expansion, i.e. roadway widening, offers about 3 times the benefit versus the investment, whereas, typical TSMO strategy deployments have been found to offer significantly higher ranges as shown in the chart below.




SOURCE: Intelligent transportation systems, Capitol Research, Council of State Governments, April 2010; Transport for London, 2007; Intelligent transportation systems benefits, costs, deployment, and lessons learned desk reference: 2011 update, US Department of Transportation, September 2011; Urban mobility plan, Seattle Department of Transportation, January 2008; McKinsey Global Institute analysis

Figure 8: TSMO Deployment Strategy Benefit:Cost Ratio Ranges

Supporting Alabama's TSMO program financially and administratively is the most efficient way to achieve statewide transportation safety, mobility, and sustainability goals.

#### *Funding Support*

Currently, TSMO strategy deployments, programs, and systems are funded through a number of different resources. The primary funding mechanism for TSMO strategies is allocated from the maintenance budget. Additionally, deployments are sometimes integrated within larger traditional transportation projects, special grants, or through partner agencies. Because maintenance funding allocations are partially dependent upon weather and unforeseen influences, this can cause challenges to the operations and management of a program.

Alabama's approach to funding TSMO strategies is similar to other state agencies throughout the nation, using multiple funding sources based on the specific project or opportunity. There is a recent trend of allocating dedicated funding for TSMO strategies and systems in addition to traditional means of funding. Georgia, Wisconsin, North Carolina, Michigan, etc. all have funds specifically budgeted for supporting TSMO-related programs and/or deployments.

It is recommended that a dedicated funding stream be allocated to support the TSMO program development and needs. It is recommended that current practices of identifying joint funding opportunities continue to be encouraged and enhanced through the recommended development of

collaborative processes and integration of the TSMO culture. Furthermore, it is recommended that all funding sources and their general processes for allocation (i.e. state, federal, grants, private partnerships, etc.) be identified and defined as a resource for TSMO engineers and staff to better take advantage of funding opportunities.

*Leadership Support*

The influence and effect of senior leadership on the department cannot be overstated. It is critical that senior leadership within the Department offer support of the TSMO program, process, and culture of collaboration. It is recommended that state and regional leadership show their support through involvement in meetings and events when possible. One of these opportunities for involvement could be through a recommended annual TSMO summit in which a program update would be provided; project highlights; technology insight; and lessons learned.

Table 10: TSMO Program Support

| Program Support | | Goal |
|---|---|---|
| 10 | Allocate dedicated funding source to support TSMO program development and needs. | S, M, A |
| 11 | Define and seek all available funding sources (i.e. state, federal, grants, private partnerships, etc.) and general processes to help staff implement TSMO projects. | S, M, A |
| 12 | Encourage state and regional leadership support through involvement. | C |
| 13 | Facilitate annual TSMO Summit to include: TSMO Program update; project highlights; technology insight; and lessons learned. | C |
| S=Safety M=Mobility A=Accountability C=Collaboration I=Innovation | | |

## 5.2 PROGRAMMATIC PROCESSES

The successful management of any program requires a systematic approach to defining, evaluating, and implementing projects, policies, and processes. The following programmatic processes are recommended to ensure that resources are allocated in the most efficient and effective manner possible, creating accountability through demonstration of data-driven decisions and fiscal responsibility.

### *5.2.1 Project Development*

The transportation industry is constantly changing with advancements in technology. The ability to be flexible and proactive, and to take advantage of technological advancements, is even more critical today with the onset of connected/automated vehicles and an expectation of mass amounts of readily available data. ALDOT is anticipating a rapidly changing environment by shifting program processes to address needs based on current technologies and using innovative strategies. It is recommended that ALDOT take a multi-faceted, integrated approach to project implementation; considering opportunities for collaboration and enhancement in addition to dedicated TSMO programming.

An annual cycle of project development and project consideration at the regional level is recommended. At the regional level TSMO engineers will consider the present and 5-year horizon needs based on a review of current data to determine best strategies to address these needs. It is further recommended that

regional TSMO engineers engage other departments, regional staff, MPOs, RPOs, and local agencies to seek opportunities for collaboration or shared efficiencies. It is recommended that there be a formal collaborative process established to integrate TSMO strategies with the State Transportation Improvement Program (STIP). For example, traditional surface transportation type projects should be considered to determine if a potential relatively low cost TSMO deployment should be added to optimize safety and/or mobility, offering enhanced benefits of an investment.

Resources should be developed and updated annually to assist regional TSMO engineers such that project development can be as efficient and effective as possible. These resources may include access to current and compiled statewide crash data, National Performance Management Research Data Set (NPMRDS), weather information, cost information, etc. Each region may have slightly differing perspectives and needs and are likely require region-specific projects, programs, and deployment densities. The following project deployment guidelines have been developed to assist regional project development such that a level of consistency can be implemented to the project development approach across the state. The following project development approach consists generally of: analyzing data to identify needs, considering a range of deployment strategies, identifying potential opportunities for collaboration, and determining if the project is a wise investment.

### *Project Development Guidelines*

TSMO Project Deployment guidelines have been developed to provide direction and guidance for ALDOT at a statewide level. The following project deployment guidelines reflect the region's strategic approach to expansion. The guidelines themselves are aligned with initiatives included in the 2015 ALDOT Strategic ITS Business Plan.

In general, it is recommended that needs be analyzed and organized based on the following criteria:

- Safety (A)
- Mobility (B)
- Facility Type (C)
- Weather (D)
- Other Considerations (e.g., stakeholder input, existing facilities, project cost, partnership opportunities)

The following chart (Figure 9) is used to determine the deployment approach depending on the criteria mentioned above. The letters (A, B, C, or D) are used to associate the criterion with the data resource or map, which allow the user to understand the relative need within each category. The following sub-sections provide a small image of relevant statewide resource maps; full-size statewide and regional resource maps as well as specific for data analyses can be found in the Appendix.

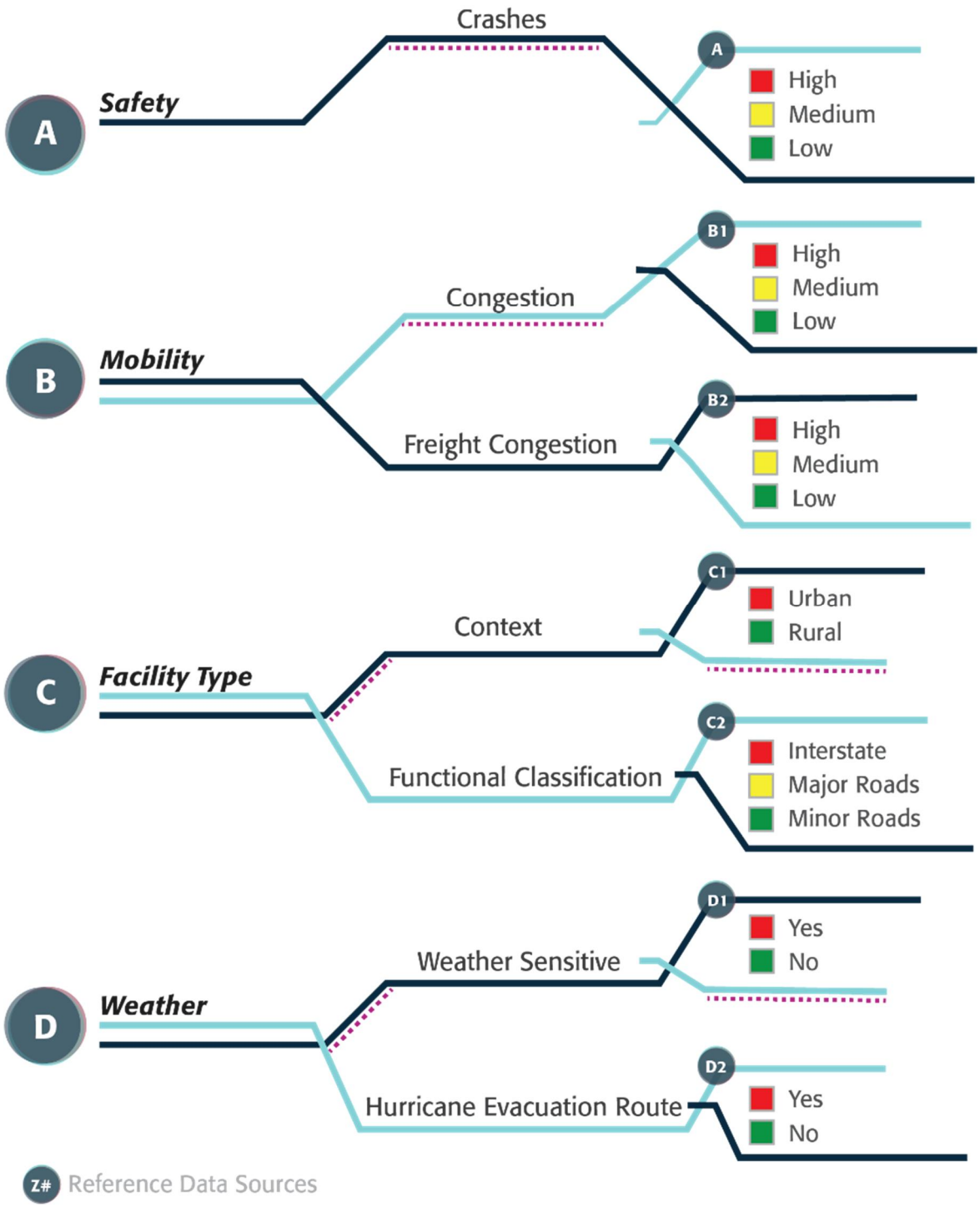
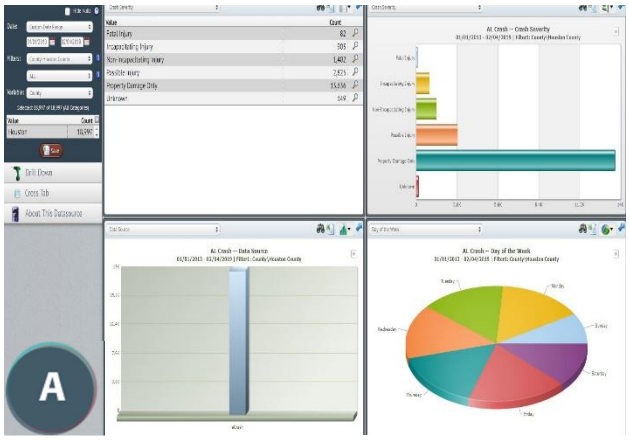



Figure 9: Statewide TSMO Project Development Guidelines

### *A: Safety*




Considering where safety concerns exist and developing potential solutions to address these concerns is paramount. ALDOT's Safety Operations Program, as a part of their database, regularly updates crash data. The data is available through an online dashboard called Advanced, dated 2013 through current. An example of the CARE crash data interface is shown at right with Houston County queried. It is recommended that regional TSMO engineers analyze current crash data each year to guide in project development. Example project recommendations may include; A.S.A.P. expansion, increased camera coverage, expanded TMC support, etc.

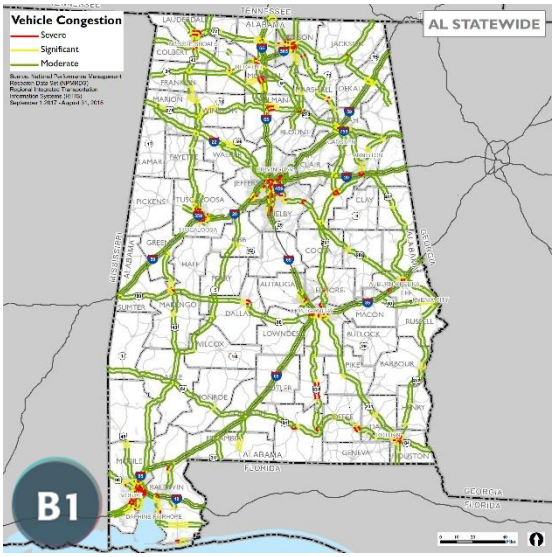
### *B: Mobility*

#### B1: Congestion

Mobility is directly correlated to congestion levels and is a key consideration for project development. It is recommended that the NPMRDS be utilized to identify corridors of regional significance that have a higher-than-average level of congestion. One year of data was pulled for all corridors from September 2017 to September 2018. The Massive Data Downloader Tool was used to generate reports that included Travel Time Index (TTI). An analysis of the data was completed to determine average relative congestion along each corridor. The following TTI thresholds based on research completed by the University of Alabama (*Congestion Quantification Using the National Performance Management Research Data Set* (Sisiopiku, Rostami-Hosuri, 2017)) were selected to reflect user perceptions of congestion and its impact on their travel times and are summarized as follows:

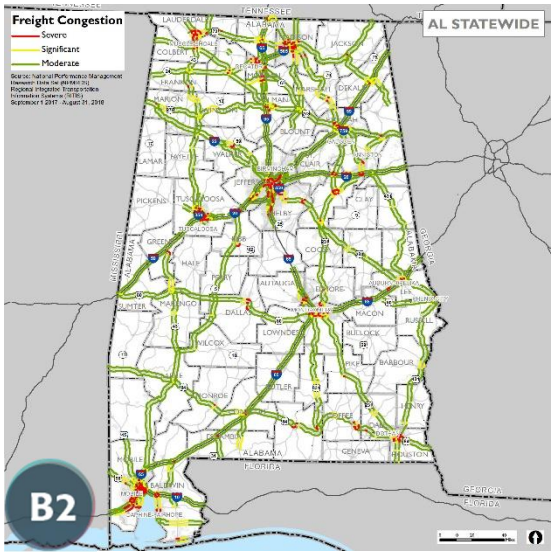
- 1.10 < TTI < 1.50 moderate congestion
- 1.50 < TTI < 2.00 significant congestion
- TTI > 2.00 severe congestion

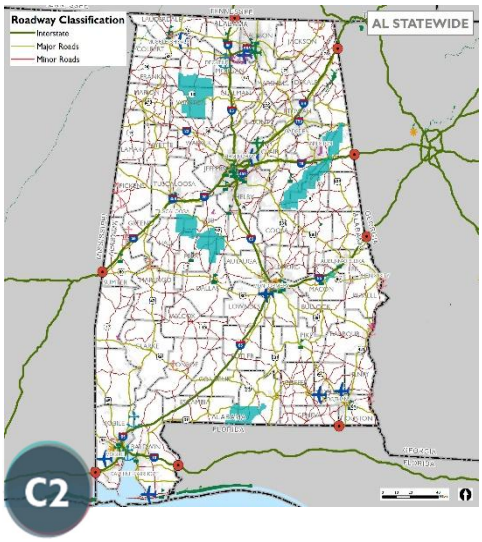
These ranges of travel time indices were used to correlate to Low, Medium, and High congestion needs for both vehicular and freight congestion.

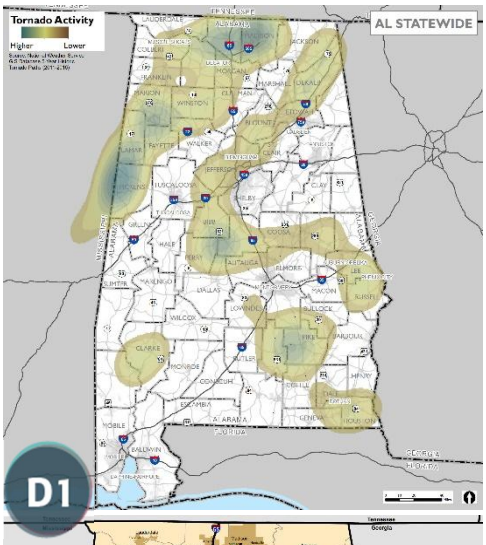


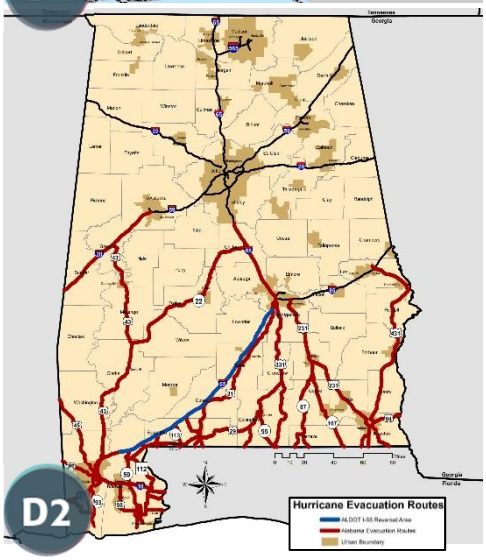

#### B2: Freight Congestion

Freight mobility is a significant consideration for the state's economy and industry. Therefore, it is recommended that freight mobility be considered like the mobility analysis described above.






### *C: Facility Type*

#### C1: Context

Context of the roadway—whether urban or rural—plays a role in determining the most effective deployment strategy. For example, corridors in urban areas may require a more significant level of deployment based on the volume and congestion more likely experienced in these areas (see Appendix for map).

#### C2: Functional Classification

Functional classification is a traditional method for departments of transportation to categorize roadways based on traditional operational characteristics. Understanding the classification of a roadway can highlight the role that it plays in the system and help overall prioritization of deployment. The level of access control is also considered in this category.

### *D: Weather*

#### D1: Weather Sensitive

During extreme weather events, transportation operations and motorist safety can be compromised. Weather conditions that may have a higher impact on the traveling public require a specific mitigation strategies and tools. For example, flood hazard areas and tornado-prone areas may require expanded TSMO deployment to better manage impacts from extreme weather events. Tornado activity is shown in this section; additional statewide and regional tornado and flood hazard maps are shown in the Appendix.

#### D2: Hurricane Evacuation Routes

Major corridors that allow rapid travel from the coasts inland are identified in hurricane-prone areas and are designated as Hurricane Evacuation Routes (map from ALDOT). These corridors are likely candidates for high device deployment density to best serve critical operations and safety in the case of an extreme weather event. It is anticipated that these devices will support corridor management systems such as contraflow, reversible lanes, or other unique strategies based on the specific need.

*Field Deployment Density Guidelines*

Field deployment density guidelines have been developed to provide direction and guidance for ALDOT at a statewide level. These field deployment density guidelines are primarily focused on ITS and communications which is only one set of strategies available to address needs. It is critical to consider a range of potential strategies to address needs. For example, if a large employment center experiences reoccurring congestion, one potential solution may be to consider managing the demand and work with the employers to stager shift changes; this strategy is significantly more cost effective rather than expanding capacity through roadway construction.

The TSMO Project Development Guidelines are intended to provide context and direction at a high-level to the area or corridor of consideration; it is expected that all locations and projects may not fall within these parameters. Likewise, it is up to the TSMO project developer to assess each of the criteria and determine the appropriate low-, medium-, or high-deployment need. For example, safety may be found to be a high need where congestion, facility type, and weather may be considered low. In this case, it would be likely that the TSMO project developer would consider high-density applications due to their understanding and professional judgement of the high-safety need.

Deployment of CCTV, Communication, DMS, Automatic Safety Warning Systems, and/or detection should follow deployment density guidelines as outlined below (Figure 10) and as aligned with the criteria presented in the Statewide TSMO Project Development Guidelines. DMS or Automatic Safety Warning Systems, for example, would be spaced at strategic decision-making points or site-specific locations with identified need. Camera deployments may have low deployment density for strategic locations, while full-coverage may be required for high-density applications. Similarly, Communication infrastructure may have low density in areas that simply require connectivity, whereas fiber would be preferred for high-density deployment applications.

| Deployment Type | Deployment Density: Low | Medium | High |
|---|---|---|---|
| CCTV | Strategic locations or specific circumstances | Key locations (high volume, speed or crash incidents, etc.) | Full coverage |
| Communication | As required by connectivity | Fiber or wireless as required for deployment | Fiber preferred |
| DMS | Spaced at strategic decision-making points | | |
| Advanced Safety Warning Systems | As recommended by site specific study or strategic locations with identified need | | |
| Detection | Strategic locations or specific circumstances | Key locations (traffic signals, high volume, speed, or crash locations) | Full coverage |
| ASAP | Interconnecting high need areas | As determined by ASAP deployment tool | As determined by ASAP deployment tool |

Figure 10: Deployment Density Guidelines

It is important to note that these guidelines are not absolute – meaning there may be specific circumstances or strategic endeavors outside of these guidelines where it makes sense to deploy TSMO strategies. For example, if an opportunity for collaboration is identified along a corridor that has existing fiber infrastructure, it may make sense to deploy a camera along a less-traveled facility if there are additional benefits received from State Highway Patrol (SHP) partners or cost share agreements for installation. It should be noted that even if the capital costs of a deployment are covered from a partnering source, consideration is still needed to determine if the benefit of the deployment is worth the cost associated with management, operations, and maintenance.

### *Data Resources*

The data driven project development approach will ensure that ALDOT is focusing on the most critical areas throughout the State. Vast amounts of data are currently available and will continue to become increasingly available as we move to a world of big data and big data analytics. By establishing a methodology of project development led by data, ALDOT will have the opportunity to continuously advance the process as the accuracy and ease of access to that data becomes increasingly improved. It is recommended that a data resource cycle be established on an annual basis to pull updated data and consider potential new data resources.

### *State Transportation Improvement Program (STIP) Integration*

As mentioned in the TSMO Integration section above and further defined in the Program Cycle below, integration with the STIP project development cycle is recommended to identify opportunities for collaboration and efficiencies. To support this integration with the STIP, it is recommended that a 5-year resource cycle update be developed and implemented to include: communications plan, performance measures, and project development guidelines. This will provide the critical data resources and guidelines that are reflective of the current environment.

Table 11: Project Development

| Project Development | | Goal |
|---|---|---|
| 14 | Engage other departments, regional staff, MPO, RPO, and local agencies in TSMO project development. | S, M, A, C |
| 15 | Utilize Statewide Deployment Guidelines. | S, M, A |
| 16 | Develop and implement an annual data resource cycle update to include: National Performance Management Research Data Set (NPMRDS); AADT; TADT; crash; and event centers. | S, M, A, C |
| S=Safety M=Mobility A=Accountability C=Collaboration I=Innovation | | |

### *5.2.2 Project Evaluation*

The ALDOT faces growing challenges addressing increasing needs with decreasing funding resources. This heightens the importance of how projects are evaluated and prioritized for funding. The following project evaluation recommended methodology has been developed to clearly and objectively allocate funding resources based on data driven decisions and critical needs throughout the state.

Project evaluation criteria have been developed within the framework of the statewide TSMO goals and are consistent with the deployment guidelines described above. This framework relies on relative prioritization of the plan goals, with weighting as outlined below.

- Safety (35%)
- Mobility (30%)
- Accountability (15%)
- Collaboration (10%)
- Innovation (10%)

Based on stakeholder input, departmental direction, and technical analysis, the weighting scale for this framework was designed with the understanding that all these goals are important to project as well as system success. It is possible that over time, the relative weighting of each of these elements may change as some priorities shift due to system maturity and other evolving conditions.

The relative weighting of each plan goal is comprised of criteria scores designed to support plan objectives. Each criterion has a corresponding data-based (quantitative and/or qualitative) assessment, which was derived based on known available data, process, and guidance designed through the Statewide TSMO Master Plan process. As part of plan implementation, as well as for future planning efforts, regional TSMO staff would leverage this framework to develop and evaluate potential projects within their region to produce a list of recommendations that can be evaluated and prioritized at the statewide level for implementation. It is recommended that a project application and evaluation cycle be developed and implemented annually.

A TSMO project evaluation tool has been developed to assist in the prioritization process, providing a transparent, consistent, data driven approach to allocating funds. The Excel-based tool compiles project specific user responses and ranks them relative to the established weighted criteria. It should be note, that the deployment guidelines and evaluation criteria are largely dependent upon the same data resources, thus encouraging use of the deployment guidelines and making efficient use of resources. Each project will be evaluated relative to the project specific need. The analysis and maps referenced in the previous deployment guidelines section will be used to score each criterion. The following criteria are considered within each goal category:

### *Safety*

Of the plan goals, safety accounts for 35% of the total prioritization score and is an important element of project evaluation. Data available for safety evaluation includes review of project extents in the most up to date eCrash data mapping. High crash rates along the project corridor would score higher than low crash rates, for example. Additional safety scoring is based on whether the project is an identified Evacuation Route, in a Weather Sensitive area, or on a Freight Corridor, as identified in the samples of relevant maps in the Project Development section of this report; data and maps will be updated annually for best results.

Table 12: Safety (35%)

| SAFETY (35%) | | | | |
|---|---|---|---|---|
| Criteria | Data source | Response | Score | Aggregate Weight |
| Crash | Map - eCrash data | High/Med/Low | 3/2/1 | 28% |
| Evacuation Routes | Map/Routes | Y/N | 1/0 | 2% |
| Weather Sensitive | Map/State Report | Y/N | 1/0 | 2% |
| Freight Corridor | Map - NTAD | Y/N | 1/0 | 3% |

### *Mobility*

Mobility impacts will consider criteria including project's organizational impact, or the sphere of influence the project will provide, whether that is statewide, a regional or local-only impact. Congestion and Freight Congestion mapping with RITIS (AADT) data will be updated annually to help identify if the project is within a high-, medium-, or low-congestion area, or freight-congestion area. Designation as urban versus a rural provides a small component of the mobility assessment and can be identified corridor map identifying urban and rural routes.

Table 13: Mobility (25%)

| MOBILITY (25%) | | | | |
|---|---|---|---|---|
| Criteria | Data source | Response | Score | Aggregate Weight |
| Congestion | Map - RITIS (AADT) | High/Med/Low | 2/1 | 23% |
| Freight | Map - RITIS (TAADT) | High/Med/Low | 3/2/1 | 5% |
| Urban vs. Rural | Map | Urban/Rural | 3/2/1 | 1% |
| Organizational Impact | Known by applicant | Statewide/ Regional/ Local | 3/2/1 | 2% |

### *Accountability*

Evaluation related to accountability includes an assessment of benefit/cost analysis per a scoring methodology described in the Appendix. The applicant must include maintenance and operations provisions to be eligible for scoring criteria for this category; resources such as available funding must have been identified to qualify. Performance measures of the project are to be prepared by the applicant project to evaluate the project post-implementation to enable ALDOT to track progress toward TSMO objectives.

Table 14: Accountability (20%)

| ACCOUNTABILITY (20%) | | | | |
|---|---|---|---|---|
| Criteria | Data source | Response | Score | Aggregate Weight |
| Benefit/Cost | See Appendix | High/Med/Low | 3/2/1 | 6% |
| Maintenance and Operations | Known by applicant/ App. process | Resource Identified/Funding Available | 2/1/0 | 6% |
| Performance Measures | Known by applicant | Y/N | 1/0 | 3% |

### *Collaboration*

Collaboration is important for overall ALDOT TSMO program success. Areas with high potential for collaboration and coordination, such as hubs, or local/regional activity centers, are strategic areas where projects can provide high impact and further ALDOT TSMO program success. Additional collaboration from a funding perspective either through public partnerships, or private partnerships, can enable greater reach and program success through joint-venture funding and coordination.

Table 15: Collaboration (15%)

| COLLABORATION (15%) | | | | |
|---|---|---|---|---|
| Criteria | Data source | Response | Score | Aggregate Weight |
| Hubs | Known by applicant | Y/N | 1/0 | 4% |
| Public Partnership | Known by applicant | Y/N | 1/0 | 3% |
| Private Partnership | Known by applicant | Y/N | 1/0 | 3% |

### *Innovation*

Innovation will continue to be an important element of any future endeavor. Future technologies, including enhanced Traffic Management System Support via integration with the latest Statewide Communications Infrastructure will be for any large-scale project deployment. Likewise, continuing to encourage and design projects for Multimodal options and/or CAV Support will better enable ALDOT to adapt to changes in travel patterns and travel technologies.

Table 16: Innovation (10%)

| INNOVATION (10%) | | | | |
|---|---|---|---|---|
| Criteria | Data source | Response | Score | Aggregate Weight |
| Traffic Management System Support | Known by applicant | Y/N | 1/0 | 6% |
| CAV Support | Known by applicant | Y/N | 1/0 | 6% |
| Multimodal | Known by applicant | Y/N | 1/0 | 3% |

Table 17: Project Evaluation

| Project Evaluation | | Goal |
|---|---|---|
| 17 | Develop TSMO project application. | A |
| 18 | Implement an annual TSMO project application cycle. | A |
| 19 | Implement the TSMO Evaluation Process. | A |
| 20 | Provide TSMO project application and evaluation process training. | A |
| S=Safety M=Mobility A=Accountability C=Collaboration I=Innovation | | |

### *5.2.3 Systems Engineering*

The systems engineering (SE) process is a proven approach to developing technology implementations such as ITS or TSMO projects. The process includes several key steps that consider the full lifecycle of the proposed project (from planning through operations, maintenance, and eventually replacement). Both the FHWA and the Federal Transit Administration (FTA) have formally adopted regulations requiring that "[a]ll ITS projects funded by highway trust funds shall be based on a systems engineering analysis." The SE process has been shown to decrease risk, reduce schedule and budget overruns, and deliver final systems that meet the initially outlined objectives of the system.

The systems engineering process recommended for use in Alabama follows the approach defined in the *USDOT Guidebook for Systems Engineering for Intelligent Transportation Systems*. The process is depicted in the "V" diagram and is shown in Figure 11.

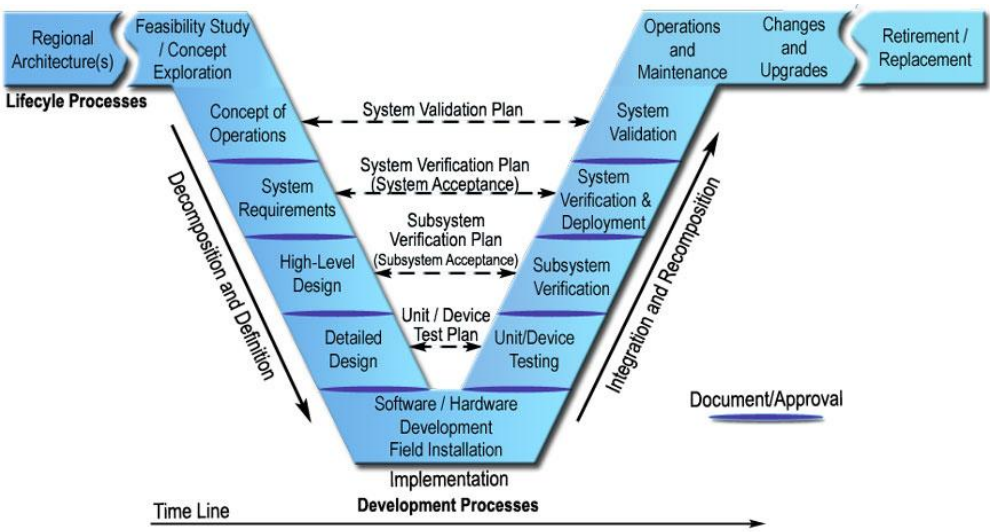



Figure 11: Systems Engineering "V" Diagram

*Source: USDOT Systems Engineering for Intelligent Transportation Systems, January 2007*

The first step mentioned in the systems engineering process references regional architectures. This is a process by which existing systems are defined and interoperability relationships within an agency are identified. Recent upgrades and capabilities supporting connected and automated vehicles have been

added to the ITS Architecture software provided and required for use by FHWA. It is recommended that ALDOT update the statewide ITS Architecture with current software ARC-IT, RAD-IT, and SET-IT.

The systems engineering process will guide project managers through each of the defined engineering steps. Each of the ALDOT regional TSMO plans that have been prepared provide a basic systems engineering framework recommended for use within that region. It is recommended that ALDOT consider these frameworks and prepare high-level TSMO systems engineering guidance based on the type of system being considered: existing system, existing system modification, new system deployment.

It is further recommended that a Statewide Configuration Management Plan and an Asset Management Plan be developed and implemented. The implementation of standard configurations and asset management will support consistent, efficient operations and maintenance of systems and allow for greater optimization; realizing added value in existing and new systems throughout the state. In addition, standardization of configurations and asset management will allow systems to be better secured.

Table 18: Systems Engineering

| Systems Engineering | | Goal |
|---|---|---|
| 21 | Update ITS Architecture with current software ARC-IT, RAD-IT, and SET-IT. | A |
| 22 | Develop and implement Statewide Configuration Management Plan. | S, M, A |
| 23 | Develop and implement Statewide Asset Management Plan. | S, M, A |
| 24 | Provide TSMO deployment systems engineering guidance. | S, M, A |
| - | Existing System Deployment Process. | S, M, A |
| - | Existing System Deployment Modification Process. | S, M, A |
| - | New System Deployment Process. | S, M, A |
| S=Safety M=Mobility A=Accountability C=Collaboration I=Innovation | | |

## 5.3 CONTINUOUS TSMO PROGRAM SUCCESS

### *5.3.1 Culture of Collaboration*

As previously noted, TSMO relies on integration and coordination for success. As ALDOT advances its TSMO program, fostering a culture of collaboration will be essential for this integration and coordination to take place. This collaborative culture will need to be fostered both internally and externally.

For internal collaboration, FHWA advises that embedding TSMO is a key priority within an agency and this embedment generally requires the integration of TSMO into other agency functions, plans, and programs, which may include Planning, Programming/Funding, Project Development/Design, and Maintenance and Asset Management. FHWA further delineates how TSMO can be integrated within these various functions[2]:

- Planning – The TSMO program should support the goals and objectives in the agency's long-range transportation plan and serve as a basis for identifying these objectives and priorities. TSMO thinking and TSMO strategies should permeate all relevant planning documents, including freight plans, bicycle/pedestrian plans, and safety plans. The strategic objectives of the TSMO program plan also should be integrated into corridor plans, and sub-area planning.
- Programming/Funding – The TSMO program's priorities should be integrated into investment and funding decisions, including integration into the TIP and STIP.
- Project Development/Design – TSMO needs to be considered at the project level when considering both project design and strategies to incorporate into a project (e.g., transit signal priority, dynamic lane control, demand management).
- Maintenance and Asset Management – TSMO needs to consider how its assets (including ITS equipment, transportation management centers, etc.) are maintained and replaced over their life-cycle.

Integration of TSMO within ALDOT will help further support this internal collaboration, and integration can be further supported with internal educational materials disbursement, such as via a TSMO-specific website, as well as regular CMM assessments that include action plans that include necessary partnerships to address critical needs.

For external collaboration, FHWA advises that for TSMO to permeate an agency, TSMO considerations must be integrated into processes and procedures used throughout an area or region, such as other types of transportation planning studies. As an example of this collaboration, FHWA cites Caltrans' collaboration and integration efforts that include conducting forums where Caltrans District staff meets with MPOs and other regional partners to advance mutual priorities. ALDOT is currently hosting similar meetings, called "TSMO Leaders Workshops," which should continue on a regular basis and include a diversity of stakeholders and partners—both internal and external—to further foster the culture of collaboration needed to advance ALDOT's TSMO goals.

[22] FHWA, *Developing and Sustaining a Transportation Systems Management & Operations Mission for Your Organization: A Primer for Program Planning*, https://ops.fhwa.dot.gov/publications/fhwahop17017/ch6.htm

Table 19: Culture of Collaboration

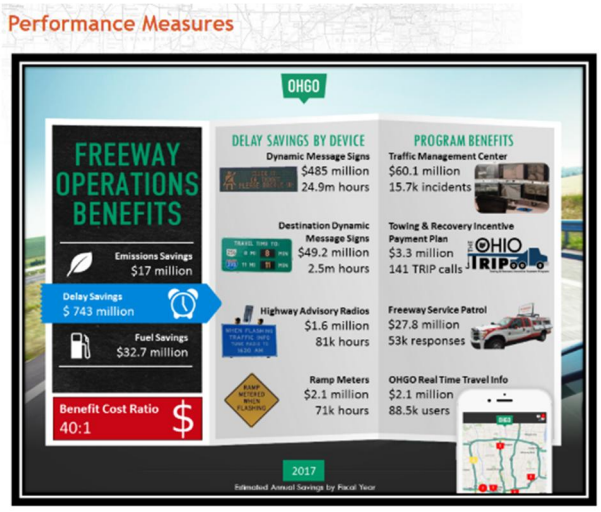
| Culture of Collaboration | | Goal |
|---|---|---|
| 25 | Continue quarterly TSMO Leaders Workshops. Rotate stakeholder invitees from other ALDOT Departments. | C |
| 26 | Develop an ALDOT TSMO Website with: TSMO overview, educational materials (brochures, service layer plans, presentation materials), program overview, key performance measures, key contacts, roles and responsibilities, resources, etc. | A, C |
| 27 | Complete basic CMM assessment on an annual cycle. Develop an action plan to address the most critical needs on a biennial basis. | A, C |
| S=Safety M=Mobility A=Accountability C=Collaboration I=Innovation | | |

### *5.3.2 Performance Measurement*

The Moving Ahead for Progress in the 21st Century Act (MAP-21) bill, passed in June 2012, formally established the practice of performance-based planning and programming to support decision-making in transportation management and operations. Theses performance measurement requirements provide greater consistency in reporting with a focus on safety and mobility. In addition, there is a stated expectation that performance data will be used to inform operations, planning, and programming decisions. For safety, these metrics focus on reducing fatalities and serious injuries while for mobility, they focus on interstate reliability and excessive delay. TSMO performance measures are required to be in line with the goals of MAP-21 and those agencies that do not meet self-established goals are subject to constraints on future funding. Furthermore, using data to drive management and operations is basic good practice; making it possible to optimize performance and be as efficient as possible within the given constrains of an area.

ALDOT has been moving in the direction of integrating performance measures into programming, management, and operations—reviewing incident clearance times, focusing on high crash and congested areas, etc. The recommended methodologies of project development and prioritization will also establish data-driven practices. It is further recommended that ALDOT develop performance measurement goals and develop resources to facilitate optimization systems and processes. Current performance measure trends and initiatives that are being implemented throughout the nation include:

- Corridor mobility and reliability
  - travel time
- TIM measures
  - response times
  - clearance times
  - secondary crashes




Example Performance Measures Website from Ohio DOT

This will require an investment of resources to develop tools to measure the performance of assets. In some cases, crashes for example, tools are currently developed with a process for maintaining data; however, there will still need to be consideration of how this data can be efficiently retrieved, analyzed, and processed to guide decisions. It is recommended that tools be developed at a statewide level for the use of regional TSMO engineers. This will promote consistency, efficiency, and quality of the data.

It is recommended that regional TSMO engineers lead an effort to develop regional performance measurement goals within each of their regions—what are key focus areas within each region that need to be addressed; what is the performance metric that can be considered to measure the progress against these goals? These goals should be used to guide project development and focus investments. It is expected that continual assessment of performance will offer insight on how best to optimize performance; therefore, it is recommended that goals be annually reconsidered to make sure current practices and recommendations are still relevant. It is recommended that an annual Statewide TSMO report demonstrating program success, challenges, status, and goals for the coming year.

### *Benefits Analysis*

It is recommended that performance measures data be used to provide an estimate of program benefits, including sustainability. Estimation of benefits is a powerful way to communicate the value of TSMO strategies and deployments which are more difficult to tangibly show. However, analysis is not an exact science, assumptions are formulated and applied in a consistent method to most accurately anticipate what has been or will be realized. As performance measures data accuracy and availability increases, so does the quality of benefits estimation.


TOPS-BC Website from FHWA

The basic methodology typically involves considering a similar deployment or system that has a published evaluation of tested results and scaling according to project/system specific data elements. U.S. Department of Transportation (US DOT) maintains a clearinghouse of ITS related cost and benefits information that has been developed over many years (https://www.itsbenefits.its.dot.gov/its/benecost.nsf/ByLink/BenefitsAbout). This clearinghouse is an extensive resource of information for ITS and TSMO strategy deployments. Additionally, FHWA has developed the Tool for Operations Benefit Cost Analysis (TOPS-BC), which guides the user through the estimation of benefits of a specific deployment.

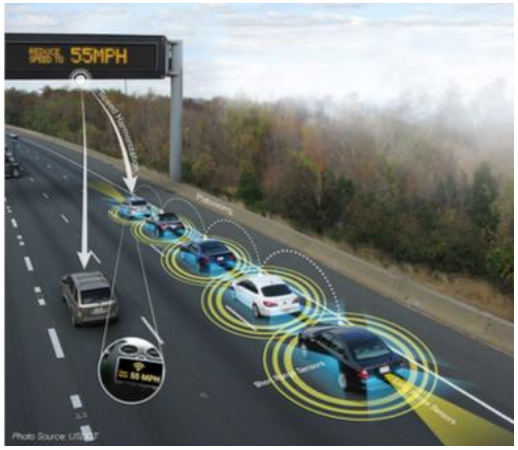
Both resources provide an extensive amount of information, however, can be labor intensive to use and dependent on data that may or may not be readily available for ALDOT users. It is recommended that simplified benefit and sustainability resources be developed to support ALDOT TSMO reporting. In addition, it is recommended that the resources be integrated to support the project prioritization methodology as described on the previous page.

Table 20: Performance Measurement

| Performance Measurement | | Goal |
|---|---|---|
| 28 | Develop performance measurement goals and resources to facilitate optimization systems and processes (mobility, safety, reliability, incident response). | S, M, A |
| 29 | Develop regional performance measurement goals within each region. | S, M, A |
| 30 | Integrate performance measurement considerations into standard development, management, and operating practices. | S, M, A |
| 31 | Review data practices annually for enhancement, quality improvements, and efficiencies. | S, M, A |
| 32 | Develop simplified benefits analysis resources. | A |
| 33 | Develop simplified sustainability analysis resources. | A |
| 34 | Demonstrate program success through an annual report providing status related to program maturity, performance measures, benefits and sustainability analysis, etc. | A |
| S=Safety M=Mobility A=Accountability C=Collaboration I=Innovation | | |

### *5.3.3 Innovation*

We are entering a time when advanced computing, sensors, and telecommunications technology are transforming automobile and road-based surface transportation. With these advancements come important policy, legal, investment, and research decisions that governments must consider. As connected and automated vehicle (CAV) advancements expand daily and are introduced into existing transportation systems, certain questions become increasingly pertinent: Is Alabama ready? Can we address safety regulations while simultaneously leveraging opportunity? Can we prepare our workforce, the legal community, and the public for shifts in how the transportation network is used and how mobility is supplied? It is critical that these changes are diligent to protect the safety of the public while maintaining a certain level of flexibility that allows innovation and business growth for Alabama. Safety should remain paramount in these discussions. It is critical that ALDOT continue to protect the safety of the public while maintaining a certain level of flexibility to allow transportation innovation and business growth for Alabama.



Example of connected vehicle technology
Source: U.S. Department of Transportation

In addition to CAV, emerging technology advancements are imminent in Smart City and Internet of Things applications, Big Data processing and automation, artificial intelligence and machine learning, and others. It is expected that all these innovations will offer significant opportunities to improve and change the way we travel.

An adopted innovation strategy for ALDOT will allow Alabama to both prepare for new transportation trends and leverage emerging Big Data to evaluate and manage project implementation. It is

recommended that ALDOT form an Innovation Board that includes DOT, public agencies, and key partners in research and industry that will allow the state to identify and task technology leads to research and consider implementation of innovative technologies.

A primary task of the Innovation Board will be to prepare a Connected and Automated Vehicle Preparedness Roadmap that can be used to guide roll-out of CAV and emerging technology enhancements throughout the state. Pilot projects can be accomplished through the partnership with academia and with stakeholders statewide to cultivate an atmosphere of innovation. Pilot projects, in turn, can provide data analytics and leverage local research to better prepare for statewide integration. As technology and innovation continue to evolve, the framework for innovation will allow the state to continue identification of pilot studies, and key projects that can be established statewide.

Table 21: Innovation

| Innovation | | Goal |
|---|---|---|
| 35 | Convene Innovation Board made up of ALDOT, local agencies, research partners, industry professionals, and private industry. | C, I |
| 36 | Identify and task technology leads to follow national research and opportunities. | I |
| 37 | Prepare Connected and Automated Vehicle Preparedness Roadmap. | I |
| 38 | Integrate academia to stay current with innovation. | C, I |
| 39 | Create an atmosphere to cultivate pilot projects for innovative ideas. | I |
| S=Safety M=Mobility A=Accountability C=Collaboration I=Innovation | | |

# 6 TSMO PROGRAM IMPLEMENTATION

The programmatic recommendations are provided in support of the stated TSMO vision, goals, and objectives. These recommendations have been developed based on consideration of existing program conditions; needs identified and discussed throughout stakeholder engagement (i.e. workshops, interviews, committee meetings, and survey); and professional experience and best practices.

## 6.1 IMPLEMENTATION GUIDE

The Alabama Department of Transportation recognizes the importance and value of implementing a TSMO program and approach to current culture, policies, and practices. ALDOT has invested significant resources in an effort to optimize the movement, management, and motivation of people, goods, and services throughout the State. It is recommended that TSMO programmatic recommendations, described in the previous sections, be implemented in a prioritized, efficient manner.

The following implementation table (Table 22) details the recommended timeframe for implementation of each of the programmatic recommendations. In addition, it is anticipated that this table can be used for frequent reference and aide in the tracking of task status. Implementation recommendations have been made in three horizons: near term, equivalent to fiscal year 2020; short term, equivalent to fiscal years 2021 and 2022; and midterm, equivalent to fiscal years 2023 and 2025. Service layer recommendations will be provided in respective service layer plans.

Table 22: TSMO Program Implementation Plan

| TSMO Program Structure | | | | |
|---|---|---|---|---|
| TSMO Integration | | Near Term (FY20) | Short Term (FY21-22) | Mid Term (FY23-25) |
| 1 | Encourage Statewide TSMO representative participation in existing management, operations, and maintenance considerations; including budgeting and ways and means committee meetings. | | | |
| 2 | Revise Guide for Development of Construction Plans (GDCP) to include Regional TSMO Engineer at preliminary project scoping meetings and throughout project planning, design, and construction. | | | |
| 3 | Integrate TSMO into Statewide Transportation Improvement Program (STIP) planning procedures and processes. | | | |
| 4 | Encourage Metropolitan Planning Organizations (MPOs), Rural Planning Organizations (RPOs), local jurisdictions or municipalities, private businesses, or other stakeholders to incorporate TSMO into their planning processes. | | | |
| 5 | Present TSMO related topics at ALDOT and professional organizational conferences, including non-TSMO focused meetings such as maintenance, design, and construction meetings and summits as well as presentations to elected officials the state legislature to foster their support and understanding of TSMO and its benefits. | | | |

| Leadership and Organization | | Near Term (FY20) | Short Term (FY21-22) | Mid Term (FY23-24) |
|---|---|---|---|---|
| 6 | Reorganize Statewide work chart structure to increase the opportunity for TSMO collaboration by the Statewide TSMO Engineer and supporting organizational structure. | | | |
| 7 | Develop and implement a reoccurring TSMO training program. Topics to include: signal timing, signal hardware, performance management, incident management, work zone management, evacuation management, and others as required. | | | |
| 8 | Encourage technical staff retention: Clearly define roles and responsibilities; Identify and create job titles with appropriate knowledge, skills, and ability; Provide pay to commensurate with knowledge, skills, and ability. | | | |
| - | Clearly define roles and responsibilities. | | | |
| - | Identify and create job titles with appropriate knowledge, skills, and ability. | | | |
| - | Provide pay to commensurate with knowledge, skills, and ability. | | | |
| 9 | Cross-train critical positions to better secure knowledge and functionality for staff changes. | | | |
| **Program Support** | | **Near Term (FY20)** | **Short Term (FY21-22)** | **Mid Term (FY23-24)** |
| 10 | Allocate dedicated funding source to support TSMO program development and needs. | | | |
| 11 | Define and seek all available funding sources (i.e. state, federal, grants, private partnerships, etc.) and general processes to help staff implement TSMO projects. | | | |
| 12 | Encourage statewide and regional leadership support through involvement. | | | |
| 13 | Facilitate annual TSMO Summit to include: TSMO program update; project highlights; technology insight; and lessons learned. | | | |
| **TSMO Programmatic Processes** | | | | |
| **Project Development** | | **Near Term (FY20)** | **Short Term (FY21-22)** | **Mid Term (FY23-24)** |
| 14 | Engage other departments, regional staff, MPO, RPO, and local agencies in TSMO project development. | | | |
| 15 | Utilize Statewide Deployment Guidelines. | | | |
| 16 | Develop and implement an annual data resource cycle update to include: National Performance Management Research Data Set (NPMRDS); AADT; TADT; crash; and event centers. | | | |

| Project Evaluation | | Near Term (FY20) | Short Term (FY21-22) | Mid Term (FY23-24) |
|---|---|---|---|---|
| 17 | Develop TSMO project application. | | | |
| 18 | Implement an annual TSMO project application cycle. | | | |
| 19 | Implement the TSMO Evaluation Process. | | | |
| 20 | Provide TSMO project application and evaluation process training. | | | |
| **Systems Engineering** | | **Near Term (FY20)** | **Short Term (FY21-22)** | **Mid Term (FY23-24)** |
| 21 | Update ITS Architecture with current software ARC-IT, RAD-IT, and SET-IT. | | | |
| 22 | Develop and implement Statewide Configuration Management Plan. | | | |
| 23 | Develop and implement Statewide Asset Management Plan. | | | |
| 24 | Provide TSMO deployment systems engineering guidance. | | | |
| - | Existing System Deployment Process. | | | |
| - | Existing System Deployment Modification Process. | | | |
| - | New System Deployment Process. | | | |
| **TSMO Program Success** | | | | |
| **Culture of Collaboration** | | **Near Term (FY20)** | **Short Term (FY21-22)** | **Mid Term (FY23-24)** |
| 25 | Continue quarterly TSMO Leaders Workshops. Rotate stakeholder invitees from other ALDOT Departments. | | | |
| 26 | Develop an ALDOT TSMO Website with: TSMO overview, educational materials (brochures, service layer plans, presentation materials), program overview, key performance measures, key contacts, roles and responsibilities, resources, etc. | | | |
| 27 | Complete basic CMM assessment on an annual cycle. Develop an action plan to address the most critical needs on a biennial basis. | | | |
| **Performance Measurement** | | **Near Term (FY20)** | **Short Term (FY21-22)** | **Mid Term (FY23-24)** |
| 28 | Develop performance measurement goals and resources to facilitate optimization systems and processes (mobility, safety, reliability, incident response). | | | |
| 29 | Develop regional performance measurement goals within each region. | | | |
| 30 | Integrate performance measurement considerations into standard development, management, and operating practices. | | | |
| 31 | Review data practices annually for enhancement, quality improvements, and efficiencies. | | | |

| | | | | |
|---|---|---|---|---|
| 32 | Develop simplified benefits analysis resources. | | | |
| 33 | Develop simplified sustainability analysis resources. | | | |
| 34 | Demonstrate program success through an annual report providing status related to program maturity, performance measures, benefits and sustainability analysis, etc. | | | |
| Innovation | | Near Term (FY20) | Short Term (FY21-22) | Mid Term (FY23-24) |
| 35 | Convene Innovation Board made up of ALDOT, local agencies, research partners, industry professionals, and private industry. | | | |
| 36 | Identify and task technology leads to follow national research and opportunities. | | | |
| 37 | Prepare Connected and Automated Vehicle Preparedness Roadmap. | | | |
| 38 | Integrate academia to stay current with innovation. | | | |
| 39 | Create an atmosphere to cultivate pilot projects for innovative ideas. | | | |

## 6.2 PROGRAM CYCLE

The annual TSMO Program Cycle is shown on the following page in Figure 10. The programming cycle is primarily centered around the budgeting cycle and it is critical that the project development cycle occur prior to this time. The Project Development Cycle runs concurrently with the overall Program Cycle, with annual resource updates (data/mapping), project development, and project evaluation/prioritization setting the stage for Project Deployment, including implementation along with baseline and post-implementation performance measurements. It is recommended that the Innovation Board has two primary meetings in Q1 and Q3, while the TSMO Leaders hold a workshop quarterly. It is anticipated that the programming cycle will need to be considered after the first year to assess and modify as necessary to best accomplish the goals and objectives of the program.

In addition to the near-, short-, and mid-term recommendations provided in the table above, it is recommended that ALDOT coordinate with its MPO and RPO partners to integrate TSMO strategies into current planning practices to further support TSMO solutions. This coordination includes identifying the MPOs' and RPOs' approach and schedule for regional transportation planning, which is largely outlined by FHWA via MAP-21 and the FAST Act, and determining how to best integrate the proposed TSMO development cycle into this framework.

At a high-level, this integration may involve each ALDOT TSMO region moving through the TSMO development cycle as recommended by the ALDOT Statewide TSMO Master Plan to align with ALDOT budgeting cycles and then partnering with their MPO/RPO counterparts during the MPOs'/RPOs' call-for-projects. This partnership may not occur in direct alignment with ALDOT budget process as various organizations have different fiscal calendar years, which should be taken into account on a region-by region basis. Based on regional MPO/RPO partnerships, these project lists and implementation strategies will be regional project lists and carried out according to the development cycle proposed by the ALDOT Statewide TSMO Master Plan, where reasonably practicable.

Beyond regional implementation strategies, programs and projects will arise that will involve a more statewide approach. Implementation of these projects should be integrated with the Statewide Transportation Improvement Program (STIP). This approach should occur in what is commonly referred to as a "Minor Update" and a "Major Update" cycle. For the Major Update project cycle, the regions will coordinate at a statewide-level to identify which of their projects requires statewide programming during the course of the next five years, which will be added to a Statewide TSMO project list. These projects will advance as feasible during this five-year timeframe. This coordination will occur every five years for the Major Update cycle, where the next five years of projects are built into a statewide implementation strategy. Every year during this five-year period, the regions will determine if there is a need to reprioritize or revise the five-year project list based on a change of needs, demands, funding, etc. This process is considered a Minor Update cycle as it does not involve the build-out of a new five-year project list. The annual TSMO Program Cycle is shown on the following page in Figure 12.

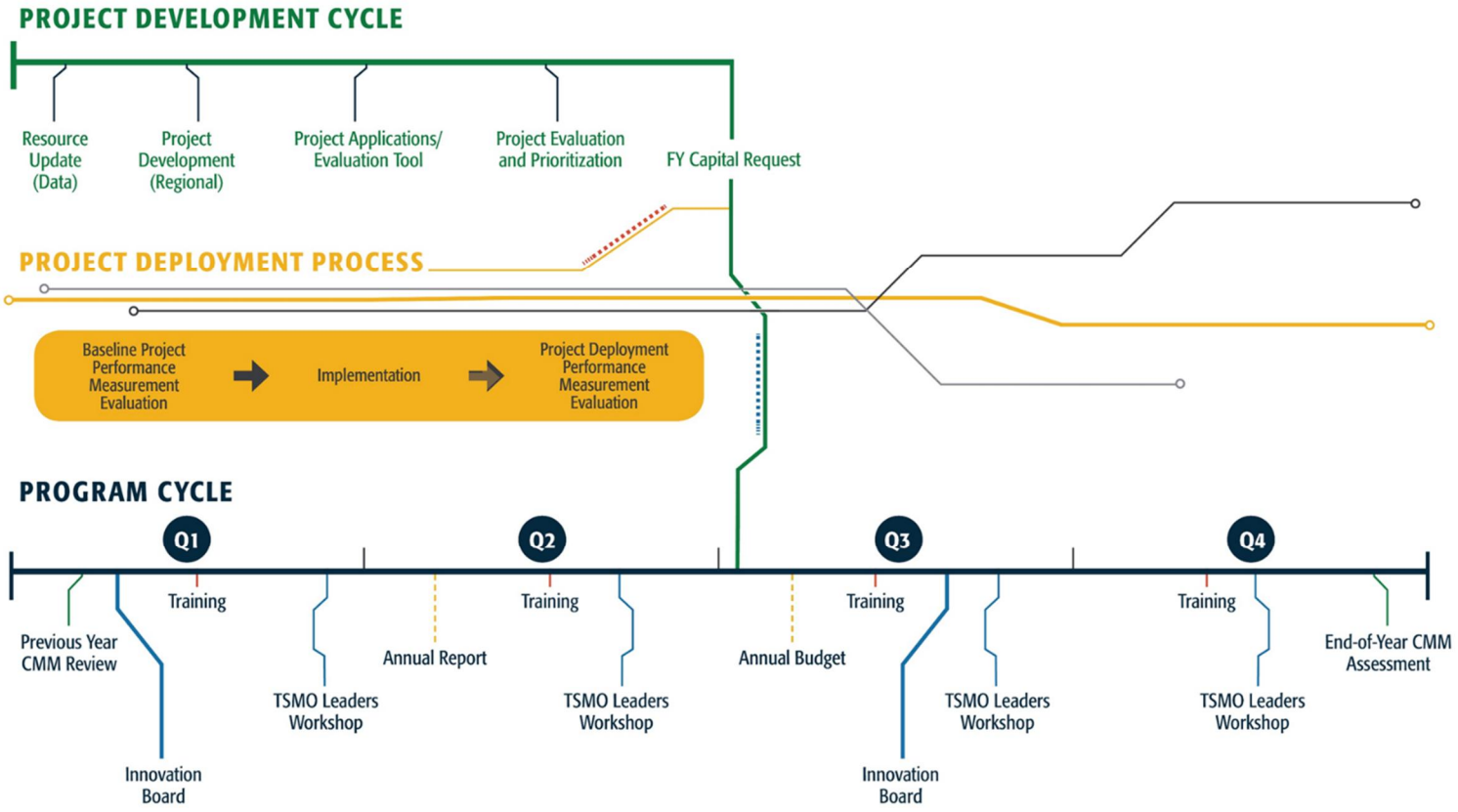



Figure 12: TSMO Program Cycle

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