NDOT STATEWIDE TSMO PROGRAM

NDOT TSMO IMPLEMENTATION

STAFFING AND WORKFORCE DEVELOPMENT PLAN

NEVADA DEPARTMENT OF TRANSPORTATION

FEBRUARY 2023

ATKINS
Member of the SNC-Lavalin Group

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CONTENTS

FIGURES

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ACRONYMS

AASHTO	American Association of State Highway and Transportation Officials
ADOT	Arizona Department of Transportation
AI	Artificial Intelligence
ASU	Arizona State University
Caltrans	California Department of Transportation
CAV	Connected and Automated Vehicle
CDOT	Colorado Department of Transportation
CDP	Core Development Program
CITE	Consortium for Innovative Transportation Education
CMM	Capability Maturity Model
DOD	Department of Defense
DOT	Department of Transportation
EEO	Equal Employment Opportunity
EITS	Enterprise Information Technology Services
ELT	Executive Leadership Team
FDOT	Florida Department of Transportation
FHWA	Federal Highway Administration
GDOT	Georgia Department of Transportation
GIS	Geographic Information System
HR	Human Resources
IPT	Investment Prioritization Tool
ITE	Institute of Transportation Engineers
ITP	Inspection and Test Plan
ITS	Intelligent Transportation Systems
KSA	Knowledge, Skills, and Abilities
LaDOT	Louisiana Department of Transportation and Development
MDOT SHA	Maryland Department of Transportation State Highway Administration
MPO	Metropolitan Planning Organization
NAU	Northern Arizona University
NCHRP	National Cooperative Highway Research Program
NDOT	Nevada Department of Transportation
NHDOT	New Hampshire Department of Transportation
NJDOT	New Jersey Department of Transportation
NOCoE	National Operations Center of Excellence
ODOT	Ohio Department of Transportation
SHRP2	Strategic Highway Research Program 2
SMART	Specific, Measurable, Achievable, Relevant, Time-Bound
SME	Subject Matter Expert
SLATE	Signal, Lighting, and Technical Electrical program
TIM	Traffic Incident Management
TMC	Traffic Management Center
TNDOT	Tennessee Department of Transportation
TRB	Transportation Research Board
TRC	Transportation Research Center
TSC	TSMO Steering Committee
TSMO	Transportation Systems Management and Operations
TxDOT	Texas Department of Transportation
UDOT	Utah Department of Transportation
UNLV	University of Nevada-Las Vegas
UNR	University of Nevada-Reno
USDOT	United States Department of Transportation
VTrans	Vermont Agency of Transportation
VDOT	Virginia Department of Transportation
WSDOT	Washington State Department of Transportation

EXECUTIVE SUMMARY

Transportation Systems Management and Operations (TSMO) strategies have been highly beneficial in enhancing the performance of existing transportation networks. In recent years, several state organizations and agencies incorporated the TSMO Program within their business practices. As agencies and organizations adopt the program, the need to develop and grow the TSMO workforce has become urgent.

In January 2020, the Nevada Department of Transportation (NDOT) formally adopted the Statewide TSMO Program. NDOT identified the TSMO Staffing and Workforce Development Plan as an action item to help implement an integrated TSMO Program. To provide guidelines for this plan, this document examines current TSMO practices adopted by state transportation agencies around the nation, discusses NDOT's existing staffing and workforce capabilities, and provides recommendations for recruiting, training, and retaining the TSMO-specific team members at NDOT.

This document provides an overview of the current TSMO practices employed by several state organizations in the U.S. and discusses their key outcomes and challenges. Based on the experiences and lessons learned for each organization, several takeaways are provided that could be applicable for NDOT.

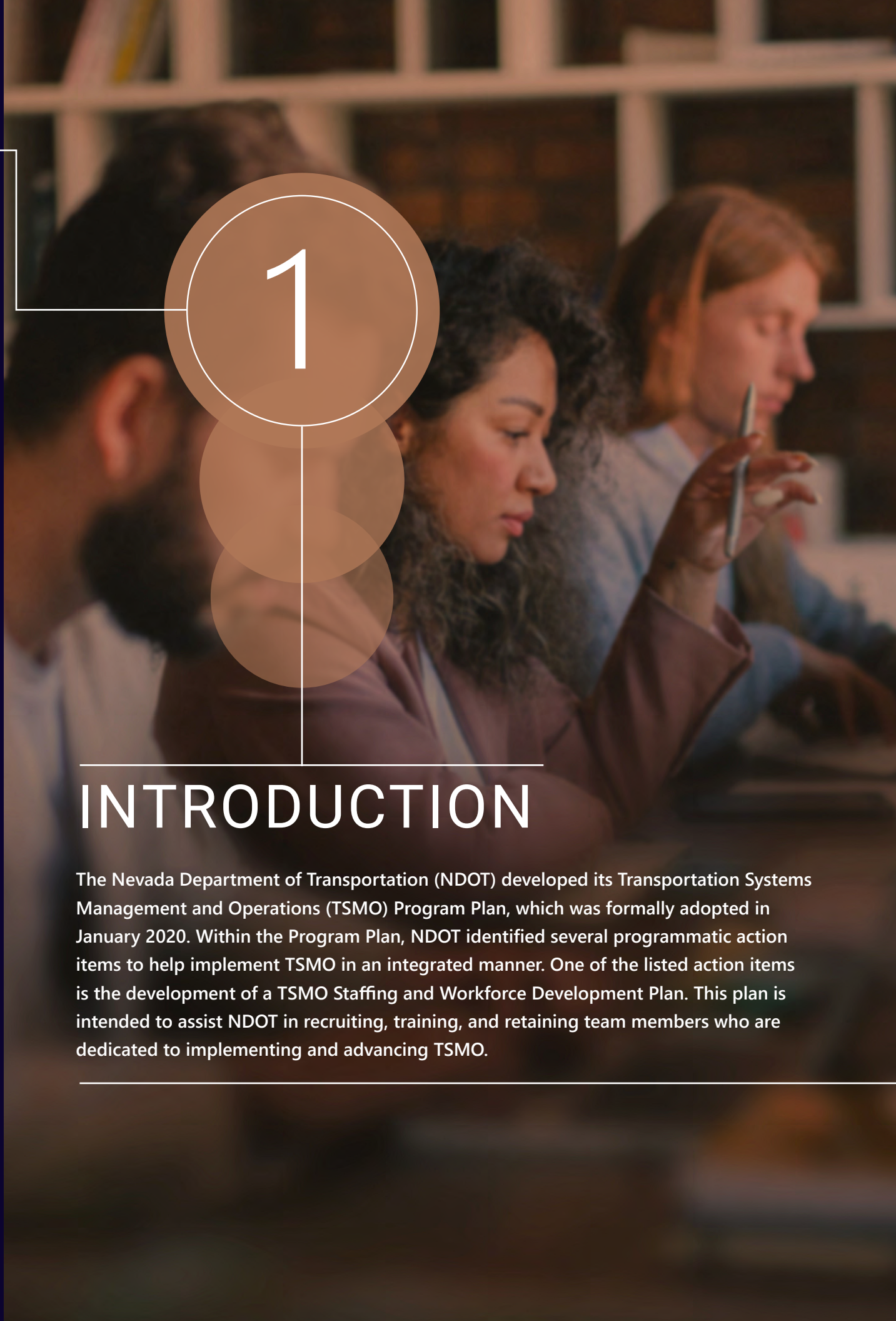
Hiring new TSMO positions is critical in developing and building a TSMO team within an agency. Section 4 of this document outlines recommendations and suggestions for the TSMO workforce recruitment process based on research findings and a series of stakeholder interviews by the National Cooperative Highway Research Program (NCHRP). Derived from these findings, a formal recruitment plan is proposed, which also includes guidelines on when and where to recruit, coordination with the human resources (HR) department for the screening and interview process, and incentive offerings. In addition, NDOT has identified five new positions that are in the process of being added to the Traffic Operations Division's organizational structure. Further analysis is performed in this document to establish better insight into how these positions will assist NDOT in targeting specific Capability Maturity Model (CMM) dimensions to advance the TSMO Program.

In order to fully leverage the benefits of the TSMO Program, employees need to be properly educated and trained. Section 5 summarizes the available TSMO education and training programs in different organizations as well as training programs and methodologies adopted by other state transportation agencies. Drawing from the findings, the NDOT TSMO training program was developed under the two main categories of basic training for new hires and current members, as well as advanced training for current team members.

Retaining a trained workforce is a critical component to continued success and growth for the TSMO Program. The retention plan should address job responsibilities, define how each position supports the agency's mission, identify training and professional development opportunities, define compensation packages and benefits, and allow flexible work conditions. Section 6 establishes a plan for retaining the TSMO workforce based on relevant findings from the research. The suggestions are divided into three categories of training, HR, and culture.

To support and advance TSMO integration, local universities and agencies can collaborate to educate, develop, and train the TSMO workforce. Section 7 discusses the observed overlaps between courses/research in local universities in Nevada and TSMO practices put forth by the federal government. Then, several approaches, such as revised course content, mentorship/internship programs, and innovative career fairs, are proposed to facilitate the partnership between universities and state transportation agencies.

Section 8 summarizes the recruitment, training, retention, and educational plans recommended for NDOT Traffic Operations Division. Priority levels, including short- (2023-2024), mid- (2024-2025), and long-term (2025-2026) time frames, are assigned to each recommendation to assist NDOT in planning and implementing the next steps.



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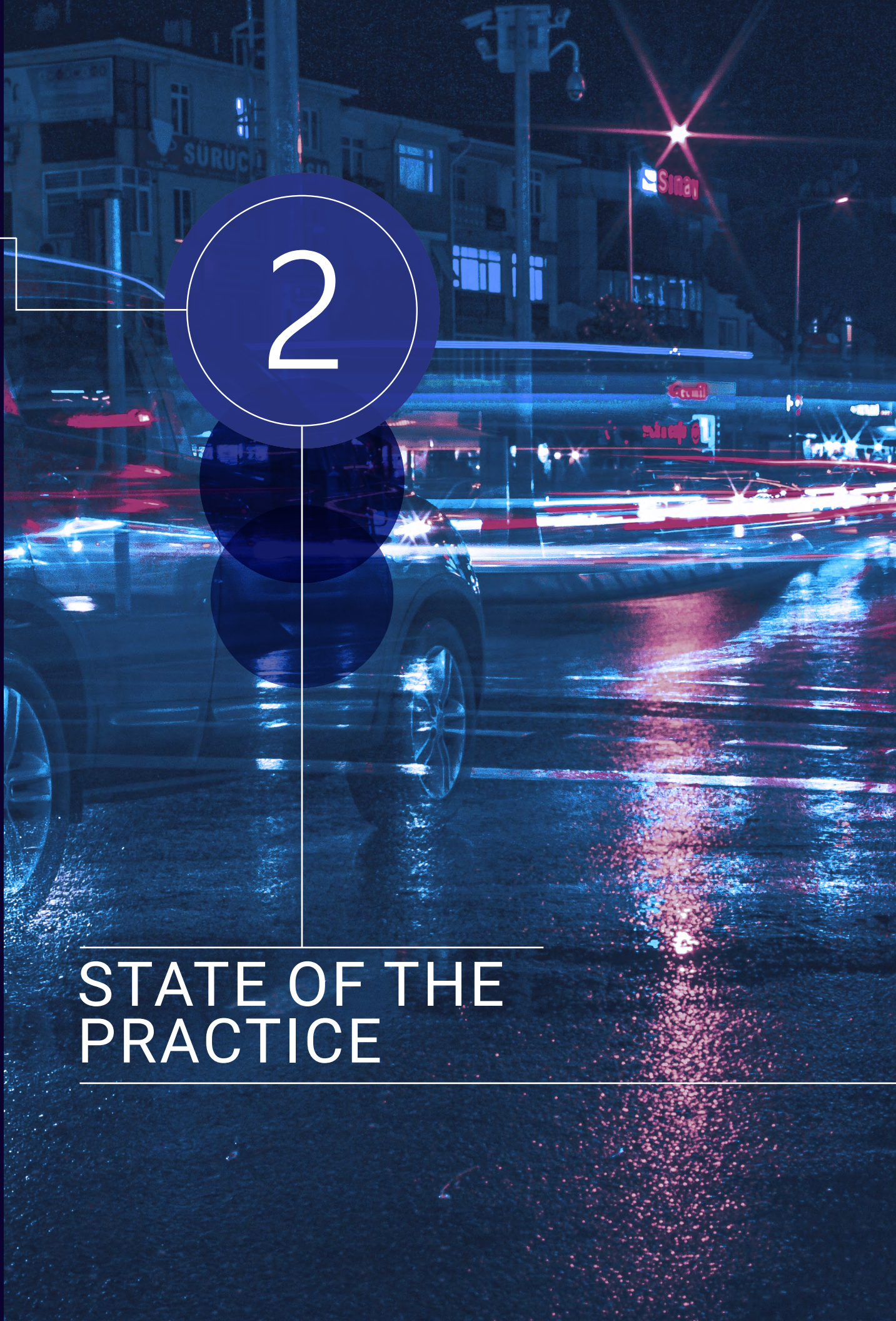
INTRODUCTION

The Nevada Department of Transportation (NDOT) developed its Transportation Systems Management and Operations (TSMO) Program Plan, which was formally adopted in January 2020. Within the Program Plan, NDOT identified several programmatic action items to help implement TSMO in an integrated manner. One of the listed action items is the development of a TSMO Staffing and Workforce Development Plan. This plan is intended to assist NDOT in recruiting, training, and retaining team members who are dedicated to implementing and advancing TSMO.



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STATE OF THE PRACTICE

TSMO is a relatively new concept in the transportation industry. Federal-level agencies established several practices that can be adopted by state agencies to initiate TSMO within the state. Following these guidelines, several state departments of transportation incorporated TSMO within their business areas and observed different key outcomes. TSMO is an expansive area that can bring different types of benefits to an organization. During initial implementation of TSMO strategies, agencies encounter many challenges. These challenges result in valuable lessons learned that assist the team members to train and learn for the next phase. As TSMO is initiated within a state and employees are trained to successfully implement TSMO strategies, the result will be a better product at an economical price. The following sections describe TSMO practices adopted by various state organizations within recent years, their key outcomes, and how they could be applied to NDOT.

2.1 ARIZONA DEPARTMENT OF TRANSPORTATION

2.1.1 DESCRIPTION

The TSMO Program of the Arizona Department of Transportation (ADOT) is considered one of the essential contributors to infrastructure development within the state. Prior to creation of the TSMO division at ADOT, each division within the agency—Intelligent Transportation Systems (ITS), Traffic Signal, Roadways, and others—supported its own group of trained professionals who also were trained for maintenance requirements of their relevant areas.

When the TSMO division was formed in 2015, it merged employees from different independent teams into one group, which resulted in high staff turnover. Figure 1 shows the breakdown of the TSMO division within ADOT.

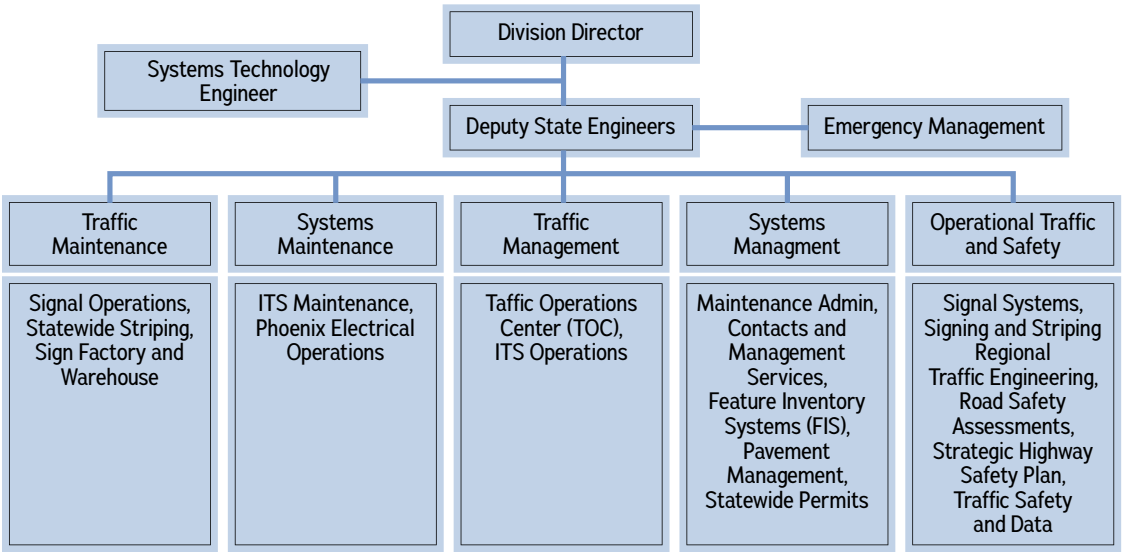


FIGURE 1: ADOT TSMO DIVISION

Observing the workflow of this unit, it was determined that TSMO maintenance positions were more technical, resulting in staff encountering lack of cross training and needing accurate directions. Considering the lack of cross training together with high staff turnover, ADOT was not able to satisfy its workforce, which in turn resulted in many employees leaving.

To address this challenge, ADOT developed the SLATE training program (Signal, Lighting, and Technical Electrical program) as a way to train, maintain, and retain TSMO technical staff. The SLATE program was created to train both junior- and senior-level employees in the TSMO division. New positions were developed in the TSMO division based on Knowledge, Skills, and Abilities (KSA). TSMO maintenance staff were transferred to a new common position called SLATE Technician. Moving forward, each technician was on a path to complete training in five tiers, advancing to higher levels—SLATE Technician I, II, III, Supervisor, and Manager.

SLATE was formulated to provide promotional advances to employees as they completed various levels of training. Because of this specialized training, ADOT was able to provide justification for its TSMO division and employees as well as prove the impact this division can have if TSMO strategies are executed by specially trained and retained professionals.

Along with reorganizing the structure of the SLATE program, ADOT also recognized the need to develop a TSMO program plan that would serve as a guide to division officials about various aspects of TSMO implementation. ADOT's TSMO Program Plan also defines benefits associated with Traffic Operations, Incident Management, Maintenance, Data and Performance Management, and more. It highlights some of the organizing and staffing practices adopted by various other states—for example, the California Department of Transportation (Caltrans) connected corridors and the Colorado Department of Transportation (CDOT) staff realignment. This plan, along with emphasizing TSMO objectives and initiatives, also highlights staff development within the agency, modifying and creating positions and roles to meet specific TSMO needs.

Staffing and organizing is one of several key elements included in ADOT's TSMO Program Plan through which they identify and apply different strategies to build their team and incorporate more positions.

2.1.2 KEY OUTCOMES

The following points highlight the major events regarding staffing and workforce in ADOT's TSMO Program Plan 2017 and its SLATE program:

- Led by the TSMO Director, the plan and SLATE helped create, modify, and organize TSMO team roles and responsibilities.
- ADOT/Arizona State University (ASU)/Northern Arizona University (NAU) partnerships have provided the department with additional resources, staff, knowledge, improved efficiencies, and helped it stay on track with improved research and innovation.
- The TSMO Plan helped define a list of ADOT strategies, including (1) prepare maintenance training, (2) establish manager positions, (3) formalize maintenance career paths, (4) establish the asset management program, (5) develop a five-year TSMO business plan to identify projects and opportunities, and (6) establish a TSMO project development engineer position and a TSMO policy and research coordinator position.
- With the new TSMO division and SLATE program, ADOT administration increased employee compensation, which allowed them to train and retain their high performers who continue to innovate and improve the system. The increase in the employees' compensation was granted administratively based on the new structure, and with the increase in specialized training, ADOT was able to justify higher pay for staff retention and staff attraction.

- The SLATE program was directed not only toward providing traditional classroom training, but employees are required to assess and train themselves on-site working with practical strategic applications.

2.1.3 LESSONS LEARNED

ADOT has identified some challenges pertaining to staffing within the agency. These include:

- With the full-time employee cap within the agency, ADOT needs to define and propose to senior management a strong case for adding new TSMO positions into the system.
- ADOT must update existing policies/processes that the staff uses regularly and change those policies/processes which are not frequently used. These changes in policies or processes will ensure that ADOT staff work with the latest standards.
- Prior to the SLATE program, ADOT was not compensating its TSMO division employees for their role transitions. This was later reviewed by administrative officials when the division was able to retain, maintain, and train the employees under the SLATE program.
- Prior to SLATE, lack of cross training resulted in employees working only in their specialized field—ITS staff worked only on ITS features, traffic signal staff focused only on signals. This created silos within the newly formed division, with employees not coordinating and assisting each other.[1]

2.1.4 APPLICATION TO NDOT

The following are key takeaways for NDOT's application of the lessons learned:

- Implement advanced practitioner cross-training and a new hires rotational program across all divisions
- Establish TSMO positions and define career paths
- Update existing staffing policies and procedures to ensure the latest standards are utilized

2.2 MARYLAND DOT STATE HIGHWAY ADMINISTRATION—ORGANIZATIONAL MODERNIZATION TO ADVANCE TSMO

2.2.1 DESCRIPTION

Over the past three years, the Maryland Department of Transportation State Highway Administration (MDOT SHA) has invested significant time and resources introducing TSMO planning, deployment, and workforce development activities within the agency to address rapidly growing demands and customer needs, which has led to providing strategic solutions. As seen in Figure 2, MDOT SHA divided its TSMO workforce into three separate divisions: the executive committee, the TSMO Working Group and Task Forces, and TSMO Implementation Teams, as described in more detail in the following sections.

1 *(Transportation Systems Management and Operations (TSM&O) Plan, 2017)*
(Maintenance Staff Training: Increasing Internal TSMO Knowledge, 2019)

1. **Executive Committee:** Serves as the head of the TSMO Task Force within the organization, performing responsibilities such as decision making, policy formation, resource coordination, TSMO program direction, etc. The TSMO project manager position within this committee is responsible for coordinating, collaborating, and communicating with other MDOT SHA districts to deliver TSMO strategies within the state. Based on the requirements, this department adds a new position and description as deemed necessary.

2. **TSMO Working Group and Task Forces:** This group comprises different task forces responsible for implementing and delivering TSMO strategies and actions. Task forces are formed of inter-district, cross disciplinary, multi-office members working toward executing an identified strategy. Certain examples of these task forces include business processes and policy, training and education, systems and technology, connected and automated vehicles, multimodal transportation, freight, etc. The Working Group serves as the interface between the Executive Committee and task forces.

3. **TSMO Implementation Teams:** This level includes staff from all districts and offices in the state who provide support to implement the strategy identified by task forces.

DECISION PARADIGM

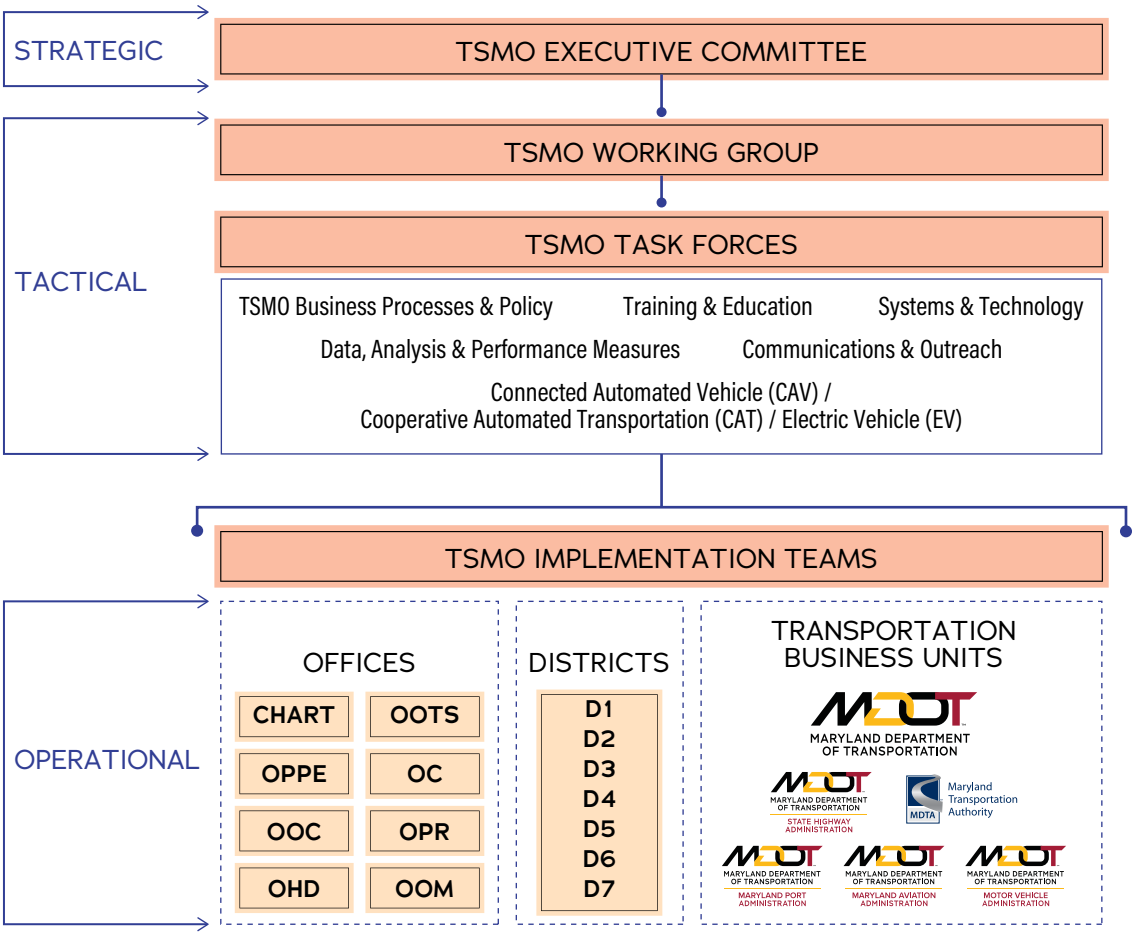


FIGURE 2: MDOT SHA TSMO ORGANIZATIONAL STRUCTURE

To incorporate TSMO strategies within agency culture, MDOT SHA prioritized key operational areas for each district where innovative solutions could be implemented. For instance,

- District 1: Flooding, seasonal travel, work zones
- District 2: Road closures, detours, travel advisory committee, work zone operations
- District 3: Multimodal transportation, safety and mobility, asset management, maintenance, and operations

This resulted in organized workforce allocation on individual assignments across all districts.

2.2.2 KEY OUTCOMES

Over the past four years, MDOT SHA successfully integrated TSMO within the agency and is prioritizing its activities to develop effective strategies with highly trained and retained workforce.

- Across all districts, MDOT SHA developed a workforce that is cross trained and educated.
- The Executive Committee or decision-making body can add a TSMO position by monitoring TSMO team activities and coordinating with department deputy administrators.
- Different task forces allocated on various disciplines results in more strategies being developed that focus on TSMO.

The MDOT SHA Office of Communications has developed a TSMO Communication and Outreach Plan. This plan has four goals: (1) increase TSMO awareness within MDOT SHA, (2) create a culture around TSMO at all levels to implement the TSMO strategic plan, (3) develop outreach strategies to inform internal and external audiences, and (4) create consistent messaging for MDOT SHA's TSMO efforts that are specific for each audience.

2.2.3 LESSONS LEARNED

Consistent efforts made by MDOT SHA to augment TSMO within the state resulted in the following accomplishments:

- Informational TSMO intranet for its employees to store, access, view, and share files
- Creating TSMO educational videos to spread its importance within the agency
- In the process of developing new public website —"TSMO in Maryland"[2]

2 *Maryland State Highway Administration: Organizational Mordernization to Advance TSMO, 2020*

2.2.4 APPLICATION TO NDOT

The following are key takeaways for NDOT's application of the lessons learned:

- Define roles and responsibilities for the TSMO Steering Committee (TSC) members. This will establish a task force or a TSMO working group that will be engaged in implementing and delivering TSMO on a project-basis.
- Define the role of TSMO positions as it relates to communication and collaboration with internal and external stakeholders, as well as the TSC.

2.3 WORKFORCE DEVELOPMENT—OHIO TSMO COORDINATORS

2.3.1 DESCRIPTION

The Ohio Department of Transportation (ODOT) identified the need to embed a TSMO coordinator position for each district to advance TSMO strategies in the state. The TSMO coordinator typically had the responsibility of managing funds, aligning resources, facilitating meetings, defining roles, and coordinating after-action reviews.

Along with this, ODOT aligned its Human Resources (HR) Department with the TSMO division to incorporate TSMO responsibilities into existing roles and develop new TSMO positions per division requirements. It also contributed toward developing the coordinator position along with its responsibilities. Deputy directors and leadership teams had a vital role in formulating the coordinator position.

Some essential duties of TSMO coordinators include:

1. Facilitate TSMO strategy implementation in each district.
2. Report to the Central Office on the effectiveness of the TSMO program.
3. Develop and monitor TSMO annual program action items.
4. Coordinate with district technical, planning, construction, and maintenance staff on TSMO strategies.
5. Coordinate with work zone coordinators.

2.3.2 KEY OUTCOMES

- The ODOT TSMO program resulted in better implementation of strategies due to newly formed coordinator positions.
- The HR department assisted in developing well-defined roles and responsibilities for TSMO coordinators.
- This department transformation change was challenging, but over time it resulted in champions at the executive level directing TSMO programs in the state.

2.3.3 LESSONS LEARNED

- Initially when these coordinator positions were established, most of the individuals transferred from a background with traffic experience but very little exposure to planning. To train these officials on their new TSMO responsibilities, ODOT had to leverage consultant support to provide meaningful studies and analysis.
- TSMO coordinator roles varied depending on the type of district (rural or urban). The more rural districts would have a different focus area and would need to take on more of the responsibilities of implementation, whereas urban coordinators were required to be true facilitators and coordinators.
- Developing the coordinator positions with varying areas of focus helped ODOT in building and strengthening the TSMO unit within the organization from the ground up, which in turn provided successful implementation of their strategies under executive governance.[3]

2.3.4 APPLICATION TO NDOT

The following are key takeaways for NDOT's application of the lessons learned:

- Coordination with HR to advance TSMO culture and mainstream TSMO recruitment.
- Engage Executive Leadership Team (ELT).
- Leverage private industry and consultant support to share resources, staff, and skillset.

2.4 WASHINGTON STATE DEPARTMENT OF TRANSPORTATION—A WORKFORCE SHIFT TOWARD TSMO

2.4.1 DESCRIPTION

The Washington State Department of Transportation (WSDOT) engages in TSMO practices, making it a priority over time to use its influence on various projects. Within a short span of time, senior management observed that employees needed to be trained properly to execute TSMO strategies. Thus, they made extensive efforts to develop new tools, curricula, and courses to support individual growth and build potential within the TSMO department.

WSDOT developed extensive training materials and tools to advance TSMO within its culture. In partnership with Caltrans, the Consortium for Innovative Transportation Education (CITE), and the Federal Highway Administration (FHWA), WSDOT developed eLearning courses for public and private sector practitioners, which are also accessible by anyone in the transportation industry for free. Courses include solving mobility problems, integrating TSMO in the agency, and "TSMO 101: What is this TSMO thing anyway?" Alongside developing courses, they created a new website—TSMOWA.org—focused on providing TSMO solutions to different types of transportation problems. This website provides TSMO education, resources, TSMO solutions, and more, through which newly hired and existing employees can learn. With TSMO being a new element brought into the agency, they are focused on developing and experimenting with new strategies to train their workforce.

3 *Workforce Development OHIO TSMO Coordinators, 2020*

2.4.2 KEY OUTCOMES

- Consistent efforts resulted in increased TSMO capacity within the agency, with partners, and nationwide.
- Trainings, courses, online modules, and other tools resulted in better overall staff understanding of TSMO, which provided the foundation for successfully executing TSMO strategies as planned.
- All the tools are available not only to employees, but also to all those individuals interested in learning and developing TSMO knowledge, skills, and abilities.
- The curriculum WSDOT developed received national interest, enabling the department to receive additional federal funding to continue course development.
- WSDOT continuously updates its TSMO website to include more useful information for an increasing number of users.

2.4.3 LESSONS LEARNED

The WSDOT TSMO Program Plan was accessible to a vast majority of its audience, including partners, employees, and local practitioners. It gave an opportunity to all levels of employees to learn TSMO fundamentals and contribute on real scale projects. Along with various pathways offered for employees to undertake the TSMO learning programs, WSDOT also offered individual development plans, which focused on the goals and objectives of each professional using resources available through the WSDOT and National Operations Center of Excellence (NOCoE) partnership.

With the intent of targeting a large audience to market its TSMO tools, WSDOT adopted strategies such as a statewide TSMO working group, executive endorsement, internal distribution, conferences, in-person training, and newsletters.[4]

2.4.4 APPLICATION TO NDOT

The following are key takeaways for NDOT's application of the lessons learned:

- Development of TSMO training program (including modules, virtual and/or in-person, and practical trainings) for internal and external stakeholders and team members.
- Utilize existing programs from other state departments of transportation (DOT) as well as possibly collaborating with other agencies to share resources.

4 *A Workforce Shift Towards TSMO, 2020*

2.5 FHWA ORGANIZING AND STAFFING FOR TSMO—CASE STUDY 5, 2019

2.5.1 DESCRIPTION

Recognition of the importance of TSMO and the various advantages it can bring encouraged agencies at the federal level to request state departments to include TSMO teams within their organizations and to successfully implement TSMO strategies.

As a new concept being introduced into the state transportation agencies, it became necessary to educate the industry about TSMO for it to be successfully implemented. FHWA, in conformance with the United States DOT (USDOT), prepared 12 case studies for local state organizations to provide guidance concerning TSMO, with some of them also focused on organization structure development to include TSMO roles to improve agency culture. ADOT, Utah DOT (UDOT), New Hampshire DOT (NHDOT), and Vermont Agency of Transportation (VTrans) were interviewed to record their experiences with TSMO team development within their states.

FHWA, along with the American Association of State Highway and Transportation Officials (AASHTO) and the Transportation Research Board (TRB), prepared a self-assessment framework through the Strategic Highway Research Program 2 (SHRP2) for agencies to identify their current level of processes and self-assess their implementation of TSMO. This Capability Maturity Model (CMM) can be used to analyze six dimensions of operations: business processes, systems and technology, performance management, culture, organization and workforce, and collaboration. Figure 3 highlights the four levels of maturity (performed, managed, integrated, and optimized) through which an agency would progress in pursuit of TSMO implementation.

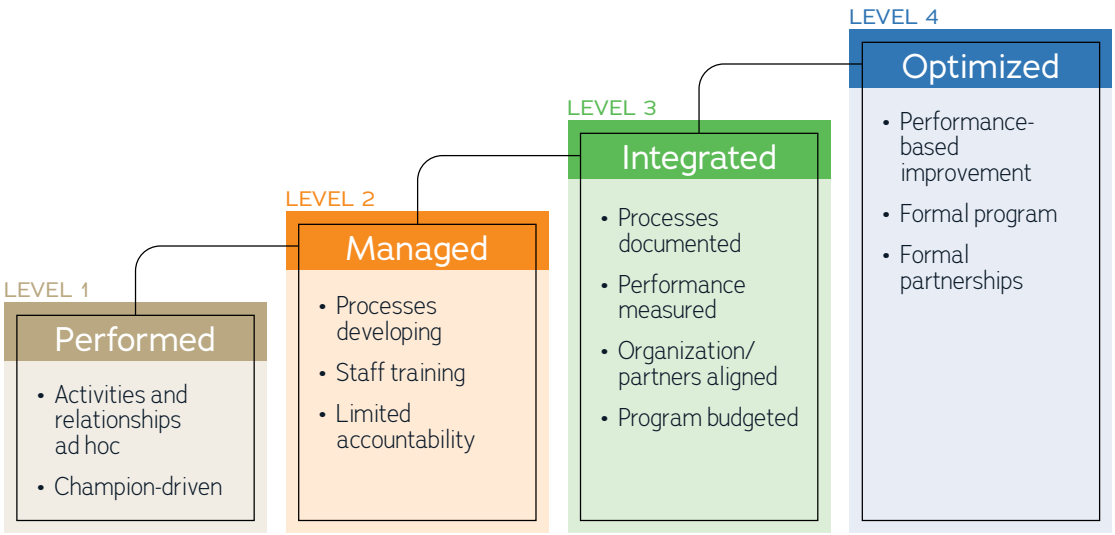


FIGURE 3: FOUR LEVELS OF MATURITY

Organizing and staffing was identified to be an important element to successfully implement the TSMO mission during interviews conducted across different agencies. Changing organization structure also requires complete support and coordination from senior-level executives, which in turn promotes strategic goal setting for TSMO objectives. Depending on the state transportation agency's vision and mission, TSMO structure will vary. Agencies evaluate each possible structure and ultimately decide the best match to align with their goals.

This case study document highlighted two organization structures that can be evaluated by agencies:

1. Functional Organization
    - Divided into several subunits based on task or expertise.
    - Operates in a vertical hierarchy—members of each subunit report to a manager who reports up through the chain until the executive level is reached (see Figure 4).
2. Matrix Organization
    - Operates both vertically and horizontally (see Figure 5).
    - This organizational structure usually is temporary and pertains to a specific project or task.

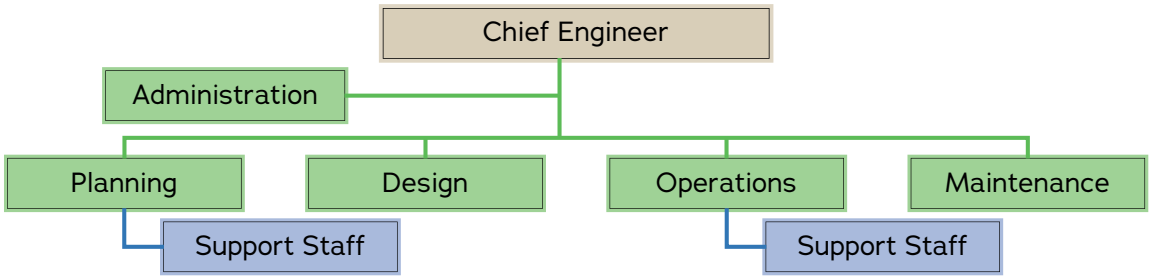


FIGURE 4: FUNCTIONAL ORGANIZATION STRUCTURE

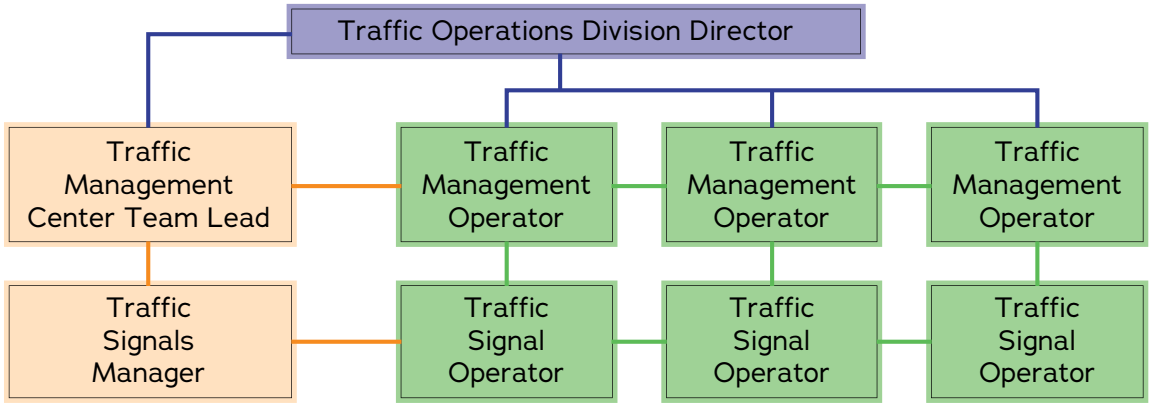


FIGURE 5: MATRIX ORGANIZATION STRUCTURE

2.5.2 KEY OUTCOMES

Agencies, including but not limited to ADOT, UDOT, NHDOT, and VTrans, used these case studies prepared by FHWA to restructure and include a TSMO division within their organizations.

1. NHDOT is composed of five divisions with a total of 18 bureaus. It incorporated a new Bureau of TSMO within the division of operations that is responsible for maintenance of state highways, bridges, and the turnpike system. NHDOT's Traffic Management Center (TMC), which was a part of the Bureau of Traffic for years, was transferred to the newly formed Bureau of TSMO to support its objectives and strategies. During restructuring, NHDOT changed from an engineering series to a supervisor series.

    - NHDOT's Bureau of TSMO is divided into three parts: TMC Dispatch Operations, Administration, and Operations/Maintenance. While restructuring the TMC team, NHDOT also included IT support staff and TSMO technician positions to support TSMO activities. Figure 6 shows NHDOT's current Bureau of TSMO.

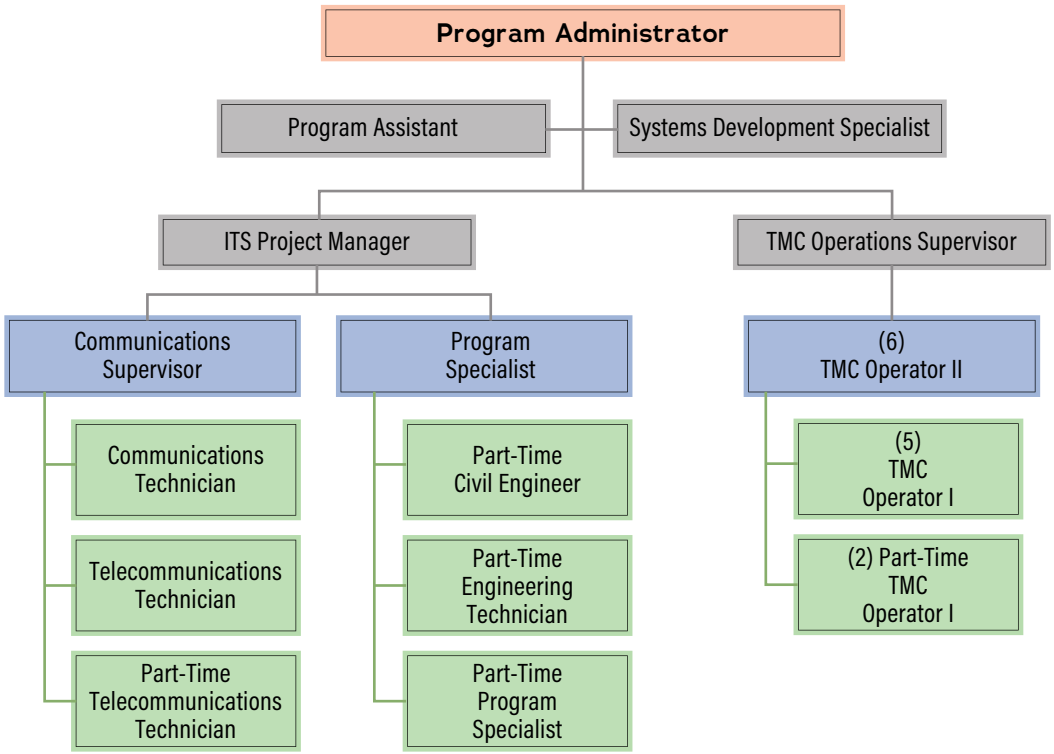


FIGURE 6: NHDOT'S BUREAU OF TSMO

- Efforts are being made to update TMC training to align with TSMO strategic goals and objectives. These efforts involve updating TMC standard operating procedures and developing TMC operator training and weather situational awareness training.
- The Bureau of TSMO, through its TSMO Strategic Plan, made sure that this department would fulfil the needs of existing TMC staff and the agency. Coordination between TMC operators and TSMO leaders filled in the gap of new staff requirements and provided funding justification. This coordination was noted to be a critical element resulting in the Bureau's success.

2. While working to accommodate a TSMO division within its culture, VTrans observed several key TSMO positions being distributed within the existing structure. The TSMO division was formed under the Maintenance and Operations Department within the Bureau of Highway. Based on resource availability, VTrans plans to complete alignment of its TSMO structure in nine different phases. Currently, the division structure is at Phase 4, as shown in Figure 7, below.

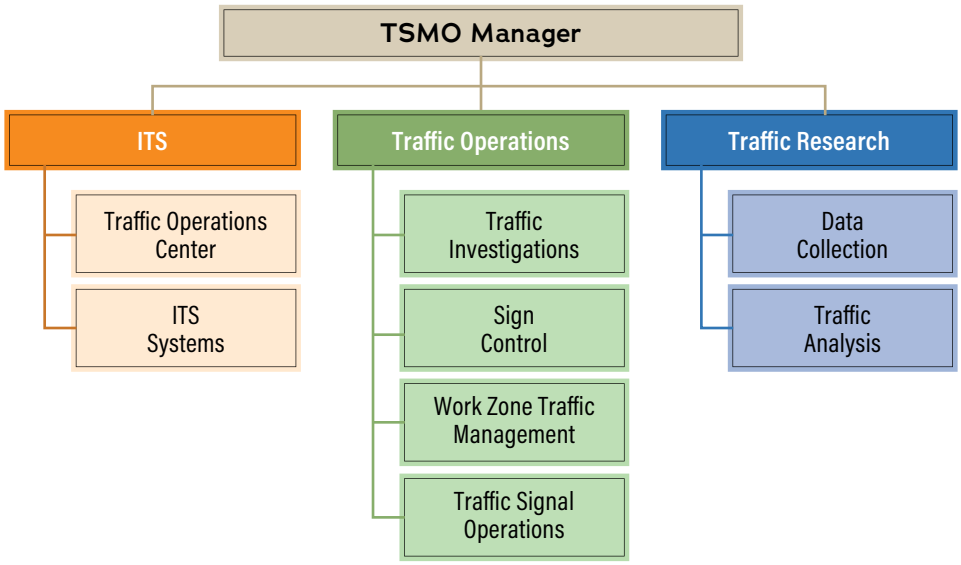


FIGURE 7: PHASE 4 OF VTRANS TSMO ORGANIZATIONAL STRUCTURE

- As seen in Figure 7 the agency combined traffic operations, ITS, and traffic research to become the TSMO division. This allowed VTrans to align various traffic duties per TSMO goals and objectives. After the traffic signal operations group was formed in the TSMO division, the team diligently developed traffic signal plans to outline maintenance, management, and operations of traffic signals. Recognizing these efforts by the TSMO division and the associated benefits, VTrans approved additional staff for the traffic signal operations group. This TSMO group later recruited an electrical engineer to support technology-based assets.
- Currently, the agency is focused on developing careers in TSMO for its existing employees and creating new positions. It is focused on hiring from within the agency for the TSMO division and also recruiting new entry-level staff to gain TSMO understanding. The focus is to hire and train new staff, who then can assist senior-level employees in the future. Given the importance of planning for TSMO strategies, VTrans plans to deploy an operating Traffic Operations Center.

2.5.3 LESSONS LEARNED

- NHDOT hired an IT specialist as a part of its TMC division to manage traffic assets, along with other networks and hardware.
- It is important to develop TSMO training material for existing and newly hired staff to educate them about TSMO strategies and its impacts on infrastructure.

- VTrans identified several key responsibilities already present in some of its job roles, which it extracted to form a TSMO division.
- VTrans plans to cross train its maintenance employees so that the duties can be carried out efficiently. Cross training its employees will allow the agency to shuffle its employees for maintenance duties and at the same time focus on TSMO strategies.
- Benefit/cost analysis is a tool that most agencies use to identify staff resources and justify the requirements to the executive level.[5]

2.5.4 APPLICATION TO NDOT

The following are key takeaways for NDOT's application of the lessons learned:

- Utilize the benefit/cost analysis to identify required resources and develop the business case for ELT.
- Include specific technical roles and responsibilities in the TSMO positions' descriptions.

2.6 NCHRP—TSMO WORKFORCE GUIDEBOOK

2.6.1 DESCRIPTION

In order to maximize transportation systems' capacity, safety, and reliability through TSMO strategies, a workforce that meets the emerging needs is inevitable. A robust TSMO program requires new positions with expertise in a wide range of technologies, applications, and analysis, as well as innovative approaches to attract and manage the TSMO workforce. Agencies must identify these needs via strategic and programmatic TSMO planning and an understanding of their current TSMO maturity level.

NCHRP TSMO Workforce Guidebook takes a comprehensive look at the emerging professional and management level positions required to promote a strategic shift from merely building capacity to maximizing the return on investment of agencies. Based on the literature review and stakeholder interviews, 19 TSMO-related positions and their descriptions were developed as part of this Guidebook. KSAs were defined for all positions to assist practitioners in understanding what is required to attract and retain TSMO positions. The Guidebook also provided insights on when and where transportation organizations need to add these emerging positions and how each position can contribute to TSMO maturity and capability advancement.

This report is intended to help TSMO workforce education, training, recruitment, retention, and development. In this Guidebook, DOTs at the state and local levels, as well as other public and private organizations (e.g., toll authorities, Metropolitan Planning Organizations (MPOs), and consulting firms), will find recommendations on how to address changing workforce needs in terms of new positions, organizational changes necessary to satisfy the evolving TSMO workforce, and opportunities to integrate new capabilities throughout the agency.

5 *Case Study 5: Organization and Staffing - Organizing for TSMO, 2019*

2.6.2 KEY OUTCOMES

- This Guidebook identified the following 19 emerging professional-level positions:
  - Traffic Data Scientist/Statistician
  - TSMO Manager/Chief/Bureau Director
  - TSMO Program Manager
  - Computer Engineer
  - Artificial Intelligence Scientist
  - Telecommunications Engineer
  - Data Management Specialist
  - Visualization Specialist
  - Connected and Automated Vehicles (CAV) Program Manager
  - Traffic Incident Management (TIM) Program Manager
  - Cyber Security Engineer
  - Transportation Data Ethicist
  - Surface Weather Specialist
  - Systems Engineer
  - TSMO Modeling Specialist
  - Emerging Technologies Industry Liaison
  - Transportation Systems Performance Manager
  - Integrated Corridor Management Manager
  - Transportation Management Center Manager
- The new positions within TSMO will help move transportation agencies toward innovation and adaptability and provide them with the opportunity to develop successful and effective TSMO programs.
- The new TSMO workforce positions will evolve current positions and attract talented employees from non-traditional sources to suffuse technology and data-savvy personnel into the transportation industry.
- The defined KSA for each position will help to understand the relative impact of the position on organizational capability maturity.

2.6.3 LESSONS LEARNED

- Multiple organizations determined the lack of a TSMO career path as a major challenge.
- The importance of accurate position descriptions and job advertisements is highlighted.
- It is critical for the success of TSMO to develop a standard recruitment plan for the new positions (including where and when to recruit, use of recruitment specialists, systematic screening and interview process, and incentives).
- Transportation agencies should implement a professional development plan to address TSMO training requirements. This could include training sessions and workshops, experiential learning, service-learning, and mentoring programs.
- Retaining a well-trained workforce is vital to the development and the continued success of the TSMO program.

2.6.4 APPLICATIONS TO NDOT

The following are key takeaways for NDOT's application of the lessons learned:

- Define accurate job descriptions for the TSMO positions.
- Investments in developing and formalizing career paths for emerging TSMO positions.
- Collaborate with HR to develop a standard screening process, including a list of KSAs and qualification examples for positions.
- Develop a formal professional development plan.
- Develop a workforce retention culture and a personalized retention plan for each employee.

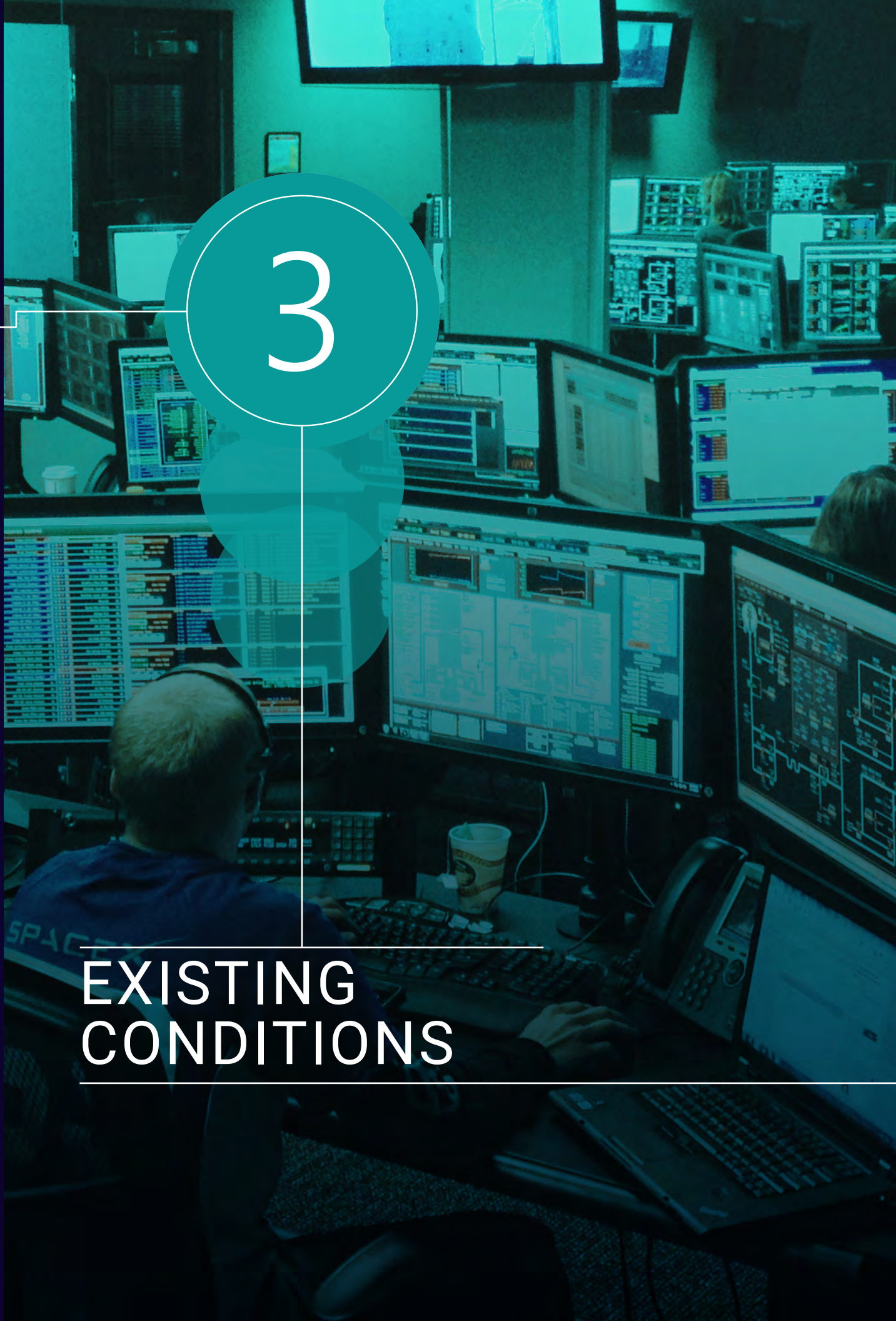
2.7 OTHER RELEVANT KEY OUTCOMES

Similar to the other state examples listed above, there are many other outcomes observed in other parts of the nation, including:

- CDOT included corridor managers, who coordinate with other CDOT regions and partners, to report directly to the TSMO Director. In conjunction with these managers, highway incident commanders are deployed to focus on improving planning and response to incidents. Positions such as planners, performance managers, and modeling specialists focus on specific needs for the TSMO division.
- Caltrans put a higher focus on managing congested corridors, which resulted in developing corridor manager positions along with other key staff responsible for performance management and maintenance.

- To support TSMO activities and state operations, various entities contracted out maintenance activities to local agencies. For instance, WSDOT and the Louisiana Department of Transportation and Development (LaDOT) have contracts with local vendors for their ITS hardware maintenance and operations infrastructure.
- Georgia Department of Transportation (GDOT) contracted out its TMC operations in 2010 for $21 million over six years. The contractor was responsible for carrying out almost all activities such as project management, performance and benefits reporting, incident timeline process, updating GDOT's regional systems, and TMC staffing.
- Another interesting practice followed by WSDOT, Florida DOT (FDOT), and MDOT SHA is to partner with local universities to support state DOT activities such as research for new technologies and approaches, support for agency project tasks, and projects to develop the workforce.
- The Tennessee Department of Transportation (TNDOT) uses technical expertise and research capabilities from major state universities in a variety of different ways to support its TSMO goals.[6]

6 *TNDOT Partners with State Universites To Enhance TSMO Research, Communication and Innovation, 2019*



3

EXISTING CONDITIONS

This section provides an overview of the existing staffing and workforce capabilities, including current organization chart, roles, job descriptions, the progress made with the phased approach defined within the 2020 TSMO Program Plan for organizational structure, existing professional education and training programs, and the existing recruitment process.

3.1 REVIEW OF EXISTING ORGANIZATION CHART, ROLES, AND JOB DESCRIPTIONS

Within the 2020 Statewide TSMO Program Plan, NDOT reviewed the current organizational structure for the Traffic Operations Division and recognized the need to realign positions to better accommodate dedicated TSMO members in a more formalized manner. These changes were suggested based on the following requirements:

- Supporting the anticipated changes in staffing for the TSMO Program
- Accommodating the emerging needs in skills and expertise for TSMO
- Integrating the TSMO Program into the districts
- Coordinating with stakeholders for TSMO activities
- Enabling a TSMO-related decision-making process
- Supporting and formalizing a sustainable TSMO Program

The existing sections under the Traffic Operations Division include:

- Traffic Operations Technology
- Signals, Lighting, and ITS
- Signs, Striping, and Traffic Control
- Operations and Network Analysis
- ITS Programs and Operations

A phased approach (Phase 1 and Phase 2)was identified within the 2020 Statewide TSMO Program Plan to develop a more TSMO-oriented organizational structure. This approach included specific steps not only to reorganize the current organization chart, but also to develop TSMO-focused positions and job descriptions. This step and associated changes were completed prior to development and adoption of this plan. In addition to the phased approach, a set of suggestions were developed to facilitate the necessary changes in organizational structure to support implementation of the TSMO Program. Table 1 includes the suggestions, along with the status of each one.

TABLE 1: SUGGESTIONS AND STATUS OF ORGANIZATIONAL CHANGES DEVELOPED WITHIN THE 2020 STATEWIDE TSMO PROGRAM PLAN

Suggestion Descriptions	Status
Modify the existing responsibilities of the Assistant Chief Traffic Operations Engineer to include TSMO Program management responsibilities.	Completed
Establish a TSMO Steering Committee.	Completed
Integrate TSMO across all NDOT divisions.	In progress
Formalize collaboration with external agencies and partners.	In progress
Develop the TSMO Staffing and Workforce Development Plan.	In progress

Currently, all job descriptions within the Traffic Operations Division have been reviewed and updated to include or highlight TSMO roles and responsibilities.

Following this, the NDOT Traffic Operations Division developed the process of implementing the second phased approach (Phase 3) as outlined within Section 4 of this plan. The division is currently undergoing reorganization of their organizational chart to compliment TSMO-centric efforts, which will identify new TSMO positions with updated job descriptions, training, and retention plan.

3.2 REVIEW OF EXISTING PROFESSIONAL EDUCATION AND TRAINING PROGRAMS

The current new-hire orientation within the Traffic Operations Division consists of the following:

1. General Orientation
2. Defensive Driving
3. IT Security
4. Sexual Harassment
5. Global Awareness (Safety) Training

The Traffic Operations Division also provides "On-the-Job" training sessions. These vary by sections in terms of how formal they are required to be. Some sections have developed hands-on training, whereas other sections have developed training programs.

The Traffic Operations Division currently does not provide TSMO training for new hires. Specific TSMO training—together with quarterly in-person training, training materials, and training schedules—has been developed as part of this plan.

3.3 REVIEW OF EXISTING RECRUITMENT PROCESS

Below are the steps of the process that NDOT follows to recruit team members within the Traffic Operations Division:

1. The hiring manager or supervisor coordinate with the administrative section to complete the hiring packet consisting of position requisition form, position description form, and the essential functions form.
2. The hiring packet is then submitted to the division chief for review and approval.
3. Once chief approval is obtained, the hiring packet is forwarded to HR for approval and public advertisement.
4. Applicants apply for the position through the NDOT HR Portal and go through the initial HR screening process to verify whether they meet the basic requirements and essential functions of the position.
5. Once the applicants are screened for minimum qualifications, HR will develop a qualified candidates list for the hiring manager to select the minimum number of interview candidates. The minimum number of interview candidates selected is then coordinated by Equal Employment Opportunity (EEO) and State policies, rules, laws, and regulations for approval.
6. Once the hiring manager or supervisor has the approved number of interview candidates, the hiring manager or supervisor will coordinate with the administrative section to schedule and conduct the interviews with the assistance of an interview panel.
7. The interview panel then ranks all interview candidates based on their performance during the interview. Once the interviews are completed, the recommendation of the first ranked candidate is reviewed and approved by the division chief.
8. Once division chief approval is obtained, the most qualified candidate recommendation along with all interview panel notes are submitted to HR for review and approval of compliance with all EEO and State policies, rules, laws, and regulations.
9. Once HR approval of the most qualified candidate is obtained, the hiring manager or supervisor will develop the offer letter for the selected candidate.

Review of the existing recruitment process identified that no fundamental changes are required for TSMO workforce development integration. Section 4 provides a description of suggestions and recommendations for recruiting a TSMO workforce. All suggestions and recommendations will be integrated into the existing recruitment processes outlined above.

4

RECRUITING A TSMO WORKFORCE

To build a robust TSMO workforce, NDOT recognizes the need to be flexible and responsive to changing needs when considering emerging roles. Literature review and research recommend that the focus must shift from recruitment of civil engineers to diversification of position descriptions to reflect the evolving skillsets and backgrounds required for successful and innovative implementation of TSMO.

Hiring new TSMO positions is a key step in developing and building a TSMO team within an agency. In this process, it is essential to have a set methodology for hiring new positions as well as including new responsibilities in the existing job descriptions. This section presents findings from the research, the TSMO recruitment plan, TSMO positions' job descriptions, and existing positions' job description updates.

4.1 RESEARCH FINDINGS ON TSMO WORKFORCE RECRUITMENT

This section presents findings regarding recruiting a professional-level TSMO workforce. The information combines research reviews and information gathered through a series of stakeholder interviews by the National Cooperative Highway Research Program (NCHRP). Organizations involved in this review included many state transportation agencies such as Arizona, Maryland, Iowa, Washington, and Minnesota. The following represents the highlights of the findings from both the research and the specific state agency interviews.

- Accurate definitions of position descriptions: identified as key to ensure the future success of a position whether in a leadership role or a subordinate position.
- Academic pipeline expansion: recruiting employees from other related engineering disciplines such as computer science, data science, and IT could bring significant strengths to TSMO programs.
- Gender inclusion: firms who view female workers as a valuable strategic resource may promote women into management to attract other women and boost the retention of female employees in the organization.
- Generation changes: these changes affect TSMO, which can focus recruitment efforts on individual contributions and goals rather than pre-existing position descriptions and standard compensations.
- Several state organizations have or are in the process of creating new TSMO-oriented positions. These include positions such as:
  - Innovative Performance Planning Division Chief
  - TSMO Program Manager
  - TSMO Engineer
  - Regional TSMO Coordinator
  - Traffic Management System Integrator
  - Traffic Data Analyst/Scientist
  - TSMO Manager/Chief/Bureau Director
  - Corridor Operations Manager
  - IT Support Staff
  - TMC Operator

  - TSMO Technician
  - SLATE Technician
  - TMC Program Analyst
  - Computer Engineer
  - Artificial Intelligence Scientist
  - Telecommunications Engineer
  - Data Management Specialist
  - Visualization Specialist
  - Connected and Automated Vehicles (CAV) Program Manager
  - Traffic Incident Management (TIM) Program Manager
  - Cyber Security Engineer
  - Transportation Data Ethicist
  - Surface Weather Specialist
  - Systems Engineer
  - TSMO Modeling Specialist
  - Emerging Technologies Industry Liaison
  - Transportation Systems Performance Manager
  - Integrated Corridor Management Manager
  - TMC Manager
- The intensity of recruiting across most agencies varies from traditional to more modern methods, including:
  - Adding talent acquisition
  - Attending technology and data meet-up groups for recruitment purposes
  - Advertising positions on AASHTO and other professional organizations' websites, including the Institute of Transportation Engineers (ITE) and the Intelligent Transportation Society of America.
  - Using social media to promote open job positions
- Many organizations identified lack of a TSMO career path as a significant challenge, including:
  - Positions with higher authority require professional licensure, and this limits the career path. Some of the engineering disciplines required to support TSMO, e.g., electrical, mechanical, etc., typically are not encouraged to obtain professional licensure.
  - There is a need to attract students at the high school level and also to target positions not necessarily in engineering.
  - TSMO requires people with varying experiences and backgrounds. TSMO needs innovation and people who can handle a job that changes every day. Employers need to be aware of that and find candidates who will survive and excel in this environment.
- Developing alternative outreach methods for recruitment is key, instead of only electronic submission. Some agencies' strict recruitment processes and procedures limit their ability to access the maximum number of resources.

4.2 NDOT TSMO RECRUITMENT PLAN

TSMO is a relatively new concept within NDOT, so it requires adjustments to the traditional hiring process for the program to be successfully implemented. Modifying existing hiring practices or replacing these traditional practices is recommended when hiring for TSMO positions. Studies show that it is considered a good practice to develop a formal recruitment plan for each new TSMO position which might include suggesting when and where to recruit, coordinating with the HR department for the screening and interview process, and offering incentives. Drawing from the research findings, the following subsections represent NDOT's TSMO recruitment plan.

4.2.1 WHEN AND WHERE TO RECRUIT

According to the multiple sources reviewed in developing this plan, the question of when to recruit has been identified as one of the biggest challenges for agencies. This is largely because of the difficulty in identifying required KSAs for brand new positions. Therefore, the first step is to envision the need for a new position.

This will require a broad understanding of current and future TSMO activities and areas that are not easily addressed within the TSMO Program. These can be used as triggers to help NDOT identify new positions. It is important to note that the triggers may be internal or external. An example of an internal trigger could be formalizing a new program such as Congestion Management or implementing a new decision software. An example of an external trigger could be emergence of a new technology or solution from the private industry, such as new cyber security applications of the Connected and Automated Vehicle (CAV) technologies.

NDOT also could take advantage of the CMM framework to identify KSAs and the needs of new positions. Dimensions with lower levels of TSMO maturity can be considered as areas that require additional team member support and TSMO-focused roles, in order to assist NDOT achieve their goals with TSMO maturity. It is important to ensure for each new TSMO position that the CMM improvement opportunities and potentials are considered.

Through analysis of current TSMO activities, Programmatic and Tactical Elements outlined within the NDOT TSMO Program Plan, and the target of Level 3 in TSMO CMM by 2024, NDOT has identified the following new positions to be added to the division's organizational structure. As demonstrated later in Figure 8, further analysis has been performed to establish a better understanding of how these positions will assist NDOT in targeting specific CMM dimensions to advance TSMO.

1. **TSMO Program Manager/Coordinator**: This position will:

   - Function as a TSMO Coordinator that will assist NDOT by advancing TSMO culture, program leadership, program direction, and partnerships, while providing cross-dimension TSMO capability maturity improvements.
   - Collaborate with our partnering agencies to identify opportunities for TSMO strategies and project implementation at a statewide level.
   - Facilitate TSMO business process improvement, policy development, and budgeting of the TSMO program.
   - Provide technical leadership for developing relevant TSMO performance measures and utilizing benefit/cost analysis tools to ensure implemented TSMO projects and programs will maximize the existing capacity of transportation systems while improving safety and reliability for travelers.
   - Be responsible for developing performance based reports utilizing the department's TSMO Evaluation Tool and Investment Prioritization Tool (IPT).
   - Ensure the TSMO Program functions in coordination with the overall goals and objectives of the department's One Nevada Plan.

2. **TSMO Performance Manager**: This position will:

   - Function as the TSMO Performance Manager and be responsible for identifying opportunities for the implementation of cost-effective solutions that will improve the safety, mobility, and reliability of the transportation system at a statewide level while focusing on maximizing existing capacity.
   - Analyze and efficiently communicate information to the pertinent stakeholders and utilize data to enhance planning for and integration of management and operations and help address gaps in agency processes and procedures as they relate to a performance-based decision-making approach.
   - Be responsible for developing and overseeing the inclusion of TSMO elements utilizing the TSMO Evaluation Tool and Investment Prioritization Tool (IPT). The TSMO Performance Manager will have the biggest impact in helping the department transition into a performance-based and data-driven decision-making process.
   - Collaborate with other divisions to target the department's funds more efficiently and maximize the performance of the state's transportation system while assuring that the funding being allocated to the system is prioritized by the need.
   - Ensure the TSMO Program functions in coordination with the overall goals and objectives of the department's One Nevada Plan.

3. **TSMO Data Analyst**: This position will:

   - Function as a TSMO Data Analyst responsible for developing predictive analytics and performance measures and will play a critical role in enhancing a performance-driven culture using real-time operation and long-term trend analysis. This will require the extraction, integration, and analysis of available data aligned with TSMO strategies and performance measures.
   - Be responsible for identifying creative and data-driven solutions for traffic and transportation challenges to improve the safety, reliability, and efficiency of transportation networks.
   - Be responsible for the inclusion of TSMO elements utilizing the TSMO Evaluation Tool and Investment Prioritization Tool (IPT). The TSMO Data Analyst will be instrumental in helping the department transition into a performance-based and data-driven decision-making process.
   - Assist the department in implementing TSMO business processes through strengthening the use of big data and data management techniques.
   - Ensure the TSMO Program functions in coordination with the overall goals and objectives of the department's One Nevada Plan.

4. **TSMO Engineer**: This position will:

   - Function as a TSMO Engineer that will significantly impact the advancement of TSMO integration and implementation through Systems Engineering (SE) development, project evaluation, application of the latest systems and technology, continual integration of change management, as well as potential improvements in TSMO business processes and culture.
   - Be responsible for incorporating the TSMO elements from the TSMO Evaluation Tool and Investment Prioritization Tool (IPT) into the department's One Nevada Plan.
   - Focus on programs and projects that will maximize the existing capacity and minimize the requirement for additional capacity and infrastructure. This will include TSMO elements to be reviewed and analyzed on all programs and projects in collaboration with the planning and scoping efforts to improve safety and mobility for all modes of travel.
   - Be responsible for keeping track of the progress of programmatic elements specified within the program plan for TSMO implementation.
   - Ensure the TSMO Program functions in coordination with the overall goals and objectives of the department's One Nevada Plan.

5. **TSMO Modeling Specialist**: This position will:

   - Function as a TSMO Modeling Specialist that will advance planning for operations and assist in performing benefit-cost analysis to implement various TSMO strategies and allocate resources efficiently.
   - Provide engineering and technical guidance on the use of microscopic, mesoscopic, and macroscopic modeling tools in TSMO projects and programs.
   - Be responsible for improving project scoping, planning, and development by incorporating modeling into various aspects of TSMO projects departmentwide.
   - Have the highest potential improvement in TSMO collaboration, systems and technology, and performance measurement through broadly sharing findings internally and externally.
   - Ensure the TSMO Program functions in coordination with the overall goals and objectives of the department's One Nevada Plan.

Traditionally, positions within a state agency are recruited from within the agency, civil engineering schools, or the transportation industry. However, some TSMO positions require specialized experience and training in areas not traditionally recruited by government agencies, such as the IT industry. Some positions also require experience and training in areas that typically are addressed in other partner agencies, such as TMCs. NDOT also could use the opportunity to hire employees from the military and access and leverage a highly trained and motivated workforce. One approach to attract service members is to partner with the Department of Defense (DOD) SkillBridge Program. The program enables service members to gain practical civilian work experience through specific industry training, apprenticeships, or internships during the last 180 days of service. NDOT could offer relevant training and work experience while evaluating the service member's suitability for the position. The consideration of where to recruit also takes a shift in geographic focus depending on the KSA needs. This may be internally within the agency, locally and regionally within the state, or nationally. Therefore, it is recommended for NDOT to expand beyond traditional sources of recruitment to enhance the availability and success of securing qualified resources based on the KSA needs.

4.2.2 COORDINATION WITH HR DEPARTMENT FOR SCREENING AND INTERVIEW PROCESS

One of the main challenges of recruiting for TSMO is the standard HR screening process. Standard procedures generally review the applicant's level of education, years of experience, and required certifications and licensure. The emerging TSMO roles and responsibilities do not have equivalent representation in the traditional transportation industry; therefore, this creates challenges for HR departments to easily identify applicants with appropriate KSAs.

To address this challenge, it is important for NDOT to develop a range of KSAs for each position that HR could use for the screening process. Table 2 shows recommended KSAs for the identified TSMO positions within NDOT.

TABLE 2: EXAMPLE KSAS AND QUALIFICATIONS FOR NDOT TSMO POSITIONS

Position	Example KSAs
TSMO Program Manager/Coordinator	Knowledge of transportation and operations industry; local and national agency procedures and standard design; project management; ITS and emerging technologies; multimodal and intermodal operations. Skills including advanced engineering and technical guidance; partnership; communication; task and time management; managerial/supervisory; leadership; mathematical; problem-solving; analytical; interpersonal, and public speaking and presentation. Abilities such as being innovative and creative; teamwork; and working in stressful and fast-paced environments.
TSMO Performance Manager	Knowledge of transportation and operations industry; national, state, and local policies and procedures; engineering and design principles and practices; performance testing, metrics, and systems analysis; gaps analysis; ITS and emerging technology; and enhanced data planning process. Skills including mathematical; problem-solving; data analytics; technical communication; and report development. Abilities such as being innovative and creative; teamwork; professional judgment; performance measure analysis; technical report development; and data-driven performance-based recommendations development.
TSMO Data Analyst	Knowledge of statistical analysis; computer programming; big data; software; database language; machine learning; geospatial analysis techniques; relevant programming language. Skills including analytical; mathematical and problem-solving; organizational skills; technical communication; report development; and research. Abilities such as data collection and data analysis; professional judgment; and teamwork.
TSMO Engineer	Knowledge of transportation engineering and operations industry; decision support system; big data; local and national standard design; ITS and emerging technologies. Skills including supervisory; leadership; analytical; mathematical; problem-solving; time and task management; public speaking and presentation; and technical report development. Abilities such as being innovative and creative; teamwork; and working in stressful and fast-paced environments.
TSMO Modeling Specialist	Knowledge of transportation and operations industry; transportation and traffic engineering software; engineering and design practices and principles; and transportation modeling tools. Skills including communication; interpersonal; analytical; mathematical; and problem-solving. Abilities such as professional judgment; data collection and analytics; and teamwork.

Similar to screening processes, interview processes should be tailored to the specific KSAs and job responsibilities for each of the TSMO positions. For some positions, such as TSMO Data Analyst or TSMO Performance Manager, the interviewers may ask for examples of previous work products. In addition, as outlined within the KSAs, collaboration and communication skills play a critical role in the selection process. Therefore, it is recommended that the interviews include interactive discussions, scenario exercises, or behavioral proficiency questions to help identify the interpersonal and collaborative skills of the candidates.

4.2.3 INCENTIVES

As stated previously, these TSMO positions are emerging, so this can introduce challenges to attract specialized resources and talents without offering competitive incentives. Considering the known challenges associated with limited funding sources, NDOT could consider incentives such as moving expenses, accelerated salaries, trainings, use of latest technologies, flexible work hours, remote work options, etc. to the appropriate candidates. Another important incentive may include defined opportunities for career development within the agency.

4.2.4 ANALYSES OF TSMO POSITIONS

In addition to KSAs and qualifications defined in Section 4.2.2, NDOT also performed additional analyses to further demonstrate the contribution of these TSMO positions in advancing the TSMO Program and associated areas.

TSMO integration is not only a strategic goal for the NDOT TSMO Program, but it also is a critical component to mainstreaming the program both internally and externally. Table 3 shows the potential relationships between the new TSMO positions other NDOT divisions and stakeholders to further demonstrate the integration and contribution of these positions at a statewide level.

TABLE 3: POTENTIAL RELATIONSHIPS BETWEEN TSMO POSITIONS AND OTHER NDOT DISCIPLINES

		Positions				
		TSMO Engineer	TSMO Modeling Specialist	TSMO Program Manager / Coordinator	TSMO Data Analyst	TSMO Performance Manager
INTERNAL	Construction	●	●	●	●	●
	Design	●	●	●	●	●
	Planning	●	●	●	●	●
	Maintenance & Asset Management	●	●	●	●	●
	Operations	●	●	●	●	●
	IT/IS	●	●	●	●	●
	Safety	●	●	●	●	●
	Environment	●	●	●	●	●
	NDOT Districts	●	●	●	●	●
EXTERNAL	MPOs	●	●	●	●	●
	Local Agencies	●	●	●	●	●

● Frequent Improvement Potential ● Moderate Improvement Potential ● Infrequent Improvement Potential

For each TSMO position, NDOT also has defined an improvement potential for CMM maturity. This is to establish a better understanding of each position's contribution to help NDOT achieve the next level of maturity and how each position helps address the gaps in CMM. This also will help the NDOT Traffic Operations Division define priorities for hiring these positions based on the Level 3 maturity target by 2024. Figure 8 shows the positions' improvement potentials. Based on the research findings, it is also recommended that NDOT utilize benefit/cost analysis to identify required resources and develop the TSMO positions' business case for ELT.

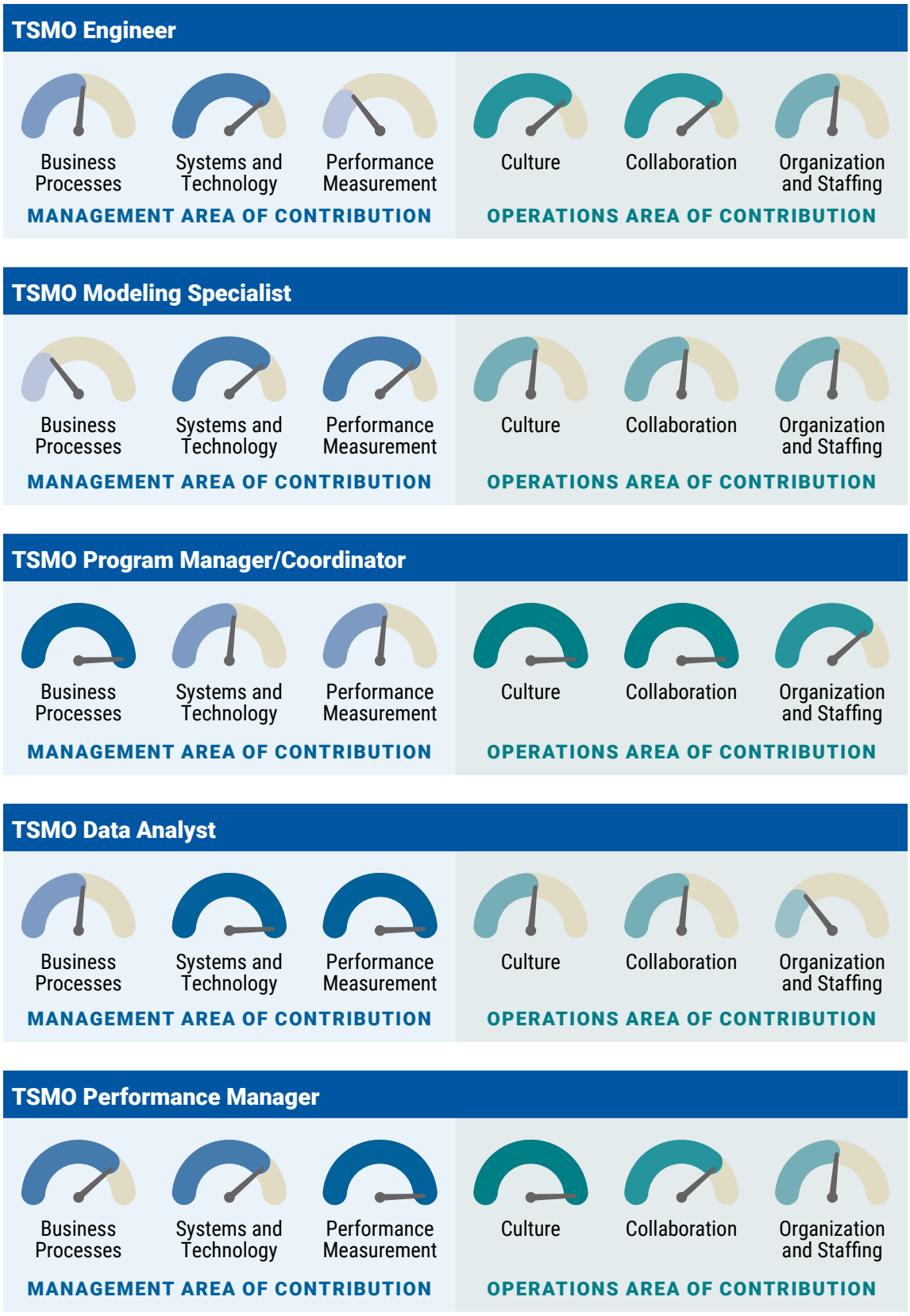


FIGURE 8: IMPROVEMENT POTENTIAL OF TSMO POSITIONS FOR CMM MATURITY

4.3 JOB DESCRIPTIONS OF TSMO POSITIONS

The following job descriptions have been developed in alignment with the six CMM dimensions to ensure the positions' contribution toward progressing in TSMO maturity. The job descriptions are developed as a general guideline, and the final descriptions will incorporate these elements. Detailed model job descriptions are included in Appendix A.

4.3.1 TSMO ENGINEER

Education: Bachelor's degree in Engineering

Certificate, Licensure, Registrations: Registered Professional Engineer

Business Processes

- Assist in the development and application of policies and procedures that support the advancement of TSMO in the division daily activities and participate in the associated routine and daily operations.
- Responsible for the application of TSMO tools and performing the recurring updates.
- Ensure TSMO funding and resources are utilized in the most cost-effective manner.
- Identify opportunities to integrate TSMO strategies during scoping, planning, design, construction, operations, and maintenance of projects.

Systems and Technology

- Assist in the planning, advancement, and administration of the TSMO Program, analyze engineering designs, specifications, and test plans while ensuring best design practices are followed.
- Perform duties as a technical advisor on the use of ITS, traffic engineering, tolling policies and practices to other divisions, stakeholders, and regional partners.
- Identify opportunities to integrate systems management, technology, traffic engineering, and operations.
- Stay up to date with emerging technology, latest TSMO strategies, and federal TSMO products to identify opportunities for the application of these technologies and programs.
- Work with IT group to develop systems and related software applications that support TSMO and collaborate with other technical team members to ensure system compatibility, interoperability, and synchronization.

Performance Management

- In collaboration with TSMO Performance Manager, track progress and development of recurring reports in regard to the TSMO Program goals and objectives, focus resources to strengthen operations, ensure that all team members are working toward common goals, and assist in establishing agreements for the intended outcomes.

Culture

- Identify strategies to maintain professional contact with elected officials, private vendors, public and government agencies.
- Participate in NOCoE webinars, seminars, trainings, and presentations, as well as national conferences and seminars as an NDOT TSMO representative.
- Provide accurate and timely responses to internal and external stakeholders regarding TSMO topics and improve/promote their participation.

Collaboration

- Effectively communicate with team members of different technical backgrounds, collaborate with them in plan development, ensure linking performance targets to specific, measurable, achievable, relevant, time-bound (SMART) objectives, and identify and provide resource recommendations.
- Lead the TSMO Steering Committee meetings, develop meeting materials, agenda, and notes, and ensure TSMO Program elements, performance measures, and functions are being implemented.
- Participate in meetings, committees, task teams, and other groups with both internal and external stakeholders to present TSMO interest.

Organization and Staffing

- Supervise and train team members in TSMO topics and identify national training opportunities.
- Meet regularly with management to report on TSMO Program progress, establish work objectives and timelines to ensure goals and objectives are met.
- Work directly with TSMO Program Manager to attend to and process human resource requirements, fill vacant TSMO positions, identify new TSMO positions' needs, and recommend adjustments to the department's direction according to a changing environment and emerging TSMO positions.

4.3.2 TSMO MODELING SPECIALIST

Education: Bachelor's degree in Engineering

Certificate, Licensure, Registrations: Registered Professional Engineer

Business Processes

- Manage and develop contracts and other agreements that support TSMO functions and/or relate to performance targets.
- Manage and develop documentation for funding, RFPs, and related documents, and participate in technical reviews, work product evaluations, and approval processing.
- Ensure TSMO modeling funding and resources are utilized in the most effective and efficient manner.

Systems and Technology

- Perform duties as a technical advisor on modeling for TSMO, including microscopic, mesoscopic, and macroscopic models.
- Implement modeling for planning, visualization, analysis, and training related to TSMO projects and programs while ensuring national standards and practices are followed and systems are compatible and operable with existing systems.
- Develop technical reports, presentations, training materials, etc., as required.

Performance Management

- Work closely with TSMO Performance Manager and other team members who undertake performance measurement activities to identify opportunities for TSMO integration into current business processes and federal reporting documents.

- Collaborate with other NDOT divisions to incorporate TSMO modeling and relevant performance measures into NDOT planning and performance measurement documents.
- Participate in relevant projects, integrate performance measurement strategies, and TSMO modeling tools, as applicable.

Culture

- Participate in internal and external meetings, tasks teams, and other groups and committees, as well as conferences and summits to represent TSMO interest and promote TSMO modeling.
- Promote public relations and provide timely and accurate responses to the internal and external stakeholders, vendors, and partners.
- Manage the resolution of outstanding contractual and technical issues related to TSMO modeling.

Collaboration

- Collaborate with other team members regarding the overall TSMO planning, development, and application of strategies.
- Communicate effectively and clearly, work well with team members from diverse technical backgrounds, and identify opportunities to integrate TSMO modeling into project scoping, planning, design, construction, operation, and maintenance.

Organization and Staffing

- Supervise and assist team members in TSMO responsibilities and activities, provide training for technical staff pertaining to TSMO duties, and ensure all employees are kept informed of departmental, statewide, and federal best practices and procedures.
- Meet regularly with team members to assign tasks, establish objectives and timelines to ensure TSMO goals and objectives are met, frequently communicate with the management to provide the progress made with each specific task, and evaluate and monitor the team members' performance against their assigned work performance standards.

4.3.3 TSMO PROGRAM MANAGER/COORDINATOR

Education: Bachelor's degree in Engineering

Certificate, Licensure, Registrations: Registered Professional Engineer

Business Processes

- Develop, implement, and maintain policies, guidelines, standards, manuals, and procedures related to TSMO and ensure the associated daily operations meet the needs and requirements of the division and the department.
- Report on utilization of the Investment Prioritization Tool (IPT) and TSMO Evaluation Tool on each project including benefit/cost.
- Identify opportunities to integrate TSMO strategies during scoping, planning, design, construction, operations, and maintenance of projects as applicable.
- Ensure TSMO business processes are current and up to date.

Systems and Technology

- Maintain knowledge of current and emerging federal and state laws, rules, regulations, and industry practices related to ITS deployments and operations.
- Develop, implement, and maintain policies, standards, and procedures to ensure the ITS Network is operated within the state and industry standards.

Performance Management

- Develop and monitor performance measures of deployed TSMO strategies, program benefit/cost analyses, and monthly or quarterly performance reports, which should be in an easily understandable format for people with different backgrounds and reflect the performance and progress of the TSMO program and projects.
- Performance measures should accurately measure the performance and viability of programs and projects and be used to support informed decisions in coordination with agency transportation planning staff.
- Provide solution-based recommendations for various projects by creating clear and attainable objectives.

Culture

- Provide information and education regarding the principles of the TSMO program, ensure they are effectively incorporated throughout the department, and prepare activity and progress reports containing milestones.
- Represent the department at meetings with federal, state, local units of government and the State Emergency Operations Center and promptly complete all associated assignments and responsibilities.
- Participate on committees, working groups, and technical panels at both the local and national levels in all areas of TSMO.

Collaboration

- Participate in management meetings and maintain professional working relationships with other managers and technical and non-technical personnel.
- Collaborate with agency staff, communicate TSMO activities among various groups of the division, and support the division with other duties, special projects, and new programs as required.

Organization and Staffing

- Supervise and assist division managers and team members in TSMO responsibilities and activities and provide training for technical staff pertaining to TSMO duties.
- Monitor employee performance and ensure employees are kept informed of departmental, state, and federal best practices and procedures.

4.3.4 TSMO DATA ANALYST

Education: Bachelor's degree in Engineering, Planning, Business Administration, Math, Geography, Economics, Statistics, or related field

Certificate, Licensure, Registrations: NA

Business Processes

- Enhance project scoping and planning process through integration of data for decision-making processes.
- Establish protocols and develop robust data sets through extraction and integration of multiple data sources.
- Support development and implementation of data management, data sharing, and data use policies and protocols.
- Perform duties as a technical advisor on the use of ITS and traffic data, standards, policies, procedures, and best practices.
- Identify opportunities to integrate data into the current division's business processes.

Systems and Technology

- Responsible for extracting, organizing, analyzing, integrating, and communicating information from the variety of available resources within NDOT.
- Develop predictive analytics, performance measures, and targets in alignment with TSMO Program.
- The ability to analyze big data, leverage strong foundational analytical skills to develop data management and data utilization, and use analytical tools to create data-based information to enhance decision-making.
- Develop and manage data acquisition/utilization and analysis performed by consultants and vendors, as well as internal and external agreements that support TSMO applications and functions related to performance targets.

Performance Management

- Work closely with TSMO Performance Manager to monitor, track, and analyze data in alignment with TSMO strategies and performance measures, identify opportunities to integrate data and performance measures into the wider NDOT performance management activities.
- As the division's representative, collaborate with internal and external stakeholders in developing plans, reporting results, and linking data to TSMO performance measures and SMART objectives.
- Develop data-driven recommendations to ensure resources and funding are utilized in the most cost-effective manner.
- Ensure TSMO program elements, performance measures and functions are monitored and implemented in alignment with traffic and transportation data science/management.

Culture

- Examine current practices and identify and enable new approaches to traffic and transportation problem solving and system efficiency improvements.

- Promote data utilization and data-driven and performance-based decision-making processes within internal and external agencies.
- Identify opportunities to integrate transportation and traffic data into current NDOT business processes, plans, and programs.

Collaboration

- Collaborate and communicate with internal and external stakeholders to share information, provide timely and accurate responses, and provide guidance for technical decisions.
- Participate in meetings, committees, and task teams as needed.

Organization and Staffing

- Work collaboratively with all sections to identify data and resource needs.
- Identify national training opportunities.

4.3.5 TSMO PERFORMANCE MANAGER

Education: Bachelor's degree in Engineering, Planning, Business Administration, Math, Geography, Economics, Statistics, or related Field

Certificate, Licensure, Registrations: NA

Business Processes

- Work with the wider NDOT and internal and external stakeholders to integrate performance measurement and management into decision-making business processes.
- Utilize data to support and secure funding for TSMO applications, functions, and infrastructure, as well as develop strategies to ensure funding and resources are utilized in the most cost effective and beneficial manner.
- Develop and implement data acquisition/use aspects of TSMO business and related plans to guide resource allocation and achieve unit performance targets.

Systems and Technology

- Perform duties as a technical advisor on the use of traffic, ITS, and tolling data, standards, policies, and best practices.
- Identify emerging technologies that enable performance-driven decision-making processes and determine opportunities to integrate them into the division's performance management practices and processes.
- Ensure TSMO program elements, performance measures, and functions are monitored and implemented in alignment with traffic and transportation data science/management.

Performance Management

- Ability to analyze big data to develop trends and summary statistics and leverage strong foundational analytical skills to develop data management and data utilization.
- Develop a data utilization and applicability work plan for the division in alignment with TSMO performance measures, which should accurately measure the performance and viability of programs and projects and be used to support informed decisions in coordination with agency transportation planning staff.

- Performance reports should be developed in an easily understandable format for people with different backgrounds and reflect the performance and progress of the TSMO program and projects.
- Provide solution-based recommendations for various projects by creating clear and attainable objectives.
- Integrate multimodal data into the operational decision-making process and assist in making operational decisions based on TSMO performance measures and in alignment with TSMO goals and objectives.

Culture

- Examine current practices and provide an overall vision that will enable the development of new problem-solving approaches through performance measurement and management.
- Promote performance-based decision-making processes and advantages internally and externally.
- Participate in meetings, committees, task teams, and other groups with internal and external customers to support TSMO interests and provide technical guidance related to traffic data/analysis.

Collaboration

- Responsible for analyzing and communicating information obtained from a variety of transportation and traffic data sources to internal and external stakeholders and providing guidance for technical decision-making processes.
- Assist the division and wider NDOT in using data to enhance the planning process and enable data-driven decision-making for the TSMO program.
- Participate in internal and external meetings, committees, and task teams.

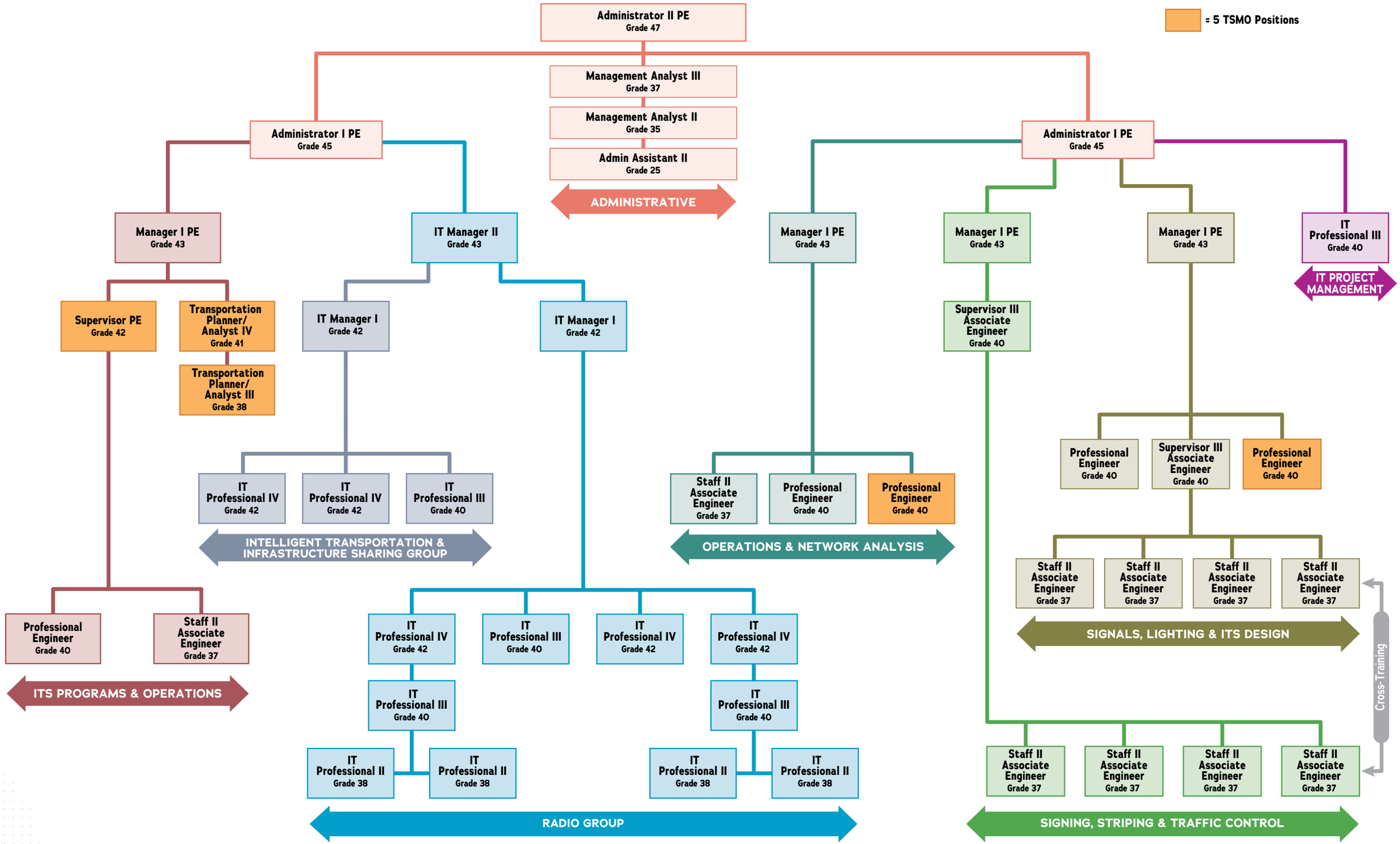
Organization and Staffing

- Oversee team and group activities, document results and related presentations as necessary.
- Work with division managers to identify resource requirements and determine and provide resource recommendations by linking performance targets and objectives to team members' expectations.

4.4 PHASE 3 ORGANIZATIONAL STRUCTURE

In order to develop a more robust workforce and maximize the efficiency of the TSMO program, NDOT plans to further restructure the current organization chart by introducing new positions, filling the current vacant positions with talented employees, and adding new technical groups. As shown in section 4.4.1, the Organizational Chart Phase 3 is developed to fulfill this objective. Org Chart Phase 3 describes the NDOT 2-year plan (by the end of the fiscal year 2023) and is divided into 8 sections, including ITS Programs & Operations, Administrative, Intelligent Transportation & Infrastructure Sharing Group, Radio Group, Operations & Network Analysis, Signals, Lighting, and ITS Design (SLI), Signing, Striping, and Traffic Control (SSTC), and IT Project Management. Intelligent Transportation & Infrastructure Sharing Group and Radio Group compose the Traffic Operations Technology Section (TOTS).

4.4.1 ORGANIZATION CHART PHASE 3



5

TRAINING A TSMO WORKFORCE

In addition to the current internal trainings listed in Section 3.2, the Traffic Operations Division has crafted professional development opportunities for basic training for new hires, existing team members, and other NDOT divisions, as well as advanced training for existing team members and TSMO positions. The following subsections include details of these training programs, as well as an inventory of available education and training programs through other sources.

5.1 AVAILABLE EDUCATION AND TRAINING PROGRAMS

The Workforce Guidebook by NCHRP presents a comprehensive list of available education and training programs for TSMO, as shown in Table 4. This guidance also recommends that the basic training could be performed in-house; however, more specialized trainings could be obtained both in-house and through outside sources such as FHWA, professional organizations, and the National Operations Academy.

TABLE 4: AVAILABLE TSMO EDUCATION AND TRAINING PROGRAMS

Organization	Training Provider	Certifications
American Association of State Highway and Transportation Officials	✓	
American Consulting Engineers Companies	✓	
American Public Transit Association	✓	
American Road and Transportation Builders Association	✓	
American Society of Civil Engineers	✓	
American Traffic Safety Services Association	✓	
Consortium for ITS Training and Association	✓	✓
Community Transportation Association of America	✓	✓
Connected Vehicle Trade Association/Mobile Comply/Society of Automotive Engineers International	✓	✓
Council of Supply Chain Management Professionals	✓	
Eno Center for Transportation	✓	
International Municipal Signal Association		✓
Institute of Transportation Engineers	✓	
Intelligent Transportation Society of America	✓	
ITS Standards Training		
National Academy of Sciences/Transportation Research Board	✓	
National Highway Institute	✓	
National Operations Center of Excellence		
National Institute of Certification in Engineering Technologies		✓
National Transit Institute	✓	
Occupational Safety Institute	✓	
Professional Development Hours Source	✓	
Small Urban and Rural Transit Center	✓	
U.S. Department of Transportation Federal Highway Administration Office of Operations	✓	
U.S. Department of Transportation ITS Joint Program Office	✓	
U.S. Department of Transportation Volpe Center		

Transportation Systems Management and Operations (TSMO) Workforce Guidebook, 2019)

5.2 FINDINGS FROM OTHER STATE TRANSPORTATION AGENCIES

Table 5 shows TSMO training programs and methodologies adopted by other state agencies.

TABLE 5: TSMO TRAINING PLANS AND PROGRAMS BY OTHER STATE AGENCIES

State DOT	Training Methodology
TNDOT	Graduate Transportation Associate Program engages entry-level civil engineers in hands-on experience in maintenance, construction, design, and project management along with providing additional training in leadership and team building.
Virginia DOT	Core Development Program (CDP) involving both engineering and business tracks. CDP cross trains staff throughout the agency while also providing participants with a formal mentor. It also has established 30-, 60-, and 90-day position swaps to temporarily fill vacant positions and provide employees with cross training and varied perspectives.
Oregon DOT	Cross training employees in different areas. Example: maintenance workers are cross trained as incident response personnel. *(FHWA, Enhancing TSMO: Connecting TSMO and Human Resources, 2018)*
Minnesota DOT	Offers various training courses/programs/webinars available to various audiences, including state employees, city/county employees, and consultant personnel. These trainings include traffic signal courses, pavement marking courses, work zone construction, changeable message sign training, and various other traffic-related courses. *(MnDOT, Traffic Engineering Training)*
Caltrans	Mobility Academy—Caltrans offers mobility academy workshops that are intended primarily for traffic operations but are useful for anyone analyzing data to determine system performance, such as delay and reliability. Caltrans has used these workshops for several years but only recently introduced TSMO into the training program through strategic partnerships as part of the CITE program. This has allowed Caltrans to align its vision of TSMO with that of FHWA. The amount of TSMO training available to Caltrans staff is steadily increasing as resources are added. Caltrans partnered with University of Maryland and WSDOT to create a centralized training program. This approach involved the University of Maryland creating an on-line TSMO training course and Caltrans using that content to incorporate a TSMO training module into their existing Mobility Academy workshops. The course developed as part of the CITE program is designed to contain general information that teaches the fundamentals of TSMO to people at any level. Caltrans staff use the TSMO training module as a precursor to their mobility workshops. Another medium that Caltrans uses for training and collaboration is the regional operations forum. In these forums, a representative from each district in the state was trained on the basics of TSMO using FHWA publications and reviewing Caltrans' findings in their initial assessment.

State DOT	Training Methodology
New Jersey DOT (NJDOT)	NJDOT prefers to think of TSMO training as an outreach activity. With this approach, the focus is on getting people to understand TSMO, why it is being adopted, and the benefits of employing TSMO. NJDOT has been engaging with many different groups because of their outreach, including colleges and universities, first responders, consulting firms, and metropolitan planning organizations (MPO). Through FHWA's Everyday Counts Initiative, and in partnership with the New Jersey Institute of Technology, NJDOT was able to develop a Traffic Incident Management (TIM) training website. This website is a nationally recognized tool where safety personnel, emergency responders, and others can register for training classes throughout the state. *(NJTIM, Traffic Incident Management)*
WSDOT	One of the big successes WSDOT had in solidifying TSMO within the agency was the creation of a dedicated TSMO position titled Workforce Development and Traffic Operations Engineer. This position is responsible for providing training for staff and elevating TSMO throughout WSDOT. WSDOT employees developed a formal process to decide which employees would attend the operations academy training program focused on TSMO. *(Operations Academy)*
FDOT	FDOT District 5 developed training as part of SHRP2 to train staff moving into management roles. This material was requested by partner agencies and MPOs. CMM helped FDOT District 5 determine the training needs of each agency and department. District 5 engaged with partner agencies and sent staff to partner agencies to participate in one-on-one and small group training sessions.
Texas DOT (TxDOT)	TxDOT—Austin District can elevate TSMO training by establishing a TSMO certification process for employees. In addition to internal district trainings, several programs are facilitated by external agencies to promote TSMO-related activities. For instance, agencies such as the National Highway Institute and the TRB provide online transportation management training. TxDOT noted that standardizing collaboration in all projects will promote TSMO and defining the person responsible for ensuring this activity is carried out further enables the success of TSMO in the district. *(TSMO - Austin District Program Plan, 2018)*

Organizing for TSMO, Case Study 8: Training for TSMO, 2019

External stakeholders also may receive different types of training depending on their goals and roles within TSMO. NDOT currently provides a basic level of training through hosting quarterly TSMO Steering Committee meetings. However, moving forward, additional training may be developed on an as-needed or project-by-project basis.

Drawing from the research findings, the following subsections represent the NDOT TSMO training program under the two main categories of New Hires (Basic) training and Advanced training.

Appendix B includes a summary of findings for TSMO training research.

5.3 BASIC TSMO TRAINING PLAN PACKAGE

Table 6 shows the TSMO workforce development and training plan for new hires, current team members, and other NDOT divisions focusing on providing basic TSMO training and knowledge.

TABLE 6: TSMO TRAINING PLAN (BASIC)

Training Title	Targeted Audience	Delivery Method	Training Material	Reference to research findings
TSMO 101—NDOT Employee Orientation	New Hires and current team members*	On-Line Module	TSMO 101 Training Module – Orientation	CITE, FDOT
TSMO 102—NDOT Employee Orientation	New Hires and current team members*	On-Line Module	TSMO 102 Training Module – NDOT TSMO Program	CITE
Hands-On TSMO Training	New Hires (Traffic Operations Division)	Combination of On-Line Module and Site Visit	TSMO Training Modules, as well as visiting TMC/ ROC	CITE, TNDOT
NDOT Traffic Operations Forum	New Hires (Traffic Operations Division)	On-Line Modules or In-Person Lectures on advanced TSMO topics by Subject Matter Experts (SME)/ Project Lead	One-hour lecture and site visits as applicable (such as TIM, CAV, Smart Work Zone, etc.)	CITE, FHWA, Minnesota DOT
New Hires Rotational Program	New Hires (Traffic Operations Division)	Combination of In-Person and Experimental Training	Rotational Program in Collaboration with other Divisions (Planning, Design, Construction, Traffic Safety, etc.)	Virginia DOT (VDOT), VTrans

**Refers to Engineering, Operations, Planning, and HR.*

TSMO 101 and TSMO 102 training modules are developed in an on-line training format and have been submitted as a supplement to this plan.

5.4 ADVANCED TSMO TRAINING PLAN PACKAGE

The advanced TSMO training plan, shown in Table 7, has been developed to help educate the current team within the Traffic Operations Division. These trainings also may be used for other NDOT division members depending on their involvement and as applicable.

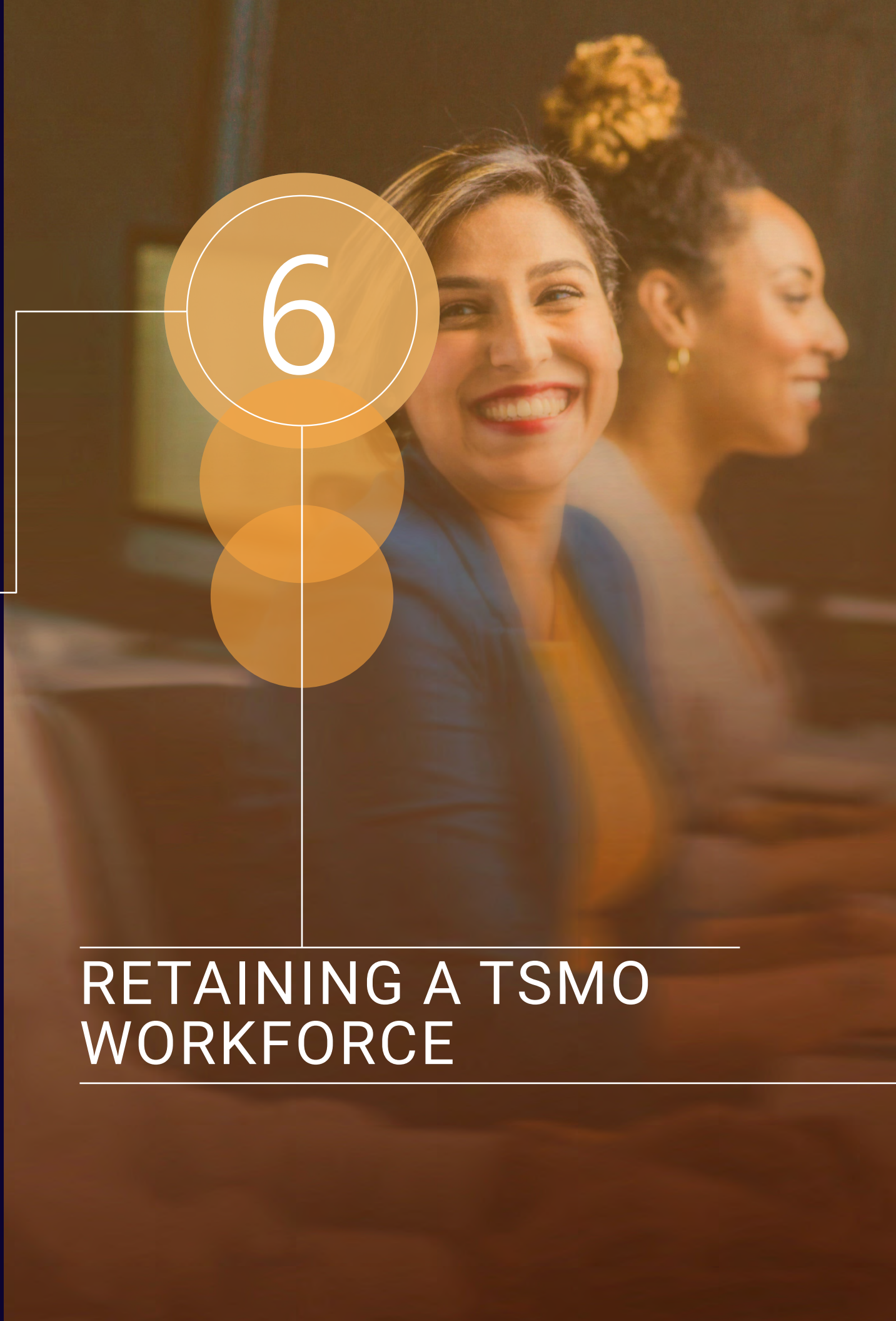
It is important to note that the advanced training plans must be updated frequently as NDOT advances in TSMO and introduces new topics and strategies. Suggested review and update cycle for the advanced TSMO training plan is every five years in coordination with the update cycle of the TSMO Program Plan elements.

TABLE 7: TSMO TRAINING PLAN (ADVANCED)

Training Title	Targeted Audience	Delivery Method	Training Material	Reference to research findings
TSMO 201—Advanced Orientation	Current Team members in Traffic Operations Division, and other NDOT divisions' team members as applicable	On-Line Module or In-Person Lecture on Current TSMO Topics	TSMO 201 Training Module – NDOT TSMO Business Cases	CITE, NHI
TSMO 202—Basic Practitioner Training	Current Team members in Traffic Operations Division	On-Line Module or In-Person Lecture	TSMO 202 Training Module – TSMO Coordination Plan with Stakeholders	CITE, NHI, TxDOT
TSMO 203—TSMO Tools Training	Current Team members in Traffic Operations Division, and other NDOT divisions' team members as applicable	Combination of In-Person and Group Exercises	TSMO 203 Training Module – IPT and Evaluation Tool	FHWA, NHI
TSMO 204—Advanced Practitioner Training/ Cross-training	Current Team members in Traffic Operations Division, and other NDOT divisions' team members as applicable	On-Line Module or In-Person Lecture	An overview of latest updates with TSMO topics in alignment with NDOT's TSMO activities	FHWA, Oregon DOT, Minnesota DOT
National Operations Academy Trainings, Partnered Trainings	Current Team members in Traffic Operations Division	Combination of In-Person Lectures, Group Exercises, and Field Visits	To be determined / subject to availability	FHWA, Caltrans, WSDOT

These trainings will not only provide educational opportunities to help employees evolve in their current positions, but they will also provide staff with opportunities to be well-positioned for current and emerging TSMO positions.

The TSMO 201, 202, and 203 training modules were developed in an on-line training format and are submitted as a supplement to this plan.



6

RETAINING A TSMO WORKFORCE

NDOT recognizes that retaining a trained workforce is a critical component to continued success and advancement for the TSMO Program. This section includes relevant findings from the research and establishes a plan for retaining TSMO staff.

6.1 FINDINGS FROM THE RESEARCH

The following is a list of findings from the research on retaining a TSMO Workforce: [7]

- Salary is one of the major determinants of employee turnover, especially due to the emerging nature of TSMO positions. Both motivation and pay are key to retaining a knowledgeable TSMO workforce. Additionally, the development of a performance-based promotion and compensation system could make employees more satisfied with their salary and encourage them to remain with the agency. The raise in the employees' compensation needs to be approved administratively. This increase in specialized training as well as the performance of the program could justify higher pay for staff retention.

- Additional training increases employee satisfaction and commitment to the organization. Development of training and educational opportunities results in establishing a better understanding of TSMO and awareness regarding how roles and responsibilities connect to TSMO success. This applies to TSMO by ensuring training is widely available for employees as departments shift to a TSMO-focused approach and points to the need to support new technologies and applications to support a well-trained staff. Furthermore, cross-training will allow staff in other areas to acquire skills needed to support TSMO operations, which could motivate them to continue working for the agency. Otherwise, they might not remain with the agency since they do not see any opportunity to progress or are not being challenged in their position. Motivational factors must both be fulfilling and allow some independence considering the emerging nature of TSMO positions. A highly competitive pay package with performance incentives is important to attract and retain a TSMO workforce.

- The development of mentorship programs and providing the time needed to train new talent can create a sense of direction and belonging for younger employees.

- Well-defined career development and a clear definition of future job prospects for TSMO positions are critical to motivate and retain a TSMO workforce. In order to achieve this goal, NDOT developed the Organizational Chart Phase 3, (the department 2-year plan with 5 new TSMO positions) which was discussed in Section 4.4.

- Agencies should capitalize on alternative strategies to recruit and retain TSMO team members such as flexible work hours, remote work settings, etc. NDOT has already implemented this strategy for retaining its workforce and will continue to conduct and improve it as necessary. This would enable NDOT to offer competitive incentives and encourage its workforce to remain with the agency.

7 *Transportation Systems Management and Operations (TSMO) Workforce Guidebook, 2019*
Study on determining factors of employee retention, 2003
Case Study 1: Defining the TSMO Workforce Pipeline, 2021
Case Study 3: Best Practices in Workforce Development from Similar Industries, 2021
Technical Memorandum: Workforce Trends and Practices Applicable to TSMO, 2022

- Various findings suggest that linking behavior with rewards (e.g., employee recognition, certificates of achievement, bonuses) yields a more positive outcome in employees compared to performance pay, especially in the public sector.
- Agencies can take advantage of cross-divisional opportunities to help institutionalize TSMO and encourage discussions beyond typical organizational boundaries. This will allow interpersonal interaction at multiple levels (from staff to executive leadership), which in turn could be a motivational factor.
- Technology plays a significant role in TSMO programs and projects. The commitment to technology makes TSMO more effective and offers a more attractive workplace to the younger, tech-oriented workforce.
- Utilizing marketing as encouragement to work for a public agency will help HR in competing with the private sector in recruiting and retaining a TSMO workforce.
- An HR strategy allowing TSMO team members to change positions and jobs within the organization with minimal paperwork will encourage the TSMO team members to obtain diverse experience and background, helping to retain the TSMO workforce. A similar strategy could also be developed to reduce the paperwork for the recruiting process and hire the expert workforce in the shortest time possible.
- Agencies should consider frequent, anonymous job satisfaction surveys. This transparency will provide managers with the opportunity to address and discuss challenges in a timely manner.

In conclusion, the research identifies several challenges associated with retaining a TSMO workforce. However, due to the emerging nature of both positions and challenges, research does not provide any specific solutions. Therefore, the agencies tend to focus on specific solutions that best fit their needs and their business culture.

6.2 BEST PRACTICES AND LESSONS LEARNED

Research shows that developing a retention plan for the TSMO workforce will better address career and personal needs and encourage commitment to the agency. The retention plan should address job responsibilities, define how the position supports the agency's mission, identify training and professional development opportunities, define salary and benefits, and allow flexible work conditions. It should address the specific needs of the TSMO positions in a way that is consistent with agency policies.

6.3 NDOT TSMO WORKFORCE RETENTION PLAN

Table 8 represents suggestions for NDOT to consider in retaining the TSMO workforce. These suggestions are developed under three categories of training, HR, and culture.

TABLE 8: SUGGESTIONS FOR DEVELOPING A TSMO WORKFORCE RETENTION PLAN

Suggestions	Category
Provide recurring training and professional development opportunities (such as conferences, seminars, national trainings, etc.).	**Training**
Offer mentorship programs and opportunities. This can be through rotational programs, cross-functional interactions, and a TSMO rotational program.	**Training**
Provide leadership training and opportunities.	**Training/Culture**
Develop and implement a voluntary rotational training program as a pilot.	**Training**
Offer performance-based incentives based on the position's Work Performance Standards (employee recognition, certificates of achievement, bonuses).	**HR**
Provide regular and effective feedback through frequent anonymous employee satisfaction surveys.	**HR**
Modify traditional certification and licensure requirements for recruitment and advancement opportunities in TSMO positions.	**HR/Culture**
Clearly articulate the relationships between TSMO positions and the agency mission and vision.	**HR/Culture**
Increase gender and professional diversity in recruitment.	**HR/Culture**
Provide clear definition and expectations for internal and external communication and collaboration.	**Culture**
Support professional organization involvement and encourage participation in local and national TSMO dialogues.	**Culture**
Offer extended leave opportunities.	**Culture**

7

TSMO WORKFORCE IN EDUCATIONAL INSTITUTIONS

Educational institutions can play a vital role for advancing TSMO within state organizations. In addition, local universities and professional institutions can contribute to TSMO workforce and strategy development. To support and advance TSMO integration, local universities and agencies can act as one in educating, developing, and training a TSMO workforce.

For NDOT, institutions such as the University of Nevada-Las Vegas and the University of Nevada-Reno, along with several others, can promote TSMO and provide considerable support to strengthen this base.

Local universities in Nevada have many unrecognized TSMO activities already in place. For instance, several institutions already offer innovative transportation research projects and traffic/transportation courses, but do not clearly define the relationships with and contribution to TSMO. The following subsections summarize the existing TSMO overlaps between federally issued guidelines and local Nevada universities which, if extracted and guided in an appropriate direction with necessary changes, can produce high-yielding results.

7.1 TSMO WORKFORCE GUIDEBOOK AND NEVADA UNIVERSITIES

Local universities can serve as a potential reinforcement for state departments to strengthen TSMO culture. They can teach knowledge and skills required on any ongoing state project. To build strong university/state agency partnerships, the pathway to university involvement needs to be formalized. The following subsections highlight many overlaps observed between courses/research in universities and standard TSMO practices put forth by the federal government.

7.1.1 UNIVERSITY COURSES

TSMO Workforce Guidebook: TSMO is focused on optimizing current and future infrastructure investments through technology, data, and information-based strategies. To maximize capacity, safety, and reliability, the TSMO workforce needs to be trained and strengthened. In other words, through optimum use of available resources, infrastructure development can be capitalized through TSMO strategies.

Universities across the U.S. offer various courses that, in one way or another, are relevant to TSMO. Based on the findings, there are 775 undergraduate and 557 graduate courses listed at different universities across the country that are considered applicable.[8]

University of Nevada, Las Vegas (UNLV): Currently, different civil engineering (focused on transportation as well as other areas) and computer-related courses are incorporated in the University's undergraduate as well as graduate curricula. Combining undergraduate and graduate programs, several courses are available to students depending on their area of interest. These include Airport Design, Computer Applications In Transportation Engineering, Geometric Design of Highways, GIS Application in Transportation Engineering, High-Speed Rail, Introduction to Railroad Transportation, Public Transportation Systems, Railroad Engineering, Traffic Engineering, Advanced Traffic Engineering, Construction Estimating,

8 *Transportation Systems Management and Operations (TSMO) Workforce Guidebook, 2019*

Advanced Soil Mechanics, Design of Highway Bridge Structures, Software Engineering, Algorithms, Data Science, and Artificial Intelligence (AI)/Big Data.

University of Nevada, Reno (UNR): UNR also offers numerous courses related to TSMO, which are included in its undergraduate and graduate programs. It currently incorporates at least two undergraduate and four graduate courses in the civil engineering program. Courses such as Traffic Operations and Transportation Engineering are included in the undergraduate program and the courses offered as part of graduate studies include Traffic Operations, Traffic Safety, Traffic Simulation, and Transportation Systems Management and Operations; however, they are heavily focused on engineering.

7.1.2 UNIVERSITY RESEARCH PROGRAMS

TSMO Workforce Guidebook: Along with courses, the research and development sector also can serve as a vital contributor to TSMO. Looking at the existing university course titles, it appears that most of the courses are focused on design and engineering, followed by planning and operations. On the other hand, TSMO requires a wider focus on all transportation elements, including traffic operations, maintenance, planning, and ITS. Thus, an extensive research and development need was identified to include TSMO within all the sectors of transportation engineering, including planning and operations.[9]

University of Nevada, Las Vegas: UNLV has a special Transportation Research Center (TRC) established in the university that has multiple transportation research programs going on simultaneously to propose smart solutions for maximizing infrastructure capacity. Research projects include GIS-based safety analysis systems, video-based vehicle detection, traffic management data tools, automated pedestrian detection systems, etc. These research projects are guided by qualified university professors and professional engineers to assist students in researching and developing potential cost-effective solutions.

The TRC can be a potential resource for NDOT in building a TSMO workforce from within UNLV.[10]

University of Nevada, Reno: UNR has a traffic engineering laboratory supporting research and development projects for students. This laboratory has done considerable work in developing smart techniques for traffic management. One of the prior recognized projects included the use of LiDAR sensors to improve traffic efficiency and reduce accidents. Other potential research areas with university professors include advanced traffic sensor technologies, driver behavior studies, autonomous and connected vehicles, and similar topics.[11]

There are numerous advantages associated with a strong, long-term university/state agency relationship, including:

- Existing undergraduate and graduate coursework can include the TSMO description, resulting in continuous discussions in ongoing classes or project work.

9 *Transportation Systems Management and Operations (TSMO) Workforce Guidebook, 2019*
10 *Transportation Research Center, 2020*
11 *Research Topics and Advisors, 2020), (New Roadside LiDAR Sensors help build a safer transportation Infrastructure, 2020*

- Students can review past projects, identify TSMO elements, use course information, and receive training to implement TSMO strategies.
- Students also can participate in ongoing state departmental research activities, shadow existing employees, and build their careers.
- Student exposure to the state organizations could result in development of work ethic, and students could learn different skills along with academics, which in turn will help them in the long run.

7.2 RECOMMENDATIONS

Same Course, Revised Course Content / Offer TSMO Elective Courses: In collaboration with NDOT, undergraduate and graduate course offerings can be revised to include TSMO elements. Doing so will result in frequent TSMO discussions in ongoing classes pertaining to the topic of interest.

Research Assistant/Teaching Assistant: University professors often work on other NDOT development projects for which they seek assistance from their students. NDOT could capitalize further on partnering with the universities for existing and future development projects that include TSMO components. Students can get exposed directly to TSMO topics, depending on the nature of the project, and be provided with hands-on training in different areas of TSMO.

NDOT Official Presentations: NDOT TSMO-oriented team members or employees of Traffic Operations Division can conduct occasional university visits to present on recent/ongoing TSMO projects and activities within the department. This will have a significant impact on providing the students with a vision and helping them pursue and select a suitable career path with TSMO roles and responsibilities.

Professional Organization: In collaboration with university professors, promote students' enrollment in professional organizations to take advantage of the TSMO trainings provided by professional organizations.

Shadow/Mentorship/Internship Programs: In collaboration with universities, NDOT could develop shadow and mentorship programs for students to help them interact and work with NDOT officials. This will advance their insights and understanding of TSMO in practice. These opportunities also may include field visits, group exercises, engagement in project meetings, and involvement in real-life scenarios, which will provide the students with even further experience in TSMO topics.

DOD SkillBridge Program: NDOT Could collaborate with DOD SkillBridge program to provide the TSMO training for service members and help them bridge the gap between the end of service and the beginning of their civilian careers. This program also allows NDOT access to the extensive experience and skills service members bring to the workforce.

Innovative Career Fairs: Every year career fairs are organized to hire interns and full-time roles in different positions. These career fairs can evaluate TSMO inclusion/responsibilities in different positions within departments.

Research, Collaboration, and Development: Students, especially those working on their theses/dissertations, can get involved with NDOT officials to discuss their project and seek assistance and guidance. This will allow them to learn about the ongoing TSMO developments within the state. Usually, TRC at UNLV and Traffic Laboratory at UNR provide an environment for the students and NDOT officials to interact at interpersonal levels and produce innovative solutions to real-life problems.

A formal transportation research collaboration agreement can be prepared between NDOT and local universities to further formalize and facilitate these activities.

Establishing Various Programs in Collaboration with Universities, Emergency Responders, IT Community, and other educational institutions: For instance: (1) Nevada CAV Technology Research Group, (2) Transportation Asset Management and Maintenance, (3) AI in the Transportation Industry, and more. These programs deliver training, knowledge, and information to university students and, in turn, these students can help in research and development of projects over a long period of time.

8

SUMMARY OF PLAN RECOMMENDATIONS

Table 9 summarizes the recommendations developed for NDOT Traffic Operations Division for recruiting, training, and retaining a TSMO workforce. A priority level has been assigned to each item in order to assist NDOT in efficiently planning and implementing the next steps, including Short-term (2023 to 2024), Mid-term (2024 to 2025) and Long-term (2025 to 2026) time frames.

TABLE 9: SUMMARY OF PLAN RECOMMENDATIONS AND PRIORITIES

Priority	Topic	Description	Focus Areas	Methodology
S	General	Define roles and responsibilities for the TSC members. This will establish a task force or a TSMO working group that will be engaged in implementing and delivering TSMO on a project-basis.	TSMO Working Group/ Task Force	Can be defined internally within Traffic Operations Division senior team members with support from ELT.
S	Recruitment	Account for the physical space required to house all TSMO positions.	TSMO Workforce Accommodation	Coordinate with Architecture Division in renovating Traffic Operations to add more desks.
S	Recruitment	Coordinate training with HR to advance TSMO culture and mainstream TSMO recruitment.	HR	Share training modules with HR and NDOT training section.
S	Recruitment	Include defined opportunities for career development within the agency for the TSMO positions.	Incentives/ Culture	Identify and document within HR processes and procedures for Traffic Operations Division.
S	Recruitment	Utilize benefit/cost analysis to identify required TSMO positions.	TSMO Positions	Monitor and record costs and benefits, include and compare with alternatives (such as staff augmentation or outsourcing).
S	Recruitment	Define the formal role of TSMO positions as it relates to communication and collaboration with internal and external stakeholders, as well as the TSC.	TSMO Positions	Define and record within the formal job descriptions.
S	Recruitment	Include specific technical roles and responsibilities in the TSMO positions' descriptions.	TSMO Positions	Define technical roles and responsibilities through review of current and future emerging technology deployments.
S	Training	Develop and implement TSMO training programs.	Basic and Advanced Training Programs	Utilize the training plan to roll out the trainings.

Legend: **S** - *Short-term* **M** - *Mid-term* **L** - *Long-term*

Priority	Topic	Description	Focus Areas	Methodology
S	Retaining	Provide regular and effective feedback through frequent anonymous employee satisfaction surveys.	HR	Distribute surveys internally within the respective Divisions as well as with the stakeholders or key contacts.
S	Retaining	Support professional organization involvement and encourage participation in local and national TSMO dialogues.	Culture	Include responsibility within an Administrator position job description to identify opportunities.
S	Retaining	Highlight the extended leave opportunities to attract and retain qualified candidates.	Culture	Work with HR to identify strategies and include them as part of the positions' advertising package.
S	Education	Conduct occasional university visits to present on recent/ongoing TSMO projects and activities within the department.	Training	Include responsibility within an Administrator position job description to serve as the point of contact for educational institutions.
S	Education	Promote enrollment in professional organizations to take advantage of the TSMO trainings provided by professional organizations.	Culture	Include responsibility within an Administrator position job description to serve as the point of contact for educational institutions
S *(as needed)*	Education	Attend career fairs that are organized to hire interns and full-time roles in different positions.	Collaboration	Include responsibility within an Administrator position job description to participate in career fairs, and other activities hosted by universities to promote the available programs.
M	General	Engage Executive Leadership Team.	Collaboration/ Culture	Identify appropriate opportunities for their engagement in meetings where TSMO is discussed, and communicate TSMO success stories through flyers, newsletters, social media, etc.
M	Recruitment	Coordination with HR for screening process to ensure TSMO roles and responsibilities are considered as outlined within the job descriptions.	HR	Encourage HR to undertake basic TSMO training and develop specific and detailed instructions for screening process.

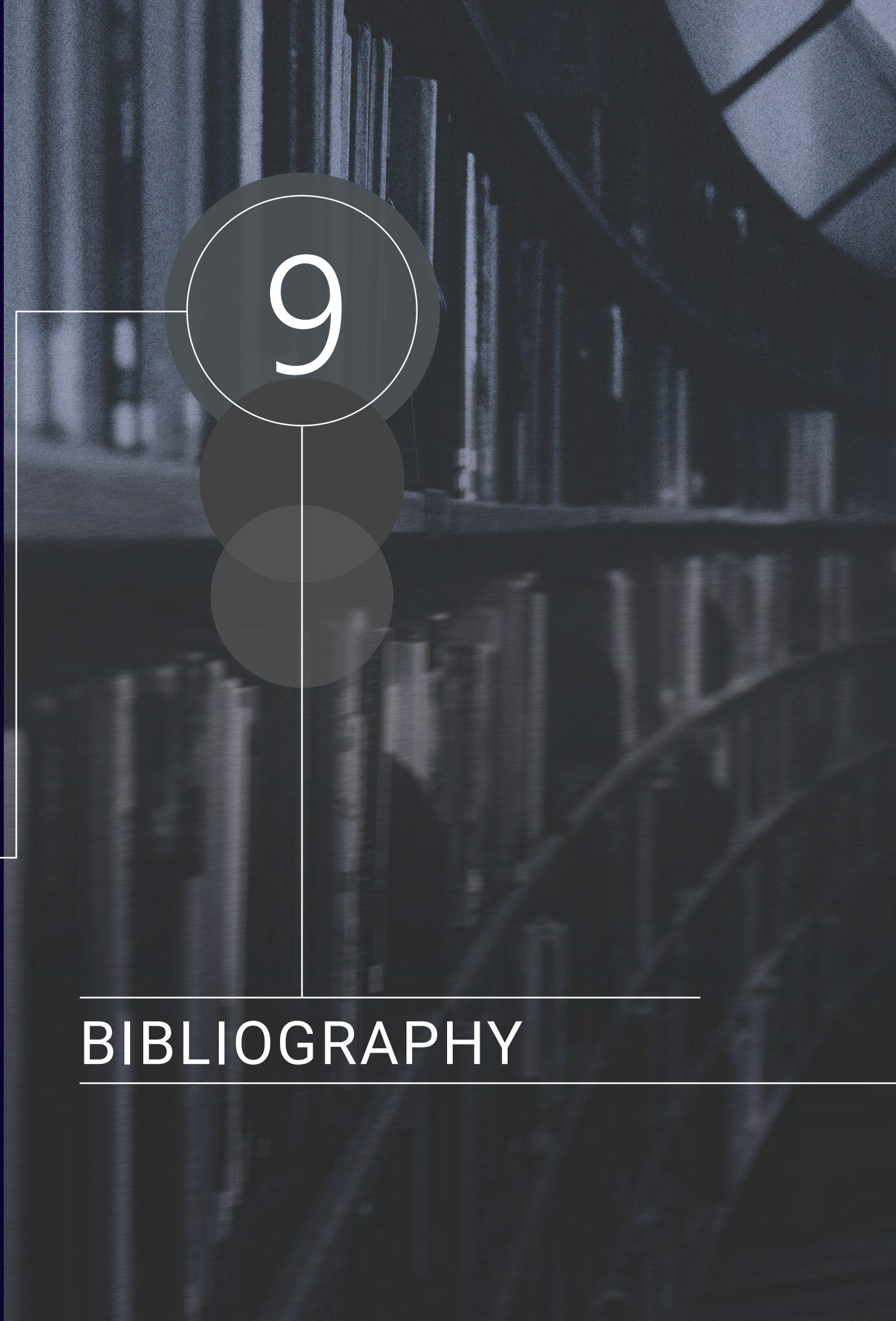
Legend: **S** - *Short-term* **M** - *Mid-term* **L** - *Long-term*

Priority	Topic	Description	Focus Areas	Methodology
M	Recruitment	Add five TSMO positions to the organizational structure (TSMO Engineer, TSMO Modeling Specialist, TSMO Program Manager/ Coordinator, TSMO Data Analyst, TSMO Performance Manager).	TSMO Positions	Update the organizational structure to include the new TSMO-centric positions.
M	Training	Cross-training through advanced practitioner training and new hires rotational programs.	Basic and Advanced Training Programs	Share TSMO training packages and encourage other Divisions to participate in the in-person trainings and meetings.
M	Retaining	Develop and implement a voluntary rotational training program as a pilot.	Basic and Advanced Training Programs	Develop the schedule based on the workload of employees who applied for the program.
M	Retaining	Provide recurring training and professional development opportunities (such as conferences, seminars, national trainings, etc.).	Training	Include responsibility within an Administrator and Supervisors position job description to identify opportunities.
M	Retaining	Clearly articulate the relationships between TSMO positions and the agency mission and vision.	HR/Culture	Document with HR, and clearly define expectations within the job descriptions.
M	Retaining	Increase gender and professional diversity in recruitment.	HR/Culture	Work with HR to identify strategies and include them as part of the positions' advertising package.
M	Retaining	Provide clear definition and expectations for internal and external communication and collaboration.	Culture	Document with HR and clearly define expectations within the job descriptions.
M	Education	Further capitalize on partnering with the universities for existing and future development projects that include TSMO components.	Training	Identify a point of contact for the universities and maintain engagement in universities' project development activities.
M	Education	Involve students with NDOT officials to discuss their projects, seek assistance and guidance, and learn about the ongoing TSMO developments within the state.	Collaboration	Identify a point of contact for the universities and maintain engagement in universities' project development activities.

Legend: **S** - *Short-term* **M** - *Mid-term* **L** - *Long-term*

Priority	Topic	Description	Focus Areas	Methodology
M	Education	Establish various TSMO programs in collaboration with universities, emergency responders, IT community, and other educational institutions.	Collaboration	Identify a point of contact for the universities and maintain engagement in universities' project development activities.
M	Education	Develop shadow and mentorship programs for students to help them interact and work with NDOT TSMO positions.	Culture	Work with HR to identify strategies and include them as part of the positions' advertising package.
L	General	Develop partnerships with private sector to leverage resources including data, staff, and skillsets.	Collaboration/ Culture	Develop standard processes and procedures within planning and financial documents and advertise opportunities.
L	Retaining	Offer mentorship programs and opportunities through rotational programs, cross-functional interactions, and/or a TSMO rotational program.	Training	Share training resources and encourage participation in the TSMO training packages.
L	Retaining	Provide TSMO leadership training and opportunities.	Training/Culture	Share training resources and encourage participation in the TSMO training packages.
L	Retaining	Offer performance-based incentives based on the position's Work Performance Standards.	HR	Document the Work Performance Standards with HR and include them as part of the positions' advertising package.
L	Retaining	Modify traditional certification and licensure requirements for recruitment and advancement opportunities in TSMO positions.	HR/Culture	Document the incentives with HR and include them as part of the positions' advertising package.
L	Education	Undergraduate and graduate course offerings can be revised to include TSMO elements.	Collaboration	Identify a point of contact for universities to provide and share resources.

Legend: **S** - *Short-term* **M** - *Mid-term* **L** - *Long-term*



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10 APPENDICES

APPENDIX A.

MODEL JOB DESCRIPTIONS OF TSMO POSITIONS

TSMO ENGINEER

Education: Bachelor's degree in Engineering

Certificate, Licensure, Registrations: Registered Professional Engineer

1. Assist in the planning, advancement, and administration of the TSMO Program. Perform duties as a technical advisor on the use of ITS, traffic engineering, tolling, policies and practices to other divisions, stakeholders, and regional partners. Identify opportunities to integrate systems management, technology, traffic engineering, and operations. Ensure design best practices are followed. Analyze engineering designs, specifications, and test plans. Learn and apply standard engineering techniques. Research and identify opportunities for application of latest technologies and programs. Work with IT group to develop systems and related software applications that support TSMO. Collaborate with other technical team members to ensure system compatibility, interoperability, and synchronization. Stay up to date with emerging technology, latest TSMO strategies, federal TSMO products, and resources. Manage and lead the TSMO Program elements update cycle.

2. Supervise and train team members in TSMO topics. Identify national training opportunities. Meet regularly with management to report on TSMO Program progress, establish work objectives and timelines to ensure goals and objectives are met. Work directly with TSMO Program Manager to attend to and process human resource requirements, filing vacant TSMO positions, and identify new TSMO positions' needs. Assess and if necessary, make recommendations to adjust the department's direction in response to a changing environment and emerging TSMO positions.

3. Assist in development and application of policies and procedures that support the advancement of TSMO in daily activities of the division. Participate in routine, daily operations resulting from these operating policies. Responsible for application of TSMO tools and performing recurring updates on the tools in collaboration with other team members. Ensure funding and resources are utilized in the most cost-effective manner. Identify opportunities to integrate TSMO strategies during scoping, planning, design, construction, operations, and maintenance of projects as applicable.

4. In collaboration with TSMO Performance Manager, track progress and development of recurring reports in regard to the TSMO Program goals and objectives, focus energy and resources, strengthen operations, ensure that all team members are working toward common goals, and assist in establishing agreements for the intended outcomes.

5. Collaborate with other team members in plan development, ensure linking performance targets to specific, measurable, achievable, relevant, time-bound (SMART) objectives, identify and provide resource recommendations. Ensure TSMO Program elements, performance measures, and functions are being implemented. Participate in meetings, committees, task teams and other groups with both internal and external stakeholders to present TSMO interest. Lead the TSMO Steering Committee meetings, develop meeting materials, agenda, and notes. Communicate effectively and work with team members from different technical backgrounds.

6. Identify strategies to maintain professional contact with elected officials, private vendors, public and government agencies. Participate in NOCoE webinars, seminars, trainings, and presentations. Represent NDOT TSMO Program at national conferences and seminars. Provide accurate and timely responses to internal and external stakeholders regarding TSMO topics. Improve and promote stakeholder participation. Make presentations before senior and executive management team.

TSMO MODELING SPECIALIST

Education: Bachelor's degree in Engineering

Certificate, Licensure, Registrations: Registered Professional Engineer

1. Supervise and assist team members in TSMO responsibilities and activities. Provide training for technical staff pertaining to TSMO responsibilities. Ensure employees are kept informed of departmental, state, and federal best practices and procedures. Meet regularly with team members to assign tasks, establish objectives and timelines to ensure TSMO goals and objectives are met. Evaluate and monitor team members' performance against their assigned work performance standards, regularly communicate and provide direct reports to the management on the progress made with specific tasks.

2. Collaborate with other team members regarding the overall TSMO planning, development, and application. Communicate effectively and clearly and work well with team members from diverse technical backgrounds, identify opportunities to integrate TSMO modeling into project scoping, planning, design, construction, operation, and maintenance.

3. Participate in internal and external meetings, tasks teams and other groups and committees to represent TSMO interest related to TSMO modeling. Promote public relations, provide timely and accurate responses to the internal and external stakeholders, vendors, and partners. Manage the resolution of outstanding contractual and technical issues related to TSMO modeling. Participate in national dialogues and represent NDOT in conferences and summits to promote TSMO modeling as applicable.

4. Manage and develop contracts and other types of agreements that support TSMO functions and/or relate to performance targets. Manage and develop documentation for funding, RFPs and related documents, participate on technical reviews, evaluation of work products and approval processing. Ensure TSMO modeling funding and resources are utilized in the most effective and efficient manner.

5. Perform duties as a technical advisor on modeling for TSMO including microscopic, mesoscopic, and macroscopic models such as TransCAD Transportation Planning Software, Highway Capacity Software, Aimsun Next, PTV Vissim, TSIS CORISM, Synchro, and other customized applications and software. Implement modeling for planning, visualization, analysis and training related to TSMO projects and programs. Assess and identify potential added value software for modeling. Work closely with other team members to ensure system compatibility and operability with existing systems. Develop technical reports, presentations, training materials, etc. as required. Ensure all activities follow national standards and practices.

6. Work closely with TSMO Performance Manager and other team members who undertake performance measurement activities to identify opportunities for TSMO integration into current business processes and federal reporting documents. Collaborate with other NDOT divisions to incorporate TSMO modeling and relevant performance measures into NDOT planning and performance measurement documents. Participate in relevant projects, integrate performance measurement strategies and TSMO modeling tools, as applicable.

TSMO PROGRAM MANAGER/COORDINATOR

Education: Bachelor's degree in Engineering

Certificate, Licensure, Registrations: Registered Professional Engineer

1. Develop, implement, and maintain policies, standards, and procedures related to TSMO. Ensure routine, daily operations resulting from operating policies, guidance, standards, manuals, and agreements meet the needs and requirements of the division and the department. Report on utilization of the Investment Prioritization Tool and TSMO Evaluation Tool on each project including benefit/cost. Identify opportunities to integrate TSMO strategies during scoping, planning, design, construction, operations, and maintenance of projects as applicable. Ensure TSMO business processes are current and up to date.

2. Maintain knowledge of current and emerging federal and state laws, rules, regulations, and industry practice related to ITS deployments and operations. Develop, implement, and maintain policies, standards, and procedures to ensure the ITS Network is operated within state and industry standards.

3. Maintain professional working relationships with other managers, technical, and non-technical personnel. Collaborate with agency staff and communicate TSMO activities among various groups of the division. Participate in management meetings and provide relevant information. Support the division with other duties, special projects, and new programs as required and complete them in a timely, accurate and highly professional manner.

4. Provide information and education regarding the principles of TSMO and ensure they are effectively incorporated throughout the department. Prepare activity and progress reports and establish milestones for the TSMO Program. Represent the department at meetings with federal, state, local units of government and the State Emergency Operations Center. Attend and effectively participate in meetings and promptly complete all associated assignments and responsibilities. Participate on committees, working groups and technical panels at both the local and national level in all areas of TSMO.

5. Supervise and assist division managers and team members in TSMO responsibilities and activities. Provide training for technical staff pertaining to TSMO responsibilities. Monitor employee performance and ensure employees are kept informed of departmental, state, and federal best practices and procedures.

6. Develop and monitor performance measures of deployed TSMO strategies, program benefit/cost analyses and monthly or quarterly performance reports, as appropriate. Performance measures should accurately measure the performance and viability of programs and projects and be used to support informed decisions in coordination with agency transportation planning staff. Performance reports should be developed in a format easily understood by persons of varied backgrounds to reflect the performance and progress of the TSMO program and projects. Provide solution-based recommendations for various projects by creating clear and attainable objectives.

TSMO DATA ANALYST

Education: Bachelor's degree in Engineering, Planning, Business Administration, Math, Geography, Economics, Statistics, or related field

Certificate, Licensure, Registrations: NA

1. Responsible for extracting, organizing, analyzing, integrating, and communicating information from the variety of available resources within NDOT. Develop predictive analytics, performance measures and targets in alignment with TSMO Program. Experience in big data and leveraging strong foundational analytical skills to develop data management and data utilization. Develop spatial databases (GIS) and relevant spatial analyses and statistics. Effectively use analytical tools to create information from data that can enhance decision-making. Develop and manage data acquisition/utilization and analysis performed by consultants and vendors, as well as internal and external agreements that support TSMO application and functions related to performance targets.

2. Enhance project scoping and planning process through integration of data for decision-making processes. Establish protocols and develop robust data sets through extraction and integration of multiple data sources. Support development and implementation of data management, data sharing, and data use policies and protocols. Perform duties as a technical advisor on the use of ITS and traffic data, standards, policies, procedures, and best practices. Identify opportunities to integrate data into the current division's business processes.

3. Collaborate and communicate with internal and external stakeholders to share information and provide guidance for technical decisions. Participate in meetings, committees and task teams as needed. Provide timely and accurate responses to internal and external stakeholders.

4. Work closely with TSMO Performance Manager to monitor, track, and analyze data in alignment with TSMO strategies and performance measures. Collaborate with internal and external stakeholders in developing plans, reporting results, and linking data to TSMO performance measures and SMART objectives. Identify opportunities to integrate data and performance measures into the wider NDOT performance management activities. Represent the division in discussions relevant to data analytics and reporting. Develop data-driven recommendations to ensure resources and funding are utilized in the most cost-effective manner. Ensure TSMO program elements, performance measures and functions are monitored and implemented in alignment with traffic and transportation data science/management.

5. Examine current practices and encourage the division toward new ways of thinking. Enable new approaches to traffic and transportation problem solving and system efficiency improvements. Promote data utilization and data-driven and performance-based decision-making process within internal and external agencies. Identify opportunities to integrate transportation and traffic data into current NDOT business processes, plans, and programs.

6. Work collaboratively with all sections to identify data and resource needs. Identify national training opportunities.

TSMO PERFORMANCE MANAGER

Education: Bachelor's degree in Engineering, Planning, Business Administration, Math, Geography, Economics, Statistics, or related field

Certificate, Licensure, Registrations: NA

1. Responsible for analyzing and communicating information obtained from a variety of transportation and traffic data sources to internal and external stakeholders. Assist the division and wider NDOT in using data to enhance the planning process and enable data-driven decision-making for TSMO program. Ability to communicate information with the internal and external stakeholders and provide guidance for technical decision-making process. Participate in meetings, committees, and task teams both internally and externally.

2. Experience in big data and leveraging strong foundational analytical skills to develop data management and data utilization. Develop a data utilization and applicability work plan for the division in alignment with TSMO performance measures. Performance measures should accurately measure the performance and viability of programs and projects and are used to support informed decisions in coordination with agency transportation planning staff. Performance reports should be developed in a format easily understood by persons of varied backgrounds to reflect the performance and progress of TSMO program and projects. Provide solution-based recommendations for various projects by creating clear and attainable objectives. Ability to analyze big data to develop trends and summary statistics in collaboration with the TSMO Data Analyst. Assist in making operational decisions based on TSMO performance measures and in alignment with TSMO goals and objectives through development of decision support tools and plans. Integrate multimodal data into operational decision-making process.

3. Examine current practices and provide recommendations for a new way of thinking. Provide guidance and an overall vision that will enable new approaches to problem solving through performance measurement and management. Promote performance-based decision-making process and advantages internally and externally. Participate in meetings, committees, task teams, and other groups with internal and external customers to support TSMO interests and provide technical guidance related to traffic data/analysis.

4. Work with the wider NDOT and internal and external stakeholders to integrate performance measurement and management into decision-making business processes. Work with TSMO Data Analyst in using data to support and secure funding for TSMO applications, functions, and infrastructure. Develop and implement data acquisition/use aspects of TSMO business and related plans to guide resource allocation and achieve unit performance targets. Develop data-driven support to ensure funding and resources are utilized in the most cost effective and beneficial manner.

5. Perform duties as a technical advisor on the use of traffic, ITS and tolling data, standards, policies, and best practices. Identify emerging technologies that enable performance-driven decision-making process. Identify opportunities to integrate technology into the division's performance management practices and processes. Ensure TSMO program elements, performance measures and functions are monitored and implemented in alignment with traffic and transportation data science/management.

6. Oversee team and group activities, document results and related presentations as necessary. Work with division managers to identify resource requirements. Work closely with the division managers in linking performance targets and objectives to team members' expectations in order to identify and provide resource recommendations.

APPENDIX B.

SUMMARY OF RESEARCH FINDINGS ON TSMO TRAINING

Training Topic	Training Highlights	Provider
TSMO 101: What Is This TSMO Thing Anyway? – 2-hour module	Provides overview of TSMO and why it is important. Provides the objectives of TSMO. Describes the organizational initiatives to sustain TSMO. Lists the benefits and challenges of TSMO strategies.	CITE – Consortium for Innovative Transportation Education Full Semester course https://www.citeconsortium.org/course/tsmo101/
Integrating TSMO Into your Agency – 2-hour module	Explains the role of TSMO within a transportation agency. Explores mobility and its associated benefits. Explains the relationship between TSMO and overall transportation system.	CITE – Consortium for Innovative Transportation Education Full Semester course https://www.citeconsortium.org/course/integrating-tsmo-into-your-agency/
Improving Highway Safety with ITS	Course intended for ITS, transportation operations, and safety professionals. Explains the overall magnitude and importance of highway safety. Illustrates different lessons relating to development and deployment of ITS strategies to address safety issues. Discusses the contribution ITS can make in improving highway safety.	CITE – Consortium for Innovative Transportation Education Full Semester course https://www.citeconsortium.org/course/improving-highway-safety-with-its/
CMM: Assessing Agency Capabilities – 2-hour course	Discusses appropriate focus on what has to change in a transportation agency to improve TSMO effectiveness. Discuss CMM, its applications, its dimensions, and level criteria for each dimension.	CITE – Consortium for Innovative Transportation Education On-demand self-paced course https://www.citeconsortium.org/course/cmm-assessing-agency-capabilities/

Training Topic	Training Highlights	Provider
Advancing Transportation Systems Management and Operations within Corridors and Subareas	Provide planning or operations professionals at state, regional and local levels with a performance-based, integrated, and multimodal approach to planning for TSMO. Includes video lectures by instructors, lessons learned, and presentations from experts on different modules like, "An Approach to TSMO within Corridors and Subareas", and "Moving to Implementation".	FHWA – Federal Highway Administration https://ops.fhwa.dot.gov/plan4ops/resources/traing.htm#wb2
Advancing Transportation Systems Management and Operations through Scenario Planning	Informs planners, operators, and other TSMO Practitioners on use of scenario planning to advance TSMO, including why and when to use it and how to apply the phases of scenario planning to TSMO. Video presentations by workshop instructors and practitioners. Provides Q&A session in mock TSMO-related cases.	FHWA – Federal Highway Administration https://ops.fhwa.dot.gov/plan4ops/resources/traing.htm#wb2
Making the Business Case for Institutional, Organizational, and Procedural Changes for TSMO	This course is designed to teach state and local TSMO champions how and why they need to make a business case for TSMO implementation. The goal of this course is to provide an overview of the importance and benefits of making changes to agency institutional, organizational, and procedural changes to support more effective TSMO practices. It teaches ways to customize a TSMO business case for different audiences. Target audience: TSMO champions in state and local agencies seeking to make business cases to their leadership.	NHI – National Highway Institute Level: intermediate https://www.nhi.fhwa.dot.gov/course-search?tab=0&sf=0&course_no=133128

- Other CITE on-demand self-paced courses - https://www.citeconsortium.org/individual-courses/
- Other CITE full semester courses - https://www.citeconsortium.org/cite-courses/full-semester-courses/tsmo-study-program/
- Other FHWA trainings - https://ops.fhwa.dot.gov/plan4ops/resources/traing.htm#wb2
- ITS Heartland Trainings- https://itsheartland.org/tsmo-university/

NDOT STATEWIDE TSMO PROGRAM

NDOT TSMO Implementation Staffing and Workforce Development Plan

Nevada Department of Transportation

June 2022

NEVADA DOT SAFE AND CONNECTED

ATKINS

Member of the SNC-Lavalin Group