ADVANCING TSMO THROUGH ORGANIZATIONAL STRUCTURES

U.S. Department of Transportation
Federal Highway Administration

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16. Abstract This report applies concepts of organizational theory, specifically related to organizational structure, to explore ways in which organizational models and structural mechanisms can be used to advance transportation systems management and operations (TSMO) within departments of transportation (DOTs). It includes several case studies of organizational structures in DOTs across the Nation and looks at how DOTs have used their structures to mainstream TSMO			
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SI* (MODERN METRIC) CONVERSION

FACTORS APPROXIMATE CONVERSIONS TO SI UNITS				
SYMBOL	**WHEN YOU KNOW**	**MULTIPLY BY**	**TO FIND**	**SYMBOL**
LENGTH				
In.	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
AREA				
$in.^2$	square inches	645.2	square millimeters	mm^2
ft^2	square feet	0.093	square meters	m^2
yd^2	square yard	0.836	square meters	m^2
ac	acres	0.405	hectares	ha
mi^2	square miles	2.59	square kilometers	km^2
VOLUME				
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft^3	cubic feet	0.028	cubic meters	m^3
yd^3	cubic yards	0.765	cubic meters	m^3
NOTE: volumes greater than 1,000 L shall be shown in m^3				
MASS				
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams (or "metric ton")	Mg (or "t")
TEMPERATURE (exact degrees)				
°F	Fahrenheit	5 (F-32)/9 or (F-32)/1.8	Celsius	°C
ILLUMINATION				
fc	foot-candles	10.76	lux	lx
fl	foot-Lamberts	3.426	candela/m^2	cd/m^2
FORCE and PRESSURE or STRESS				
lbf	poundforce	4.45	newtons	N
$lbf/in.^2$	poundforce per square inch	6.89	kilopascals	kPa

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SI* (MODERN METRIC) CONVERSION (continued)

APPROXIMATE CONVERSIONS TO SI UNITS				
SYMBOL	**WHEN YOU KNOW**	**MULTIPLY BY**	**TO FIND**	**SYMBOL**
LENGTH				
mm	millimeters	0.039	inches	in.
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
AREA				
mm^2	square millimeters	0.0016	square inches	$in.^2$
m^2	square meters	10.764	square feet	ft^2
m^2	square meters	1.195	square yards	yd^2
ha	hectares	2.47	acres	ac
km^2	square kilometers	0.386	square miles	mi^2
VOLUME				
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m^3	cubic meters	35.314	cubic feet	ft^3
m^3	cubic meters	1.307	cubic yards	yd^3
MASS				
g	grams	0.035	ounces	oz
kg	kilograms	2.202	pounds	lb
Mg (or "t")	megagrams (or "metric ton")	1.103	short tons (2000 lb)	T
TEMPERATURE (exact degrees)				
°C	Celsius	1.8C+32	Fahrenheit	°F
ILLUMINATION				
lx	lux	0.0929	foot-candles	fc
cd/m^2	$candela/m^2$	0.2919	foot-lamberts	fl
FORCE and PRESSURE or STRESS				
N	newtons	0.225	poundforce	lbf
kPa	kilopascals	0.145	poundforce per square inch	lbf/in^2

***SI is the symbol for the International System of Units. Appropriate rounding should be made to comply with Section 4 of ASTM E380. (Revised March 2003)**

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LIST OF ACRONYMS

BIL	Bipartisan Infrastructure Law
DOT	department of transportation
FHWA	Federal Highway Administration
HSIP	Highway Safety Improvement Program
IT	information technology
ITS	intelligent transportation systems
REACT	Regional Emergency Action Coordination Team
SHA	State Highway Administration
TIM	traffic incident management
TMC	transportation (or traffic) management center
TRAC	Transportation and Civil Engineering Program
TSMO	transportation systems management and operations
TTRI	travel time reliability index
VTrans	Vermont Agency of Transportation

EXECUTIVE SUMMARY

Transportation systems management and operations (TSMO) is a crosscutting, multidisciplinary approach that comprehensively examines safety, mobility, and reliability needs and uses a wide range of tools and management strategies to support a transportation agency's core functions. TSMO focuses on maximizing the operational performance of existing transportation infrastructure. TSMO includes low-cost, flexible solutions to meet changing conditions and operational challenges. State and local departments of transportation (DOTs) define and implement TSMO differently depending on their goals and priorities. Some DOTs include safety and maintenance within TSMO, and others define TSMO more narrowly.

An important aspect of integrating TSMO in an agency is how TSMO is addressed in an organizational structure. Different approaches to placing TSMO in the structure have implications for how TSMO is viewed, what influence it has, and how it coordinates with other functions in the agency. This report reviews different organizational structures of transportation agencies and how these structures impact the advancement of TSMO. Traditional hierarchical structures can create barriers to integration and coordination of TSMO activities across functional areas and organizational divisions. This report explores a number of strategies for enhancing linkages across the agency through information systems; TSMO liaisons, committees, and task forces; TSMO integrators; and relational coordination. These strategies can support a more crosscutting approach to TSMO and overcome structural limitations to integration.

No two transportation agencies have the same structure or approach to how they include TSMO organizationally. Each agency considers its strategic priorities, specific mission and responsibilities, budget and staffing capabilities, and current structure to determine the most effective placement of TSMO in the organization. Chapter 5 provides case studies of how TSMO is included in the organizational structure of State and local DOTs. Since the introduction of TSMO, each of the State DOTs has evolved its structures to reflect their priorities and capabilities. In some cases, TSMO has a prominent place in the structure. In other cases, TSMO is considered a subdiscipline. The case studies highlight how the agencies have organized their TSMO activities and the actions they have taken to address structural limitations.

The final chapter of this report discusses key takeaways and potential actions to advance TSMO in relation to an agency's organizational structure. In the State and local DOT case studies, the report authors found that each DOT used some form of horizontal linkages to connect and coordinate across divisions, regardless of the formal organizational structure. This coordination is important to advancing TSMO in the organization. Agencies with TSMO located higher in the organizational structure reported several advantages. TSMO leaders believed a higher position in the organizational structure made TSMO more visible across the organization and communicated to others in the DOT that TSMO is a priority. In agencies where a TMSO unit is positioned within in a lower-tier unit, TSMO leaders used horizontal linkages to overcome challenges, such as limited visibility and resource constraints. Funding for TSMO is also impacted by the structure of an organization. Agencies with a formal TSMO unit typically have a dedicated TSMO budget.

Formally structuring TSMO activities and responsibilities can advance TSMO, making it less dependent on interpersonal relationships, advocacy, and particular leadership buy-in. Creating horizontal linkages in the agency can bring a TSMO perspective to all DOT activities and projects, increasing the visibility of and commitment to TSMO regardless of where TSMO is positioned in the organization structure.

CHAPTER 1. INTRODUCTION

The adoption and advancement of transportation systems management and operations (TSMO) within a transportation agency is greatly influenced by the organization's structure and how it integrates TMSO activities across its divisions and functional areas. This report focuses on organizational structure and why they are important for creating an environment in which TSMO strategies are fully integrated throughout an agency's approach.

ORGANIZATIONAL STRUCTURE: WHAT IT IS AND HOW IT IMPACTS THE ORGANIZATION

The organizational structure of a State or local department of transportation (DOT) impacts its success in accomplishing its goals, including managing and operating the transportation system. An organization's structure is critical to its ability to accomplish its mission and goals through aligning functions to reach desired outcomes, including how organizations are structured to support and coordinate the full range of agency functions and responsibilities. Organizational structure is an enabling mechanism to accomplish the organization's mission, and it can facilitate or impede linkages throughout an organization.

The primary components of the organization's structure are:[1]

- **Relationships**: How formal reporting relationships are designed, including the number of levels in the hierarchy and the span of control managers and supervisors exercise
- **Structure:** How individuals are grouped into divisions and how divisions are structured within the total organization
- **Systems:** How systems are designed to ensure effective communication, coordination, and integration of efforts across departments; these relationships are referred to as horizontal linkages

Successful organizations align their organizational structures to their needs. For example, if a DOT's stated goals are safety and reliability, the structure of the organization should support these goals by creating clear connections across functional divisions to allow coordination that advances the goals. If stated priorities are not reflected in the organization, such as relegating priority functions to lower levels of the organizational structure or to siloed functional areas, it is difficult to grow an awareness of and support for that priority function. Understanding the relationship between structure and function and the importance of alignment among discrete organizational structures (e.g., divisions) is key to success for advancing TSMO.

1 Child, J. 1984. Organization: *A Guide to Problems and Practice*. London, England: Harper & Row.

WHAT IS TSMO?

TSMO is an approach that applies operational improvements to maximize system performance. TSMO can be applied on existing transportation facilities, in the design of new facilities, and systemwide. TSMO is defined in part in 23 U.S.C. 101(a)(32)(A) as the use of "integrated strategies to optimize the performance of existing infrastructure through the implementation of multimodal and intermodal, cross-jurisdictional systems, services, and projects designed to preserve capacity and improve security, safety, and reliability of the transportation system."[2]

TSMO includes programs that enable transportation agencies to implement low-cost solutions, balance supply and demand, provide flexible solutions to meet changing conditions, and benefit more areas and customers. How TSMO is defined and implemented across State and local DOTs varies based on agency goals and priorities. Some DOTs include safety and maintenance within TSMO, and others define it more narrowly.

Figure 1 illustrates some of the strategies commonly considered to be TSMO.

Source: FHWA.

Figure 1. Illustration. Sample TSMO strategies.

TSMO is a crosscutting, cross-disciplinary approach that looks comprehensively at mobility needs and integrates a wide range of tools and management strategies to support a transportation agency's core functions. TSMO can be enhanced through a variety of organizational structures, as discussed throughout this report.

2 The research for this publication was conducted before the passage of Bipartisan Infrastructure Law (BIL). Since then, the BIL has passed and changed the definition of TSMO, now referenced in 23 U.S.C. 101(a)(32)(A).

BENEFITS OF TSMO

The Federal Highway Administration (FHWA) Office of Operations' What is TMSO website provides the following list of benefits agencies can realize from advancing TSMO in transportation agencies:

- Improved quality of life
- Smoother and more reliable traffic flow
- Improved safety
- Reduced congestion
- Less wasted fuel
- Cleaner air
- Increased economic vitality
- More efficient use of resources (facilities, funding)

These benefits of TSMO support an agency's strategic goals, as well as the goals and objectives of a variety of functional areas within a DOT, such as planning, safety, maintenance, design, and construction. Structuring an organization to enhance these shared goals and benefits creates greater integration and the ability to leverage limited resources and expertise to support common goals.

A number of organizational indicators characterize an agency when TSMO has been mainstreamed, including:

- Senior executive support
- Full TSMO participation in decisionmaking bodies within the DOT
- Incorporation of TSMO strategies and considerations in policies and process (e.g., planning, design, and construction)
- Formal standing within the organization (e.g., a TSMO office, division, and budget)
- Coordination or linkages between TSMO and other functional and geographic areas of a DOT (e.g., cross-functional committees and working groups)

These indicators can occur organically over time or can be designed and implemented intentionally in the organizational structure.

REPORT OBJECTIVES AND TARGET AUDIENCES

This report applies concepts of organizational theory, specifically related to organizational structure, to explore ways in which organizational models and structural mechanisms can be used to advance TSMO within DOTs. Several case studies of organizational structures in DOTs across the Nation are included, as is an examination of how DOTs have used their structures to mainstream TSMO. The case studies and examples are based on a review of documents from a wide range of State and local DOTs and are supported by discussions with select agencies. The following agencies are subjects of the review and discussions:

- Arizona DOT
- Arkansas DOT
- Delaware DOT
- Maryland DOT
- Michigan DOT
- New Hampshire DOT
- New Jersey DOT
- North Carolina DOT
- Ohio DOT
- Pennsylvania DOT
- Tennessee DOT
- Texas DOT
- Vermont Transportation Agency
- Washington State DOT
- Gwinnett County DOT, Georgia
- Maricopa County DOT, Arizona
- New York City DOT, New York
- Palm Beach County DOT, Florida

There is no single model of how a DOT should be structured to advance TSMO given the variety of approaches that State and local agencies have used to evolve their organizational structures to meet this goal. This report will provide examples of approaches that State and local agencies have used to advance TSMO. The most effective structure for any DOT will depend on the agency's strategic priorities, existing culture, current capabilities, and functional responsibilities. The most effective structure varies by the size and characteristics of the State, city, or county; responsibilities of the DOT; and existing workforce and capabilities. Agencies reported several advantages to having TSMO positioned higher in the organizational structure, including its being more visible across the organization. By virtue of its higher positioning and visibility, the message that TSMO is a priority is effectively communicated to other DOT units. As of the publishing of this report, agencies have not reported any disadvantages to having TSMO higher up in the organizational structure; however, agencies should take into consideration the risks that may ensue if they decide to place TSMO high in the organization. One risk may be that a higher hierarchical position could result in a disconnection from day-to-day problems if there is not enough support from lower level staff or organizational units. In addition, transitioning TSMO to a higher level in the organization without making a clear business case for the need to do so may damage relationships and collaboration opportunities with other units in the agency.

The target audiences for this report include State and local DOT senior staff, managers, and agency leaders who are interested in advancing TSMO and understanding the role of organizational structure.

ORGANIZATION OF THE REPORT

This report provides an overview of various forms of organizational structures and dimensions. It applies concepts of organizational theory as they relate to organizational structure and explores ways in which organizational models and structural mechanisms can be used to advance TSMO within DOTs. This chapter has provided an overview of the report. In the remainder of this report:

- Chapter 2 describes typical indicators of organizational effectiveness as a backdrop for focusing more specifically on State and local agencies.
- Chapter 3 discusses the potential advantages and disadvantages of various structures for advancing TSMO and how these may be different in State and local DOTs.
- Chapter 4 examines ways to link TSMO across functional areas or divisions in a DOT. Links may take the form of a TSMO champion, committees or teams, TSMO integrators, crosscutting policies, processes, or executive directives, or the integration of information systems across the DOT. Each of these tools or horizontal linkages can be part of an organizational strategy to advance TSMO across an agency.
- Chapter 5 provides a number of case study examples of State and local DOT organizational structures. These examples demonstrate a range of approaches, including the placement of TSMO within an organization, the evolution of TSMO within the organization, horizontal linkage mechanisms, and the advantages or disadvantages of various structures for advancing TSMO.
- Chapter 6 summarizes how the theory of organizational structures informs the way TSMO is addressed in DOT structures. Chapter 6 also discusses what can be learned about current organizational placements of TSMO in DOTs and the effect on the advancement of TSMO. This chapter also identifies potential action items for agencies to advance TSMO in DOTs through changes in organizational structure and cross-functional linkages.

Table 1 provides a summary outline of the report.

Table 1. Focus and key points for each chapter in this report.

Chapter Number and Title	Focus	Key Points
1. Introduction	Introduces the primary content of the report.	What is transportation systems management and operations (TSMO)? • Benefits of TSMO • Objectives and audience • Report overview
2. Indicators of Organizational Effectiveness	Provides background assessing organizational effectiveness based on available information.	• Alternative ways for assessing organizational effectiveness • Relationships between organizational effectiveness measures
3. TSMO in Department of Transportation Organizational Structures	Discusses the various forms of organizational structures and dimensions with a description of advantages or disadvantages these may have for advancing TSMO within a DOT. This chapter also describes the different models or examples of where TSMO resides within an organizational structure and the considerations for local agencies	• Forms of organizational structures • Structural dimensions • TSMO in organizational structures • Local agency considerations
4. Horizontal Linkages: Tools for Advancing TSMO	Highlights mechanisms that TSMO champions can use to advance TSMO, regardless of where TSMO is within the organizational chart.	• Importance of coordination • Definitions of horizontal linkages • Mechanisms that can be used to advance TSMO
5. Case Studies	Provides example case studies of organizational models and horizontal linkages that are used to advance TSMO in State and local DOTs.	• Arizona DOT • Maricopa County DOT • Texas DOT • Michigan DOT • New Jersey DOT • Vermont DOT
6. Key Takeaways and Potential Actions to Advance TSMO	Summarizes how the theory of organizational structures can lead to the advancement of TSMO within an organization.	• Elements that enable TSMO integration • Review of TSMO placements within DOTs • Potential action items

CHAPTER 2. INDICATORS OF ORGANIZATIONAL EFFECTIVENESS

Four different approaches can provide a framework for assessing an organization's effectiveness.[3] These approaches are not mutually exclusive, and most organizations can be assessed in multiple ways. The differences among the approaches revolve around what is observed or measured and the accessibility of the measurement. The approaches are:

- Resource-based—assesses effectiveness by the level of resources the organization can attract, which is a measure of the inputs to an organization. In other words, organizations that compete successfully for limited funding and staff are more effective.
- Internal process—examines how smoothly the organization runs its processes, concluding that an organization run like a well-oiled machine is effective.
- Goal—views an organization's success by how well it is achieving its goals or desired outcomes.
- Strategic constituents—assesses based on the satisfaction of important organizational stakeholders, such as shareholders, employees, and the community.

The resource-based approach focuses on financial, personnel, and physical resources (i.e., the inputs) available to an organization to carry out its mission. Resources may not always be directly related to outcomes, but generally they can be the easiest to observe. Resource availability can also be a useful surrogate for measuring outcomes if linkages between resources and outcomes are understood. For example, if the agency has an adequate number of well-trained and properly equipped professionals, the agency may be more likely to achieve its mission than if it lacked these resources.

The internal process approach assesses how the agency uses its resources on business operations. Measuring internal processes is easier than measuring outcomes but more difficult than measuring resources; this decrease in effort is because agencies perform processes over time and observe both resource use and intermediate results (e.g., project development, resource programming, planning activities, design and construction activities, real-time monitoring, and control). Efficient and effective processes indicate the agency is applying resources in a manner that is likely to achieve the desired outcomes. Again, the linkage between well-conceived and properly executed processes and desired outcomes must be understood to ensure the right processes are being performed.

The goal approach focuses on outcomes and, if possible, enables an organization to see how well it is accomplishing its mission. However, measuring outcomes is difficult because of the longer time periods to observe or measure outcomes and the number of factors that can influence outcomes, especially in the public sector where changes in the economic, fiscal, or regulatory environment can affect outcomes.

3 Daft, R. L. 2016. *Organizational Theory and Design*. Boston, MA: Cengage Learning, page 68, Kindle.

Finally, the strategic constituents approach focuses on how well an agency meets the needs and expectations of stakeholders. This approach implies that the agency's goals and desired outcomes are aligned with the needs of these stakeholders (e.g., employees, customers, users, clients, community members, and governing entities). If the agency's goals are aligned with stakeholders' needs and expectations, then feedback from these stakeholders affirms whether the agency is meeting stakeholder needs and achieving the agency's own goals.

In reviewing these four approaches, one might see both the value and difficulty in applying the approach in assessing organizational effectiveness. The optimal measures of organizational effectiveness may likely be some combination of the four, depending on the value of the measure to understanding the organization's effectiveness and the cost to obtain it. Table 2 shows a comparison of these four approaches to evaluating organizational effectiveness.

Table 2. Comparison of approaches for evaluating organizational effectiveness.[4]

Approach	Relative Cost To Measure	Relative Value in Measuring Effectiveness
Resource-Based	Least costly, essentially a count of available resources compared with what is considered essential to performing the mission of the agency.	Assumes that if an organization is properly equipped, staffed, and has adequate resources, it can effectively carry out its mission.
Internal Processes	Modest cost, observe and track key performance indicators over time (e.g., cost, intermediate results, collaborative actions, on-time completion, and process quality metrics, such as service responsiveness and variance).	Assumes that well-conceived internal processes that are properly performed lead to desired outcomes.
Goal	Can be high cost and/or unrealistic to measure accurately due to the long time required to observe outcomes and potential for confounding factors.	Generally, the most valuable insight into organizational effectiveness, as long as outcomes can be attributed to organizational actions.
Strategic Constituents	Requires access to key constituencies whose experiences and opinions are important to understanding organizational effectiveness and responsiveness to constituent needs.	Important indicator of how well the organization's mission is aligned with constituent needs and expectations and how well they are met by the organization.

4 Developed by FHWA based on concepts discussed in Daft, R. L. 2016. *Organizational Theory and Design*. Boston, MA: Cengage Learning, page 69-74, Kindle.

Based on conversations with TSMO leaders within DOTs, the most accessible indications of organizational effectiveness in advancing and mainstreaming TSMO may be (as stated in chapter 1):

- Senior executive support
- Full TSMO participation in decisionmaking bodies within the DOT
- Incorporation of TSMO strategies and considerations in policies and process, such as planning, design, and construction
- Formal standing within the organization, such as a TSMO office, division, and budget
- Coordination or linkages between TSMO and other functional and geographic areas of a DOT (e.g., cross-functional committees and working groups)

While the State and local DOT TSMO unit leaders did not always mention strong support from their DOT leadership, they often indicated that executives valued TSMO. These indications include TSMO leader participation in influential committees and a formal TSMO standing within the organization.

Representatives from several DOTs and local transportation agencies provided their perspectives on how they measure the success of TSMO within their organization. Several States linked TSMO success to high-level outcome-oriented transportation system performance measures. These measures typically included measures associated with safety, user cost of delay, and related mobility measures. Other DOTs noted performance measures more closely related to TSMO processes, including road closure time following incidents, incident clearance times, number of traffic incident management (TIM) training sessions, traffic signal performance (e.g., arrival on green/red), and safety service patrol services rendered.

> For example, Ohio DOT has a set of TSMO performance measures linked to TSMO program objectives, and the DOT has specific target values against which it measures performance. Each objective and performance measure is also linked to a data source for measuring performance and to the specific offices responsible for measuring performance. Examples of Ohio DOT's program objectives, related performance measures, and performance targets are shown in Table 3. Program measures are the measures for which the TSMO program will be evaluated, and they will guide priorities, track implementation, and define success.[5]

5 Gannett Fleming and Burton Planning Services. 2017. *ODOT Transportation Systems Management & Operations Plan | Performance Measures Brief.*

Table 3. Ohio Department of Transportation TSMO performance measures.

Level	Program Objectives	Performance Measures	Targets
Program Measures	Reduce secondary crashes caused by traffic incidents	Percentage of secondary crashes to primary crashes on monitored freeways	<15 percent of all traffic management center (TMC)-verified crashes
	Reduce work zone-related crashes	Frequency of work zone crashes	Reduce by 1 percent over a 5-year moving average
	Reduce roadside "struck by" incidents	Frequency	Zero
	Maximize free-flow travel time on Ohio's freeway system	Percent of time motorists experience free flow (travel time travel time reliability index [TTRI])	>88 percent
	Increase transportation system resilience to winter weather events	Percent of routes that recover speeds within 10 miles per hour of the expected speeds within 2 hours of a snow event ending	>96 percent
	Reduce incident clearance	Duration	To be determined
	Reduce roadway clearance	Duration	To be determined
	Optimize signalized corridors	Percentage of corridors retimed per year	25 percent of Tier 1 and Tier 2 corridors.
	Reduce work zone traffic delays	Number of hours the operating speed is less than 35 miles per hour per monitored work zone	Increase no more than 25 percent over preconstruction
	Provide consistent incident response and management across the State	Percentage of emergency responders trained in traffic incident management in State (department of transportation [DOT]/public works, fire, police, towing, and emergency management system)	Increase by 5 percent per year over 5 years
Secondary Measures	Optimize signalized corridors	Percent arrival on green	>97 percent
	Optimize travel time reliability on major freight corridors	Percent of time freight operators experience free flow travel time (TTRI)	>94 percent

Table 3. Ohio Department of Transportation TSMO performance measures. (continuation)

Level	Program Objectives	Performance Measures	Targets
Monitoring Measures	Maximize equipment and communications reliability	Percent asset uptime	97 percent
		Communications network up time	97 percent
		Percent asset beyond service life	Less than 10 percent
	Respond to and clear heavy vehicle incidents as quickly as possible	Response <45 minutes; clearance <90 minutes	Informational only
	Expand TMC surveillance and management capabilities	Percent of congested corridors (based on TTRI and level of service analysis) with fixed intelligent transportation systems	Informational only
		Number of mobile data collection devices (automatic vehicle location/ global positioning system, cameras, and weather sensors)	Informational only
	Manage TMC staff workload	Number of incidents logged	Informational only
	Provide timely, accurate, and comprehensive information to customers	Increase the use of the OHGO smart phone application—average number of notifications opened per incident	Increase year to year
		OHGO application usage—number of personalized routes created	Informational only
		Incident verification (incident occurrence to time public is notified)	90 percent of incidents posted within 10 minutes
	Hold after action review meetings for 100 percent of incidents that exceed clearance goals	Percentage of meetings that occur within 30 days	100 percent
	Monitor key transportation assets/events to prevent harmful acts	Number of assets/events monitored	Informational only
	Promote transportation systems management and operations tools to improve emergency management	Number of agencies with closed-circuit television and Ohio DOT data access	Informational only

Source: Ohio DOT.

Note: For a complete list of Ohio DOT's TSMO performance measures and related data sources, see https://www.transportation.ohio.gov/wps/wcm/connect/gov/a38f6966-747c-4be9-a2a4-c4affb8eb63c/Performance_Measures_2018_0117.pdf?MOD=AJPERES&CONVERT_TO=url&CACHEID=ROOTWORKSPACE.Z18_M1HGGIK0N0JO00QO9DDDDM3000-a38f6966-747c-4be9-a2a4-c4affb8eb63c-nch7Txx.

Two county DOTs interviewed included both process and outcomes measures as indicators of TSMO success. One county included project completion among its performance measures, and both included outcome measures, such as travel time and travel time reliability.

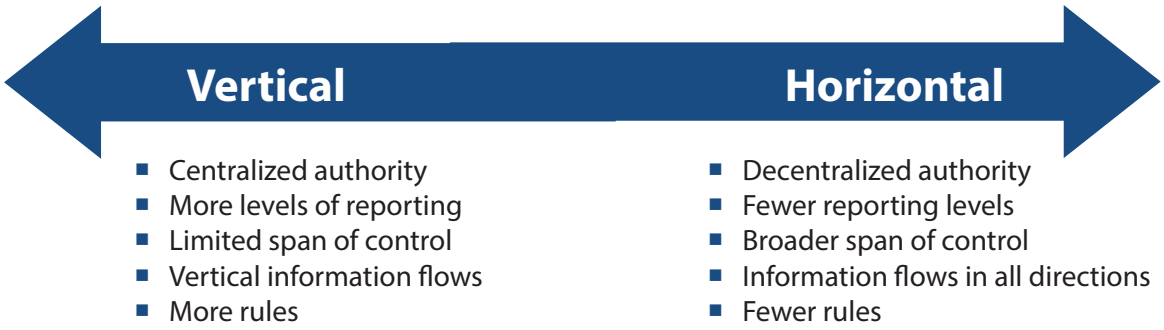
Measures of success for TSMO in an organization vary among the State and local transportation agencies. Few of the performance measures are designed to measure organizational performance (e.g., efficiency, training, and skills) other than those related to organizational resources. Rather, the performance measures focus on either processes (e.g., incident clearance times) or outcomes (e.g., travel time, crashes/fatalities) affected by the deployment and use of TSMO strategies. Ohio DOT offers an example of a DOT with a comprehensive list of performance measures and specific performance targets, data sources, and responsible entities within the DOT.

CHAPTER 3. TSMO IN DEPARTMENT OF TRANSPORTATION ORGANIZATIONAL STRUCTURES

This chapter discusses various organizational structures and dimensions and describes advantages or disadvantages these may have for advancing TSMO within a DOT. This chapter also describes the different models and examples of where TSMO resides within an organizational structure and includes considerations for TSMO within local agency structures. This chapter begins by presenting alternative organizational configurations, then discusses the characteristics of five key dimensions of organizations and concludes with examples of how TSMO is positioned within a variety of State and local DOTs. Different models reflect different policies within State governments, different contexts (e.g., rural versus urban), different responsibilities (e.g., share of State versus local responsibility for roads), and different institutional arrangements among public and private entities (e.g., toll authorities, port authorities).

ORGANIZATIONAL DESIGN

Organizational designs fall along a continuum between mechanistic (or vertical) and organic (or horizontal) (figure 2.). Vertical designs commonly feature a centralized structure whose members execute specialized tasks, use formal systems, communicate vertically, and follow a strict hierarchy of authority. Conversely, a horizontal design typically features a decentralized structure in which staff are empowered to act individually or in teams, systems are informal, communication is both vertical and horizontal, and leadership emphasizes collaborative teamwork across divisions or groups. Many organizations share a combination of these attributes based on where they fall along the continuum. Because TSMO is crosscutting, implementing horizontal mechanisms may allow agencies to advance TSMO organically. Figure 2 describes several types of organizational structures from organizational theory.

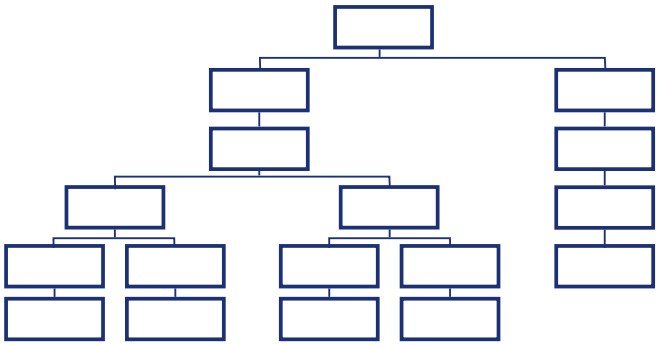


Source: FHWA.

Figure 2. Graph. Continuum of approaches to organizational structure.

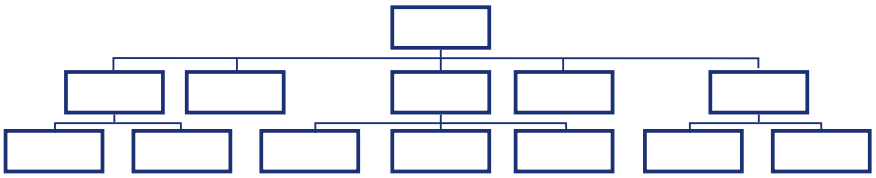
Vertical versus Horizontal Structures

Vertically structured organizations are typically characterized by a highly centralized hierarchy of authority and limited span of control. In these structures, information typically flows vertically. Communication is usually formalized and may become siloed unless horizontal linkages enable open communications and information sharing among different dedicated groups. In vertical organizations, high-level managers pass down policies, goals, strategies, instructions, and procedures to mid and lower level managers, who in turn disseminate this information to staff (figure 3). Staff and lower level management then submit reports back up through the management chain, providing information on problems, performance, and budget. A vertical organizational design is often viewed as more efficient with a focus on observing the chain of command. Lower-level staff activities may be more strongly aligned with top-level goals due to increased top-level control of the organization.



Source: FHWA.

Figure 3. Illustration. Vertical organizational structure.



Source: FHWA.

Figure 4. Illustration. Horizontal organizational structure.

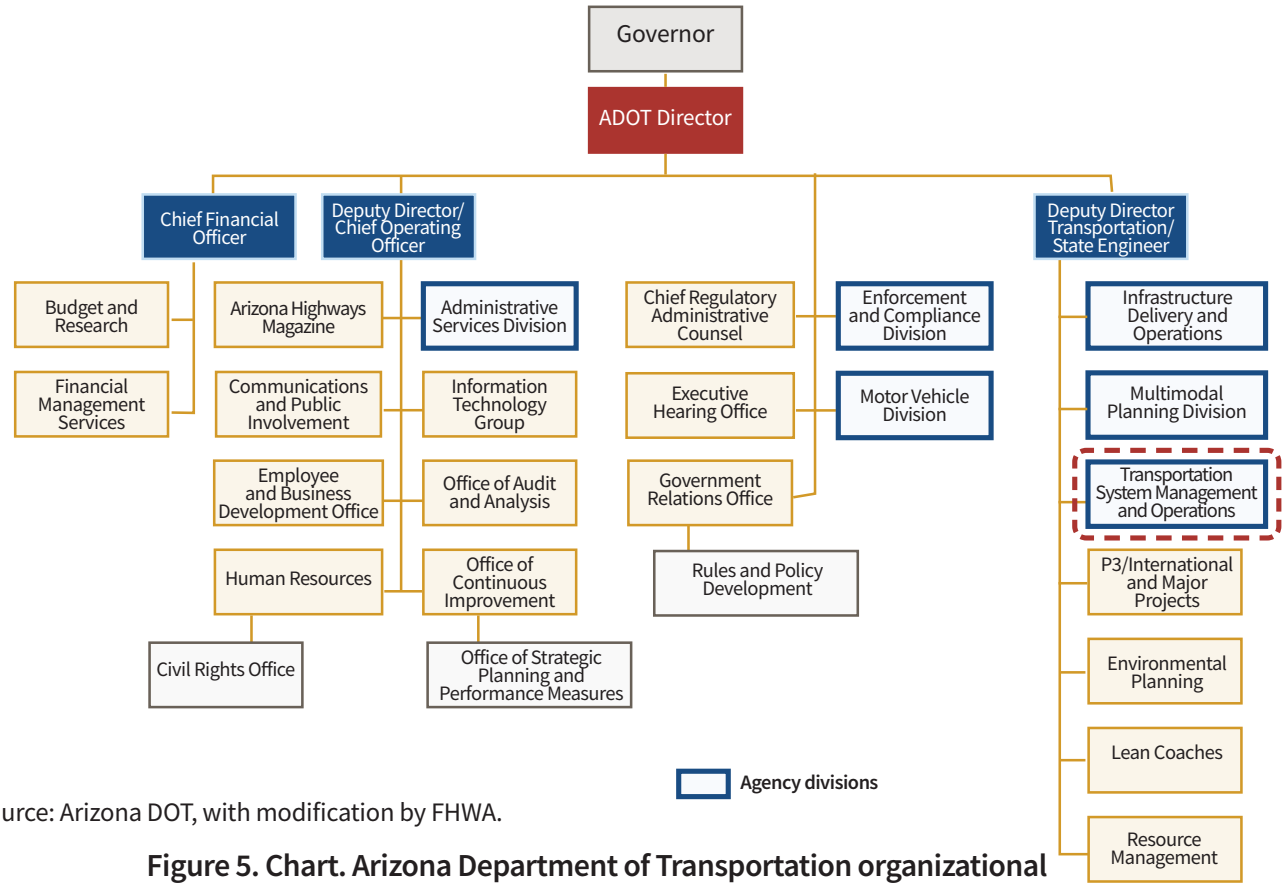
Horizontal structures are characterized by a relatively flat structure with few reporting levels and a broader span of control within higher-level entities (figure 4). Horizontal organizations enable and encourage information flows in all directions within and across departments and structural levels. Widespread information sharing enables knowledge and data to permeate throughout the organization and allows staff to act quickly in response to—and to coordinate their activities with other groups that may be affected by—changes in contingent factors, which are defined as elements that influence the effect of organizational characteristics on organizational performance. Horizontal structures allow timely communications with other agencies, the public, and industry by reducing the need for multiple levels of review and approval prior to sharing or releasing information, enhancing the organization's overall agility in responding to unanticipated events.

Departmental Groupings

Departmental groups reflect the agency's organizational structure and are influenced by the degree to which information sharing is vertical or horizontal in nature. There are four types of departmental groupings: functional, divisional, geographic, and matrix. Many organizations use a combination of departmental groupings to design a structure that works best for their priorities and environment. Nearly all State DOTs combine functional and geographic groupings.

Functional structure refers to the way similar functions or activities are grouped together. For example, all staff responsible for construction are in the same division, even if their particular expertise areas would overlap with other divisions (e.g., information technology [IT] expertise). Advantages include providing for a high degree of specialization and simplified reporting, while offering the ability to scale if an organization grows.

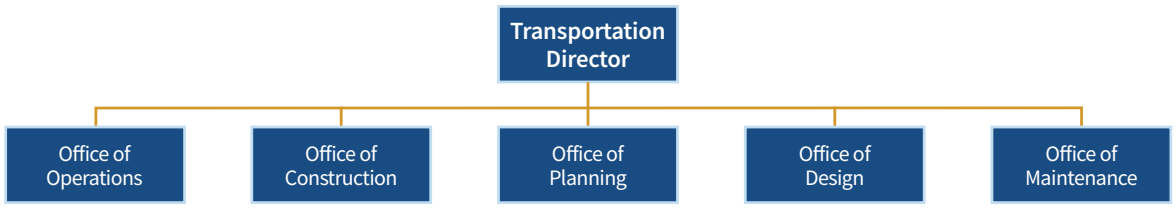
> Dedicated TSMO divisions exist in many DOTs. For example, Arizona DOT created its TSMO Division in 2015 (figure 5). One benefit of a TSMO division at the executive leadership table is helping get the TSMO message out to agency leaders who have the authority to make changes. The Arizona DOT TSMO Director participates in monthly leadership meetings with other Divisions to synchronize activities and ensure plans and policies align across the agency. Arizona DOT uses a "lean" approach to drive out silos and work horizontally. At every level, there is crossover communication and coordination among divisions.



Source: Arizona DOT, with modification by FHWA.

Figure 5. Chart. Arizona Department of Transportation organizational structure with Transportation System Management and Operations Division circled.

Disadvantages of the functional structure include slowness to adapt to changes in the environment, which can lead to less innovation and coordination across functions. TSMO-oriented staff could benefit by working closely together in the same functional area, but this structure requires active champions and significant effort for TSMO to be mainstreamed across the functions to avoid siloes. Figure 6 is a nominal example of an organizational structure grouped by functional departments.



Source: FHWA.

Figure 6. Chart. Organizational structure of functional departmental groupings.

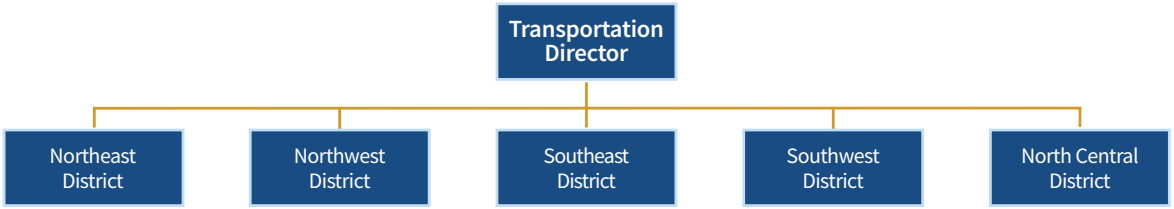
Divisional structure refers to the degree to which division members are grouped by major products or services (figure 7). An example of such grouping may be an agency with completely separate divisions focused on arterials, freeways, bridges, and toll/express lanes, with each division operating autonomously and with its own leadership. Advantages of functional departmental groupings include allowing division members to focus on a single product or service, with clear lines of authority and leadership support of resources. In addition, divisional groups often have their own unique culture. Disadvantages include the potential for competition between divisions over resources, disparate cultures that clash, and the increased chance for incompatibility across products and services. The divisional structure presents challenges similar to the functional structure, depending on how products and services are defined at a DOT. If a DOT had a divisional structure in which divisions were defined by facility type, TSMO functions and activities would apply across the divisions and may be best implemented through horizontal communications mechanisms and by identifying and supporting champions within each division to advance TSMO.

Source: FHWA.

Figure 7. Chart. Organizational example of divisional departmental groupings.

Geographic structure brings together all functions required for products or services in a geographical area (figure 8). For example, an agency may assign divisions or units across functions to a particular district. The geographic districts generally report to a headquarters entity. Advantages of the geographic structure include the division's position to readily adapt to the needs of each individual district. TSMO strategies would be specifically focused within the district's geographic boundaries. Disadvantages are that district staff do not always identify as well with central organizational goals and may not be inclined to proactively form linkages between districts. As is true of other functions, maintaining a consistent approach to TSMO or integrating effective practices across multiple geographic areas can be challenging.

> An example of an agency addressing this potential disadvantage is Ohio DOT, which combines functional and geographic departmental groupings. It has a TSMO division at the central office in Columbus, OH, and a designated TSMO coordinator in each of the 12 Ohio DOT districts in the State. Through collaboration and communication among the TSMO division at the central office and the district coordinators, Ohio DOT is able to integrate its approach to TSMO throughout the State.



Source: FHWA.

Figure 8. Chart. Organizational structure of geographical departmental groupings.

Matrix structure is a strong form of horizontal linkage that incorporates both product managers and functional managers concurrently (figure 9). For example, IT staff may work across functional units and be managed under a divisional structure, but they may support functional units like asset management (which may be under a functional management structure). Advantages of the matrix structure include increased collaboration between departments and a wider range of skill development for employees who may cross-train and interact with both functional and divisional systems. Disadvantages include ambiguity of staff roles reporting functions and priorities, as well as a slowed decisionmaking process. A matrix structure would benefit TSMO by allowing TSMO staff to work across functional areas, while being managed by a TSMO leader providing consistent TSMO direction. One disadvantage to TSMO would be ambiguity of roles.

	Planning	Construction	Operations	Design
Arterials	Staff	Staff	Staff	Staff
Freeways	Staff	Staff	Staff	Staff
Bike/Pedestrian Facilities	Staff	Staff	Staff	Staff
Aviation	Staff	Staff	Staff	Staff

Source: FHWA.

Figure 9. Chart. Organizational structure of matrix departmental groupings.

Outsourcing

Agencies with limited staff expertise in TSMO or availability to work on TSMO activities may find it challenging to integrate and advance TSMO. Outsourcing TSMO activities or functions to consultants is one option for overcoming this challenge.

> For example, Texas DOT's central office developed a statewide TSMO policy. Each district is responsible for developing a TSMO program plan for the district that follows the strategic direction in the statewide policy. Included in the Texas DOT TSMO Statewide Strategic Plan is a 2016 executive directive that requires new construction and roadway work to include intelligent transportation systems (ITS) devices and traffic signals. Districts facilitate TSMO planning through consultant contracts, which the central office manages and the districts fund. These efforts have helped to mainstream TSMO throughout the districts.

> TMCs may be staffed by consultants. In Florida, Florida DOT currently funds the TMC consultant staff in Palm Beach County, although the county plans to provide the staff in the future.

While outsourcing can help agencies overcome internal staffing limitations and advance TSMO activities, there are some risks to this practice. TSMO may not become integrated into agency practices and culture if internal staff do not develop expertise and ownership in TSMO. Transportation agencies may also risk losing momentum in advancing TSMO and institutional knowledge when consulting staff or companies are replaced.

Structural Dimensions and Characteristics of Each

Structural dimensions are simply labels that describe an organization's internal characteristics, creating a basis for measuring and comparing organizations. Five standard structural dimensions of an organization help determine if an organization's structure is more vertical or more horizontal: formalization, specialization, hierarchy of authority, complexity, and centralization (table 4).

Table 4. Descriptions of structural dimensions.[6]

Structural Dimension	Description of Dimension
Formalization	The degree to which established procedures and policies regulate workflow
Specialization	The degree to which staff are dedicated to specific tasks and focused areas of expertise
Hierarchy of Authority	The number of reporting levels and the span of control held by units (departments or individuals)
Complexity	The number of departments in an organization
Centralization	How high in an organization decisionmaking authority resides

Formalization describes the degree to which procedures and policy manuals document and regulate established workflows with formal descriptions. In the context of a transportation agency, formalization translates into operating procedures, legal requirements, job categories, and a written TSMO plan or strategy. Agencies with dedicated TSMO divisions or units have a higher degree of formalization than those who deploy TSMO champions or other horizontal communications structures, such as working groups or committees.

Agencies with formal TSMO units may realize several advantages, one of which is increased visibility across the organization. A formally established TSMO unit also communicates to others in the DOT that TSMO is a priority.

> For example, the Vermont Transportation Agency TSMO unit leadership is "at the table" with decisionmakers and is able to influence cross-functional activities through relationships developed among high-level managers.

TSMO units that are structured to report to executive-level positions have an opportunity to engage more directly with the strategic direction of the organization and across different functional areas. One disadvantage to a specific TSMO budget is potentially limiting collaboration between functional areas and creating competition between programs for budget allocation.

In agencies where TSMO is lower in the organization, TSMO is less visible and requires the use of stronger horizontal linkage mechanisms to collaborate with other functional areas. One way to increase visibility and collaboration is through formal structures that support TSMO.

> For example, there is a formal TSMO program for Maryland DOT primarily led by the agency's public highway branch, the State Highway Administration (SHA). Within SHA, the TSMO program falls under the Office of Transportation Mobility and Operations, which is overseen by the Deputy Administrator for Hanover Operations. Despite falling lower down the agency hierarchy, Maryland DOT SHA established an active TSMO program enabled through a diverse executive TSMO committee and relational coordination among the TSMO program leader and other functional areas within the larger Maryland DOT family of agencies (e.g., ports and transit).

6 Developed by FHWA based on concepts discussed in Daft, R. L. 2016. *Organizational Theory and Design*. Boston, MA: Cengage Learning, page 69-74, Kindle.

Specialization refers to the existence of dedicated TSMO staff who focus on a specific operational area or TSMO-related activity. Based on interviews with several agencies, some State DOTs had staff who worked solely on TSMO activities, whereas other State DOTs—and most local DOTs—had staff who worked only partially on what they would consider TSMO. Applying the definition of TSMO broadly, it is likely that all the State organizations interviewed would have staff working full time on TSMO activities as part of TMCs, signal timing, and other activities that build up to a TSMO approach.

Hierarchy of authority describes the authority flows and the span of authority each unit director holds within the organization. Vertical organizations typically have more levels within the organizational structure with fewer reporting units under each level and a narrower span of control. Horizontal organizations have fewer levels and broader span of control within each unit.

Complexity refers to the number of departments in an organization. As the number of units within the organization expands, the number of communication channels required to coordinate across organizational units grows geometrically. Conversely, a simple structure with few organizational units can dilute the focus of the units because multiple functions are combined into single units.

Centralization describes how high in the organizational hierarchy TSMO-related decisionmaking authority resides. The centralization of decisionmaking authority was one of the largest differentiators among DOTs interviewed. Some State DOTs that gave a wide degree of decisionmaking authority to the districts or regions with guidance coming from the central office. Other State DOTs hold decisionmaking control within the central office, a characteristic of a more vertical organization.

Understanding structural dimensions alone, however, does not necessarily help an agency effectively design organizations. In addition, characteristics and contingency factors may also need to be considered. Contingency factors and characteristics include the size of the organization and its component structures; organizational technologies (i.e., tools and techniques used to conduct business); the external environment (e.g., laws, regulations, suppliers, industry, and financing); goals and strategy; and culture (i.e., the underlying set of values, beliefs, and norms shared by employees).

Structural dimensions and agency characteristics and contingency factors are interdependent. For organizations to be effective, there must be a goodness of fit among the organization's design and the factors that affect daily operations.

Examples of TSMO in Department of Transportation Organizational Structures

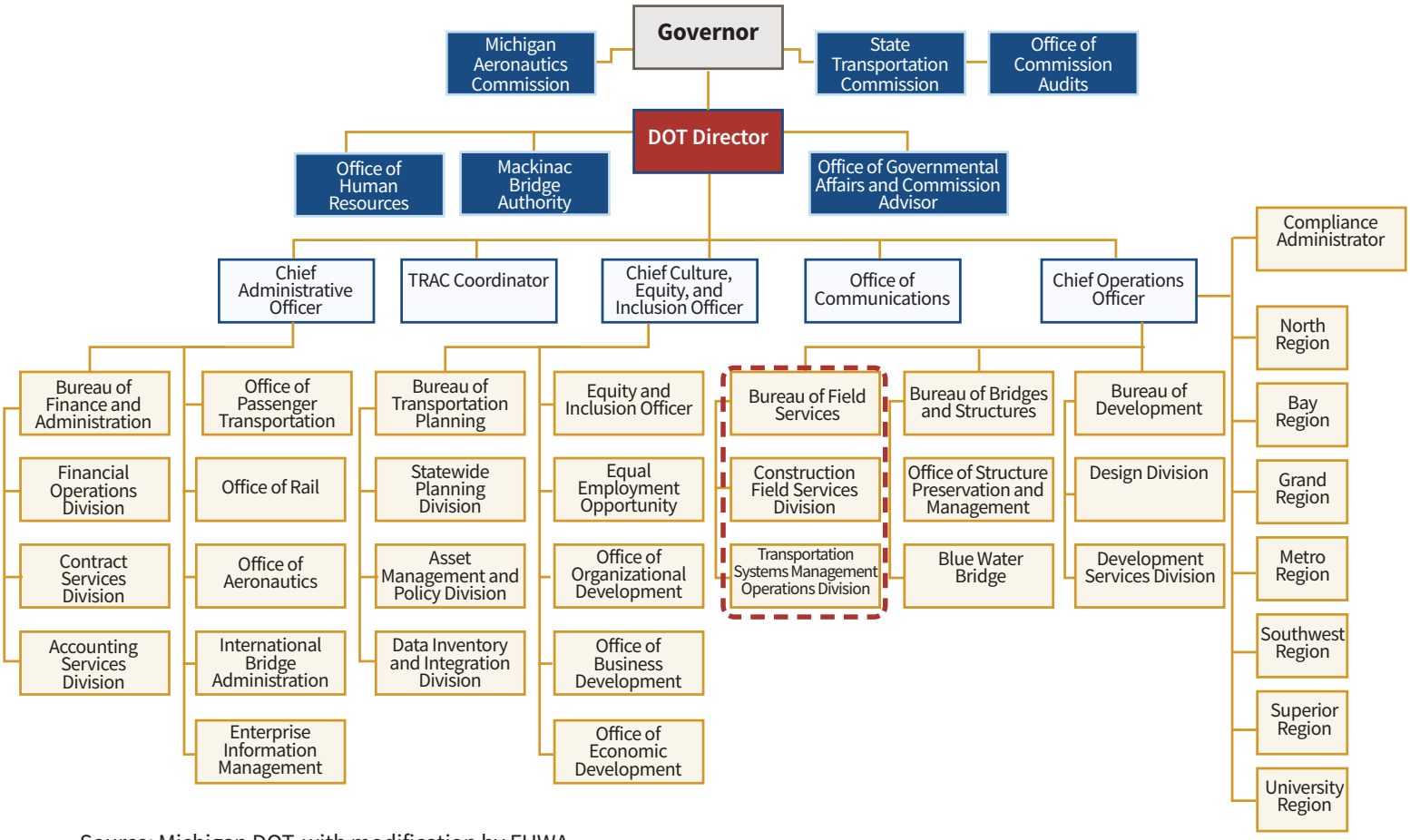
State Department of Transportation

No two DOTs are organized the same way, and there is no one right way to incorporate TSMO into an organizational structure. Some DOTs successfully advance TSMO through creating a high-level division that encompasses multiple functions, such as operations, safety, planning, and maintenance. Other DOTs spread TSMO-related activities across two or more units. TSMO affects—and is affected by—every unit within a State DOT, such as planning, programming, design, construction, maintenance, and safety. Where TSMO resides within an organization can influence how TSMO interacts with other parts of the agency. The following examples exhibit the range of organizational approaches used by State agencies across the Nation.

Michigan DOT positions TSMO as a high-level division within the organization. At Michigan DOT, the TSMO Division is housed within the Bureau of Field Services (figure 10). The Bureau of Field Services has a Research Administration with about 10 employees, a Safety and Security Administration with four employees, the TSMO Division with approximately 131 employees, and the Construction Field Services unit with 74 employees. Typically, an administration (also referred to as a section) is below a division in the hierarchy, but some administrations are placed directly under a bureau, as is the case with the Safety and Security Administration. As part of establishing a TSMO Division, a number of Michigan DOT components were brought together. These components include Traffic and Safety, ITS, Signals, and Maintenance/Congestion-Mobility. The TSMO Division is currently broken into four components: ITS Program Administration, Traffic and Safety Programs, Maintenance and Systems Operations, and Fleet & Facilities (figure 11). Staffing in the seven Michigan DOT regions includes a TSMO champion and an associate engineer of operations who focuses on TSMO at the regional level.

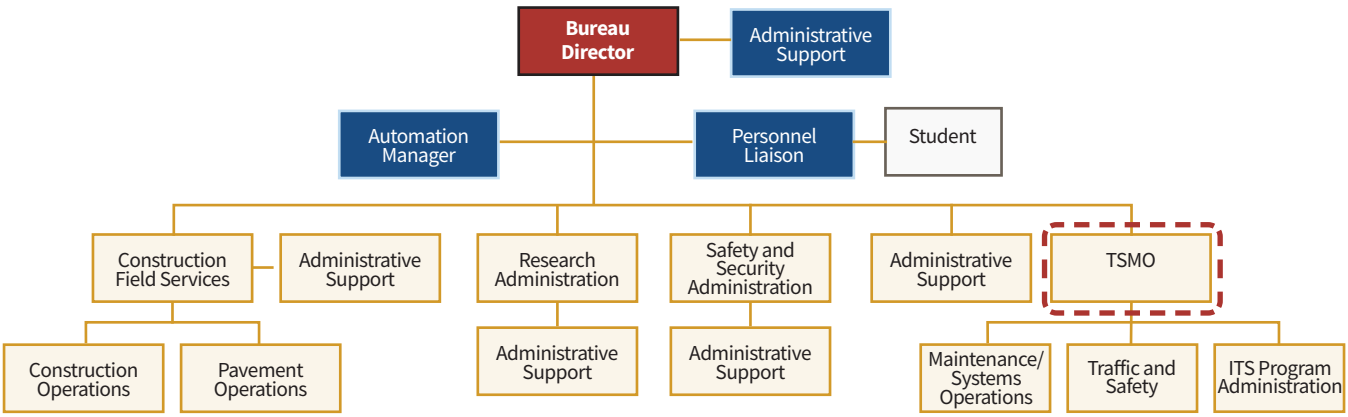
North Carolina DOT has positioned TSMO as a unit under a high-level branch. Within North Carolina DOT, the TSMO unit is under the State Traffic Engineer within the Transportation Mobility and Safety Division (figure 12). The TSMO unit's top position was recently renamed from ITS and Signals Engineer to TSMO Engineer to better represent the responsibilities of the position, which include planning, designing, and managing ITS devices and managing the Statewide Operational Center. The TSMO unit also has a group that designs, manages, and optimizes signals. The group employs electrical engineers to develop electrical details and help maintain electrical parts of traffic signals, changeable message signs, cameras, and other devices. The TSMO unit also includes traveler information and incident management and is responsible for setting standards, policies, and processes. The State traffic engineer is a TSMO champion and views everyone in the North Carolina DOT as a key part of advancing TSMO.

The Ohio DOT's Traffic Management Office is housed within an Operations Division that reports to the Assistant Director of Field Operations (figure 13). The Traffic Management Office includes traffic operations and emergency management functions. The office is not named "TSMO" because the agency wants to avoid the idea that it is the only place within Ohio DOT that TSMO exists. Ohio DOT does not want TSMO to be perceived as limited to one group and believes it should be integrated into every area of Ohio DOT—construction, engineering, IT, and maintenance. The Office of Traffic Management is currently coordinating with Ohio DOT's IT team to stand up a new advanced traffic management system and works with the districts to support TSMO and TIM initiatives.



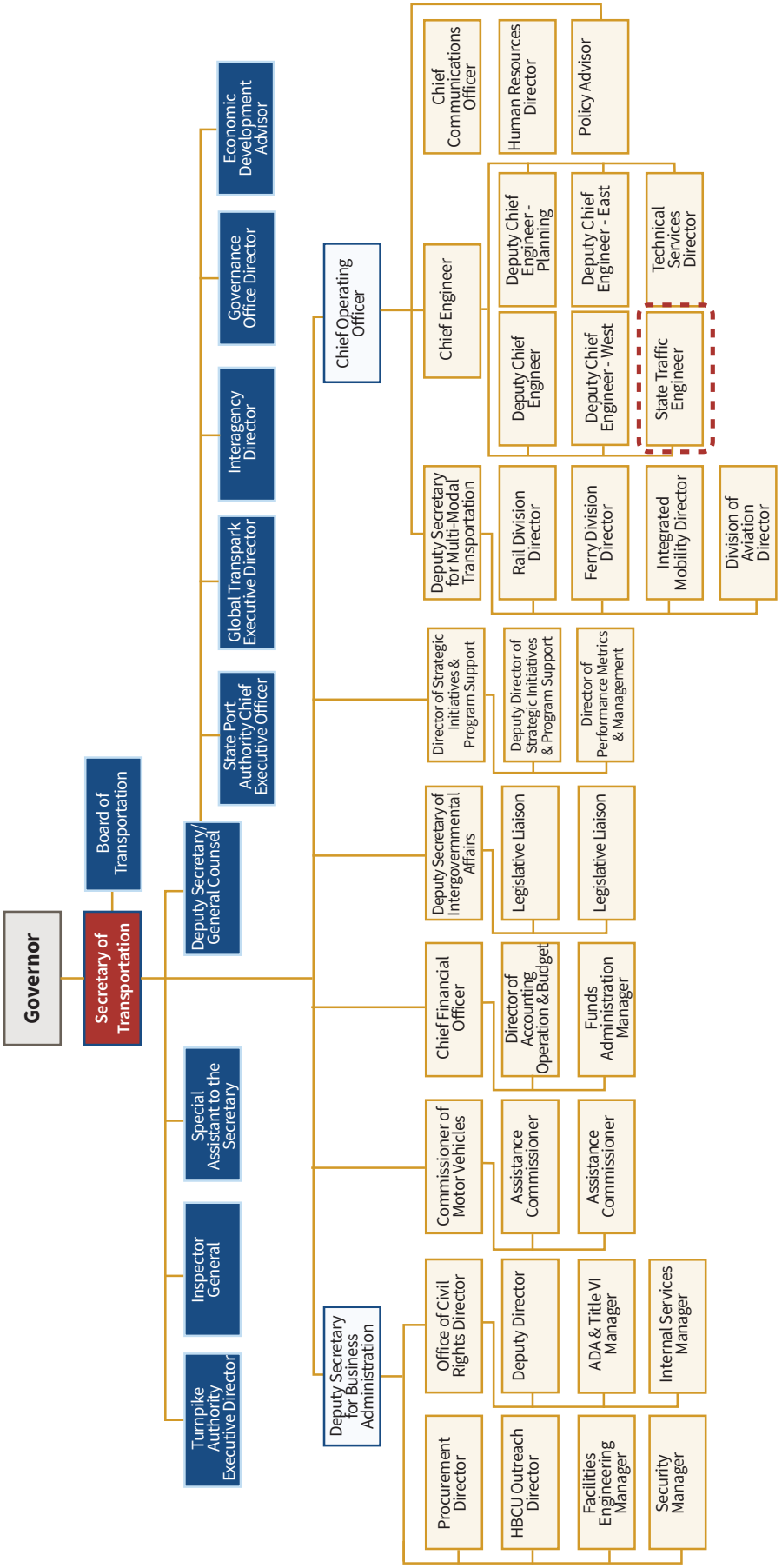
Source: Michigan DOT, with modification by FHWA.
TRAC = Transportation and Civil Engineering Program.

Figure 10. Chart. Michigan Department of Transportation organizational structure.



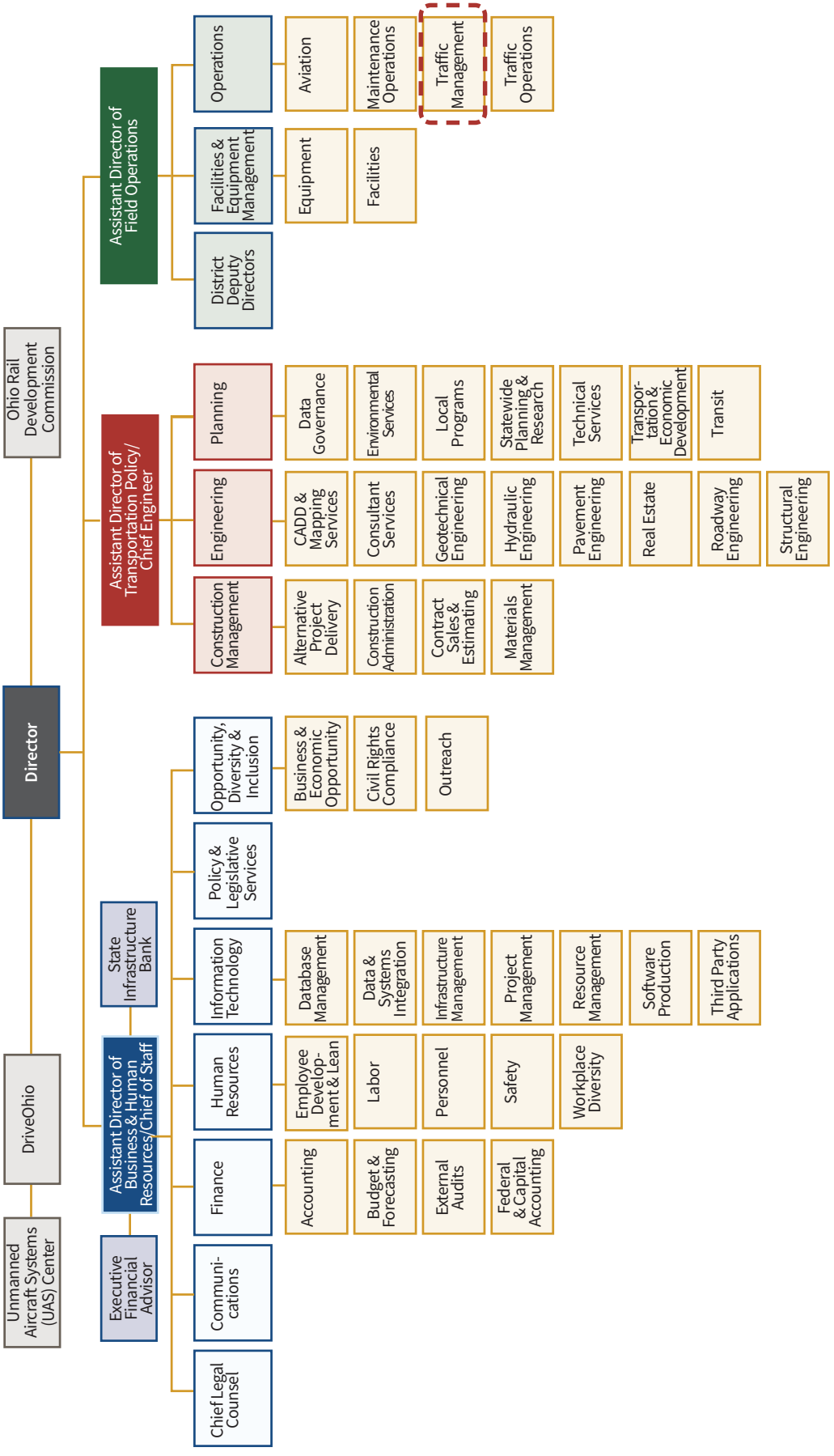
Source: Michigan DOT, with modification by FHWA.

Figure 11. Chart. Michigan Department of Transportation Bureau of Field Services organizational structure.



Source: North Carolina DOT, with modification by FHWA.

Figure 12. Chart. North Carolina Department of Transportation organizational structure.



Source: Ohio DOT, with modification by FHWA.

Figure 13. Chart. Ohio Department of Transportation organizational chart.

Local Agencies

Similar to State-level DOTs, the extent to which TSMO has been incorporated into transportation agency structures at the county and city levels varies widely, with some agencies having not begun efforts to incorporate TSMO approaches and others having established programs that are well integrated into the organizational structure. Local agency organizational structures differ based on the needs of the citizens they serve and the resources they have available. The size of the organization, geographic area, population served, and transportation characteristics influence the organizational structure needed for TSMO. The following examples illustrate the approach taken by several local agencies in addressing their TSMO needs.

Gwinnett County DOT in Georgia is in the early stages of adopting TSMO approaches. The agency has a director with four deputy directors representing major sections: Traffic Engineering, Operations and Maintenance; Program Delivery; and Transit Capital Projects Intermodal Operations. The Traffic Engineering, Operations and Maintenance section contains two divisions: the Traffic Engineering Division and the Operations and Maintenance Division. While there is no specific TSMO program, some TSMO facets are represented by those divisions at the executive level.

In Gwinnett County, day-to-day decisionmaking largely rests with the division directors and their direct reports. While the agency is generally decentralized, deputy directors weigh in at the division level when information or guidance is needed. The deputy director also sits on the Atlanta Regional Commission TSMO Committee, which helps the Traffic Engineering, Operations and Maintenance section interact with Georgia DOT and learn from their TSMO approaches. For example, the first thing the Gwinnet County DOT did as part of its TSMO plan was to develop improved approaches to tracking and managing traffic signal infrastructure, including documenting the systems so that the Traffic Engineering Division members can make data-driven recommendations on program delivery projects.

New York City DOT Traffic Operation division has a System Engineering ITS Unit and designated staff to conduct TSMO-related activities managed by an Advanced Asset Management System and various dashboard systems for projects and operations. The unit's main focus is on systems, electronics, equipment, operational functions, and TMC operations. New York City DOT has a Chief Operations Officer and Executive Deputy Commissioner, both of whom report to the Commissioner. Under each branch, several divisions are designated either by support and backbone (e.g., human resources and facilities management), function (e.g., bridges or planning and management), or location (e.g., Staten Island). The ITS division (the proxy for TSMO) is housed within the Traffic Operations Division—one of 14 Divisions under the Chief Operations Officer in addition to six other divisions under the Executive Deputy Commissioner. Functioning like a hybrid matrix organizational structure, ITS staff are embedded within, and coordinate with, most of the other divisions.

The Maricopa County DOT in Arizona has an established and well-integrated TSMO Division positioned one level below the organizational head. The TSMO Division has six branches: Traffic Design, Traffic Development, Traffic Maintenance, Traffic Operations, Traffic Technology, and the Regional Emergency Action Coordination Team (REACT) Program. While Maricopa County DOT does not have a specific TSMO coordinator, coordination is occurring as needed across levels within the organization. Horizontal linkages are well-developed, as described by several examples provided. A particular task force composed of construction, technology, permits, and operations staff created a process to share construction and flooding information with the traveling public. The TSMO Division works closely with maintenance and safety and is also actively considered as part of the project scoping process. Monthly status reports involving the organization also provide opportunities to share information about projects.

The Palm Beach County Engineering & Public Works Department, Traffic Division (Traffic Division) does not have a defined TSMO team but delivers TSMO on certain roadways through three different teams within its Traffic Signal Systems Section: a signal timing group, a network group, and the ITS group.

The Traffic Division has horizontal linkages with other areas within and outside the county. Within the county, the Traffic Division's Signal Systems Section works with the Roadway Construction Office Coordination Division, county construction contractors, and Maintenance of Traffic coordinators. Externally, the Traffic Signal Systems Section supports the Florida DOT District 4 Traffic Operations Office in managing real-time incidents on certain State Roads through signal retiming. In addition, the Traffic Division works with the sheriff's office, television stations, and others to share information. Data sharing efforts between offices internally is in the early stages.

The Traffic Division's future plans include expanding the network of arterials monitored to other parts of the county.

CHAPTER 4. HORIZONTAL LINKAGES: TOOLS FOR ADVANCING TSMO

Understanding where TSMO fits into the organizational structure of a DOT involves identifying where in the hierarchy TSMO resides, the decisionmaking authority of a TSMO unit leader, how TSMO is grouped with other units, and the systems in place for coordinating and communicating with other units across the organization. Those systems, referred to as horizontal linkages, are not typically included on an organizational chart, but are essential elements of an organization's structure. Within a DOT, such linkages may take the form of cross-functional committees, including TSMO staff, TSMO liaisons, and task forces, or other means of linking units across the organization.

Horizontal linkages are key to overcoming silos among departments in organizations by supporting information sharing, collaboration, mutual activity, and problem solving. The linkage mechanisms range in terms of strength. Strong linkages support more frequent, ongoing collaboration and communication in which a greater amount of information is shared. Information sharing is especially important in more formal vertical organizations, such as the case with many State DOTs. Smaller organizations often may not need to use as strong of methods to create horizontal linkages as larger organizations because there is less separation between departments and staff, and they may have more informal collaboration because of the structure. While State DOTs with TSMO units often have some type of horizontal linkage between their TSMO units and other functional units, local DOTs did not often have this.

Systems designed to ensure effective communication, coordination, and integration of efforts across departments are key to an organization's structure.[7] Communication between and among groups is particularly important for State agencies attempting to adopt or advance TSMO methods because TSMO is inherently cross-cutting, broadly touching on, if not affecting, many of a transportation agency's core functions.

The following methods of horizontal coordination or linkages can help break down silos among departments and increase the coordination and communication necessary to advance TSMO throughout an organization. The use of each linkage has its benefits and challenges. For example, there is an investment of staff time for all of the mechanisms that agencies typically consider relative to the potential benefits when considering how to apply the horizontal linkages. They are ordered in terms of weaker to stronger linkage mechanism.

7 Child, J. 1984. O*rganization: A Guide to Problems and Practice*. London, England: Harper & Row.

INFORMATION SYSTEMS

Communications technology and IT enable staff in different departments to share information and work together using online collaboration tools, such as SharePoint, or, in some cases, custom-built geographic information system platforms that help TSMO professionals communicate with planners about project needs. TSMO can have large amounts of data from ITS technologies that can be helpful to other units for identifying safety issues, maintenance needs, or areas for investment to support planning and programming in meeting agency goals.

> Pennsylvania DOT TSMO and planning staff, as well as other stakeholders, use OneMap to coordinate and share highway project data.[8] Pennsylvania DOT developed the OneMap software, which overlays transportation data onto a map. OneMap supports TSMO planning decisions about the types of operations tactics to use and locations (e.g., placement of ramp meters and other ITS assets). The software also includes crash data and helps identify where to best spend a limited budget.

LIAISON ROLES

Individuals in one department of an organization who are tasked with communicating and coordinating with another department promote direct contact between departments. Liaisons are typically housed within functional units and may have primary duties in addition to communication and coordination activities. Several State DOTs are moving toward using this linkage mechanism.

> For example, Michigan DOT has an Associate Engineer of Operations who fills the role of a TSMO champion in each of its seven regions but does not have the label of TSMO champion. The Associate Engineer of Operations reports to the Region Engineer. In Michigan, the central office has a "Trunkline Program" that sets the budget and work priorities. Liaisons provide input to this process to ensure regional TSMO needs are communicated upward in the organization, coordinated with needs from other regions, and considered for funding.

> In each of its 12 districts, Ohio DOT has a designated TSMO Coordinator who reports to a planning engineer, highway operations engineer, or other manager within their district. These liaisons help incorporate TSMO into planning and deployment activities in the regions and support Ohio DOT's goal of expanding TSMO beyond a single central headquarters office. Ohio DOT also has a strong central office, but the districts are getting involved in TSMO planning and analysis.

Liaisons may also be part of a committee, combining both the liaison and committee linkage mechanisms.

8 For more information, see the Pennsylvania DOT's OneMap website at: https://gis.penndot.gov/onemap/.

> Maryland DOT SHA has a TSMO Executive Committee that includes representatives from central offices and each district across the SHA. The TSMO leader within Maryland DOT SHA serves as a liaison to other areas on committees. Washington State DOT has a newly formed TSMO Committee that contains TSMO liaisons who are staff in each functional area of the DOT within the central and regional offices. The representatives from various disciplines across Washington State DOT and Maryland DOT SHA help connect TSMO with their activities such as construction, safety, and planning.

TASK FORCES

Individuals from multiple departments can gather together into a task force to address a temporary problem or need. Task forces may include multifunctional teams that guide large DOT infrastructure projects and may include traffic management staff.

> As the TSMO program launched in Maryland, the Maryland DOT SHA regularly used task forces to establish TSMO program baselines. There were initially eight TSMO-related task forces, including one to develop business processes. The TSMO Business Processes and Policy task force succeeded in initiating an executive directive that required the consideration of TSMO in all relevant agency activities. As the program evolved, the task forces were combined and integrated into normal agency processes. The task forces are able to re-form on an as-needed basis.

> Tennessee DOT has also established task forces to address TSMO topics, such as work zone management, Regional Operations Forum implementation, and the second Strategic Highway Research Program projects. The Maricopa County DOT TSMO Division created a multidisciplinary tiger team/task force to create a process for dissemination of construction and flood information. Tiger teams are cross functional teams brought together for a limited period to solve a critical issue.

FULL-TIME INTEGRATOR

A full-time integrator is a person or department whose sole purpose is to coordinate between departments. Integrators are traditionally based in a separate department or unit that is outside of the functional units of an organization. This person or department is distinct from a liaison, who is typically housed within the functional area (e.g., TSMO) and has other responsibilities besides serving as a liaison. The project team did not see any examples of a full-time integrator during its review of State and local DOT organizational structures.

PERMANENT TEAMS OR COMMITTEES

Permanent teams or committees are cross-functional teams that permanently work together to create products or provide services. Although the interaction is less frequent than typical product or service teams, permanent committees also provide linkages. These teams or committees can be at the staff level, manager level, or executive level. Depending on the management and staff level, they may collaborate to develop policy, establish programs, design solutions, implement strategies, or monitor progress to advance TSMO within the agency.

The TSMO directors (or administrators) from Arizona DOT, Vermont Agency of Transportation (VTrans), and New Hampshire DOT participate in executive-level committee meetings. The directors advocate for TSMO, share information on how TSMO can work with other units to jointly address issues and meet goals, and get a line of sight into their organizations' priorities and actions.

Several State DOTs have a TSMO Committee, including Arkansas, Maryland, Michigan, New Jersey, Tennessee, and Washington State.

Arkansas DOT's TSMO committee members are from Maintenance/ITS, Transportation Planning and Policy, Program Management, System Information and Research, IT, and Roadway Design Divisions, as well as representatives from District Construction/ Maintenance. The committee was formed to provide a multifaceted approach to addressing TSMO issues and to develop recommendations for advancing TSMO within the agency. The current focus of the TSMO committee is the development of an agency TSMO plan with strategic, programmatic, and tactical dimensions. Although the committee does not meet regularly, the members share information through an internal information system. Arkansas DOT hosts a TIM committee that meets quarterly.

At Maryland DOT SHA, the TSMO program is run through a TSMO executive committee, with on-demand task forces available for support. The Executive Committee has representation from district engineers and key people from offices across Maryland DOT SHA. This structure helps to bridge any information gaps between the central office and the districts.

Michigan DOT has a TSMO Committee that meets regularly on the development of new programs and priorities and where funding will be committed.

New Jersey DOT jointly leads what could be considered a TSMO committee that extends beyond the organization. New Jersey DOT has the Complete Teams initiative, which brings together multiple units within the department and some entities outside the department. The team talks about improving programs for maximizing mobility, including planning, bike/ pedestrian, and reliability targets, among others. Complete Teams is a joint effort and is held at New Jersey DOT Headquarters, with participation from FHWA, the Delaware Valley Regional Planning Commission, the North Jersey Transportation Planning Authority, the South Jersey Transportation Planning Organization, NJ Transit, and academia.

Tennessee DOT has an ITS Coordinating Committee, which will be rebranded as a TSMO Coordinating Committee. It will serve as an integration point for TSMO-related activities. The TSMO Coordinating Committee is a multidisciplinary committee. When the committee began as the ITS Coordinating Committee, it was a collection of champions; now re-formed as the TSMO Coordinating Committee, it is an integration point and serves to achieve buy-in and consensus for TSMO projects.

Washington State DOT has convened a multidisciplinary TSMO committee, titled the "TSMO Implementation Group," to guide the development of a TSMO program plan. The council brings together representatives from multiple units across the organization and has helped to increase awareness and ownership for TSMO in disciplines that were previously not connected to TSMO. The disciplines represented on the council include:

- Design
- Construction
- Maintenance
- Ferries
- Planning
- Freight
- Asset Management
- Performance Management
- Safety

RELATIONAL COORDINATION

While not a linkage mechanism, relational coordination refers to frequent communication through relationships among staff in an organization. It is a high degree of coordination in an organization and is often part of the culture and can support mainstreaming TSMO through frequent staff interactions and shared understanding of TSMO benefits and applications across functional areas. This type of coordination is built into the daily working environment of the organization.

For example, Arizona DOT's TSMO Division Director described having frequent dialogue with other executive-level leaders and an incredible synergy with other leaders beyond established meetings. This coordination supports the integration of TSMO into areas such as capital programs.

The Michigan DOT TSMO Division Director appears to be heading toward strong relational coordination. He reported there is open dialogue with other departments within the DOT and a sense of transparency and trust.

KEY CONSIDERATIONS

Careful oversight by leadership is one element of success when instituting horizontal structures to foster communication and coordination within otherwise primarily vertical structures. Such oversight requires managers to establish TSMO policies and core processes around which to organize TSMO functions. Such a shift in structure includes changes in culture, staffing (including job descriptions), management philosophy, and information systems. Potential disadvantages of a horizontal structure include limiting the development of subject matter expertise and skills among staff without agency leadership focused on maintaining and building staff expertise.

Horizontal communications mechanisms within DOTs have proven to be a successful means of sharing the TSMO message and successfully incorporating TSMO into day-to-day activities, advancing TSMO in DOTs across the United States.

CHAPTER 5. CASE STUDIES

This chapter provides case studies of organizational models and horizontal linkages used to advance TSMO in State and local DOTs.

The case studies highlight the current placement of TSMO within the organization, the evolution of TSMO within the organizational structure and the motivation for changes, the use of horizontal linkage mechanisms, and the effects of organizational structure on TSMO. The following agencies are included as case studies:

- Arizona DOT
- Maricopa County DOT
- Texas DOT
- Michigan DOT
- New Jersey DOT
- VTrans

ARIZONA DEPARTMENT OF TRANSPORTATION

Arizona DOT's TSMO Division was created in 2015 and is an example of an agency with a top-level TSMO unit. Arizona DOT's organizational structure is fairly centralized. Arizona DOT's regional traffic engineers and districts play an important role in advancing TSMO.

Where does Arizona DOT's TSMO initiative sit along four dimensions of organizational structure?

- Formalization: High
- Specialization: Dedicated TSMO staff
- Hierarchy of authority: Two levels below the director
- Centralization: Authority is centralized

Prior to standing up the division, TSMO activities had been housed within the Infrastructure Delivery and Operations Division. The State engineer at that time was a strong proponent of maintaining an operations focus and championed the idea of creating an independent TSMO Division. As a result, the TSMO Division was created as a standalone, high-level unit whose director reported to the State engineer. The State engineer, who also has the title of deputy director of transportation, oversees three divisions: Planning; TSMO; and Program Delivery, Construction, and Maintenance.

The TSMO Division is made up of the following seven programs:

- Traffic Maintenance
- Traffic Management
- Systems Management
- Business Administration
- Operational Traffic and Safety
- Systems Maintenance
- Systems Technology

Regional traffic engineers in the Operational Traffic and Safety group coordinate with the DOT districts. The regional traffic engineers are TSMO Division staff co-located in the districts and integrated with the district staff.

TSMO Division leadership regularly report metrics on key performance measures to connect across divisions and support increased TSMO integration with other divisions. There is ongoing discussion about how to align the divisions with Arizona DOT's vision of reducing fatalities. The TSMO Division maintains an open dialogue with leadership and other divisions about agency priorities.

Below the executive level, regular business reviews within the TSMO Division assess performance metrics to help determine division priorities. Group managers discuss the results with their staff and changes cascade outward from there.

Arizona DOT's centralized structure carries over to the TSMO Division. An advantage of this organizational approach is that it strengthens Arizona DOT's focus on system efficiency. TSMO is highly visible in the organization, and because the TSMO Division's regional traffic engineers are colocated among district staff, TSMO strategies and activities can be shared across the agency. This emphasis on eliminating silos facilitates cross-pollination, which gives other divisions and groups insight into successful approaches to operations and the benefits of more efficient operations.

MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION

Maricopa County DOT in Arizona is an example of a county DOT with a very active TSMO program. Maricopa has a top-level TSMO unit that includes design, development, technology, and operations and focuses on advanced ITS deployment and operations. The TSMO Division holds a prominent position within the organization. Located one level below the organizational head, it comprises six branches: Traffic Design, Traffic Development, Traffic Maintenance, Traffic Operations, Traffic Technology, and the Arterial Incident Management Program, known as REACT.

Where does Maricopa County DOT's TSMO program sit along four dimensions of organizational structure?

- Formalization: High
- Specialization: Dedicated TSMO staff
- Hierarchy of authority: High-level authority within the DOT
- Centralization: Authority is often delegated to lower-level managers

Although Maricopa County DOT created its TSMO Division about 5 years ago, the TSMO Division recently reorganized into its current structure to align with Maricopa County DOT's increasing focus on current TSMO strategies. Understanding the importance of incorporating TSMO in all stages of project development, traffic engineering, and operations, Maricopa County DOT created groups within the TSMO Division to focus on streamlining workflows that follow current TSMO best practices, applying lessons learned, and preparing for future regional initiatives. This approach has proven successful for the county.

One example of the benefits of an active, highly placed TSMO division in a DOT's organizational hierarchy is the increased ability to broadly integrate TSMO considerations throughout the agency's other divisions. For example, the TSMO Division was able to improve internal and public communication using a tiger team/task force to bring together multiple disciplines to address ways to better disseminate traveler information during floods that cause road closures. The task force comprised of construction, technology, permits, and operations staff, all of whom worked together to develop a process to share important information with the traveling public in real-time. TSMO works closely with maintenance and safety and is actively part of the project scoping process. Monthly status reports provide opportunities to share information about projects and help identify the need for ITS devices to be included.

TEXAS DEPARTMENT OF TRANSPORTATION

Texas DOT is a centralized organization at the policy level. Texas DOT headquarters guides the strategic direction and initiatives for TSMO, and the 25 DOT districts develop and deploy the TSMO initiatives.

In 2018, Texas DOT reorganized to create a Traffic Safety Division. That division currently includes five sections: Traffic Management, Traffic Engineering, Crash Data and Analysis, Special Crew, and Behavioral Traffic Safety. The TSMO leadership for Texas DOT includes the Traffic Safety Division director and deputy director.

Texas DOT's TSMO Statewide Strategic Plan and a 2016 executive directive require that new construction and roadway work include ITS devices and communications infrastructure in their project plans. Including these elements helped to launch Texas DOT's efforts to advance TSMO throughout the State. Since that time, all districts have been moving forward with their TSMO plans. Consultant support facilitates TSMO planning in the districts, and these efforts have helped to mainstream TSMO throughout the districts. At the implementation level, each district within Texas DOT has a TSMO champion who is usually someone in the traffic operations field. Texas DOT does not have a statewide TSMO committee. The central office leaves decisions with each district on how to implement TSMO.

Where does Texas DOT's Traffic Safety Division's TSMO initiative sit along four dimensions of organizational structure?

- Formalization: Moderate
- Specialization: No dedicated TSMO staff
- Hierarchy of authority: Three levels below the executive director
- Centralization: Highly centralized at policy level, highly diffuse at the implementation level

Having TSMO under the umbrella of the Traffic Safety Division was a natural fit for Texas since signals and ITS are already managed through that unit. This organizational placement also helps to align TSMO with Texas DOT's top priority: safety. One advantage of this organizational approach to mainstreaming TSMO is that it enables districts to use consultants to support developing TSMO plans, providing greater TSMO expertise than currently exists in-house.

MICHIGAN DEPARTMENT OF TRANSPORTATION

Michigan DOT is an example of a DOT with a mix of central and regional authority for TSMO. Michigan DOT has a TSMO Division, located in the central office in Lansing. The TSMO Division administrator reports to the bureau of field services director, who reports to the chief operations officer, who in turn reports to the DOT director. Each of the DOT's seven regions has an associate engineer for operations who acts as a TSMO champion and liaison. The associate engineer for operations reports to the region engineer and assists with delivering the statewide, 6-year call for projects.

Where does the New Jersey DOT's TSMO initiative sit along four dimensions of organizational structure?

- Formalization: High
- Specialization: Dedicated TSMO staff
- Hierarchy of authority: Two levels below the commissioner
- Centralization: Moderate, with high-level decisions occurring at the director level while daily operational decisions occur at lower levels of management

In 2019, Michigan DOT underwent an organizational change to consolidate more functions under a dedicated TSMO unit. As part of the structural changes, everything related to bridges was moved out of the Operations Field Services unit. The Traffic and Safety Division was moved from Design Services to what is now the Operations Field Services. The Operations Field Services unit became the TSMO Division. The TSMO Division includes four sections: Maintenance/Operations Services, ITS, Traffic and Safety, and Fleet & Facilities. The reorganization resulted in a less centralized structure. Decisionmaking within the TSMO Division reflects this; regional TSMO representatives participate directly in funding decisions.

In addition to the associate engineer of operations at the regional level, Michigan DOT has a statewide committee that regularly meets to advance the development of new programs and determine funding priorities. Other avenues for advancing TSMO integration include the Transportation Operations Center User Group, which provides a forum for open discussions to advance TSMO coordination, and the ITS Users Group, a forum dedicated to advancing operations strategies and priorities.

Some coordination had been a challenge due to staff being located in different facilities based on their functional areas (e.g., Traffic and Safety is in a location about 8 miles from the rest of the division). About 95 percent of staff were forced to work from home due to national events during 2020. Working remotely has led to more interaction via online meetings, which, while sometimes challenging, may turn out to be positive for the new division. Moving to online meetings has helped strengthen the relationships among safety and operations, improving transparency and building trust.

NEW JERSEY DEPARTMENT OF TRANSPORTATION

Within New Jersey DOT, the Transportation Mobility Division is responsible for planning, designing, and overseeing construction, maintenance, and operation of all TSMO activities for the department. These activities include managing the State's TMCs, safety service patrols, the TIM program, ITS devices, fiber, travel-time data, signal optimization, remotely controlled and adaptive signals, and hard shoulder running programs.

The Transportation Mobility Division was formed several decades ago as the Statewide Traffic Operations Division. The division had been headed by an executive director who reported to the deputy commissioner, in the same way that other units' assistant commissioners did. In July 2018, a change in leadership resulted in the division being merged into the larger operations unit, which offered the opportunity for additional, enhanced coordination and collaboration. The assistant commissioner, to whom the division reports, named the entire unit Transportation Operations, Systems, and Support.

The State is broken up into regions, each with its own regional leadership having the autonomy to oversee day-to-day activities based on regional effects. Each region reports up to senior directors at the statewide level, who make high-level personnel decisions or unit-impacting financial decisions. Day-to-day decisions (e.g., operational tactics, signal or construction analysis) occur at lower levels.

Managers and staff from the Transportation Mobility Division regularly collaborate with all other areas of New Jersey DOT. The DOT has monthly director meetings that facilitate solving crosscutting issues.

New Jersey DOT noted that a major advantage of the reorganization is there are no limitations to cooperation in terms of day-to-day practice. The operations teams work together closely, and the department processes are set up to allow staff to effectively collaborate and execute tasks with their counterparts. Effective collaboration is possible because staff understand each other's roles and the corresponding benefits of cooperating.

VTRANS

VTrans comprises eight districts. About 5 years ago, the Operations and Safety Bureau—which combines ITS, traffic signals, data, traffic operations, and TMC teams into one TSMO team under the Highway Division—was created after conflicting construction projects caused travel issues for the public.

Recently, the safety unit joined the TSMO team, resulting in the creation of a new Operations and Safety Bureau within the Highway Division. While combining the groups on paper and putting them in the same building was easy, breaking old habits was not. Each team under the new TSMO group still operated as they did before. It took time for the employees to understand and adopt a shared TSMO vision.

Where does VTrans' TSMO initiative sit along four dimensions of organizational structure?

- Formalization: Low
- Specialization: Dedicated operations and safety staff
- Hierarchy of authority: Two levels below the secretary
- Centralization: Highly centralized

The original plan for integrating TSMO throughout the agency was to build support for TSMO in the districts through a TSMO ambassador program. Under this plan, one person in each district would be trained as the TSMO champion and become the team's main point of contact for the district, coordinating with regional staff to integrate TSMO into their processes. Ultimately, the program failed because districts had varying levels of interest in the program, and the central office staff did not pursue continued training. Now TSMO messages are shared more organically, with the Operations and Safety Bureau working with regions and districts to build relationships and share the TSMO approach. With only about 60 people in each district, the bureau staff has found it easier to communicate directly with district engineers to complete projects around the State.

The benefit of the bureau's organizational position is the team is highly visible, and the TSMO message cannot be ignored. There are still opportunities within the Operations and Safety Bureau to move infrastructure safety employees to the same side of the bureau as the behavioral safety employees, which would enable the team working on Highway Safety Improvement Program projects to work with the mobility experts who can validate the effectiveness of plans for specific treatments for a corridor. There are also opportunities for better horizontal linkages between teams across VTrans as a whole.

CHAPTER 6. KEY TAKEAWAYS AND POTENTIAL ACTIONS TO ADVANCE TSMO

This chapter summarizes the organizational structures of State and local DOTs and how organizational structure can enable the integration of TSMO. This chapter provides observations from the case studies presented in chapter 5 and interviews with State and local DOTs. It also outlines some potential actions that DOTs can take to use organizational structure and horizontal linkages to support and advance TSMO.

ORGANIZATIONAL STRUCTURES AND TSMO

As discussed in chapter 3, organizational structures fall along a continuum between vertical and horizontal, with vertical structures being more centralized and having a strong sense of hierarchy. Conversely, horizontal organizational structures are decentralized, systems are informal, and communication and collaboration are necessary and common across groups and divisions. Traditional DOT structures tend to be more vertical in nature, with clearly defined functional areas and formal roles and responsibilities. This structure has led to top-down policies and often siloed functional areas. A traditional DOT structure is commonly organized around project life cycle phases: planning, design, construction, maintenance, and operations. This structure can limit communication and creative sharing of new and emerging strategies.

As a result of its crosscutting and evolving nature, horizontal linkages are particularly important to advancing TSMO in a DOT. TSMO is by nature an application of strategies that crosscut traditional functional areas. Therefore, agencies that move from a more rigid vertical structure to a more horizontal structure or develop horizontal linkages make it more possible to advance TSMO throughout the organization.

A number of strategies for developing horizontal linkages in DOTs support integrating TSMO across the organization. Enabling horizontal linkages for TSMO include TSMO liaisons, multidisciplinary committees that include or focus on TSMO, and regular coordination and communication across departments. Liaisons and committees strengthen communication and coordination across divisions and functions and can be used to inform other disciplines of the benefits and opportunities provided by TSMO and to soften existing silos and separations.

INSIGHTS FROM STATE AND LOCAL DEPARTMENTS OF TRANSPORTATION

Chapter 5 discussed one local agency and five State DOTs exemplifying a range of structural approaches, including varying levels of formalization, specialization, hierarchy, and centralization. Each DOT applied horizontal linkages for connecting across divisions and coordinating with other divisions, regardless of the formal organizational structure. This coordination through liaisons, committees, information sharing, or performance metrics is important to advancing TSMO in the organization.

In terms of where agencies position TSMO in the structure, select discussions with staff from State DOTs found that regardless of where TSMO is located within the organization, TSMO unit leaders reported a high degree of satisfaction with where TSMO is positioned.

Agencies having a TSMO unit positioned more highly in the organization reported several advantages. In such cases, the TSMO leaders felt that it made TSMO more visible across the organization and communicated to others in the DOT that TSMO was a priority. For example, the TSMO Division within Arizona DOT is at a high level and visible. Agencies with higher level TSMO units typically have larger spans of control. Within its TSMO Division, Arizona DOT placed the safety office, systems technology support, TSMO-specific maintenance, contracting services, human resources, permitting, and procurement. This grouping allows TSMO to more efficiently advance without being as reliant on support outside its division.

TSMO leaders appeared to be able to overcome challenges a lower tier unit may face (e.g., limited authority or visibility and resource constraints) by making use of horizontal linkage mechanisms. As these leaders were able to establish connections to other divisions, the placement of TSMO could be managed. When TSMO is lower in the organization, mainstreaming and advancing TSMO can be more successful with a leader who excels in making connections. Lower level TSMO placement may mandate the use of interpersonal skills to mainstream and advance TSMO.

Formalizing a TSMO unit can help formalize TSMO funding, although it is not a requirement. Organizations having TSMO units typically also had a dedicated budget. Having a steady budget helps to avoid losing funding to other priorities in the DOT. One disadvantage to a specific TSMO budget mentioned by a TSMO leader was that it may make it less likely that TSMO could compete against other types of projects and receive additional funding.

Until TSMO is formally part of the responsibilities of relevant staff within a DOT, advancing TSMO will depend on interpersonal relationships, advocacy, and particular leadership buy in; this may be unsustainable when there is staff turnover or new leadership. While TSMO is being integrated into the agency, a TSMO-focused unit can provide a center of focus for TSMO within the organization for coordination.

POTENTIAL ACTIONS TO ADVANCE TSMO IN AN ORGANIZATION

Agencies can take a number of actions to expand the role of TSMO and advance its adoption throughout the organization. Some of these actions include the following:

- Formalize the positions of TSMO champions to create a more visible and sustainable role for TSMO in an organization.
- Identify a TSMO lead in a prominent position in the organization to create visibility and authority for TSMO. Beyond a TSMO champion, creating an organizational TMSO unit or division on par with other functional areas, with a budget, staff, and program plan, can elevate TSMO in decisionmaking and strategic initiatives within the DOT.

- While helpful in advancing TSMO in an agency, a formal TSMO unit is not the only way to establish TSMO in an agency, nor is it a realistic option for some agencies. Several key horizontal linkage mechanisms can be used to advance TSMO across DOTs, as highlighted in chapter 4.
- Establish crosscutting TSMO committees to consider ways to advance TSMO in the following areas:
  - Business processes and policies
  - Systems and technology
  - Data analysis and performance management
  - Communication and outreach
  - Training and education
  - Innovations and emerging technology
  - Multimodal management for people and goods movement

TSMO committees that meet regularly facilitate information and idea sharing across disciplines and can shift a DOT's culture from a design, build, and maintain emphasis to a TSMO focus.

- Include TSMO staff on project teams to infuse the project or program with the TSMO perspective.
- Integrate TSMO-related performance measures into agency-wide dashboards and performance reports to serve as a type of information system that provides a linkage across functional units of the DOT. These activities increase the visibility of TSMO and communicate the importance of TSMO and its performance benefits.
- Create TSMO leaders or champions at both the central office and regional/district offices to reinforce the visibility and acceptance of TSMO across the geographic divisions of a DOT and expand the implementation of TSMO strategies.
- Leverage areas that are closely aligned with TSMO, such as safety, work zones, and planning, through coordination and communication, regardless of where TSMO is on the organizational hierarchy.
- Incorporate TSMO into decision processes and formal guidance as a method of horizontally linking functional areas. Such actions may include integrating TSMO into planning, project development, and construction processes and manuals to provide a formal link between TSMO and other functional areas.

DOTs can consider a number of structural changes to advance the acceptance and mainstreaming of TSMO in their organizations. The organizational structure and horizontal linkages discussed here are a starting point. Each DOT has its own culture and priorities, and the most effective structures and strategies are the ones that work to achieve the desired results for each individual agency.

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