Role of Agency Culture in Mainstreaming TSMO

March 2023

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16. Abstract This White Paper aims to increase understanding of the role agency culture and cultural change can play in mainstreaming transportation systems management and operations (TSMO) and help agencies identify ways to influence their agency's culture to better facilitate mainstreaming TSMO. It presents concepts from fields such as change management, industrial/organizational psychology, and organizational development. It also incorporates examples and lessons learned from State departments of transportation (DOTs) in using cultural change to support mainstreaming 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 (2,000 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

APPROXIMATE CONVERSIONS FROM 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 (2,000 lb)	T
TEMPERATURE (exact degrees)				
°C	Celsius	1.8C+32	Fahrenheit	°F
ILLUMINATION				
lx	lux	0.0929	foot-candles	fc
cd/m^2	candela/m2	0.2919	foot-Lamberts	fl
FORCE and PRESSURE or STRESS				
N	newtons	2.225	poundforce	lbf
kPa	kilopascals	0.145	poundforce per square inch	lbf/in^2

*SI is the symbol for 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 ABBREVIATIONS AND ACRONYMS

AASHTO	American Association of State Highway and Transportation Officials
AMS	Arizona Management System
CAV	connected and automated vehicles
CMM	Capability Maturity Model
DOT	department of transportation
FHWA	Federal Highway Administration
ITS	intelligent transportation system
MPO	metropolitan planning organization
NIST	National Institutes of Standards and Technology
SHA	State Highway Administration
TSMO	transportation systems management and operations

1. INTRODUCTION

Every organization has a culture, which consists of the underlying values, assumptions, and behaviors that contribute to the social and psychological environment of the organization. It affects how the organization functions because the values and assumptions are absorbed by employees of all levels and affect the decisions made. Culture is the "organizational iceberg" that hides below the water line. (Herman 1978) It is an informal understanding of the ideals, expectations, mindsets, and norms of the people within the organization. (Cunningham and Kempling 2009)

Culture is considered one of the key elements for advancing transportation systems management and operations (TSMO) capabilities within a transportation agency. When an agency values TSMO as an important approach to accomplish its mission and clearly communicates that to staff, it builds a culture of TSMO support that helps mainstream TSMO in an agency. A culture of TSMO shows up in different ways in different organizations. In some, the planning process requires TSMO to be considered to address a mobility need before any other solutions. Other agencies with a TSMO culture have specific career paths for TSMO professionals and the inclusion of TSMO leaders among department leadership committees.

There are numerous ways to support both mainstreaming TSMO throughout transportation agencies and advancing TSMO as a way of doing business. The Federal Highway Administration (FHWA) has developed a series of white papers focused on mainstreaming TSMO through formal policies and processes, changes in agency culture, advances in decisionmaking and information management, and development of business cases for TSMO.

This White Paper identifies ways to influence agency culture and how that could be applied to mainstreaming TSMO in a transportation agency. It presents concepts from fields such as management, industrial/organizational psychology, organizational development, and change management. In addition, there are examples of improving organizational performance using a range of well-known approaches, with emphasis on examples that are more relevant to public agencies and transportation. It also incorporates examples and lessons learned from State departments of transportation (DOTs) in using cultural change to support mainstreaming TSMO. The focus of this White Paper is the role of agency culture in mainstreaming TSMO in a State DOT, but it also acknowledges that culture change occurs in other types of organizations and many of the points made have applications across a transportation agency.

Objectives of the White Paper

This White Paper aims to increase understanding of the role that cultural change in transportation organizations can play in mainstreaming TSMO and help agencies identify ways they can influence the culture in their agencies to better facilitate mainstreaming TSMO. This is supported by findings and practices from change management and other fields and examples of cultural change impacting TSMO in State DOTs.

This paper contains six chapters and an appendix that cover a range of topics in organizational culture and mainstreaming TSMO. Chapter 1 provides the background and motivation for the paper.

Chapter 2 describes four approaches—Lean Six Sigma, the Baldrige Performance Excellence Program, the Balanced Scorecard, and the Capability Maturity Model—to organizational improvement and culture change and how they could be applied to mainstream TSMO.

Chapter 3 defines four common ways (i.e., leadership influence, employee engagement, employee awareness of the organization's mission, and quantifiable metrics) to influence culture in an organization and examples of how these levers are used to mainstream TSMO.

Chapter 4 briefly discusses the cognitive processes that can impede change. This chapter raises awareness of barriers to change and ways to overcome them.

Chapter 5 provides practical considerations for agencies interested in changing their culture as a way to mainstream TSMO.

Chapter 6 contains references for additional information.

The appendix contains additional information on the theory of approaches for organizational change and levers of influence.

Intended Audience

Practitioners and managers at various levels of a transportation organization and their partners with a range of specialties should use the ideas in this document as a guide to establish TSMO in their organizations. The guidance is intended for State DOTs and may also be applicable to regional and local transportation agencies.

Why Mainstream TSMO?

Transportation agencies have focused on the design, construction, and maintenance of transportation facilities. TSMO is intended to expand this focus by looking to operational improvements to existing facilities to maintain and restore system performance before adding physical capacity. Mainstreaming in the context of business processes is defined as "[P]roducts and services which are readily available to and appealing to the general public, as opposed to being of interest only to a very specific subset of the public." (Business Dictionary 2020) TSMO mainstreaming is viewed as making management and operations strategies readily understood, considered, appealing, and available to agency leadership and staff, regardless of where they sit in the organization, as well as to the system users (public).

Typically, TSMO has been initiated in operations and maintenance business areas within transportation agencies, often evolving with intelligent transportation system (ITS) technologies and functions that involve ITS deployment programs and other operations (maintaining signal systems, detecting and clearing incidents, etc.). Mainstreaming TSMO allows a broader range of strategies to be integrated throughout transportation departments and related agencies and organizations. Mainstreaming TSMO engages planners, designers, operators, and system users (public and private sector) and touches all aspects of mobility, including congestion, air quality, sustainability, safety, security, reliability, and related quality of life concerns. The goal of mainstreaming is to routinely include TSMO strategies as an "equal player" to address transportation needs within a community or region, along with other options to improve transportation system performance.

2. APPROACHES TO ORGANIZATIONAL IMPROVEMENT AND CULTURE CHANGE

This chapter presents well-known examples[1] of organizational performance improvement techniques, including Lean Six Sigma, the Baldrige Performance Excellence Program, the Balanced Scorecard, and the Capability Maturity Model (CMM), that can help agencies make changes in their organization, including changes to culture. They enable an agency to understand what needs to be changed in its culture and track its changes to achieve the desired outcomes. The approaches discussed apply to changing an agency's or organization's culture regardless of field:

- Lean Six Sigma is a quality management technique to run a more efficient and productive business. It requires detailed data analysis and monitoring progress.

- The Baldrige Performance Excellence Program is a systems approach to improve an organization's performance by focusing on leadership, strategy, customers, measurement analysis and knowledge management, workforce, operations, and results. It has recently been used in hierarchical government agencies with success.

- The Balanced Scorecard is a tool to measure an organization's performance in areas of concern to help target improvements.

- The Capability Maturity Model is a benchmarking approach that helps agencies identify the maturity of their current capabilities and ways to improve those capabilities. The CMM for TSMO includes culture as a key capability.

Each of the approaches highlighted in this chapter is different, but they all provide a structured framework to measure, understand, and change culture at every level. There is no right or wrong approach, but rather one should use the approach that would best fit with the goals of the agency and the inherent perspectives on measurement, systems integration, and structure. Any of these approaches is better than being purely reactive when it comes to the topic of culture change.

Performance improvement techniques have a range of advantages that can be beneficial to an organization beyond just process controls and improved manufacturing, where many of these approaches were first developed. Fryer et al. (2007) found several benefits in their review of performance improvement approaches:

- Low capital investment.

- Ideas generated by those most engaged with the issues.

- Increased employee commitment.

- Improved performance/quality and customer satisfaction.

- Reduction of wastes and costs.

The research spanned across sectors and regions and found that, within the public sector, management commitment was universally cited as critical for any success. Next were customer

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[1] FHWA is not endorsing any particular approach or method, and this list is not exhaustive.

management, process management, and employee empowerment, which were considered key in 75 percent of the cases. (Fryer et al. 2007) The public sector is prone to reorganizations and leadership changes, which impact continuing commitment to an approach for organizational improvement.

Lean Six Sigma

Six Sigma began in the mid-1980s at Motorola to improve engineering processes and eliminate variation. Lean is another process improvement and excellence approach that was developed from the Toyota Production System that sought to reduce waste, overburden, and inconsistency. (Antony et al. 2017b) Lean Six Sigma branched out by combining these approaches and expanding certifications to all professions/occupations.

Lean Six Sigma is collaborative and aims to reduce the eight sources of waste in any profession or occupation. As noted by Summers (2011), the first letter of each source forms the acronym DOWNTIME:

- **D**efects
- **O**verproduction
- **W**aiting
- **N**on-utilized talent
- **T**ransportation
- **I**nventory
- **M**otion
- **E**xtra-processing

Lean Six Sigma has been used as a framework for organizational culture change. (Summers 2011, Thomas et al. 2008) It could be applicable beyond the manufacturing industry to the more services-oriented public sector fields that may be most similar to transportation agencies. (Furterer 2016, Fryer et al. 2007, Antony et al. 2017a)

Examples from the Field

The government of Arizona has transformed how agency leadership and staff conduct their work using the Lean approach. In 2015, the incoming Governor of Arizona brought with him the Lean approach from his work in the private sector. He led the State in developing and implementing the Arizona Management System (AMS) through a focus on innovation and continuous improvement. As noted by the State of Arizona (2020), primary components of AMS are as follows:

- Performance management, including performance measures, targets, and huddle boards.
- Leader behaviors, including Gemba walks and one-on-one coaching.
- Problem solving, including a structured approach to identifying root causes and countermeasures.

All State agencies within Arizona have adopted the system, including Arizona DOT and its TSMO Division. The TSMO Division was created around the same time as when the State adopted the AMS, which has permeated the work of the TSMO Division. According to the TSMO Division Director, the leadership and managers have been thoroughly trained in Lean management, and it has been engrained into their work. They work continually to have the Lean approach embraced by staff. Managers constantly use this system and encourage (or require) their staff to use it through huddle boards and tiered huddles to share and move issues up and down the management chain. The TSMO Division applies process mapping to remove waste in processes and structured problem-solving approaches and implements a "Plan – Do – Check – Act" approach to their functions.

The TSMO Division Director reports that there have been significant positive impacts from using the AMS. For example, Arizona DOT significantly reduced wait times at the Department of Motor Vehicles by diving deep into its processes. The TSMO Division also won a national award for a restriping and signing project in the Phoenix area for a corridor that used to have vehicle crashes multiple times a day. The benefit-cost ratio of the project was very high, around 700 to 1.

As part of the AMS, the TSMO Division has performance measures that feed up into the DOT cabinet level. Managers within the TSMO Division are responsible for reporting, up to the TSMO Director, three to four simple performance measures using green, yellow, and red color-coding. Managers are encouraged to report red if there are problems and detail how they will address those issues. It is instilled into their culture, and managers are not penalized for revealing negative metrics. They focus on positive incentives, such as bonuses and weekly kudos reports, instead of penalties. They measure how well this is changing the culture of the DOT and TSMO Division using annual employee engagement surveys.

The Lean approach has also been used in the Lean Everyday Ideas program as part of the Colorado DOT, wherein one person identifies a problem, comes up with an innovation, implements the plan, and then informs others so that it can be borrowed (see https://www.codot.gov/business/process-improvement). While the ideas span the range of DOT activities, they also apply to TSMO (e.g., collecting site data through applications, creating a folding icy bridge sign).
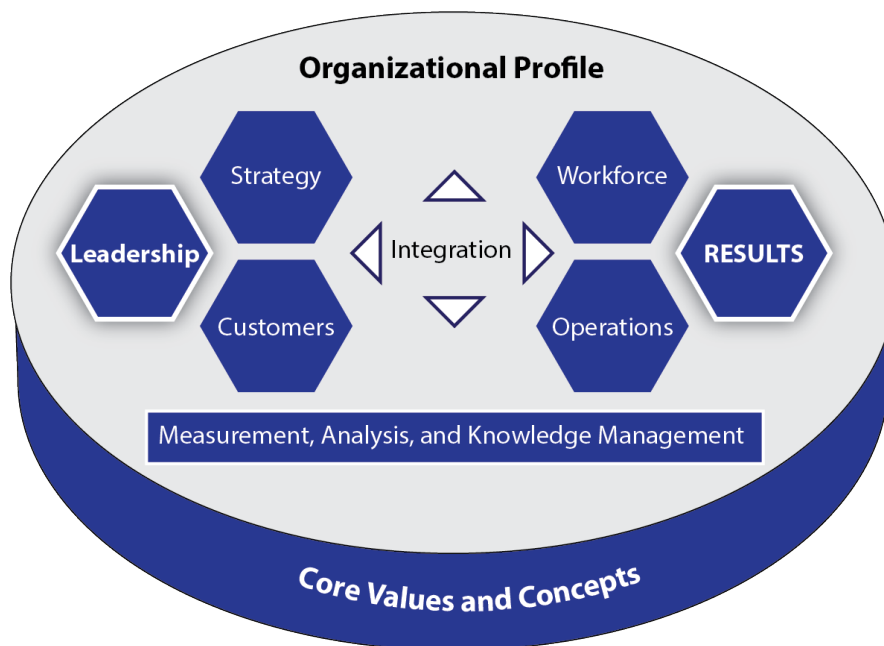
Baldrige Performance Excellence Program

The Baldrige Performance Excellence Program represents a framework for high-performance management systems. (Evans and Jack 2003) It was originally developed by the National Institutes of Standards and Technology in the late 1980s as U.S. leaders realized that American companies needed to focus on quality to compete in a global marketplace. The goal of the Malcolm Baldrige National Quality Improvement Act of 1987[2] was to enhance the competitiveness of U.S. businesses, with its scope expanding from manufacturing to healthcare, educational, and non-profit/government organizations. (National Institute of Standards and Technology 2019)

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[2] Pub. L. No. 100-107.

The Act created the Malcolm Baldridge National Quality Award, which was developed to identify role-model businesses, establish criteria for evaluating improvement efforts, and disseminate best practices. The award has brought recognition, resources, and improvement to a range of organizations over the years (from household names to largely unknown organizations—see https://www.nist.gov/baldrige/award-recipients).

It is different from other approaches because it takes a systems approach to understand and change an organization. This is particularly relevant for the complex domains within which transportation agencies operate, and it reflects a key aspect of TSMO. The systems approach and framework are represented in figure 1. As noted in the figure 1, measurement, analysis, and knowledge management underpin the effective integration of strategy, workforce, operations, and customers to provide results.

Source: NIST 2019.

Figure 1. Graphic. Baldrige Performance Excellence Program framework.

How Can Agencies Apply This to TSMO?

A TSMO Division of a transportation agency could use the Baldrige framework, which entails a structure of internally facing questions and measures, to become more learning-oriented with a focus on improving results and creating value. The results and value related to TSMO may be measured in decreased average travel time, reduced incident clearance time, and increased travel-time reliability. Baldrige assessment questions ask individuals to mark whether they strongly agree to strongly disagree to statements such as: (https://www.nist.gov/baldrige/self-assessing)

- "My organization asks what I think."

- "I know the parts of my organization's plans that will affect me and my work."

- "I am allowed to make decisions to satisfy my customers."

Balanced Scorecard

The Balanced Scorecard is another approach to performance management that was originally conceived to manage intangible assets. (Kaplan and Norton 1992, Kaplan 2010) It is a semi-structured report form that is used by managers to track various aspects of strategic execution activities, as well as monitor the impact of those activities.

There are three critical aspects of the Balanced Scorecard: (1) focus on the strategy set forth by the organization, (2) select a small number of data items for monitoring, and (3) include a mixture of financial and non-financial data. (Kaplan 2010)

As discussed in Kaplan and Norton (1992), the Balanced Scorecard focuses on four perspectives and related questions:

- **Customer perspective**—How do customers perceive the organization?

- **Internal perspective**—What must the firm focus on and excel in?

- **Innovation and learning perspective**—Can improvement and value creation continue?

- **Financial perspective**—How do shareholders perceive the organization's performance and worth?

The Balanced Scorecard has been successfully implemented in a range of businesses; however, it should not be viewed as purely a set of performance measures. Instead, it should be incorporated into the management approach as a cornerstone of how things are done, both for ongoing performance and during the change process. (Kaplan and Norton 1993)

How Can Agencies Apply This to TSMO?

A transportation agency could use this approach to align strategy and performance measures, including measures related to human capital and customer satisfaction, as well as a non-financially related measure of impact on the community (which are becoming more important to the evolution and operations of DOTs).

Capability Maturity Model

Although the Capability Maturity Model is not considered a formal framework of culture change, it is derived from earlier work in the software development field, which did include a notion of changing process and performance improvement. It focuses on three tenets: (1) process matters, (2) prioritizing the right action is important, and (3) focus on the weakest link to improve performance overall. (FHWA 2016)

For TSMO, the approach looks at process improvement in six capabilities (business, systems and technology, performance measurement, culture, organization and workforce, and collaboration) and across four levels (low to high). The approach was first applied to focus on overall TSMO improvement and has now been adapted for individual TSMO strategies, such as incident management, work zone management, and signal control as "capability maturity frameworks." The TSMO Capability Maturity Model, used by many State DOTs to assess and advance their TSMO capabilities, describes the culture dimension as "technical understanding, leadership,

outreach, and program authority." (FHWA 2012) FHWA (2012) defines the four levels of the culture dimension as follows:

- **Level 1**—Value of TSMO not widely understood beyond champions

- **Level 2**—Agency-wide appreciation of the value and role of TSMO

- **Level 3**—TSMO accepted as a measurable, formal core program

- **Level 4**—Explicit agency commitment to TSMO as a key strategy to achieve the full range of mobility, safety, and livability/sustainability objectives

The American Association of State Highway and Transportation Officials (AASHTO) provides a web-based tool that guides users through a customized self-evaluation based on the TSMO Capability Maturity Model. (AASHTO n.d.) It helps agencies identify their current levels of TSMO maturity and provides recommended actions to advance through the levels. For example, to move from level 1 to 2 on the culture dimension, the tool recommends "Developing a business case for TSM&O and continuous improvement of operations performance." (AASHTO n.d.) The tool recommends "Establishing TSM&O with a formal core business program status equivalent to other major programs" to move from level 2 to 3. (AASHTO n.d.)

The TSMO Capability Maturity Model is a tool that agencies can adapt to better gauge and guide the culture of mainstreaming TSMO within their organizations.

3. LEVERS OF INFLUENCE IN ORGANIZATIONAL AND AGENCY CULTURE CHANGE

Departments of Transportation, like other public sector organizations, have long-service employees who are deeply entrenched in the legacy culture. Some DOTs have maintained a culture focused on road and bridge construction, and TSMO is not viewed within the DOT with the same level of understanding or recognition. To change the culture, people within the organization should incorporate new policies or innovations into their daily routines. New behaviors need to become part of their daily routines until they become part of the norm, supplanting old behaviors. (Fernandez and Rainey 2006)

Four levers of influence on the behaviors of people within the organization and, in turn, the organization and its culture are:

- Leadership influence
- Employee engagement
- Employee awareness and understanding of the organization's mission
- Quantifiable metrics

These methods can facilitate or impede change. The discussion below addresses these four levers of agency culture change and how they can mainstream TSMO.

Leadership Influence

Leaders, regardless of their position or rank, play a critical role in organizational change in the public sector. (Fernandez and Rainey 2006) The definition of a leader varies drastically by framework or perspective, but a broadly applicable definition is "an individual who significantly affects the thoughts, feelings and behavior of a significant number of individuals." (Gardner and Laskin 1995, p. ix) This definition of leadership opens up the possibilities of a leader being at any level of an organization, field, or specialty area. This is relevant to transportation agencies, which may have both formal and informal leaders that shift roles throughout the agency. According to Gardner (1990) and Gardner and Laskin (1995), the six features of effective leaders, based on an assessment of great historical leaders include the following:

- **Story**—The leader must have a central story or message that others can follow.
- **Audience**—The audience must be ready and receptive to the leader's story.
- **Organization**—There needs to be some type of institutional basis or structure for leadership to endure.
- **Embodiment**—The creator of the story must embody it (what is now called authenticity).
- **Direct/indirect leadership**—The leader begins as a specialist and then grows to a generalist because it is easier to move from indirect leadership (domain-specific expertise) to direct leadership (wide-ranging issues and generality).

- **Expertise**—The leader must be an expert in a domain to gain credibility (although that domain does not have to be the same one in which the individual eventually becomes a leader).

The role of senior leadership is often emphasized at the onset of change, while direct supervisors and junior leadership guide its implementation and longevity. (van der Voet et al. 2015) Leadership is responsible for supporting change by disseminating information and justifying the need for change to employees and stakeholders. To establish a foundation for change, leaders need to generate desire for something different from the status quo. (Denning 2007)

Transformational leadership is the primary leadership theory that is generally agreed to have the most positive effect on organizational change because those who follow it can articulate their vision and foster support among followers. (Bass 1990, van der Voet et al. 2015) Transformational leaders support organizational change because they follow the Four I's— individual consideration, intellectual stimulation, inspirational motivation, and idealized influence. (Bass 1990, Riggio 2014) Basically, leaders provide employees with an appealing vision for change that is accepted because it is related to the employees' interests and values, while also supporting those employees' efforts. (van der Voet et al. 2015) By articulating outcomes and allowing frank discussions of perceived issues and factual inefficiencies that relate to the employee's daily work, leaders connect the need for change to the employee and mitigate change resistance. (Cunningham and Kempling 2009) Connecting employees' pride in the organization to the vision for change and improvement in the new iteration of the organization is an effective way to reduce resistance to change and increase employee support. (Fernandez and Rainey 2006)

Although aspects of leadership can influence change implementation and sustainability, leaders can also indirectly support change by identifying and supporting staff champions. (FHWA 2018) Staff members can be formal leaders (e.g., direct supervisors) or informal leaders who have been identified by formal leaders as highly respected individuals who have personal ties and can influence other employees. (Fernandez and Rainey 2006) These champions raise the profile of the envisioned change by informally discussing it in a positive light during face-to-face interaction (Cunningham and Kempling 2009) and being a visible example of someone adopting the change. (Schraeder et al. 2005)

How Can Agencies Apply Leadership to Mainstream TSMO?

Agencies successful in advancing and mainstreaming TSMO often cite the role that leaders and champions have played. TSMO champions both inside and outside an organization can make an important impact. Significant change with respect to TSMO requires buy-in and approval from top-level management across the organization. The role of leadership is key, which is why it is also critical for TSMO staff and mid-level management to make the case for culture change as a key part of improved performance.

The business case for culture change and mainstreaming TSMO should be tailored to leadership. As noted by FHWA (2018), the following ideas may help tailor a business case:

- Contain justifications to both career agency senior management who are well-versed with (and somewhat partial to) legacy systems, as well as elected officials with little familiarity in the domain.

- Get TSMO and the need for change on their radar early on (especially given the limited tenure of most State DOT CEOs).

- Frame TSMO as a strategy that can yield low-cost, quick-turnaround solutions that can have lasting impact.

- Protect the program and staff from leadership changes by not connecting changes to a particular leader or administration (build it for the long term and institutionalize it).

- Be mindful of leadership "capital" (e.g., reputational, representative, and intellectual), and the benefits/costs of supporting a TSMO program.

- Use case studies of high-performing peer States.

Examples from the Field

Three common themes related to the role of leadership in mainstreaming TSMO and culture change emerged through interviews with several State DOTs:

- **Organizational structure and common forums.** Several agencies noted some type of high-level restructuring or the development of a TSMO committee or task force that facilitated communication at the leadership level as being key to implementing TSMO. For example, Florida DOT developed a TSMO-specific task team and a leadership team to help ensure appropriate levels of structural change as part of the mainstreaming process. Florida DOT also adapted the central office of Traffic Engineering and Operations and Districts Office organizations to focus on and highlight TSMO roles and responsibilities. Similarly, Iowa DOT developed a TSMO steering committee that serves as a central place where representatives from every area of the agency come together around matters related to TSMO. It provides a central, coordinated point for TSMO matters and also allows for connections across the agency where TSMO benefits can be showcased.

- **Leadership buy-in and public support.** Some agencies noted the importance of leadership buy-in to gain traction. Ohio DOT specifically cited the strong buy-in from leadership to overcome resistance to change around agency culture. Washington State

DOT noted that its leadership was publicly supportive of TSMO and culture-change initiatives. The agency's leadership also recognized the need to effectively operate the system for the future using TSMO approaches (and adapting the current structure as needed). Texas DOT noted the value of leadership in defining TSMO, relating it to Texas DOT's mission, and identifying areas that needed help overcoming skepticism around change. In Florida, the TSMO program at MetroPlan Orlando, the metropolitan planning organization (MPO) for the Orlando region, received a major boost from leadership through board members and a U.S. Congressmember who spoke at a TSMO committee meeting. All major metropolitan area MPOs in Florida have active TSMO committees that inform the regional ITS architectures, strategic plans, and funding decisions.

- **Education and communication.** Leadership happens at many levels, and often leaders need to be educated about new approaches, technologies, or systems. There can be resistance to something new that may not be well understood. Tennessee DOT's leadership sent regional operations directors to a Regional Operations Leadership Forum, which fostered a better understanding of TSMO and generated buy-in on its usefulness. This would not have occurred without the most senior management mandating and supporting participation in this training. The TSMO Director at MetroPlan Orlando is bringing awareness and buy-in for TSMO to other MPOs in the Interstate 4 corridor of Florida by speaking at their board and executive director meetings to build collaboration for TSMO across the corridor.

Employee Engagement

Training and education are important when attempting to change an organization's culture, especially when new tools or processes are introduced. No matter how effective a leader is, one cannot induce a sustainable change if employees are unsupportive of the change initiative and do not have a shared responsibility for its success. Employees should support the incorporation of TSMO into a DOT's culture; otherwise, employees may revert to the legacy values and norms. DOTs can enable employee engagement and support for a particular change by presenting a strategic narrative, engaging managers, encouraging and recognizing employee voices, and establishing a sense of integrity represented in consistent organizational behavior. (MacLeod and Clark 2009)

One of the best ways to engage employees in the change process is to include them in the development of new policies and procedures. One suggestion is to ask employees to work in groups where they represent senior management and prepare a recommendation for how to adapt the envisioned change to their department. (Schraeder et al. 2005) This activity exposes participants to the challenges behind the change initiative and encourages them to take ownership over how it affects their daily work. (Schraeder et al. 2005) Another way to accomplish this is through internal surveys in which employees are able to provide feedback and new ideas. By empowering staff to take part in the change process, individual employees can have a positive impact on the way the department works and can be proud of those results. (National Academies 2010) Additionally, managers can include aspects of these changes in employee development goals and track their progress toward this change.

Training can play an important role in creating cultural changes by communicating the strategic narrative. Presenting the strategic narrative during training conveys the reasoning for change,

motivates the desired behaviors, cultivates communication, and mitigates employee apprehension. (Lougee and Poitevin 2019) Schraeder et al. (2005) noted that the following topics can enhance awareness and promote cultural change among employees during formal training:

- **Background**—The impact on organizational effectiveness and the role of values, behaviors, and norms

- **Development of the organizational culture**—The role of leadership and the impact of internal and external environments

- **Attributes of the current organizational culture**—The impact of subcultures, communication processes, and decisionmaking processes

- **Introducing the need for change**—Benchmarking with other organizations, internal financial trends, trends on customer feedback, and a realistic overview of anticipated implications

Expanding training beyond a single organization is also an effective way to emphasize a cultural change. For example, TSMO is not conducted within a vacuum at a State DOT or MPO, and it is often helpful to include local agencies or other TSMO partners in TSMO training. Interagency TSMO efforts are more effective when all partner agencies understand TSMO and have integrated it into their processes. This training may also help MPOs consider TSMO as a key option in the metropolitan transportation planning process.

An additional consideration is that new technologies or trends in processes or management are often already part of a change movement. Finding a way to link mainstreaming TSMO efforts to these trends can allow for contextual benefits in instituting new policies, changing behaviors (e.g., if another program results in updated training materials, then including TSMO-related changes is not as difficult), or enhancing performance metrics.

Examples from the Field

Recommendations from several State DOTs to enhance employee engagement coalesce into several themes:

- **Connect to something familiar.** For staff without exposure to or familiarity with TSMO, it may seem like something that is completely different and separate from their daily duties. It may also be seen as a burden of "extra work" in addition to their normal duties. Maryland DOT State Highway Administration (SHA) focused their employee engagement on connecting TSMO to what staff were already doing in their day-to-day duties and explaining how TSMO could support those efforts.

- **Clear definitions for overcoming resistance.** Texas DOT worked toward employee engagement by clearly defining TSMO, articulating what it means in various aspects, demonstrating how it relates, and highlighting how it can help improve performance. Maryland DOT SHA is also translating the TSMO language into terminology that can be incorporated into agency-wide communications. Maryland DOT SHA rolled out an agency-wide TSMO directive and is developing documents that detail how TSMO strategies and concepts can be embedded in various planning, engineering, construction, operations, and maintenance activities that various offices and district personnel perform on a day-to-day basis. Maryland DOT SHA TSMO actively engages various levels of

staff and management across the organization through townhalls and seminars to discuss collaboration opportunities.

- **Education and communication.** Florida DOT spends a fair amount of time on the basic activities of training and outreach to work with staff across the agency on TSMO. Several TSMO training courses are published on Florida DOT's training portal. Topics include ITS construction engineering and inspection, traffic signals, and system engineering. Personnel from Florida DOT's Traffic Engineering and Operations Office regularly attend statewide meetings of other disciplines to share TSMO updates and to learn about needs that could be addressed through TSMO. The Florida DOT TSMO Leadership Team and Task Team include representatives of all modes and many technical disciplines. Iowa DOT had to overcome resistance to TSMO being viewed as a fad and is developing a 5-minute TSMO video for all new staff as well as a TSMO curriculum to help with overall acceptance of TSMO as something that staff understand from the beginning as part of the agency's approach. Pennsylvania DOT started a training committee to understand gaps and needs related to TSMO and developed a transportation management center boot camp that can fit into the larger theme of TSMO throughout the agency. Washington State DOT developed a TSMO website as an educational tool and delivered various training for staff. As previously mentioned, Tennessee DOT sent leadership staff to Regional Operations Forums to educate key staff and overcome skepticism.

- **Tap into something that causes change and excitement.** Agencies use the linkages between TSMO and connected and automated vehicles (CAV) to engage a broader base with TSMO. Florida DOT ties in strategic planning for mainstreaming TSMO as a component that also works with their CAV program planning. CAV garners attention and excitement, and mainstreaming TSMO can piggyback on CAV momentum. Florida DOT TSMO champions convey to others in the agency and their partners that mainstreaming TSMO is the basis for future CAV planning, policy, and deployments. TSMO leaders can also connect TSMO to an agency leadership priority, such as asset management, for increased exposure and support.

- **TSMO liaison roles.** Several State DOTs have assigned TSMO Coordinators to communicate and coordinate with other departments or divisions regarding TSMO. For example, Michigan DOT has a TSMO champion in each of its seven regions. Similarly, Ohio DOT has a designated TSMO Coordinator in each of its 12 districts. These liaisons help incorporate TSMO into planning and deployment activities in the regions.

Employee Awareness and Understanding of the Organization's Mission

Culture change is supported when organizations and agencies ensure that employees understand the organization's mission, purpose, and goal agreements. Organizations and agencies do this in many ways, including adjusting their internal materials to reinforce their dedication to a mission and overall cultural change.

While articulating that the envisioned change is important, organizations should go a step beyond articulation and update structures and systems to correspond with the envisioned change. Clear vision, mission, and policy statements are essential for ensuring continuity of implementation. Policy ambiguity can sow confusion and lead to different interpretations throughout the

organization. (Fernandez and Rainey 2006) Agencies can ensure that employees understand the organization's mission, purpose, and goals by producing and distributing consistent internal materials that reinforce the agency's dedication to a mission or overall cultural change. Having clear, understandable goals and objectives readily available to all employees may help keep long-term projects and day-to-day tasks aligned with the agency's mission. (Smart Growth America 2012)

An agency's mission sets the foundation for all of its policies and decisionmaking frameworks. This usually sets the direction of the overall organization, and then program plans flow down from this framework.

Examples from the Field

Below are examples of areas in which DOTs have advanced employee awareness about TSMO:

- **Plans and manuals.** One way to increase employee awareness of TSMO is to incorporate it into long-range plans, strategic plans, mission statements, and other guiding documentation that employees will likely encounter. Developing a TSMO program plan is another approach to ensure that staff understand TSMO is vital to the organizational mission. Communicating the new mission demonstrates the importance of the change and ensures its consistent adoption. Florida DOT includes TSMO in all relevant manuals and guides and highlights safety and mobility goals supported by TSMO throughout the *Florida Transportation Plan*. Iowa DOT developed a TSMO strategic plan and a TSMO program plan that align with the DOT's overarching strategic plan. Ohio DOT developed its own TSMO program plan and articulated a business case for TSMO. Pennsylvania DOT is incorporating TSMO language into various Pennsylvania DOT publications and is developing a series of guidebooks to address the planning, design, construction, maintenance, and operations aspects of TSMO. Texas DOT has included TSMO in its strategic plan, mission statement, and agency goals. Tennessee DOT has a TSMO plan entitled Traffic Operations Program Plan.

- **Roadshows, websites, webinars, and other communication venues.** Several DOTs (e.g., Florida DOT and Iowa DOT) noted the use of a roadshow to meet with various divisions around the agency and make the case about the importance of TSMO and what is being done by each agency. Personnel from Florida DOT's Traffic Engineering and Operations Office regularly attend statewide meetings of other disciplines to share TSMO updates and to learn about needs that could be addressed through TSMO. The Florida DOT TSMO Leadership Team and Task Team include representatives of all modes and many technical disciplines. Washington State DOT developed a TSMO website that describes TSMO and various TSMO strategies and incorporated use of the website into some grant application processes.

- **Job descriptions.** Job descriptions and personnel-related documentation are a fundamental aspect of staff understanding. If TSMO is in the job description, then staff and leadership should be aware of TSMO from the beginning of a staff member's tenure with that position. Along with onboarding training, the job description is crucial to early exposure to the central role of TSMO. Maryland DOT incorporated TSMO in the job description for its Deputy Director, who serves as the agency's TSMO Program Manager. The agency has hired mid-level managers who are required to understand and have

experience with the TSMO program. Similarly, Tennessee DOT has included TSMO in job descriptions for managers and operators. Washington State DOT has developed TSMO-specific job descriptions and career paths. Florida DOT created a District TSMO Program Engineer position and job description.

Quantifiable Metrics

Quantifiable metrics are vital to the iterative process of improvement and culture change. These measures are also critical to making the argument for TSMO (i.e., business case) to initially resistant leadership or staff who want to hold onto traditions and may not initially see the benefits of a particular change or policy; engineers and business people alike want to see numbers and how they affect the bottom line. The use of metrics to illustrate the effectiveness of TSMO is key to convincing agency decisionmakers to prioritize and mainstream TSMO in their organizations. Data-driven methods, such as goal matrices, key performance indicators, and quantitative metrics, are tools that organizations and agencies can use to support the value of the mission or to change goals.

The change effort should be connected to other facets of the organization, especially performance evaluation and reward systems, which may help determine the state of progress, both from a baseline point and also throughout the change. (Bass 1990) Measurement is an important aspect of the change process—both to assess before and after changes as well as to assess what is working and what is not. These measurements may allow employees to focus on continuous, iterative improvement. (Cunningham and Kempling 2009)

An agency would benefit from setting clear criteria for State transportation projects where possible and evaluate current project delivery processes. (Smart Growth America 2012) It is beneficial to identify a limited number of achievable, measurable objectives related to performance. "Having readily available data and information about the performance of both the agency and the transportation system can help the public and stakeholder understand the progress that agencies are making to address performance and the challenges that transportation agencies face." (National Academies 2010) There are numerous types of metrics used in assessing performance, including return on investment, return on assets, and benefit-cost analysis, that are relevant to TSMO.

Transportation agencies can explore data on human capital management, which may take on increased importance as the transportation workforce goes through increasingly drastic changes in skills and needs. With an increase in data analytical needs within transportation agencies and the pivot towards more customer-focused and "softer" skills, data related to relevant skills of applicants and current employees in these domains should gain importance. These skills would be related to emerging positions in DOTs, such as traffic data scientist, statistician, and telecommunications manager. (Fecheyr-Lippens and Tanner 2015, Szymkowski et al. 2019)

As noted in the Balanced Scorecard approach discussed earlier, best practices for culture change try to tie strategies to performance measures and data. Proper data and performance metrics allow one to answer questions related to strategy success potential and weaknesses. Also, strategies should provide a framework for interpreting data and measures that should be targeted. The coordination of these two components may improve the chances of successfully and efficiently changing an agency culture.

Examples from the Field

State agencies provided examples of quantifiable metrics within certain themes:

- **Performance measures and outcomes.** DOTs are becoming more aware of the importance of performance measures that are inward looking, as well as tangible outcome measures in areas of TSMO, to complement measures often related to construction project completion. Portland's 2035 Regional Transportation Plan includes a new focus on performance measures and outcomes as well as a complementary Transportation Performance Management Plan. (FHWA 2010) Iowa DOT conducted an evaluation and found that they had nearly 200 performance measures, as well as a TSMO business case related to the utility of these performance measures in various other aspects of strategic planning and management. To streamline and focus these to be more useful, Iowa DOT is completing an analysis of operations performance measures to identify critical measures and a process to track and report on these measures.

- **Reporting and dashboards.** With all the data that are now available, as well as new performance metrics continually being added, it is necessary for a clean, comprehensive, and easily usable way to report information to management and other users. Incorporating TSMO into existing reports institutionalizes TSMO and aids in mainstreaming TSMO and raising awareness of its benefits and key role in moving people and goods. Arizona DOT's TSMO division uses a scorecard to track approximately 30 performance metrics in areas such as systems maintenance and systems management. Ohio DOT is building a dashboard to track all the program numbers and performance measures identified in its TSMO program plan. Pennsylvania DOT has a district executive scorecard with different performance measures based on the needs of executives and other users, with tailorable output. Additional TSMO-related measures are also being considered. Texas DOT is creating traffic management system status reports for all five metropolitan districts showing the results of TSMO activities, which is an example of institutionalizing TSMO at the reporting level.

- **Inward-looking metrics.** Examples in transportation are more limited than in other industries, as noted in earlier sections, but metrics should not just be outward facing. Continuous assessments of internal performance and goal achievement facilitate making changes and improvements iteratively based on results and trends. DOTs are often focused on outputs, but there is a growing recognition of the need to put more emphasis on outcomes (i.e., determining the impact of actions). Focusing on outward-only metrics while potentially overlooking internal checks and balances can lead to costly errors and negative press that are often avoidable. (For a recent DOT example, see Sommerhauser 2017.) The District of Columbia DOT has conducted performance accountability reports to determine how well it is meeting its objectives. Similarly, Arizona DOT has 20 performance metrics with specific targets and goals that are reported monthly for internal assessments, with varying levels of red, green, and yellow categories on a reporting scale.

4. COGNITIVE PROCESSES THAT MAY IMPEDE EXECUTING CHANGE

This chapter discusses the common cognitive processes that can impede the acceptance and execution of change. This chapter also offers techniques that can overcome these challenges.

Decisionmaking is a complicated process with a myriad of potential influences to consider. These influences can affect the decisions of individuals, including those who are in leadership positions, and drive overall organizational strategies (including change). Oberholzer-Gee and Kunreuther (2002) conducted a study on how public opinion polls influence the decisionmaking of elected officials and found that social pressure is critical for explaining local policy-making and organizational strategy. In an evaluation of different managerial decisionmaking processes, Omarli (2017) determined that factors affecting the administrative decisionmaking processes were personal, environmental, and psychological. Robinson et al. (2018) noted that decisionmakers under stress can exhibit a variety of behaviors such as narrowed or distorted perception, decreased ability to handle complex or difficult tasks, and a focus on short-term survival goals at the expense of long-term benefits. The focus on short-term goals at the expense of long-term benefits may be necessary as transportation agency decisionmakers are often faced with short-term urgencies that may interfere with their long-term goals (see Torma-Krajewski and Powers, 2010 for an emergency response training example). The desire to change an organization is an example of the reverse—there is short-term pain, but long-term benefits.

There are four common biases that can affect decisionmaking in everyday tasks and are quite common in organizations:

- **Framing**—A common decisionmaking bias involves people reacting differently to information depending on the phrasing, context, or "framing." (Tversky and Kahneman 1981) This bias can have profound impacts on organizational change efforts and a transportation system (i.e., switching or transitioning operations during a major incident or emergency if the personnel do not adjust their thinking). It is also related to mental set, which is often a source of change resistance—people are used to thinking or doing things a particular way and are reluctant to change. A strategy to mitigate this bias is to change labeling/logos (which is why organizations will often spend time/resources on marketing refreshes), colors, or codes to indicate clearly that the context has changed (e.g., from normal operations to emergency operations or from one organizational structure to another). In addition, one should be aware of how information is presented and whether it may be framed in a negative or positive way, especially when making a business case to leadership to support TSMO efforts.

- **Confirmation bias**—People often favor or seek out information that confirms a prior hypothesis or belief, leading to confirmation bias. (Wason 1968) This bias can affect leadership when there is the tendency to focus more on data that support an initial approach or only listen to opinions that support their plans. Thus, management may not seek out alternate explanations and inadvertently ignore other useful information. Instead, the decisionmaking process or a properly deployed framework (with appropriate metrics and reporting support) would be to sample the full range of both negative and positive possibilities rather than just the positive ones. In other words, present alternatives to a decisionmaker (e.g., the best-case clearance time as well as the worst-case clearance time if several separate incidents happen simultaneously).

- **Anchoring**—Individuals have the tendency to rely on the first piece of information or limited pieces of information when planning or forming an estimate; this is known as anchoring. (Ariely 2008, Tversky and Kahneman 1973) This bias often manifests itself in operational situations where the first incoming field reports (e.g., of evacuation times on a roadway) drive estimates or the more salient images affect planning. Similarly, when undertaking organizational change, estimates of scope, costs, timing, and success probability may be driven by early misleading sources or data. To mitigate this bias, one should be careful about overweighting early or limited information and should generate alternative or counterfactual options. Another option is to constantly refine estimates as data become more reliable over time. (Robinson et al. 2018) A proper framework and reporting set of tools for management would iteratively adjust estimates as new data come in, and present options across the full range to combat the tendency to overweight one part of the spectrum based on early estimates.

- **Groupthink**—A bias that is particularly salient in more hierarchical and structured organizations is the concept of groupthink (demonstrated by the famous Asch experiments (1951)). It is defined as a desire for harmony, often at the expense of optimal solutions. In other words, subordinates or peers may follow along with sub-optimal approaches so that the team or organization can "get along." When leading a change effort or in a position of authority, one can combat this bias by: (1) encouraging objections consistently and publicly, (2) not indicating preference for a particular choice or approach until after the team has provided their opinions, (3) asking designated members to play "devil's advocate," and (4) regularly evaluating previous patterns to determine if there has been a standard approach that is regularly repeating (i.e., a 'rut'). Transportation agencies are hierarchical and structured, so groupthink is a potential problem. If an agency wants to avoid some of the pitfalls of groupthink, then making it clear that alternative opinions and truth will be rewarded helps to increase the comfort level and improve information sharing, which is often restricted when groupthink is endemic.

5. CONSIDERATIONS FOR LEVERAGING ORGANIZATIONAL CULTURE TO MAINSTREAM TRANSPORTATION SYSTEMS MANAGEMENT AND OPERATION

This chapter draws out themes and lessons learned across the span of organizational culture and mainstreaming TSMO. Although direct examples of structured organizational change for mainstreaming TSMO are limited, this chapter outlines ways in which mainstreaming TSMO may be helped or hindered by various approaches and topics mentioned in this White Paper. In addition, it draws connections to other similar areas where these applications have been used to further overall structural change and to increase operational efficiency.

Success Factors for Organizational Culture Change

Although there are numerous aspects to the complex task of culture change, reviews of case studies and previous research have yielded some common themes. For example, interviews and focus groups with staff at various levels of public and private organizations in the United Kingdom and document reviews conducted by Miller et al. (2011) and Gourlay et al. (2012) provide a list of factors associated with successful organizational culture change:

- Plan for change; there should be clear public action and transparency, and the organization attempting change needs to "own it."

- Determine who needs to be involved in the change process and when those individuals should get involved

- Encourage leadership to create and communicate strategic narratives.

- Ensure management and staff maintain integrity in pursuing the vision of change.

- Engage managers, especially line managers who are key to communicating with frontline staff

- Give employees a voice in the process and encourage buy-in.

- Enable change through infrastructure (e.g., revamping information technology to align with the proposed changes)

- Develop new skills and capabilities through appropriate training and education

- Measure the impact of the change (i.e., proper internal and external metrics are necessary to truly measure change and adapt)

All of these factors can be directly relevant to a transportation agency that is contemplating or engaged in organizational change. Numerous agencies across the country have engaged in various aspects of transformation. Many of the factors mentioned above are similar, but there were also several additional points worth highlighting and that came directly from mainstreaming TSMO efforts:

- **Leadership is key.** Leaders should support change, both publicly and privately, and should facilitate the change and be involved with the process throughout.

- **Follow the momentum.** Latching onto something exciting (e.g., CAV) is a strategy that can have success in finding ways to incorporate TSMO. If divisions are already

undergoing change and staff are excited, then connecting with that energy and momentum can make the process easier.

- **Emphasize relevance and practical use.** Transportation agency staff are extremely busy and becoming busier. Asking them to take on another task related to mainstreaming TSMO or collecting new data for a change effort may encounter resistance. Successful implementations often have a cornerstone strategy of finding the right "hook" to make TSMO relevant to each employee and every division across the agency. One should be mindful that staff may wonder if TSMO is just another term for the existing way of doing business, or a label for a fad that will quickly go away. "What can TSMO do for you?" is a question that should be at the forefront of engaging employees across the agency.

- **Communicate.** Many of the successful mainstreaming TSMO efforts had a central component of constant communication in every direction (up the leadership ladder, laterally, and with subordinates). Communicating the importance of TSMO, its uses and relevance, and the process of change were all considered vital to a successful change.

- **Make the case.** Through a combination of skillful communication, relevant data, and analysis, TSMO champions advanced the mainstreaming of TSMO in their organizations by making a persuasive business case. This included developing motivating case studies, compiling benefit-cost information on TSMO, and showing the system impacts of TSMO strategies.

- **Build for the long term.** It is important to develop organizational structures that will outlive the current administration, ingraining TSMO into numerous elements of the agency through integration or restructuring (such as embedding TMSO at various levels of committees, in the early stages of the planning process, and during project execution). Widespread staff training in TSMO regardless of functional role is critical for long-term success.

- **Identify the right data.** As the number of data sources and size of datasets grows, transportation agencies may find data management challenging. Agencies may benefit from being strategic in the type of data collected and its uses, especially with respect to organizational performance and change connected to TSMO. There is also the inundation of big data from ITS and connectivity throughout the system that may play a central part in TSMO evolution, but also has to be managed, with the right data for the right needs. Inward-facing data and useful methods of presentation to leadership are important in tracking, managing, and optimizing change.

- **Organizations are people.** Organizations are made up of people; therefore, it is important to account for natural human biases, tendencies, and desires when developing a strategy of successfully mainstreaming TSMO. As roles and emphasis areas change, and funding and staff resources may be shifted accordingly, there can be a tendency for leaders and staff to hold fast to the status quo and legacy approaches and systems. Prepare for the biases and connect with the strengths that can facilitate the mainstreaming processes.

Questions to Consider for a Culture of Mainstreaming Transportation Systems Management and Operations

The following questions are examples that can be used by transportation agencies to assess where they are and advance a culture that supports mainstreaming TSMO:

- Does your agency's leadership understand and communicate to others in the agency about the value of and business case for TSMO?

- Do executive-level managers support the advancement and mainstreaming of TSMO activities?

- Is there regular cross-functional or inter-departmental collaboration focusing on TSMO?

- Have you identified key TSMO champions at every level of the agency?

- Is TSMO regularly considered as a strategy or solution for addressing transportation needs or issues?

- Are staff who are knowledgeable in TSMO integrated into the activities of other functions within the agency?

- Is TSMO integrated into staff training across the agency?

- Is TSMO part of job descriptions and staff performance goals?

- Does the organizational structure of your agency facilitate or hinder the integration of TSMO throughout other areas of the agency?

- Does your agency's performance management system reward mainstreaming TSMO?

- Is there a plan for addressing resistance to mainstreaming TSMO?

- Are additional workforce capabilities needed to mainstream TSMO?

- Have successful TSMO efforts been leveraged to mainstream TSMO?

- Has your agency built the partnerships among other agencies and stakeholder groups necessary for effective TSMO?

Conclusion

Transportation agencies are undergoing rapid change, and various aspects of organizational and personnel topics are evolving. The previous sections review the cultural and organizational change aspects of mainstreaming TSMO to support agencies in making those changes. In the end, any approach to mainstreaming TSMO is based on groups of people working together toward an end goal. Changing organizational norms and increasing efficiency while incorporating TSMO throughout an agency still requires addressing the key building blocks of any transportation organization—understanding the biases and habits of the people who work there, effective communication, robust data, and leadership buy-in over the long term.

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APPENDIX. INFLUENCING ORGANIZATIONAL AND AGENCY CULTURE

This appendix contains additional information on well-known approaches for managing organizational change and the levers of influence.

Additional Information on General Approaches to Organizational Change

Lean Six Sigma

The health sector has a rich background in using Lean Six Sigma, with lessons learned that may benefit transportation agencies looking to make similar improvements. (Yaduvanshi et al. 2017) Examples include implementations in the health sector and hospital management related to: (1) length-of-stay and patient discharge (e.g., Commonwealth Health Corporation, Mount Carmel Health System with a financial return of $1.3M; Thibodaux Regional Medical Center with savings of $475K), (2) operating room flow and scheduling (e.g., Bay Medical Center with $2M in savings, Southwestern Vermont Medical Center with a 500 percent increase in operating room on-time starts), (3) emergency departments, (4) hospital laboratory (e.g., Nebraska Medical Center with a $750K increased yield), (5) diagnostic imaging, (6) revenue cycle, and (7) supply chain management and standardization (e.g., Toronto Hospital for Sick Children with $140K in savings).

Baldrige Performance Excellence Program

An example of a recent governmental agency winner is the U.S. Department of Energy Strategic Petroleum Reserve (managed by DynMcDermott, the first government contractor to receive the award) for its work as the manager of the Strategic Petroleum Reserve during the 2005 hurricane season and in the wake of Hurricane Katrina, when the company maintained the nation's crude oil supply despite tumultuous conditions that damaged its facilities.

Several reviews have validated the criteria for the award with respect to performance improvement, with one of the key linkages being between external results and internal performance metrics, which are the drivers of results in an organization. (Evans and Jack 2003) Overall, organizations report increased delivery of value to stakeholders and customers, contributing to organizational sustainability, improvement of overall effectiveness and capabilities, and organizational/personal learning.

Balanced Scorecard

The term "scorecard" was originally used by Herb Simon and colleagues at Carnegie Mellon, and part of the development of strategic management by objective that evolved out of the 1950s from Peter Drucker's work. (Kaplan 2010, Drucker 1954)

Additional Information on the Levers of Influence in Organizational and Agency Culture Change

Leadership Influence

Leaders can influence employee support for change with a variety of methods. Stephen Denning noted that while presenting reasons and arguments for change can support a leader's efforts, they are not enough on their own (Denning 2007). Leaders should stimulate employee desire for

change by showing positive examples, presenting the obstacles to change as positive challenges to overcome, and connecting the entire effort to "who we are" as an organization. (Denning 2007, Fernandez and Rainey 2006, van der Voet et al. 2015, Bass 1990)

Leaders set the tone for change. By making regular use of performance data and reports, leaders and champions demonstrate that performance and data-based decisionmaking are a priority of the organization. (National Academies 2010)

Employee Engagement

A one-time formal event is generally not adequate for culture change. Continuous and informal training opportunities may support cultural change and prompt employee engagement. Employees who are given real opportunities to improve their skills have a higher level of engagement. Organizations that provide continuous training opportunities, which are individualized based on a needs assessment of the individual or group, reinforce desired behaviors and showcase a data-led, evidence-based approach to continuous improvement. (Hagel et al. 2018) One TSMO-related example is how DOTs have helped engage employees who were initially resistant by giving them training opportunities through the Regional Operations Forums.

Quantifiable Metrics

Many industries have well-established norms for internal business intelligence metrics, accounting standards, and external performance measures that are then used for decisionmaking. The transportation field is in the early stages of this development, although most industries have a long way to go with respect to proper use of business intelligence metrics. Reviews show that 87 percent of companies have low business intelligence maturity (Gartner 2018) and only 3 percent have quality data standards. (Nagle 2017)

A detailed review of the role of metrics in culture change is beyond the scope of this White Paper; however, for a detailed review of related industries and performance metrics as well as transportation industry uses of business intelligence metrics (collected via interviews and document reviews), refer to *Business Intelligence Techniques for Transportation Agency Decision Making*. (National Cooperative Highway Research Program 2019)