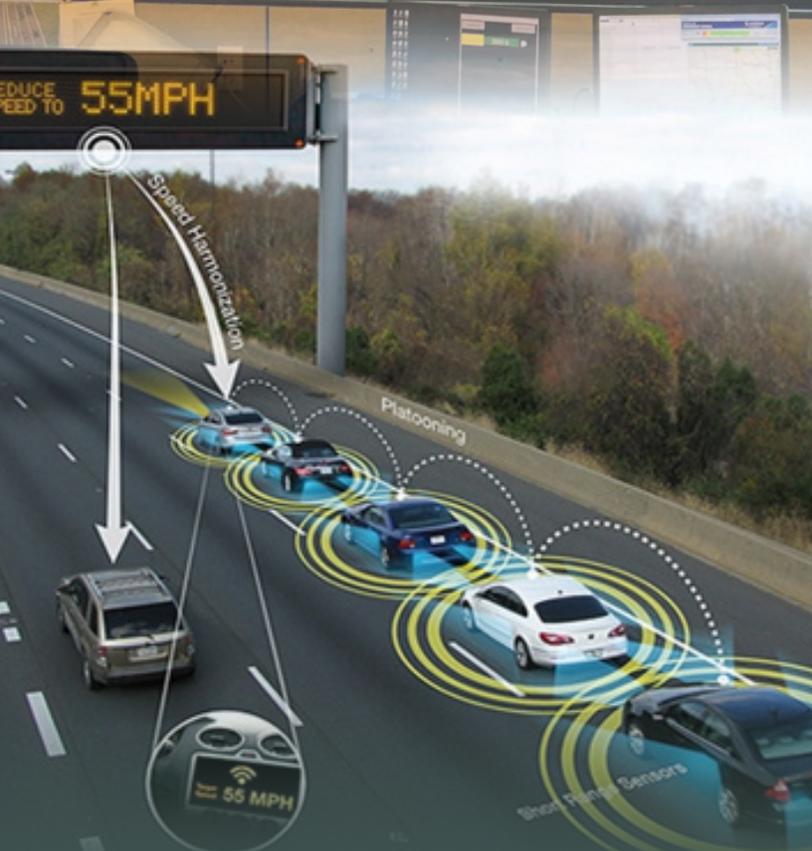


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SCAN TEAM REPORT

NCHRP Project 20 68A, Scan 18-02

Leading Practices in Modifying Agency Organization and Management to Accommodate Changing Transportation System Technologies

Supported by the

National Cooperative Highway Research Program

The information contained in this report was prepared as part of NCHRP Project 20-68A U.S. Domestic Scan, National Cooperative Highway Research Program.

SPECIAL NOTE: This report IS NOT an official publication of the National Cooperative Highway Research Program, Transportation Research Board, or the National Academies of Sciences, Engineering, and Medicine.

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The purpose of each scan, and of Project 20-68A as a whole, is to accelerate beneficial innovation by facilitating information sharing and technology exchange among the states and other transportation agencies and identifying actionable items of common interest. Experience has shown that personal contact with new ideas and their application is a particularly valuable means for such sharing and exchange. A scan entails peer-to-peer discussions between practitioners who have implemented new practices and others who are able to disseminate knowledge of these new practices and their possible benefits to a broad audience of other users. Each scan addresses a single technical topic selected by AASHTO and the NCHRP 20-68A Project Panel. Further information on the NCHRP 20-68A U.S. Domestic Scan program is available at <http://144.171.11.40/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=1570>.

This report was prepared by the scan team for Domestic Scan 18-02, *Leading Practices in Modifying Agency Organization and Management to Accommodate Changing Transportation System Technologies*, whose members are listed below. Scan planning and logistics are managed by Arora and Associates, P.C.; Harry Capers is the Principal Investigator. NCHRP Project 20-68A is guided by a technical project panel and managed by Andrew C. Lemer, PhD, NCHRP Senior Program Officer.

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Disclaimer

The information in this document was taken directly from the submission of the authors. The opinions and conclusions expressed or implied are those of the scan team and are not necessarily those of the Transportation Research Board or its sponsoring agencies. This report has not been reviewed by and is not a report of the Transportation Research Board or the National Academies of Sciences, Engineering, and Medicine.

Scan 18-02

Leading Practices in Modifying Agency Organization and Management to Accommodate Changing Transportation System Technologies

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Abbreviations and Acronyms

AASHTO	American Association of State Highway and Transportation Officials
AV	Autonomous Vehicle
CAT	Cooperative Automated Transportation
CAV	Connected and Automated Vehicles
CDOT	Colorado Department of Transportation
CEO	Chief Executive Officer
DOT	Department of Transportation
FHWA	Federal Highway Administration
GIS	Graphic Information System
IowaDOT	Iowa Department of Transportation
IT	Information Technology
ITS	Intelligent Transportation System
MDOT	Maryland Department of Transportation
MnDOT	Minnesota Department of Transportation
NCHRP	National Cooperative Highway Research Program
NMDOT	New Mexico Department of Transportation
QIT	Quality Improvement Team
SHA	State Highway Association (Maryland)
SME	Subject Matter Expert
TDOT	Tennessee Department of Transportation
TRB	Transportation Research Board
TSMO	Transportation Systems Management and Operations
UDOT	Utah Department of Transportation
WSDOT	Washington State Department of Transportation

Executive Summary

This report summarizes the findings from the scan “Leading Practices in Modifying Agency Organization and Management to Accommodate Changing Transportation System Technologies.” The purpose of the scan was to investigate and exchange information about how Departments of Transportation (DOTs) are changing their organizations, institutional arrangements, and management practices to improve transportation system performance through the implementation of new technologies and/or other innovative programs, while at the same time maintaining their traditional role in capital improvement, operations, and maintenance programs. However, the focus of this scan was not on technology deployments; rather, it was on exposing its panel members to detailed examples of new organizational structures and management approaches that foster greater collaboration and communication across the entire DOT agency.

A scan team consisting of representatives from state DOTs, the Federal Highway Administration (FHWA), and the American Association of State Highway and Transportation Officials (AASHTO) was formed to guide the scan and develop findings, recommendations, and implementation actions. Michael Lewis, former director of the Colorado DOT (CDOT) chaired the scan team.

The scan team ultimately decided to interview and study various cultural, leadership, organization, staffing, business process, performance management, and collaboration aspects of the state transportation agencies of Utah, Maryland, Washington State, Tennessee, Iowa, and Minnesota. These states were asked to consider a list of amplifying questions as they prepared their presentations. The scan team did not require the presenters to formally submit written responses to the amplifying questions, but it did ask that the presenting teams address as many topics contained in the amplifying questions as possible. The topics were ultimately organized into the following thematic areas, as were the findings, observations, recommendations, and implementation strategies:

- Leadership and Cultural Traits of Highly Successful Organizations
- People – Knowledge, Skills, and Abilities and the Strategies to Attract Them
- Organizational Structures – A Study of Principles
- Business Process Improvements
- Performance Management
- Collaboration at Its Finest

While the technologies deployed in transportation initiatives are often the highlight of the discussions and information sharing, the most critical aspect currently facing DOTs is the collaboration that occurs among all the relevant functional areas within any one DOT (traditional and innovative). As the scan team investigated and studied each agency invited to participate

in the scan, the team turned its attention to identifying successful strategies to change agency culture, acquiring and retaining talent, and organizing in ways that eliminate the need for traditional silos typically found in transportation agencies. The team also focused on practices that improved business processes, performance management, and on better internal and external collaboration.

The scan team spent time discussing and contemplating these examples to determine the best or leading practices and, in doing so, gained a deeper understanding about the collaboration that is possible and what factors helped collaboration occur. Summarizing the scan study and this report one might conclude the following:

- Establishing and sustaining an agency culture that is conducive to greater collaboration and innovation starts with its leadership.
- Acquiring and retaining employees for a technology-driven agency will require new and innovative techniques and strategies and will need a staff that has capabilities in a diverse set of core competencies. Job responsibilities may include data analysts, programmers, electrical and communications engineers, as well as cybersecurity and artificial intelligence specialists.
- There are various types of organizational structures, and there is no one perfect structure for all DOT organizations everywhere. However, the organizations that seem to work best allow for flexibility, are nimble, cut across traditional silos, engage field and headquarters staff, and, above all, encourage collaboration.
- When it comes to business process improvements, strategic planning, program planning, and the development of service layer plans seem to hold a great deal of promise.
- While great strides have been made in performance reporting and measurement, there is still work to be done, and research is required in managing transportation organizations from a few key strategic performance measures.
- While most of the strategies above focused on internal collaboration, considerable emphasis during the scan also included the need for external collaboration. The nontraditional transportation partner becomes incredibly important in the implementation and use of the newest innovations surrounding connected and automated vehicles (CAV) and cooperative automated transportation (CAT) strategies.

These techniques and strategies form the basis of the scan's in-depth reporting that follows. This scan provided a rich source of material, as well as DOT contacts, that other transportation agencies can utilize as they begin to contemplate their own organizational structure in an age and industry that is increasingly driven by technology. Finally, the scan team identified and is pursuing an extensive set of outreach activities to disseminate the scan's findings.

Introduction

Background

The introduction of new and rapidly evolving transportation technology, including such things as public and private deployments of connected and automated vehicles (CAV), as well as improvements in real-time road and traffic condition monitoring is changing the transportation industry. The introduction of these and other transportation solutions is occurring simultaneously with a transition in many state Departments of Transportation (DOTs) toward a transportation systems management and operations (TSMO) -centric management approach. These two occurrences together are creating opportunities to reevaluate, and even reinvent, many aspects of our transportation industry, organizations, and management approaches.

As state DOTs transition to a TSMO-centric management approach or contemplate implementing other innovative transportation initiatives (e.g., asset management programs, big data warehousing, and analysis programs) while utilizing and implementing rapidly evolving transportation technologies, each DOT will also continue to perform traditional maintenance, operations, design, construction, and traffic engineering functions. However, the interdependence of traditional DOT activities and the implementation of emerging innovative programs increases the need for collaboration and cooperation between all functional areas within the comprehensive DOT organizational structure. We know from experience that cross-functional activities are not always as well coordinated as they could be. Furthermore, with the enormity of real-time data now available from third-party data providers and with data collection being used on DOT vehicles, as well as the future data expected from CAVs, it is more important than ever for DOTs to have clear management plans for how they will use, manage, secure, and benefit from the data, not just from within the TSMO group, but throughout the entire agency.

While the technologies deployed in these transportation initiatives are often the highlight of the discussions and information sharing, the most critical aspect currently facing DOTs is the collaboration that occurs among all the relevant functional areas within any one DOT (traditional and innovative). There is a need to do more than just identify these collaboration success stories. There is a need to explore and investigate how such collaboration can be institutionalized within any given DOT, what barriers to this collaboration exist, and how best to overcome those barriers.

Purpose

A scan of the “Leading Practices in Modifying Agency Organization and Management to Accommodate Changing Transportation System Technologies” was conducted under the National Cooperative Highway Research Program (NCHRP) 20-68A U.S. Domestic Scan Program. More specifically, this scan investigated and exchanged information about how DOTs are changing their organizations, institutional arrangements, and management practices to improve transportation system performance through the implementation of new technologies and/or other innovative programs, while at the same time maintaining their traditional role in capital improvement programs. TSMO is a recent example of how changing transportation technology is influencing organizational structure and management approaches. However, other equally compelling examples exist when one considers the use of big data readily available now and expanding exponentially in the future.

The focus of this scan was not on technology deployments or on policy and procedure documents. Rather, the scan focused on exposing its panel members to detailed examples of new organizational structures and management approaches that foster greater collaboration and communication across the entire DOT agency. The panel spent time discussing and contemplating these examples to determine the best or leading practices. In doing so, it gained a deeper understanding about the collaboration that is also possible and what factors helped the collaboration occur. The goal of this final document on the subject is to provide useful information to individual DOTs across the country as they consider future staffing structures, internal management policies, institutional culture, and workforce development strategies.

Scan Team

A scan team representing 12 state DOTs, the Federal Highway Administration (FHWA), and the American Association of State Highway and Transportation Officials (AASHTO) was formed to guide the scan and develop findings and recommendations. Michael Lewis, former director of Colorado DOT (CDOT), chaired the scan team.

Scan Framework

This scan relied first on identifying subject matter experts (SMEs) at state DOTs that appear to be leading the nation in the most innovative transportation industry initiatives. This was done by gathering recommendations for experts from the scan team members themselves and relying on AASHTO committee liaisons’ recommendations in the areas of TSMO, big data, and human resources. In addition to an online search of relevant resources, most of the information was gleaned by conducting preliminary interviews with candidate organizations.

The scan team was mindful that the organizations chosen for in-depth study have limited time to engage in this project. Specifically, in asking the candidate organizations to prepare for our interview sessions with them, the scan team limited its pre-visit inquiries and requests for lengthy responses. Additionally, the scan’s SME found that virtually all the organizations that

were candidates for study had previously developed documents and presentation materials that the team could use to gain a basic understanding of the agencies' transformation in terms of reorganizations and changed management philosophy.

Since the scan team consists of high-ranking DOT representatives, the scan was conducted at a high level of discussion and included presentations by and collaboration with others in similar management positions. Additionally, it was determined that the information to be gathered did not require field or site visits, so the scan team decided to congregate in one location, Salt Lake City, Utah, where all the interviews were conducted.

Transportation Agencies Interviewed

The scan's SME conducted initial interviews with several transportation agencies. From the information compiled, the scan team decided to invite and study the state DOT organizations of Utah, Maryland, Washington State, Tennessee, Iowa, and Minnesota. All these organizations gave powerful and interesting presentations during the week of August 5 to 9, 2019, in Salt Lake City, Utah.

Report Organization

This report documents the results of the scan meeting and is organized in three major sections. The first presents the scan team's key findings with relevant examples from the presentations and background material provided by the participants. The second provides a brief summary of the scan team's recommendations based on the key findings and the scan team's discussions; these are offered for state DOTs to consider. The final section presents strategies and actions the scan team identified for disseminating this information.

The following information is provided in the appendices:

- Appendix A – Scan Team Contact Information
- Appendix B – Scan Team Biographical Sketches
- Appendix C – Key Contacts
- Appendix D – Desk Scan
- Appendix E – Amplifying Questions

Scan Findings and Observations

The scan team discussed and cataloged its key takeaways from each of the six state presentations. To better organize its findings, the scan team also developed thematic areas for state DOT consideration and then grouped its findings within each of these topical areas. Overarching Issues.

For this report, the findings and observations from the scan are organized into six thematic areas:

- Leadership and Cultural Traits of Highly Successful Organizations
- People – Knowledge, Skills, and Abilities and the Strategies to Attract Them
- Organizational Structures – A Study of Principles
- Business Process Improvements
- Performance Management
- Collaboration at Its Finest

Leadership and Cultural Traits of Highly Successful Organizations

As the six DOTs presented information about their organizations and about their adaptations in organizational structure to drive or accommodate changes related to the use of new technology, the scan participants identified some key leadership and cultural traits that fostered their successes. While not all states that presented during this scan exhibited all the traits listed, all states had many of these traits in common.

- Foster an environment of trust
- Give permission to make mistakes, create the confidence to share those mistakes, and offer the mistakes as learning experiences
- Foster a culture where there is a willingness to take risks
- Are opportunistic when there is a catalyst for change
- Can articulate their story and the need for change well
- Believe that good ideas will win
- Are learning organizations
- Are organizations that create ambassadors
- Value communication across the entire organization

Merriam-Webster defines *leadership* (noun) as the power or ability to lead other people; it defines *culture* (noun) as the set of shared attitudes, values, goals, and practices that characterize an institution or an organization. During his presentation to the scan team, Carlos Braceras, executive director of the Utah DOT (UDOT) and president of AASHTO, said, “My job as the leader of this organization is to establish a vision and create a culture.” He often asks his staff, “How do we make this the ‘community of your dreams?’”. Braceras believes that to recruit and retain the best talent, we must make our work fun and challenging. Along this line of thinking he created “Carlos’s Top Ten”¹ (Figure 2-1) to create a culture of fun and excitement within his organization.

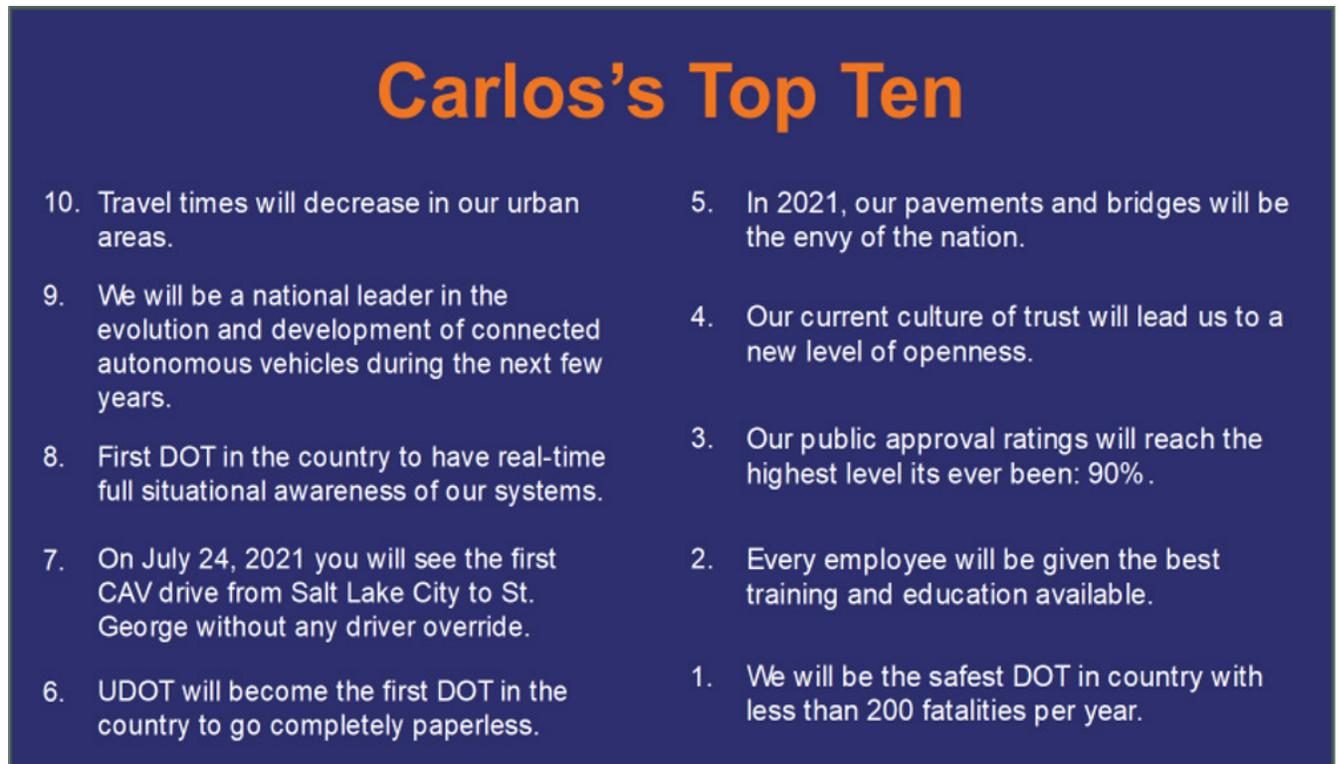


Figure 2-1. Carlos's Top Ten

Braceras believes that UDOT has a culture that fosters innovation, allows for risk taking, and recognizes that all people make mistakes. Speaking of himself he says, “I can make more mistakes faster than anyone I know, but I’ll never make the same mistake twice.” He went on to say that the worst thing about making a mistake is not sharing it, because when a mistake isn’t shared and diagnosed, we lose the opportunity to learn together.

Braceras added that leaders within state DOTs must be purposeful in encouraging change within the organization and says the “why” of change is much more important than “what” the organization is doing to change. The consensus in the room was that technology drives change. However, this is not a study of emerging technology; rather, it is a study of methods and approaches for change.

¹ Carlos’s Top Ten, Innovations and Using Data in Driving Decisions PowerPoint presentation, slide 4, UDOT Traffic Signals, Aug. 5, 2019

People – Knowledge, Skills, and Abilities and the Strategies to Attract Them

This topic area is often thought of as Human Resources within an organization. However, in this scan and this context the definition will be broadened to include such nontraditional concepts as hiring, partnering, or contracting with the right people. There is a growing need for a different mix of workforce classifications, including data analysts, meteorologists, programmers, electrical and communications engineers, cybersecurity specialists, and those with expertise in the artificial intelligence fields. Scott Marler, director of Iowa DOT’s Operations Bureau and a member of the scan team said, “We need to close the gap between the people we need and the things we need to do.”

The scan team identified these findings related to this thematic area:

- Recognize that the required skill sets are evolving
- Focus on new or evolving technical skills and abilities
- Recognize that cross-trained employees are necessary and should be highly valued
- Recognize the value to employees of career mobility
- Understand that both employees and managers value flexibility
- Respond to the need to recruit and retain a younger workforce
- Recognize that the development of internal staff is critical
- Outsource work when necessary because a menu of options is desirable

The scan team heard many good strategies in this thematic area, among them one from Washington State DOT (WSDOT). In the area of workforce development, WSDOT states its goal is to “be an employer of choice, creating a modern workforce while attracting and retaining quality workers to deliver our legislative, regulatory, and service requirements.” The scan team found WSDOT’s workforce development strategies to be comprehensive, providing a full spectrum of activities, from developing a talent pipeline to developing a modern work environment and investing in its staff through talent development approaches (Figure 2-2²).

2 Workforce Development Strategies, WSDOT, Workforce PowerPoint, slide 5, Aug.6, 2019

Workforce Development

Strategies

- **Talent Pipelines** – find the best possible talent for WSDOT
- **Workforce Analysis and Growth** – evaluate systems to achieve and maintain competitive compensation and career path development
- **Employee Engagement** – listen and act on employee feedback
- **Modern Work Environment** – implement initiatives to attract and retain our workforce
- **Talent Development** – invest in our staff through training and other opportunities



Figure 2-2. Workforce development strategies

Jeff Pelton, director of WSDOT’s Human Resources and Safety, explained that like many DOTs across the country, WSDOT is facing a significant loss of staff due to retirements in the next five years, and this does not include employees that might leave for better compensation. Therefore, approaching workforce development holistically is vital to the agency’s future success.

Maryland DOT’s (MDOT’s) State Highway Administration (SHA) has also carefully looked at its workforce challenges. Again, like many other states concerned with new technology deployment, its challenges include recruitment, compensation, proper classification, staffing levels, and retention. The agency has identified succession planning; assessed its “bench strength,” talent pipeline, and employee development; and explored the need for external staff support as the activities that it will undertake as it looks toward its future hiring needs. Additionally, MDOT SHA’s TSMO staff has identified the need for job classifications such as data scientists, data analysts, business intelligence experts, network engineers, system integrators, and specific procurement specialists for TSMO technology projects (Figure 2-3³).

³ Future TSMO Workforce, MDOT, Re-Org and Procurement PowerPoint, slide 88, Aug. 6, 2019

FUTURE TSMO WORKFORCE

- Integrating Systems Engineering & Traffic Engineering Functions
- Role of Big Data & Crowd Sourcing Opportunities – Data Scientists
- GIS enabled Data Portals – Data Analysts
- Business Intelligence Experts
- Network Engineers and System Integrators
- Procurement Specialists for TSMO/ Technology Projects



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Figure 2-3. Future TSMO workforce

Organizational Structures – A Study of Principles

An organizational structure defines how activities such as task assignment, coordination, delegation of authority, and supervision are directed toward the accomplishment of organizational goals and objectives. An organization can be structured in many ways, depending on its goals and objectives, as demonstrated by the various presentations during this scan. However, it was clear that the structure of the organizations studied also determined the modes in which the agency operated and performed, either within traditional silos or across traditional workgroup boundaries. In listening to these presentations, it was also clear that maintaining a progressive advantage in this ever-changing data-driven industry will require successful organizations to be efficient, flexible, innovative, and caring to achieve their stated goals and objectives.

The scan team listened to several state presentations regarding different approaches to organizational structure and identified these findings:

- There is no perfect structure for all DOT organizations everywhere.
- Implementing organization structures that cut across traditional silos can be beneficial.
- Being open to the right management structure placed in the right organization proved to be a sound approach (matrix versus traditional organization structures).
- Successful matrix management or alternative organization structure models blended headquarters staff with regional or other field staff.
- Focus the organizational structure on key organizational priorities.

- Working across boundaries to build relationships is a healthy practice.
- Embedding Information Technology (IT) staff within topical working units has proven to be very beneficial.
- Needing access to information drives organizational change.

As the team had general discussions about organizational change, it concurred with the assessment of Ray Starr, Minnesota DOT's (MnDOT's) assistant state traffic engineer, of what drives organizational change. The team concluded that nearly all the presentations related to this scan involving organizational change could be captured in one of the drivers depicted in Figure 2-4⁴.



Figure 2-4. Drivers of organizational change

A case in point is Utah's Traffic Signal organizational structure. In 2011, the governor requested that UDOT's traffic signal operations be improved. The agency's executive leadership issued this challenge to a quality improvement team:

- What would it take for UDOT's traffic signal system to be world class?
- What's the trend – are the signal operations getting worse, staying the same, or improving?
- What are the areas of most need?

Utilizing an internal self-assessment that compared national best practice to current UDOT practice, the department studied five functional areas: staffing, signal maintenance, signal operations, planning and processes, and management and planning. Regarding staffing and management, the self-assessment led the agency to consider and then implement a matrix type

⁴ What Drives Organizational Change?, MnDOT, Transportation Systems Management and Operations (TSMO) Program Planning PowerPoint, slide 7, Aug. 8, 2019

of organizational structure that includes both headquarters and regional staff ⁵. It created a new position titled region signal engineer, which reports to two supervisors, is physically located and responsive to the region, and supervises regional signal maintenance crews but is managed by headquarters. This new type of working relationship has worked so well that the matrix structure is being replicated across other UDOT organizations.

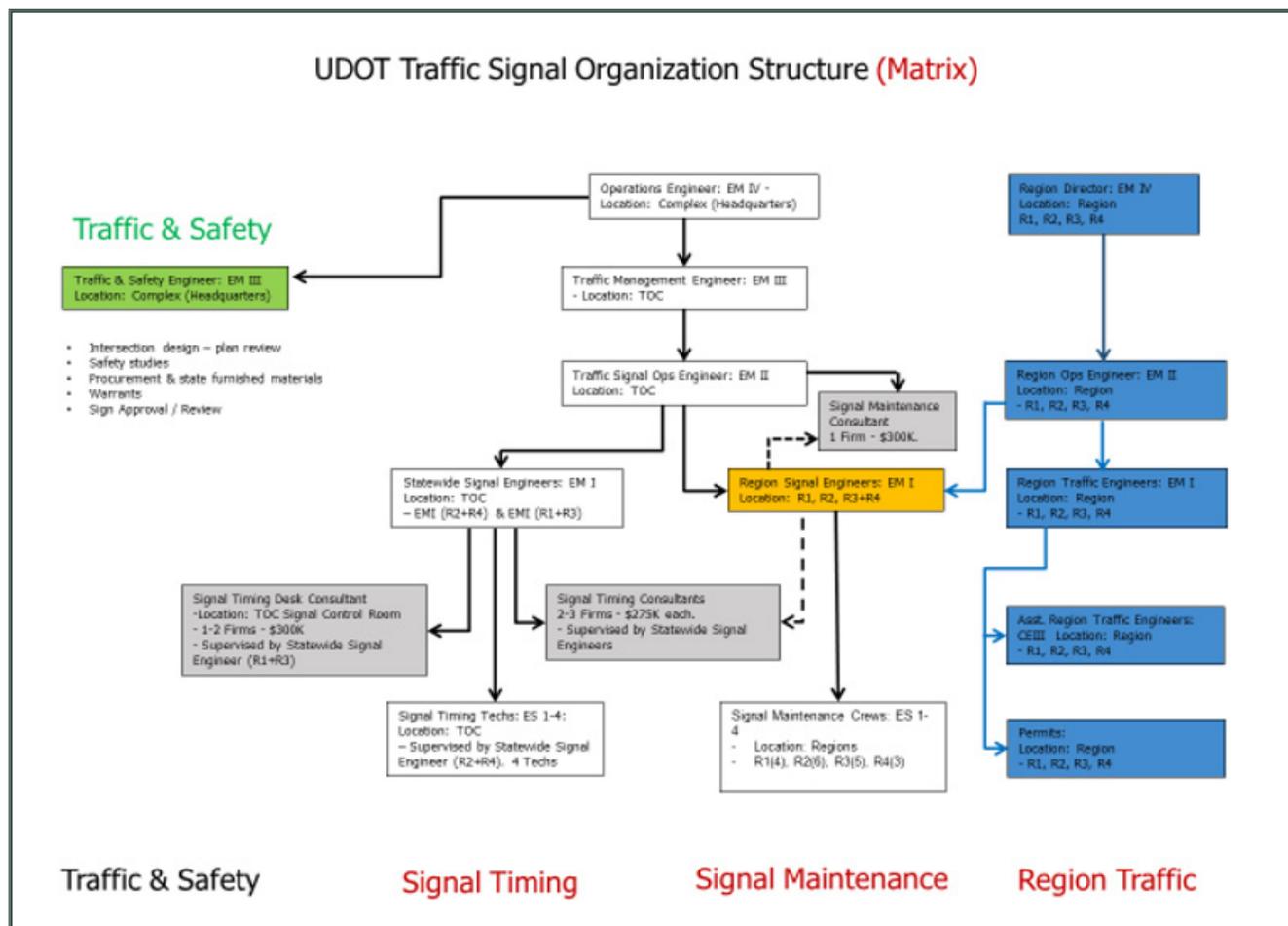


Figure 2-5. Sample matrix organization

In contrast, following a 2009 TSMO capability maturity model self-assessment Tennessee DOT (TDOT) found that:

- Its operations efforts were fragmented, spread across multiple divisions and work units.
- Champions working outside their job responsibilities were leading its operations initiatives.
- Disparate TSMO-focused programs were separated by geographic regions with standard guidance or procedures.
- Strategic department direction for these efforts was absent.

5 Sample Matrix Organization, UDOT, Innovations and Using Data in Driving Decisions PowerPoint, slide 11, Aug. 5, 2019

Although the conclusion was to vet and implement a new organization that would elevate the TSMO to a division level within TDOT, no immediate or substantial organizational changes were made. It appears that this idea's time had not yet arrived. Then, in December 2011, a tractor-trailer carrying a load of about 40,000 pounds of potatoes crashed on Interstate 40, blocking the eastbound lanes, forcing an estimated 400 motorists to spend 11 hours in their vehicles over the cold winter night. To make matters worse, this included a bus of school-aged children. Two state agencies were required to make public apologies and implement changes. TDOT reorganized to better support its TSMO efforts, establishing the Traffic Operations Division at headquarters. This change was obviously driven by the incident, but TDOT took advantage of the opportunity to execute the organizational changes it had strategically planned for two years. The benefits the TDOT reorganization achieved included:

- Creation of standard transportation management center and traffic incident management guidelines
- Engagement of the IT division in systems operations
- Development of a TDOT TSMO program plan
- Incorporation of a pathway for systems operations performance measurements into the agency's overall objectives
- Integration of TSMO into TDOT's long-range transportation and strategic highway safety plans
- Increased cooperation with TN Highway Patrol, culminating in the construction of and co-location within the Traffic Management Center

Despite TDOT choosing to make its TSMO organization more centralized, the agency recognizes the need for critical interfaces for optimal integration (Figure 2-66). TDOT has also created a TSMO Coordinating Committee, with a charter that includes its goals and objectives. The committee includes member organizations from design, freight, planning, investments, program development, administration, IT, maintenance, the regions, and FHWA.

6 Critical Interfaces, Organizing to Support TSM&O and Innovation in Tennessee PowerPoint, slide 84, Aug. 7, 2019

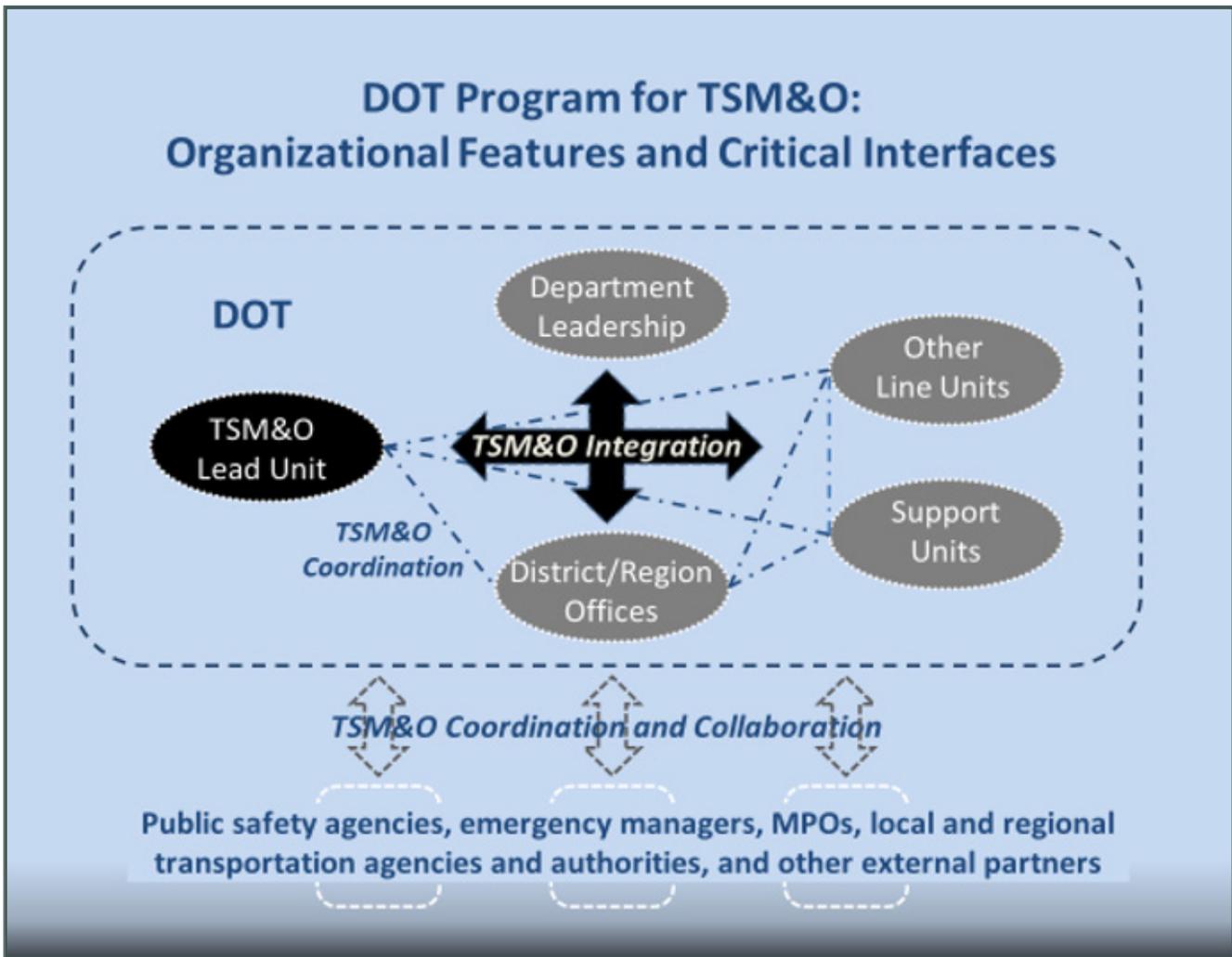


Figure 2-6. Critical interfaces, organizing to support TSM&O and innovation in Tennessee

Clearly whether an organization establishes a matrix model, a more traditional model, or a hybrid of both, the key to success is flexibility, creating opportunities for innovation, and enhanced communication and collaboration. Perhaps equally importantly is an organization’s ability to change and enhance its business processes to improve the delivery of services to its customers.

Business Process Improvements

In both organizational case studies described above, the changes also resulted in business process changes. The scan team noted that an organizational change alone did not result in the breadth and depth of transformation that the agencies sought. In the case of the Utah signal system organizational changes, Utah also instituted a process and data collecting equipment to measure the effectiveness of its signal performance, resulting in the honor of being selected for the 2014 Governor’s Award of Excellence. In Tennessee, TDOT’s reorganization launched a series of process changes, including the development of a strategic plan, a corridor development and selection process for strategic TSMO deployments, a project development and selection process for discrete TSMO deployments, and plans for the I-24 SMART Corridor.

The scan team identified these important findings related to business process improvements:

- Continuous business improvement cycles are essential to success.
- Nontraditional procurement methods may be necessary.
- New methods of funding and programming traditional and emerging technologies projects are critical.
- Project development processes for emerging technology construction and installation are vital.
- A focus on asset management for emerging technology is necessary for future infrastructure investment decisions.

While the Utah and TDOT reorganizations led to business process improvements, other states lead with business process improvement and allow the organizational changes to follow. A case in point is the “Iowa Model,” which allows for three levels of business process improvement planning: the strategic, the programmatic, and the tactical.

First, in its *strategic plan* Iowa DOT (IowaDOT) builds a business case for a change, identifying the challenge, vision, mission, goals, and objectives. The audience of this plan is all levels of the DOT. Second, the *program plan* includes the specific program goals, discusses leadership and organization, provides an overview of business processes, and describes the decision-making process. The audience for this plan is the agency leadership. Finally, the *service level plan* is tactical in nature, describing the challenges and opportunities for the business process change and the service activities and projects that will be included in the business process change. The plan also walks the reader through the existing condition, a gap analysis, and provides a recommendation with associated costs for the business process change. The intended audience for this plan is staff involved with the change. Each planning level includes internal and external focus groups to test the theories and initiatives.

Within TSMO, the most recent activities and accomplishments of this process at IowaDOT have included:

- An automated vehicle pilot
- The issuance of the new traffic management software request for proposals
- A truck parking information management system
- The establishment of the Traffic Incident Management Committee
- Production of the TSMO policies

Within the TSMO strategic plan and program plan, IowaDOT has the following eight service layers or tactical plans it is or will be working on:

- Traffic incident management
- Traffic Management Center

-
- Traveler information
 - Intelligent transportation system (ITS)/communications
 - Emergency management
 - Work zone management
 - Connected/autonomous vehicles
 - Active transportation and demand management

While Iowa's focus has been on the strategic planning of business process change, MnDOT's approach has been to develop a strong focus on asset management (the actual business process change), the byproduct of which has also led to organizational change. MnDOT found that implementing the business change also required implementing organizational change, including a cultural shift in mindset, to support the improvement. The agency found the following components necessary to implement its intended changes:

- Declare the goal: A to B by when
- Engage everyone at some level
- Dedicate a small level of resources exclusively to the goal
- Garner top management support
- Devise a formal process for accountability (e.g., weekly commitments, scorecards, and check-ins)

MnDOT's implementation of a new asset management system required a multitude of new, but smaller, *business process changes*, cultural changes, and ultimately staffing/organizational changes. In terms of business process changes, the new asset management system was developed to gather and manage a new set of asset data but would also incorporate the bridge and pavement legacy data. For the first time ever the system integrated finance, timesheets, equipment usage, materials, linear referencing system, the Esri⁷ mapping system, electronic documents, graphic information system (GIS), as well as the data warehouse. The new system also included simple timesheets for front-line workers, inspection applications, collection applications, GIS map functionality, editing, a work order system, and a report builder.

Culturally, MnDOT learned as an organization to focus on preventive maintenance investments for its bridge, pavement, and technology assets, to focus on level of service performance priority for routine maintenance crew activities, and to utilize program-level decision-making strategies with a better understanding of tradeoffs.

Organizationally, it partnered with its software vendor and the state's independent IT organization to embed staff into the organization to support the software application, including job titles such as database administrators, system architects, desktop computer support, and

7 Esri, <https://www.esri.com/en-us/home>

project management staff. In the case of this unique staffing situation, MnDOT paid for and directed the work, so the collaboration among the various agency staff was very good. The MnDOT implementation of its new asset management system successfully incorporated many of the scan team's findings related to this thematic area.

MDOT developed a unique project development process related to TSMO technology construction and installation, which led to the scan team's interest in this area. In rethinking its project development process, MDOT concentrated on three aspects: the incorporation of TSMO technology into major projects, the reinvention of system preservation projects, and the development of standalone operational projects. MDOT changed several of its business processes, including the project scoping process and the use of annual mobility reports, to help justify the inclusion of communications and operations technology in major and system preservation projects. Its focus on delivering a system of systems leveraged some significant former TSMO projects and used its master plan as a guide. MDOT's TSMO efforts can offer or take advantage of at least three buckets of funding that are readily available to it, including safety, asset management, and mobility. Further, it utilizes three strategies for the delivery and procurement of specific standalone TSMO strategies, including the use of performance-based service contracts, public/private resource sharing opportunities, and opportunities for areawide operations improvements. All these strategies break from the traditional MDOT business process norms, particularly in the area of procurement, and are helping to shape the achievement of the TSMO master plan.

Performance Management

On the topic of performance management, Scott Marler, IowaDOT, said, "We are still trying to figure this one out." Yet, the scan team found the principles and practices described in his presentation to be among the most compelling. Performance measurement is the practice of gathering data to track progress against a strategy; it should not be confused, though it often is, with performance management. Performance management is the practice of using and analyzing gathered data to manage an agency strategy and to ultimately ensure that the agency goal or objective is being realized.

The scan team found that within the performance management thematic area, the following were highest predictors of successful performance management programs and, thus, formed the basis of these findings:

- The actions must show benefits.
- The collection of data must inform decisions.
- Customer input and user expectations must be considered.
- Workforce satisfaction measures are useful.
- Performance measures must be relevant to employees and their leaders.
- The critical few – quality over quantity in terms of actual measures is key.
- Cascading performance measures from visionary to tactical help make the tie-in.

IowaDOT's performance management program for transportation operations seemed to exemplify most of the findings the scan team deemed most important. The program starts with some simple objectives: identify performance measures that matter most, improve performance reporting and communications, and provide the basis for next steps toward performance improvement. To accomplish this, IowaDOT enlisted the help of a multidisciplinary work group and developed an approach or plan to complete the work. The six aspects of this approach included:

- Confirming the agency goals and objectives in the operations area
- Cataloging existing processes, data, and metrics
- Linking desired outcomes to the goals
- Defining excellence measures
- Measuring, tracking, and reporting
- Defining performance improvement

IowaDOT wanted to ensure there was both organizational alignment and a performance “cascade” (Figure 2-7⁸).

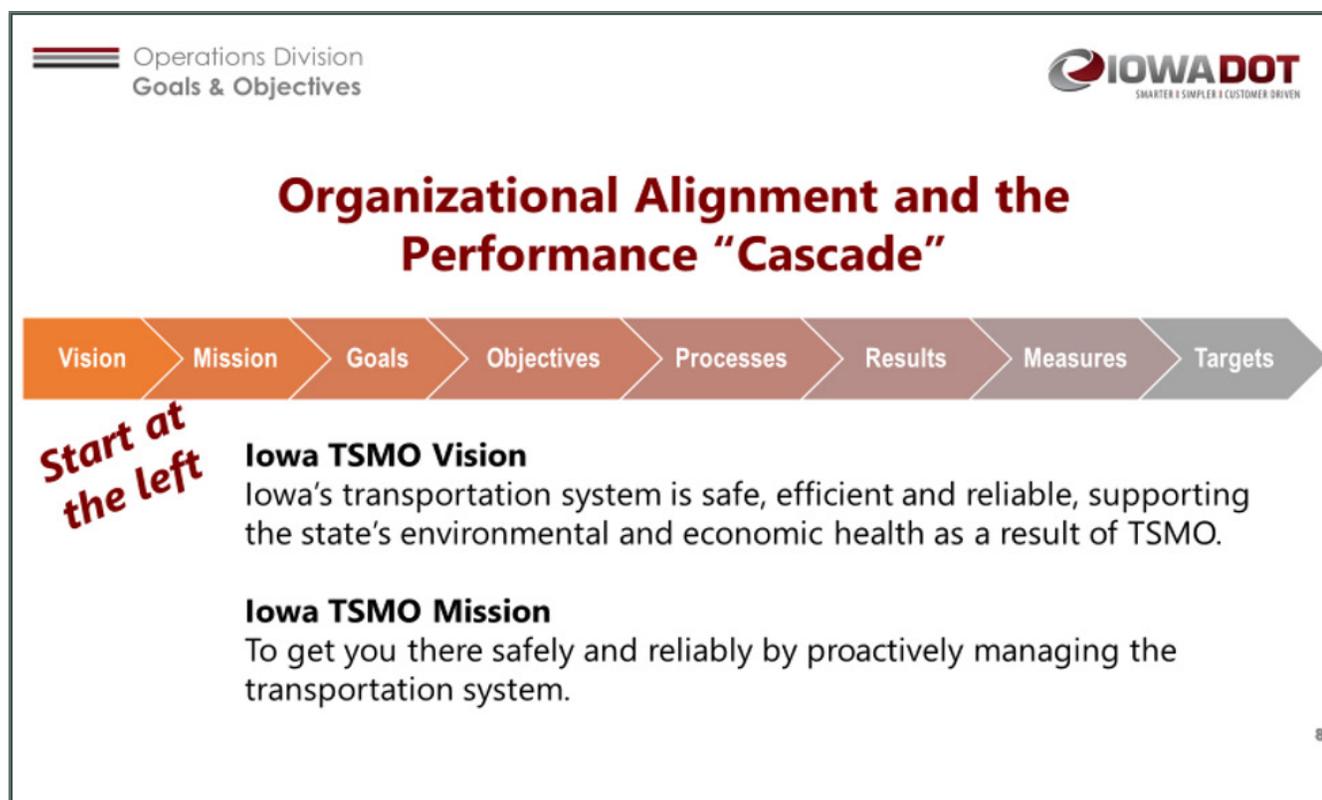


Figure 2-7. Performance cascade

Additionally, to the working group it was important to ensure that there was an evident tie to the existing organizational goals (Figure 2-8⁹).

8 Performance Cascade, IowaDOT, Transportation Operations Performance Management PowerPoint, slide 8, August 2019

9 Organizational Goals Tie-in, IowaDOT, Transportation Operations Performance Management PowerPoint, slide 12, August 2019

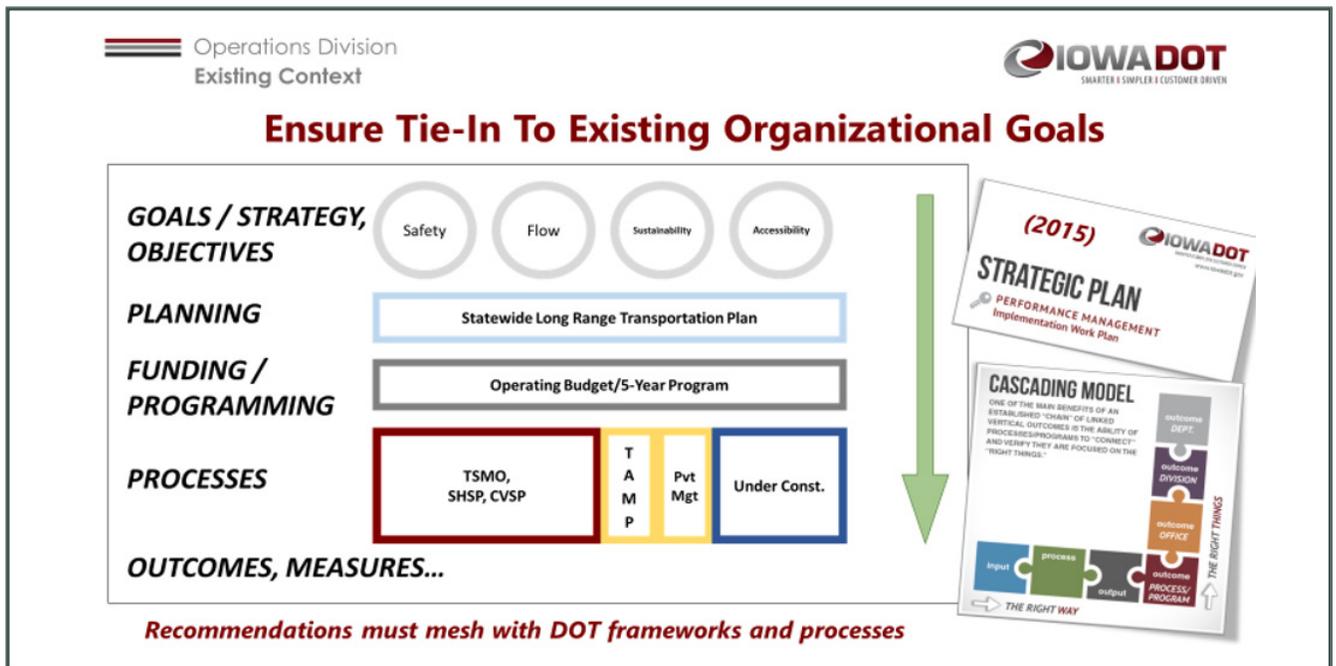


Figure 2-8. Organizational goals tie-in

Skipping to defining excellent measures, the IowaDOT working group knew it needed to understand the organizational culture, needed to avoid myths and agency pitfalls, needed ruthless prioritization, and had to recognize that not everything we can measure is ready for prime-time use. The group used a cascading map exercise/process to propose appropriate measures (Figure 2-9¹⁰).

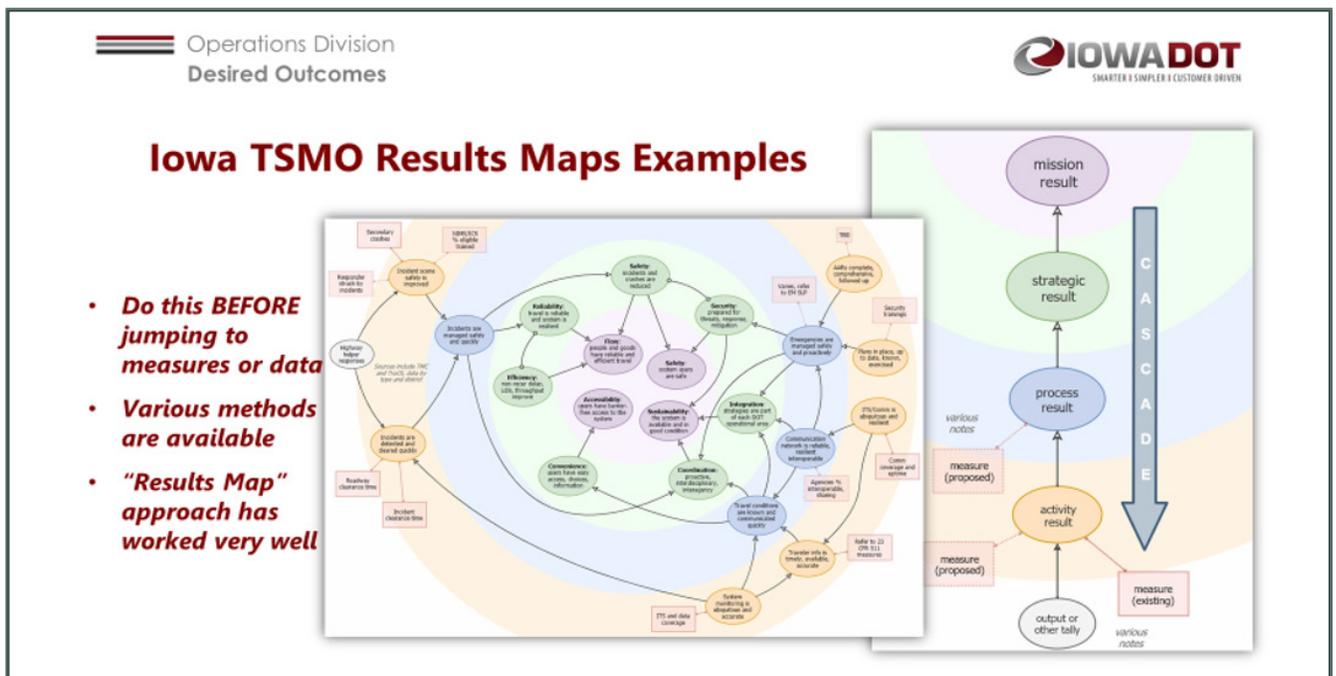


Figure 2-9. Performance measure results cascade

10 Performance Measure Results Cascade, IowaDOT, Transportation Operations Performance Management PowerPoint, slide 16, August 2019

Once the working group identified the priority performance measures, it began to monitor performance and communicate the findings. It used annual reports and quarterly and monthly updates, as well as dashboards that were updated daily. To Marler’s point, IowaDOT is still working on the management piece of the puzzle and has identified its next steps, which will include updating the TSMO program plan to emphasize performance improvements. As an agency, IowaDOT may expand the use of this approach to manage the performance of the larger agency.

On a somewhat smaller scale UDOT manages its signal timing system in much the same way. Again, referencing the governor-requested traffic signal operation improvement, the UDOT traffic signal team deployed its automated traffic signal performance measures system. This system automatically collects data from each signal controller; aggregates the information; and provides useful information about the intersections, corridors, an entire city, or the full statewide system. The team is fond of saying, “Why estimate what you can measure?” By Utah standards this is big data collection. The stats include 2050 signals online, collecting high-resolution data at a rate of 1.3 terabytes per month, which is approximately equal to 19 megabytes per signal per day or 354 million lines of data per signal per day. The data includes signal controller detection by phase, signal coordination diagrams, turning movement counts, pedestrian delay and actuation, approach speeds, signal phase termination, as well as left turn queue failure. The system provides five types of “health” alerts to the traffic signal staff, including no data collection, too many maximum phases at a signal, too many signal phase forced offs, too many pedestrian calls, and low detector counts. For each of the health alerts a prescribed set of actions/activities help ensure the signal system is managed at peak performance. Further, to ensure customer satisfaction, UDOT convened a signal timing focus group of citizens and plans to do this again during the winter of 2019. The key findings from this focus group included that the public positively perceives UDOT, with innovation as the primary driver; that Utah drivers believe traffic signal synchronization is improving; and that drivers believe that UDOT should be more open to sharing its accomplishments while protecting its credibility. Using performance measures to manage the performance of the signal system led the *Salt Lake Tribune* to run this article on June 5, 2019: “Global study says Salt Lake City is a rare place where traffic congestion is decreasing as population booms.”¹¹

Collaboration at Its Finest

Advancing the state of the practice will certainly involve collaboration. While this was evident in many of the scan presentations, the presentations related to CAV and cooperative automated transportation (CAT) stood out as being on the leading edge of collaboration. UDOT presented an interesting collaboration maturity path that is worthy of documenting here (Figure 2-10¹²).

¹¹ Global study says Salt Lake City is a rare place where traffic congestion is decreasing as population booms, *The Salt Lake Tribune*, published June 5, 2019, Updated June 6, 2019, <https://www.sltrib.com/news/politics/2019/06/05/global-study-says-salt/>

¹² Collaboration Maturity Path, UDOT, GIS Evolution PowerPoint, slide 11, August 5, 2019

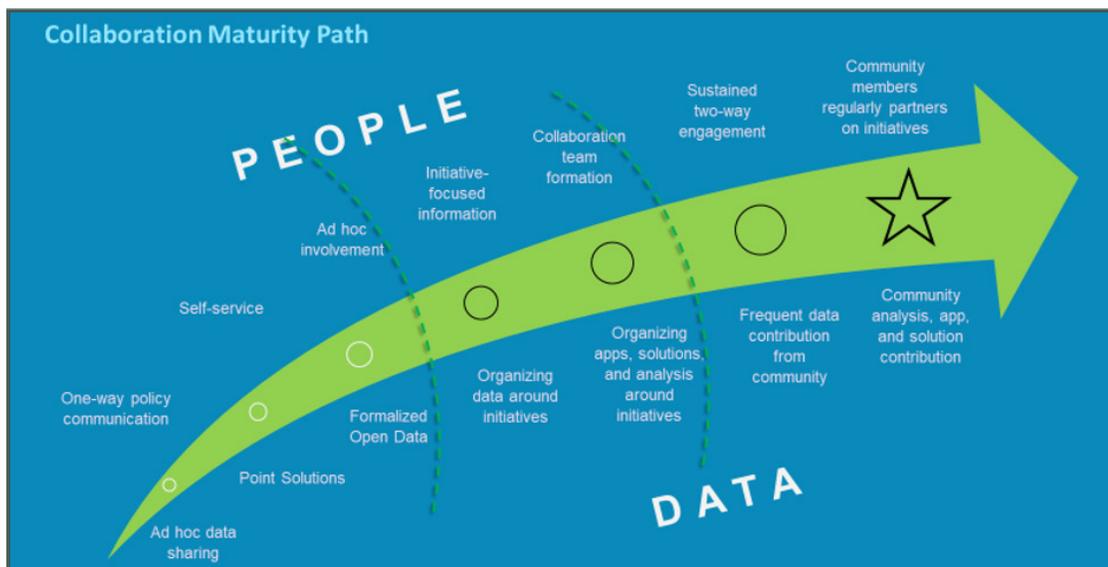


Figure 2-10. Collaboration maturity path

With a keen ear for advanced collaboration strategies particularly related to emerging technology, the scan team identified the following key findings exemplifying the best in class for collaboration.

- Early and often engagement and empowerment are key.
- Internal collaboration across organizational boundaries will be necessary.
- External partnerships should be comprehensive.
- University partnerships will help develop the next workforce.
- Private partnerships include new competencies and skills that are key to success but are not normally found in the public sector.
- Legislative partnerships are necessary to allow for the use of new technologies and processes within the public sector and on public facilities.

Connected and Automated Vehicles at Minnesota DOT

MnDOT's CAV program is important to both the agency and the state, and both understand that this program will provide opportunities to improve traffic operations and safety; increase mobility and thereby provide equity in transportation alternatives for their citizens; provide economic development opportunities; offer infrastructure improvement opportunities; and generally has the potential to improve the quality of life in the state, especially as it relates to the health and the environment. MnDOT has proven its commitment to this effort by creating and staffing a CAV-X Office. (X represents connectivity to a variety of transportation modes and technologies.) This office coordinates internal collaboration as well as external partnerships, committees, councils, and an interagency team. MnDOT has also supported and facilitated authorizing legislation. Its mission is to, "Improve the quality of life for Minnesota residents, guests, and businesses through public policy and planning, research, and implementation of emerging transportation technologies such as ITS, CAV, and shared and electric vehicles." The staffing of this office breaks with traditional DOT staffing patterns in that it is largely co-directed by an engineer, an attorney, and a planner.

The priorities of the CAV-X Office include:

- Establishing MnDOT as the lead agency for CAV policy
- Advancing the national policy and standards related to this topic
- Developing and implementing a CAV strategic plan
- Researching and implementing CAV
- Developing key public/private partnerships
- Engaging the public

MnDOT facilitates a program called the CAV Challenge, which allows industry to submit creative ideas that use CAV to solve transportation challenges. This open-ended request for proposals provides an opportunity for industry to submit unsolicited proposals. However, the CAV projects that submitted must pass a “smell test”; they “can’t just be cool” CAV technology projects. The smell test requires the project to provide opportunities to gain substantial institutional knowledge, offer a path for large-scale deployment, can be used in operations today, and/or provide an opportunity to engage and educate the public.

The office leads 18 internal DOT working groups and facilitates an interagency CAV team boasting 12 state or quasi-state government offices. The CAV-X Office also supports 10 policy subcommittees and is the leading authority and resource for proposed legislation in this topic area.

MnDOT’s strategic plan includes nine focus areas, including:

- Capital investment
- Research and development
- Partnerships
- Regulations
- Operations and maintenance
- Strategic staffing
- Multimodal transportation
- Communications
- Long-range planning

Each of these focus areas has key recommendations; however, specific to engagement and collaboration, the office intends to communicate with the freight industry; the roadway technology industry; their employees; the public; and their private sector partners, in particular the Teamsters, together with state and national businesses. MnDOT’s traditional partners, including local governments, FHWA, academia, consultants, and other state agencies, will be asking to join new partnerships with the auto industry, tech companies, and the telecom industry to deliver the CAV projects.

Scan members agreed that this effort is like collaboration “on steroids,” but that it is producing real projects that will advance our industry and accelerate the CAV discussions at all levels.

Cooperative Automated Transportation at Washington State DOT

The CAT program at WSDOT has become instrumental in its mission to improve safety, keep its infrastructure in a state of good repair, provide improved system operations, and manage increased demand on the system. It has even helped the agency focus on system expansion with an eye on the future. Two key policy initiatives led to the formation of this program: an executive order that formed the governor’s Autonomous Vehicle (AV) Work Group¹³ and legislation that led to the establishment of the Transportation Commission-facilitated AV Work Group. The CAT program priorities for 2019-2021 include:

- Building organization capability while aligning engagement and investments with existing resources
- Developing the Washington State CAT policy framework
- Developing the WSDOT CAT policy framework
- Facilitating and participating in conferences, pooled fund studies, peer exchanges, policy forums, and the governor’s and Transportation Commission’s AV work groups
- Deploying several pilot projects and partnerships

Focusing heavily on internal and external collaboration, this program also relies heavily on the practical solutions framework developed by WSDOT (Figure 2-11¹⁴).

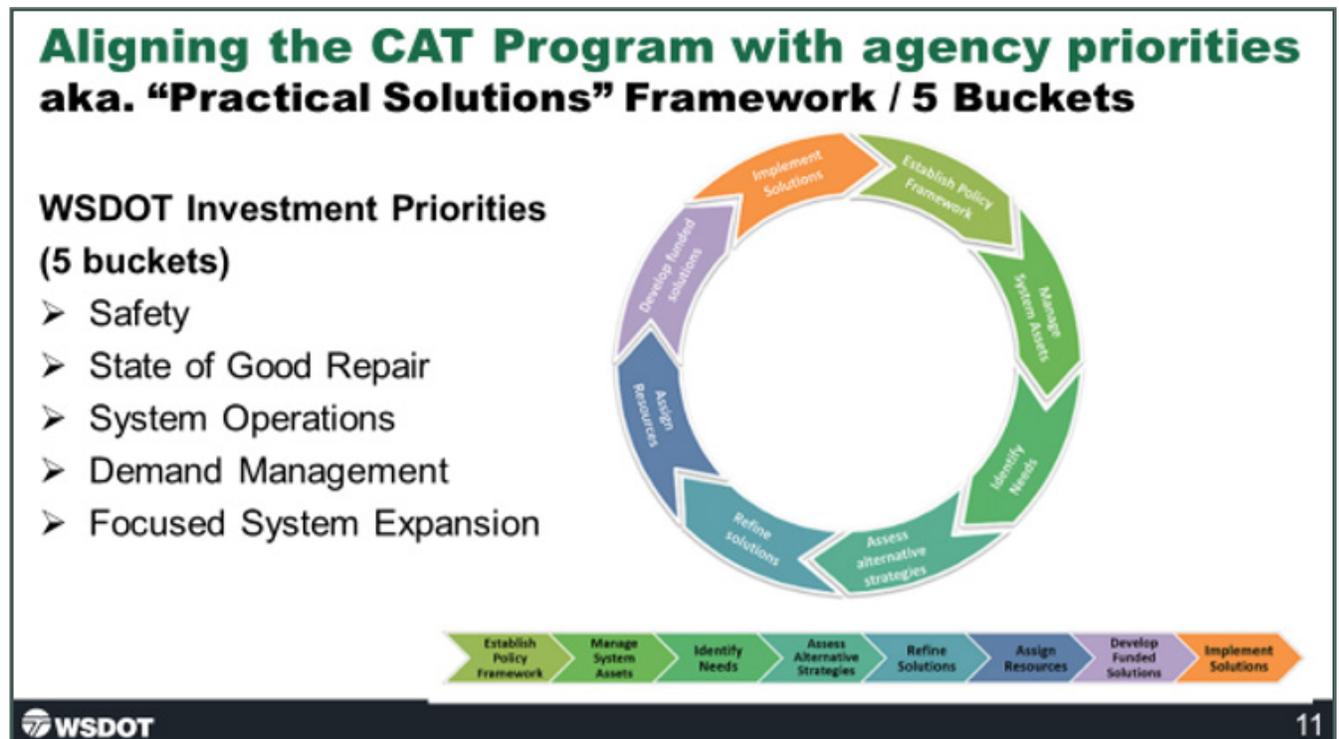


Figure 2-11. Aligning the CAT program

13 Washington State Autonomous Vehicle Work Group, <https://avworkgroupwa.org/>

14 Aligning the CAT Program, WSDOT, #3.0 Cooperative Automated Transportation PowerPoint, slide 11, August 6, 2019

Utilizing this framework, the CAT program aligns with the state’s priorities and engages heavily with its internal and external partners (Figure 2-12 ¹⁵).

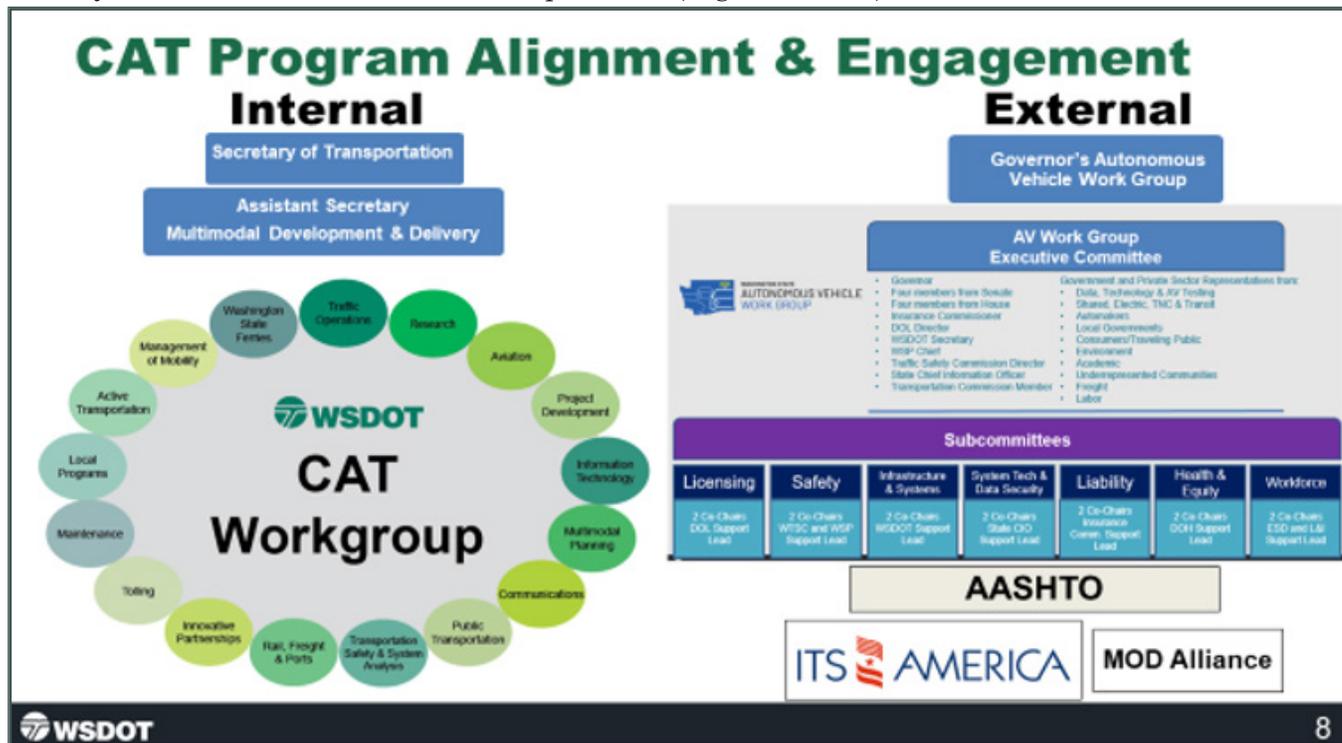


Figure 2-12. Internal and external engagement

The WSDOT CAT program promotes mobility with, for example these initiatives:

- On-demand cell phone application
- Automated shuttle pilots that link people to transit
- Machine-readable signing and striping
- Automated bus braking and pedestrian detection
- An electric vehicle-charging infrastructure
- Leverage of the right-of-way asset to improve communication links
- Autonomous truck-mounted attenuators
- Improved winter roadway operations
- Driver-assisted truck platooning

Regarding this program and specifically the need to foster collaboration, the program managers have identified a list of lessons learned. This list is derived from their experiences or their observations of the technology deployment and also from recommendations from the initiatives of their external partners. The scan team determined the lessons learned list, especially as it relates to collaboration and organization for our technology-driven future, as an important takeaway. It includes these elements:

15 Internal and External Engagement, WSDOT, #3.0 cooperative Automated Transportation PowerPoint, slide 8, August 6, 2019

- Engagement outside the DOT is paramount.
- Dedicated staff and champions with flexible resources are required.
- Matrix organizational structures require more time for mentoring and coaching.
- Coordinated, consistent, relevant, and transparent messaging is needed.
- Leaders need to stay positive and celebrate the near-term wins.
- Measure near-term success by the number of people and organizations that are engaged.
- Be relentless and responsive when pursuing resources.

Recommendations

Using the same thematic topic areas and based on the findings, the scan team identified a set of recommendations that DOTs might consider when exploring the possibilities surrounding the modification of their agency organizations and management practices to accommodate a technology-driven future.

Leadership and Cultural Recommendations

- Leadership at all levels should consider conducting an organization culture self-assessment and work to develop an organization of high trust where there is a willingness to take risks that may possibly result in mistakes but with the intention of continually moving the organization forward.
- Integrating operations into agency culture requires shifting from a project focus to a transportation systems outcome focus. Utilizing data-driven operational analysis for corridor improvement prioritization is one approach for making investment decisions.

People – Recommendations to Attract and Retain Talent

- Recognize that attracting and retaining people to meet the needs of technology-driven initiatives is a growing challenge. Strategies for obtaining and maintaining the core competencies required to implement and manage evolving technologies need to be adopted and/or developed.
- When possible, keep the most interesting projects in house as a strategy for retaining and engaging employees.

Organizational Structures – Recommendations for Consideration

- When considering the implementation or introduction of new technology, consider more flexible staff arrangements that allow employees to work across traditional organizational boundaries for a more meaningful integration and use of the technology.
- Consider embedding IT and GIS staff within more traditional work units as this appears to lead to significant benefits in implementing and supporting technology initiatives.

- Consider the use of agency steering committees that include senior-level management as an effective tool to garner support for and implement technology initiatives.
- When organizational change is necessary, utilize proven change management techniques and strategies.

Business Processes Improvement Recommendations

- Be open to utilizing nontraditional procurement methods.
- Consider asset management strategies for maintaining emerging technology.
- Consider incorporating emerging technology projects into the state transportation plan, either with major capital projects or as standalone projects; this will ensure proper programming and funding of these equally important projects.

Performance Management Recommendations

- Use specifically targeted and prioritized data to augment the reporting of performance measures.
- Focus on a few key strategic measures and relate them to the agency's goals.
- Use performance measures to drive improved performance management strategies.

Recommendations for Enhanced Collaboration

- Develop and enhance internal and external partnerships, particularly with nontraditional partners.
- Engage with partners outside the DOT; this is paramount to innovative program success.

Strategies and Actions to Elevate Organizational Considerations in Technology-Driven Industry

The scan team discussed and identified possible dissemination strategies and actions to bring more awareness to the organizational needs of this ever-changing industry. These are strategies and actions that scan team members, AASHTO, the Transportation Research Board (TRB), FHWA, and other organizations can pursue to disseminate this scan's results. These are strategies that can inspire and add value to the continuation of the discussions surrounding a new technology-driven transportation industry. The strategies and actions are summarized in this section, most of which were identified directly following the formal scan meeting.

Increase Awareness of Scan Findings and Recommendations

- Present the preliminary findings and recommendations at several upcoming meetings including, but not limited to, the:
 - AASHTO Committee on Transportation System Operations Pavement Preservation Technical Expert Group
 - AASHTO Annual Meeting
 - AASHTO Committee on Construction
 - AASHTO Committee on Right of Way, Utilities and Outdoor Advertising Control
 - AASHTO Committee on Human Resources
 - Various TRB committees
- Develop a series of news articles for the National Operations Center of Excellence newsletter
- Develop a series of webinars for the National Operations Center of Excellence outreach program
- Develop in-depth resource-based case studies derived from the scan material and presentations
- Conduct organizationally based peer exchanges with scan participants and interested DOTs
- Develop and incorporate a new leadership module that considers technology-driven organizations and corresponding staffing approaches for the AASHTO's CEO orientation

- Develop and incorporate a new leadership module that considers technology-driven organizations and corresponding staffing approaches for the AASHTO executive leadership training
- Incorporate technology strategies and data collection opportunities within Every Day Counts, then study and report on these outcomes
- Connect to Domestic Scan 19-02, “Leading Practices in Strategic Workforce Management by Transportation Agencies”

Develop Tools and Resources to Support Organizational Leadership

- Identify and develop an agency culture self-assessment tool
- Develop a research-based needs and personnel assessment for a technology-driven agency
- Develop an Operations Academy version 2.0, using examples of data-driven operational analysis for corridor improvement prioritization and investment decisions
- Develop a new organizationally based training module to be included at the regional operations forums; such a module would/should explore various organization models (i.e., matrix, traditional, and embedded) and the pros and cons of implementing each.
- Develop academic coursework in the areas of technologies and tools for the transportation sector, ideally prepared as college coursework or curriculum

Develop Tools and Resources to Attract and Retain Talent

- Review and update hiring practices and position descriptions to support technology-driven initiatives. This should include strategies for obtaining and maintaining core competencies for new, nontraditional, technology-driven positions, such as data analysts, programmers, electrical and communications engineers, and cybersecurity and artificial intelligence specialists.
- Collect and disseminate a set of standard job descriptions for titles such as data analysts, programmers, electrical and communications engineers, and cybersecurity and artificial intelligence specialists.
- Develop a core competency versus prevailing wage matrix. State DOTS could use this to determine which job descriptions are best recruited and which are best obtained by contract or outsourcing.
- Develop a hiring manager satisfaction survey that includes an assessment of the hiring process from start to finish.

Develop Tools and Resources for Organizational Change

- Develop a new organizationally based training class that would be a deeper dive into organizational structure for technology-driven agencies. (The Operations Forum module mentioned above would be the introduction for this class.) This class would be an in-depth study of various organization models (i.e., matrix, traditional, and embedded staff) suited to the transportation industry.
- Develop an organizationally based change management class to help plan and implement major organizational changes. The class could focus on the use of steering committees and working groups to engage employees at all levels to garner required support.

Develop Tools and Resources to Support Business Process Improvement

- Develop and offer coursework designed to help standardize the asset management processes for new and emerging technologies.
- Develop a process or freshen existing policies and procures surrounding the planning, programming, funding, and implementation of new and evolving technologies. Technology projects can be incorporated into major capital projects or planned and programmed as standalone projects in FHWA's Surface Transportation Program.

Develop Tools and Resources to Support Enhanced Performance Management

- Develop and offer a national class on using technology-driven data to enhance performance reporting and measurement. This class should emphasize the use of just a few key strategic measures. Develop a follow-on national class for the use of performance measures to enhance and support overall agency management.

Develop Tools for Enhanced Collaboration

- Develop and support processes for enhanced collaboration, particularly with nontraditional partners. This could be in the form of industry conferences where these partners are invited to speak, presentations by DOT representatives at nontraditional forums, guest speakers on National Operations Center of Excellence webinars, and guest articles written by nontraditional partners for the center's newsletter.

Conclusion

In conclusion, this scan team found that the technology changes being deployed now and in the future will drive organizational change. The scan team chair was quick to recall a famous quote:

“Even if you’re on the right track, you’ll get run over if you just sit there.”

— *Will Rogers*

It is safe to say that the week of meetings the scan team conducted was thought provoking and stimulating and was certainly profound and timely.

The scan team spent time discussing and contemplating the best or leading practices and, in doing so, gained a deeper understanding about the collaboration that is possible and what factors helped collaboration occur. Summarizing the scan study and this report one might conclude the following:

- Establishing and sustaining an agency culture that is conducive to greater collaboration and innovation starts with its leadership.
- Attracting and retaining employees for a technology-driven agency will require new and innovative techniques and strategies and will require a staff that has capabilities in a diverse set of core competencies. Job titles might include data analysts, programmers, electrical and communications engineers, as well as cybersecurity and artificial intelligence specialists.
- There are various types of organizational structures, and there is no one perfect structure for all DOT organizations everywhere. However, the organizations that seem to work best allow for flexibility, are nimble, cut across traditional organizational silos, engage field and headquarters staff, and, above all, encourage collaboration.
- When it comes to business process improvements, strategic planning, program planning and the development of service layer plans seem to hold a great deal of promise.
- While great strides in performance reporting and measurement have been made, work is still to be done and research is still required in the area of performance management. The key seems to be based on identifying a few critical strategic performance measures.
- While most of the strategies above focused on internal collaboration, considerable emphasis during the scan study also included the need for external collaboration. The nontraditional transportation partner becomes incredibly important in the implementation and use of the newest innovations surrounding CAV and CAT strategies.

This scan provided a rich source of material, as well as DOT contacts, that other transportation agencies can utilize as they begin to contemplate their own organizational structure in an age and industry that is increasingly driven by technology. Finally, the scan team identified and is pursuing an extensive set of outreach activities to disseminate the scan's findings. The scan team is already undertaking this extensive set of actions to disseminate this important information. The future of our technology-driven industry is promising, with this team leading the way.

Appendix A: Scan Team Contact Information

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Appendix B: Scan Team Biographical Sketches

MICHAEL LEWIS (AASHTO CHAIR) is an Associate Vice President and Principal Program Manager at HDR. He currently serves as Project Director for Program Management for the implementation of the CBD Toll Program (Congestion Pricing) on behalf of Triborough Bridge and Tunnel Authority (TBTA) in New York. Prior to joining HDR, he served as the Deputy Executive Director/COO and later Executive Director for the Colorado Department of Transportation (CDOT) from 2015 - 2019. Prior to joining CDOT, he served as the Director of the Rhode Island Department of Transportation (RIDOT) from 2008 - 2015. From 1984 – 2007, he advanced through progressive levels of authority with the Massachusetts Highway Department and the Massachusetts Turnpike Authority culminating in his appointment as the Director of the Central Artery/Tunnel Project from 2000 through Project completion in 2007. He is a past President of AASHTO where he has served in various leadership capacities including Chair of the Committee on Transportation System Security and Resiliency, Chair of the SCOH Sub-Committee on Construction, the SHRP II Executive Oversight Committee and TRB Executive Committee. He is a member of the National Academy of Construction (NAC).

GLENN BLACKWELDER is Utah DOT's Operations Engineer for Traffic and Safety. He is responsible for policy and procedure regarding barrier and guardrail, signing, temporary traffic control, ADA compliance with the right-of-way, safety asset management and the Utah MUTCD. Prior to working on this he spent 9 years working for UDOT in intelligent transportation systems, including supervising control room operations, signal timing, weather group operations, ITS asset management, congestion reporting, incident management and emergency management. Glenn has worked on the interface of the labor force with automation and with policy and procedure throughout his time at UDOT and how technology changes the requirements and capabilities of the UDOT workforce. Prior to joining UDOT, Glenn Blackwelder worked as a traffic engineering consultant, and taught at Walla Walla University. Glenn holds a Bachelor's degree in Engineering from Walla Walla University and a Masters in Civil Engineering (Transportation) from the University of California at Berkeley. Glenn is a member of the AASHTO Committee on Traffic Engineering and a technical member of the National Committee on Uniform Traffic Control Devices. He is a registered professional engineer in Utah and California and is a certified Professional Traffic Operations Engineer

ANITA BUSH currently serves as the chief maintenance and asset management engineer for Nevada DOT. Since joining the agency in 1999, she has held various increasingly responsible positions in the Roadway Design, Structure Design, Materials, and Maintenance, and Asset Management divisions. Bush currently chairs the American Association of State Highway Transportation Officials Committee on Maintenance Pavement Technical Working Group and the Transportation Research Board's Pavement Maintenance Committee. She holds master's and bachelor's degrees in civil engineering from the University of Nevada, Reno, and is a licensed professional engineer in Nevada and California.

GENE DONALDSON is the TMC operations manager with Delaware DOT and has been with the agency since 1997. His primary responsibility is to manage the agency's transportation management program, including operation of the 24-hour statewide Transportation Management Center, planning and implementation of Delaware's intelligent transportation system, incident and event management, emergency management, and transportation homeland security. Prior to Delaware DOT, Donaldson was with the Montgomery County, Maryland, Department of Public Works and Transportation, for 27 years. When he retired, he was chief of the Transportation Management Section, where he was responsible for managing the implementation and operation of the nation's first fully integrated advanced transportation management system. Donaldson is a past president of District 2 and the Washington, DC, Section of the Institute of Transportation Engineers.

THOMAS HARMAN is the director of the Federal Highway Administration's Center for Accelerating Innovation. The center leads the FAST Act – Every Day Counts initiative, the Accelerated Innovation Deployment Demonstration grant program, and the Accelerating Market Readiness program; it also supports the National State Transportation Innovation Council network. Harman has a bachelor's degree in civil engineering from the University of Maryland and a master's degree in civil engineering from the University of Illinois. He has over 30 years of experience in technology implementation, policy, and research. Harman serves as a liaison on the American Association of State Highway & Transportation Officials Special Committee on Research and Innovation and its Innovation Initiative. His expertise is in technology deployment, materials, and quality assurance.

JOHN HIBBARD is the director of the Operations Division for Georgia DOT. His responsibilities include the oversight and direction of the State Maintenance Office, the State Utilities Office, the Office of Traffic Operations, and the Office of Transportation Data. Hibbard's 30-year career includes tenures at PBS&J/Atkins, TransCore, and Cobb DOT; he started with Kimley-Horn in Dallas in the mid-1980s. He is the secretary of the Signals Technical Committee, one of the technical committees that is part of the National Committee on Uniform Traffic Control Devices, which is the committee that edits the Manual on Uniform Traffic Control Devices. He is also on the leadership team of the Committee on Transportation Systems Operations of the American Association of State Highway Transportation Officials and directs Georgia DOT's implementation of connected vehicle technologies. Hibbard is a graduate of Georgia Tech, where he earned bachelor's and master's degrees in civil engineering. He is a registered professional engineer in Georgia.

WILLIAM (BILL) LAMBERT is the state traffic engineer for New Hampshire DOT. In that capacity, he leads a bureau responsible for the design, installation, and maintenance of all traffic control devices on state highways. He is also responsible for traffic engineering and traffic operations services to support the department's capital improvement program and constituent responses. As state traffic engineer, he is an active participant in the department's Temporary Traffic Control and Highway Safety Improvement Program Committees. The department's initial Transportation Management Center and Intelligent Transportation System applications were developed under his direction. Lambert was chair of the department's task force assigned to develop broad organizational recommendations for the structure of and related job classifications for the Division of Operations. He is a member of the American Association of State Highway and Transportation Officials Committee on Traffic Engineering, the National Committee on Uniform Traffic Control Devices, the Institute of Transportation Engineers, the American Traffic Safety Services Association, and the American Society of Civil Engineers. Lambert is a graduate of Worcester Polytechnic Institute and a licensed professional engineer in New Hampshire.

STEVE LUND is the state maintenance engineer of Minnesota DOT. He has worked for the DOT for the past 36 years and has held a variety of positions, including physical research, contract and research administration, construction administration, and district maintenance management; he has been in his current position for 13 years. Lund is vice chair of the American Association of State Highway Transportation Officials Committee on Maintenance, chair of the organization's Snow and Ice Cooperative Program, and has served on a number on National Cooperative Highway Research Program project panels. Lund is the English secretary for the international PIARC (World Road Association) Winter Service Technical Committee. He received a bachelor's degree in engineering from the University of Minnesota and is a registered professional engineer in Minnesota.

SCOTT C. MARLER became the director of the Operations Division at Iowa DOT in December 2017. In this role, he is responsible for highway operations and traffic management on the state's 9,400 miles of highways and bridges, including the construction and materials, maintenance, motor vehicle enforcement, traffic operations, and traffic and safety areas. Marler is active on several national committees associated with the American Association of State Transportation Officials and the Transportation Research Board. He has served on a national technical committee for the U.S. Army Corps of Engineers, an expert panel for Transportation Research Board, and a course development committee for the National Highway Institute. Marler has also served on governor's councils and other state of Iowa task forces. He has worked for Iowa DOT for 22 years, with experience in traffic operations, highway project development, regulatory compliance, and the natural environment. Marler has been active in leadership development and workforce planning and has also been instrumental in advancing geospatial technologies and systems throughout the department. He holds a master of science degree from Miami University in Oxford, Ohio, and a bachelor of science degree from the University of Southern Mississippi in Hattiesburg.

GALEN McGILL is the System Operations & Intelligent Transportation Systems (ITS) Manager for the Oregon Department of Transportation (ODOT) where he has statewide responsibility for developing and implementing strategies and technology based solutions to improve the safety and efficiency of the transportation system. He serves on the leadership team for the American Association of State Highway and Transportation Officials (AASHTO) Committee on Transportation System Operations as the Research Coordinator, and he serves on the technical advisory committee for the National Operations Center of Excellence. Additionally, he represents the US on the PIARC (World Road Association) Road Network Operations and ITS technical committee. Galen is a registered professional engineer in the State of Oregon. He has a Bachelor's degree in electrical engineering from Oregon State University and a Master of Business Administration degree from Willamette University's Atkinson Graduate School of Management.

JOHN NISBET is the Director for Traffic Operations and the State Traffic Engineer for the Washington State Department of Transportation. He provides leadership in development of the agency's Traffic Operations Plan, and oversight for the delivery of the programs and budgets for the statewide Traffic and Intelligent Transportation Systems operations. John began his appointment as Director in October, 2010. John has 34 years of experience in traffic and transportation engineering with WSDOT, having worked in the agency's Northwest and Olympic Regions, as well as Headquarters. His background includes traffic operations, transportation design, and maintenance. John earned his Bachelor's Degree in Civil Engineering from Saint Martin's College and his Masters in Civil Engineering from the University of Washington.

RICHARD ROMAN has served as Pennsylvania DOT's district executive for Engineering District 4 since January 2019. In this role, he is responsible for overseeing all engineering, maintenance, and operational functions of the district, which serves Lackawanna, Luzerne, Pike, Susquehanna, Wayne, and Wyoming Counties and includes nearly 4,000 miles of state highways and 2,100 state bridges. Prior to that, Roman served as the director of the Bureau of Maintenance and Operations from February 2014 to January 2019. The bureau's primary goal is to serve, support, and lead the 11 district maintenance offices and 67 county maintenance organizations across the commonwealth in their efforts to safely operate and properly maintain the state's 40,000 miles of roads and 25,000 bridges. Prior to joining the bureau, Roman worked in Engineering District 8 (Harrisburg) for 16 years. He served as the ADE for maintenance from November 2009 to January 2014, design services engineer from August 2004 to October 2009, and various civil engineering capacities starting in 1998. He began his career with Pennsylvania DOT in June 1997 with Engineering District 4 and served in construction and maintenance. Roman is a graduate of Pennsylvania State University, where he earned a bachelor's degree in civil engineering with a minor in environmental engineering; he also earned a master's degree in public administration. Roman has been a licensed professional engineer in Pennsylvania since 2002.

RON VESSEY is the state ITS operations engineer for Washington State DOT. He directs statewide operations, including freeway and arterial systems operations, traffic incident management, incident response, and coordinated multiagency incident and congestion management. Vessey represents the agency relative to state and national efforts associated with system operations, incident management, and traveler information. He is also responsible for identifying, developing, and implementing statewide operational strategies, policies, and procedures in alignment and support of the DOT's strategic goals and objectives. Vessey has a bachelor's degree in civil engineering from Washington State University and has worked for Washington State DOT since 1985.

ROB WIGHT currently serves as operations director for Utah DOT. In this capacity, he oversees the Traffic Management, Traffic and Safety, Aeronautics, Motor Carriers, and Equipment Divisions. Each of these divisions is using technology and data to drive operational decisions, develop organizational structure, and leverage new technologies to better serve the citizens of Utah. Wight holds a bachelor's degree in civil and environmental engineering and engineering management from Brigham Young University. He is licensed as a structural engineer in Utah and is a member of American Association of State Highway and Transportation Officials Committee on Transportation System Operations.

PAMELA HUTTON (Subject Matter Expert) is the SHRP2 (the second Strategic Highway Research Program) implementation manager for the American Association of State Highway and Transportation Officials, a position she has now held for six years. She is the former chief engineer for Colorado DOT. Hutton has 40 years of progressive engineering experience in the transportation industry, primarily with Colorado DOT, where she started her career in safety and traffic engineering. She holds bachelor's and master's degrees in civil engineering from the University of Colorado in Denver and is a licensed professional engineer in Colorado. She is a former member of the American Association of State Highway and Transportation Officials Standing Committee on Highways and served as vice chair of the Standing Committee on Highway Traffic Safety.

Appendix C: Key Contacts

Iowa

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Appendix D: Desk Scan

January 15, 2019

Desk Scan Scope

The scope of this desk scan is to:

- Provide introductory information about the genesis of the scan
- Provide guidance to the scan team on the purpose of the Domestic Scan 18-02, “Leading Practices in Modifying Agency Organization and Management to Accommodate Changing Transportation System Technologies”
- Document the desk scan method
- Recommend guidelines to ensure that the project will be conducted in a fashion that will result in useful results for state DOTs
- Provide a framework for conducting the scan
- Inform the decision and selection of organizations to be invited for the detailed investigation and interview
- Propose draft amplifying questions to be used while conducting the scan

Introduction

The introduction of new and rapidly evolving transportation technology, including such things as public and private deployments of CAV, as well as improvements in real-time road and traffic condition monitoring is changing the transportation industry. The introduction of these and other transportation solutions is occurring simultaneously with a transition in many state DOTs toward a transportation systems maintenance and operations (TSMO) -centric management approach. Together, these are creating opportunities to reevaluate, and even reinvent, many aspects of our transportation industry, organization, and management approach.

As state DOTs transition into a TSMO-centric management approach or contemplate implementing other innovative transportation initiatives (e.g., asset management programs, big data warehousing, and analysis programs) while utilizing and implementing rapidly evolving transportation technologies, each DOT will also continue to perform traditional maintenance, operations, design, construction, and traffic engineering functions. However, the interdependence of traditional DOT activities and the implementation of emerging innovative programs increases the need for collaboration and cooperation between all functional areas within the comprehensive DOT organizational structure. We know from experience that cross-functional activities are not always as well-coordinated as they could be. Furthermore, with the enormity of real-time data now available from third-party data providers, with data collection on DOT vehicles, and the future data expected from CAVs, it is more important than ever for DOTs to have clear management plans for how they will use, manage, secure, and benefit from the data, not just from within the TSMO group, but throughout the entire agency.

While the technologies deployed in these transportation initiatives are often the highlight of the discussions and information sharing, the most critical aspect currently facing DOTs is the

collaboration that occurs between all the functional areas within any one DOT (traditional and innovative). There is a need to do more than just identify these collaboration success stories. There is a need to explore and investigate how such collaboration can be institutionalized within any given DOT, what barriers exist, and how best to overcome the identified barriers.

Purpose

This scan will explore and investigate how DOTs and other agencies are changing their organizations, institutional arrangements, and management practices to improve transportation system performance through the implementation of new technologies and/or other innovative programs, while at the same time maintaining their traditional role in capital improvement programs. TSMO is a recent example of changing transportation technology that is influencing organizational structure and management approaches. However, there are other equally compelling examples when one considers the use of big data readily available now and expanding exponentially in the future.

The focus will not be on technology deployments or policy and procedure documents. Rather, the scan will focus on exposing its panel members to detailed examples of new organizational structures and management approaches that foster greater collaboration and communication across the entire DOT agency. The panel will spend time discussing and contemplating these examples to determine the best or leading practices and gain a deeper understanding of what collaboration is possible and what factors helped the collaboration occur. The goal will be to produce a final document on this subject that will be useful to individual DOTs across the country as they consider future staffing structures, internal management policies, establishing institutional culture, as well as workforce development strategies.

Desk Scan Method

This desk scan relied first on identifying subject matter experts at state DOTs and federal agencies that appear to be leading the nation in the most innovative transportation industry initiatives by gathering recommendations from the scan team members and from the AASHTO committee liaisons in the areas of TSMO, big data, and human resources. In addition to an online search of relevant resources, most of the information was gleaned by conducting preliminary interviews with candidate organizations.

Recommended Scan Guidelines

It is imperative that we be mindful that all members of the scan team have limited time to engage in this project. Therefore, it seems important to establish guidelines for the scope and process of the project to ensure everyone's time is used in an effective and efficient manner. This is also true for the agencies and organizations that we choose to study in depth and for the employees of those organizations; we must not overburden or overly impose on their time. Specifically, in asking the candidate organizations to prepare for our sessions with them, we must limit our pre-visit inquiries and our request for lengthy responses. In speaking with the candidate organizations, virtually all had previously developed documents and presentations that the scan team could use

to ascertain a basic understanding of the agency's transformation in terms of reorganizations and changed management philosophy.

Recommendations:

- Limit the number of organizations that will be interviewed to six or seven
- Limit the number of pre-interview questions
- Request predeveloped supporting documentation
- Set an expected range on the page limit for the final report of 20 to 25 pages, plus appendix material
- Consider preapproval of the content of the final report:
 - Introduction
 - Scan method
 - Brief overview of agencies interviewed
 - Key findings
 - Key recommendations
 - Conclusion

Framework for Conducting the Scan

Since the scan team consists of high-ranking DOT representatives, the scan is proposed to be high-level discussion and collaboration with others in management positions. Because the information to be gathered does not require field or site visits, the scan team might consider congregating in one physical location and request the candidate organizations to travel to the team for the in-depth interviews. All candidate agencies interviewed to date agreed they would be able to travel to meet with the scan team if travel assistance were offered.

Candidate Agencies for Consideration

The first attachment to this document is a spreadsheet containing a brief summary of findings regarding the agencies the SME have interviewed, as well as placeholders for those I still hope to interview. (See Desk Scan Contacts for this information.) It is my hope that this information will guide the team in making selections for their in-depth interviews and investigations.

Based on the information in Desk Scan Contacts, the recommendations of the AASHTO committee liaisons, the information the SME gathered during the desk scan interviews, and the recommendations of the candidate state DOTs about their peers, the SME would offer the following candidate states for the scan team's consideration:

-
- California – Recognized as having one of the most comprehensive and large organizations in the country
 - Colorado – Recognized as a leader among peers with RoadX and other programs
 - Florida – National leader in new technology and deployment, as well as the handling of big data
 - Iowa – Recognized as a leader in many respects; strategic and well-planned-out approach leading to a deliberately slow approach to its reorganization for TSMO
 - Maryland – Recognized as a leader in TSMO, with a middle-of-the-road approach to reorganization (i.e., collaborative planning and then pulling the trigger for quick reorganization)
 - Massachusetts – National leader in new technology deployment
 - Michigan – Recognized as a national leader in innovative technology deployment
 - Tennessee – Recognized as a leader in elevating the TSMO function within its organization; the reorganization for TSMO occurred following a major incident/crash
 - Utah – National leader in the use of crowd-sourcing data
 - Washington State – Comprehensive program in all aspects, including TSMO and big data
 - Other well-recognized leaders in the area of innovation that should be considered are Utah, Florida, and Massachusetts
 - Others that should perhaps be interviewed are Georgia, Ohio, and Texas
 - A federal organization (the National Aeronautics and Space Administration and the Federal Aviation Administration have not yet responded to my request)
 - A private-sector organization that perhaps utilizes matrix management approaches

Amplifying Questions

The second attachment to this desk scan is the first draft of the amplifying questions that may be considered for use during the conduct of the scan. I fully expect the scan team to eliminate questions, create additional questions, reword questions, and streamline the document. [Appendix E in this final report provides the amplifying questions that were provided.]

I recommend to the scan team that a few questions be selected for pre-interview response by the candidate organizations. The remaining questions should be used to guide the in-depth interviews and should also be sent prior to the interview. I would also recommend that the scan team request supporting documentation that has already been prepared by the candidate organizations (e.g., PowerPoints, organization charts, and executive summaries from strategic plans) as reference material for the scan team and the SME.

Desk Scan Contacts

Maryland

Contract Name	Greg Slater
Area of Interest	TSMO, Asset Management, Big Data
Contact Number	(410) 545-0412
Peer Recommended States	Colorado, Arizona, Michigan, California, Minnesota

Summary of Interview

Maryland SHA has recently undertaken an effort it calls a collaborative modernization strategic plan for its department. This effort primarily considers the needs of its customers, with no desire for further separation or silos within the organization. This has changed the agency's organizational structure and culture. Its TSMO-related plan is in full swing now and stems from its strong transportation incident management heritage. Its asset management program has a 20-year history but is evolving as Maryland SHE is to include financial decision-making in each of its capital investment/asset management topic areas (e.g., bridges, pavement, signing, and guardrails). When it comes to this area, it is careful to foster a culture that asset management is everyone's job; this is also true for TSMO at the SHA. At this agency, planning for the reorganization is a two- to three-year process that is characterized as being very collaborative. However, **once the planning phase is complete, it pulls the trigger and the reorganization is very quick.**

Minnesota

Contract Name	Tim Henkel
Area of Interest	Asset Management
Contact Number	(651) 366-4829
Peer Recommended States	Maryland, Washington, Colorado, California

Summary of Interview

Asset management is a very comprehensive effort at MnDOT, including establishing overarching policy, organizing for success (top down and bottom up), and creating an advisory team. Four years ago, it launched this effort, dedicating time, effort, and financial and human resources as it knew all of them would be necessary. It has formalized the advisory committee, the organizational structure, and the investment of resources and has performed a gap analysis. It uses a big data analysis tool for asset management: AgileAssets¹⁶. It is now preparing its asset management plan in accordance with the federal regulations but was already **engaged in the activity because it's just the right thing to do.**

¹⁶ Agile Assets, <https://www.agileassets.com/>

Contract Name Steve Lund
Area of Interest Maintenance Engineering
Contact Number (651) 366-3566
Peer Recommended States

Summary of Interview

MnDOT has embarked on several aggressive transportation initiatives lately, which are led by high-level management staff who are temporarily reassigned. These include TSMO, CAV (CAV-X), safety culture, reinventing maintenance funding, and asset management. Lund is working on the reinventing maintenance funding initiative. The CAVX initiatives is just about ready to offer public and private sector partnerships in this area, and MnDOT has been holding community-based focus group meetings. Additionally, it had **a very mature ITS organization, which it is currently in the process of “repurposing” for TSMO.**

Iowa

Contract Name Matt Haubrich
Area of Interest Asset Management, Big Data
Contact Number (515) 233-7902
Peer Recommended States

Summary of Interview

Transportation asset management started in Maintenance but required an organizational change, so IowaDOT created a new division: the Strategic Performance Division. There is a formal top-down governance structure. The culture is that asset management is everyone’s job, and the agency has adopted asset management principles for all job classifications. The Transportation Asset Management Implementation team meets weekly; technical committees meet monthly. **Asset management is not well-directed by a traditional organizational structure.**

Contract Name Scott Marler, Donna Matulac
Area of Interest TMSO
Contact Number (515) 239-1205, (515) 239-1192
Peer Recommended States

Summary of Interview

Iowa’s TSMO program was facilitated by a 2013 Strategic Highway Research Program 2 capability maturity model assessment that identified an organizational (i.e., transportation agency wide) culture leaning toward TSMO was its weakest dimension. With that in mind IowaDOT embarked on a three-tier approach to reinvent its approach to this topic. The three-tier approach included preparing a strategic plan, a programmatic plan, and eight service-level plans. (Four of the service-level plans are finished, four are still under development.) FHWA uses this model in the TSMO primer, but also holds it up as a best practice for many reorganization uses. The actual reorganization in Iowa occurred over time, was deliberate in terms of identifying the business need within the organization and was not

launched all at once. It has a TSMO Steering Committee that represents a cross-section of the whole organization. While organizational culture continues to be a challenge, **the “secret sauce” for success was a culture that embraces new technology and strong support from executive management.**

Arizona

Contract Name	Brent Cain
Area of Interest	TSMO
Contact Number	(602) 319-1602
Peer Recommended States	Colorado, Iowa, Florida, Tennessee, Maryland, Texas, Ohio, California

Summary of Interview

In 2014 Arizona DOT (ADOT) participated in a SHRP2 capability maturity model assessment, which laid the groundwork for the establishment of the agency’s TSMO Division in 2015. This was accomplished with the strong support of both its chief executive officer (CEO) and chief engineer. With this reorganization, the TSMO Division manager became a member of the department’s Executive Management Team. Cain describes the launching of this division as a very dynamic process that included a newly written strategic plan, strategic planning meetings inclusive of all DOT employees, significant collaboration across the entire organization, and an education campaign. The process was described as very transparent. He describes this as **a huge change for the department that will propel it forward. Seek champions and use them.**

Tennessee

Contract Name	Brad Freeze
Area of Interest	TSMO
Contact Number	(615) 741-5017
Peer Recommended States	Colorado, Arizona, Iowa
Contract Name	Paul Degges (SHRP2 Interview)
Area of Interest	TSMO

Summary of Interview

Using the SHRP2 tool Reorganizing for Reliability, TDOT conducted its own capability maturity model assessment looking at the seven dimensions of maintenance and operations within its department. One of its actions items was to elevate its Traffic Operations section to the division level within the organization. In 2011 it experienced a major incident that closed the highway for 11 hours and did not turn the queue around, which stranded, without relief, one school bus and several elderly people for the entire 11 hours. As a direct result of the public scrutiny, TDOT launched several major efforts to reorganize and elevate its Traffic Operations division. There was good management support for the changes, but buy-in was somewhat difficult. The agency **formalized by charter a multi-disciplinary TSMO Coordinating Committee.**

Colorado

Contract Name Josh Laipply
Area of Interest TSMO, RoadX, Asset Management, Big Data
Contact Number (303) 757-9204

Peer Recommended States

Summary of Interview

Reorganization for Reliability (TSMO) was established in 2011-2012, but in 2014 the department took a major turn to leverage new and emerging technology to operate the transportation system and save lives in an innovative manner. The RoadX initiative anticipates enormous quantities of real-time data being available from third-party vendors. CDOT also anticipates CAV and has already instrumented its mountain corridor maintenance vehicles with probes that relay vital travel information to the department. Further, its mountain corridor itself is outfitted with roadside sensors and lane departure technology, in large part provided by the agency's private sector partner, Panasonic. Knowing the data is coming also means having efficient ways to warehouse, manage, and analyze the data, which is another function of the RoadX initiative. CDOT has had its challenges in terms of hiring staff with appropriate technology skill sets for these endeavors within the civil service pay ranges. The agency has opted to hire "consultant" extensions of staff, utilizing five-year contracts for positions such as the chief data officer. **With a culture of innovation, implementing any reasonable technology that makes the job of satisfying their customers easier – is CDOT's current key to success.**

New Mexico

Contract Name Tammy Haas
Area of Interest Asset Management
Contact Number (505) 795-2126
Peer Recommended States Colorado

Summary of Interview

In 2013 the New Mexico DOT (NMDOT) created a new division (not heavily staffed) for the purposes of focusing on asset management. Haas started by educating herself, hiring a contractor to help with the effort, and conducting workshops across the agency about the federal requirements. The agency continued the effort by conducting a risk management workshop, developing performance measures and objectives, and planning a data collection program. Since asset management requires effort and collaboration across the department, it has formed an Asset Management Executive Steering Committee that includes all six regions, FHWA, and the Asset Management division director. **Haas indicated that NMDOT was the first in the nation to submit and receive approval for its data quality management plan, which FHWA then used to create the checklist for future DOT submittals.**

Washington State

Contract Name	Daniella Bremmer, Todd Lamphere
Area of Interest	Asset Management
Contact Number	(360) 705-4140
Peer Recommended States	Colorado, Utah, Minnesota, Connecticut

Summary of Interview

Washington State is complying with more than just the federal mandate for asset management; it is measuring 22 asset classes in four major categories. The CEO has strong ownership of this program and is the executive sponsor for the effort. The CEO created this organization to break down the silos within the traditional pavement and bridge management systems and to begin measuring performance statewide and across all disciplines. WSDOT simply believes that this is the right thing to do; however, the program also offers a new platform for expressing financial need and for talking about the consequences of not make the necessary financial investments. **Its goal: right project, right time, right place**

Contract Name	John Nisbet
Area of Interest	TSMO
Contact Number	(360) 705-7280
Peer Recommended States	Colorado, California, Virginia

Summary of Interview

TSMO has meant many things over the last 20 years within this department. Effectively managing the transportation systems means aligning efforts with investments and resources. This included updating the agency's strategic plan: TSMO in workforce development, in planning, in engineering, in maintenance, and elsewhere. CAT, formerly TSMO, is everyone's job throughout the department. It has an agency working group that is cross-discipline and cross-organizational. It has specifically looked at private sector organizations that organized for innovation. **New technology = New process**

Contract Name	Jeff Pelton
Area of Interest	HR
Contact Number	(360) 705-7388
Peer Recommended States	Massachusetts (MassDOT), Colorado, Vermont, Minnesota

Summary of Interview

WSDOT has established strategic principles: inclusion, practical solutions, and workforce development. Within workforce development, the strategies include employee engagement, talent development, and talent pipeline. Within talent development, the department is performing workforce analysis and trending talent growth patterns. It has an annual workforce conference and it analyzes new needs and develops strategies to address them. **Where is it today and where does it need to be in terms of workforce talent in the future.**

Florida

Contract Name Nathan Lee, Rob Wright, Glenn Blackwelder
Area of Interest Big Data, Director of Construction, TSMO
Contact Number (801) 965-4111, (801) 518-4180
Peer Recommended States Utah, Colorado, Florida, Washington State

Contract Name John Krause
Area of Interest Big Data
Contact Number
Peer Recommended States Utah

Summary of Interview

The Utah DOT was clear to point out it did not reorganize for the sake of TSMO but to bring some new functions into its Traffic Operations division to be more efficient. Additionally, it wanted a cultural shift within the organization, so that the mindset would be on incorporating operations into all aspects of the department's activities. Also, it wanted to foster an environment of innovation, particularly with technology. This January they will launch the second effort in the nation to charge a road user fee, in lieu of a gas tax, for all electric vehicles. It manages this task with a GIS interface similar to Colorado's RoadX project with Panasonic. **While it believes it is a leader in big data initiatives and is purchasing crowdsourcing data, including Here ¹⁷, Ways, and Google data, it also believes it is just scratching the surface on all the ways to use the data.**

California

Contract Name Michael Johnson
Area of Interest Asset Management
Contact Number (916) 653-2572
Peer Recommended States Minnesota, Colorado, Maryland

Contract Name Michelle Tucker
Area of Interest HR

Summary of Interview

The California DOT (Caltrans) Office of Asset Management, created in 2015, has been elevated to the executive management level. Several attempts at asset management within the organization were made prior to this reorganization; however, it is felt that without a direct line to the executive management team the last attempts were not as successful as they might have been. At this level there is control of approximately \$4.5B in funding that is distributed to the districts. The significant difference is that the Office of Asset Management has achieved nearly 100% performance-driven project selection. After undergoing a Lean 6 Sigma program/process review, it identified 34 performance objectives it measures for all programmed projects. Each district receives one funding pot of money, along with detailed target performance objectives. The districts select projects to meet the performance objectives in the most efficient

17 Here, <https://360.here.com/here-safety-services-suite-brings-actionable-intelligence-to-your-car>

fashion. This may include partnering with local agencies to achieve the performance objectives. After all the performance objectives are achieved, the remaining funds can be used for district priority projects. The Office of Asset Management is utilizing a custom-built software package created by the department. It will soon implement a new enterprise software package. Its culture and management after the reorganization has changed, and it now asks itself **are we on time, on budget, and did we deliver the projects we intended to deliver to improve the system's performance.**

Appendix E: Amplifying Questions

NCHRP 20-68A**U.S. Domestic Scan 18-02: Leading Practices in Modifying Agency Organization and Management to Accommodate Changing Transportation System Technologies****Amplifying Questions****January 15, 2019**

The objective of this scan is to examine leading or best practices in modifying agency organizations and/or management style and culture to accommodate the fast-paced growth of innovative transportation systems technologies. Specifically, the scan proposes to explore how DOTs and other agencies are changing their organizations, institutional arrangements, and management practices to improve mobility through adoption of new technologies.

Your organization has been selected by the scan team for further investigation because of the agency's reputation in successfully implementing and/or preparing for the future implementation of new transportation system technologies. The team is specifically interested in changes to the typical or traditional DOT organizational structure. The scan team also has a desire to speak with agencies that have successfully transformed their employee culture to embrace these new ways of conducting business.

The following questions are designed to inform the scan team about these types of activities within your organization.

To prepare for the scan team peer exchange please be ready to address the following 10 major topic areas so that the important factors in your agency's success can be ascertained by the scan team. While the scan team is interested in your ultimate success, it is also interested in hearing about the lessons learned, challenges, barriers, and even failures that you faced along the journey.

1. Organization or Agency Information (High Level)

- Please tell us about you and the others representing your agency
 - Contact Name/s and Title/s
 - Contact information – telephone numbers, e-mail addresses, physical address
- Please tell us about your overall agency
 - Size and jurisdiction
 - Agency Organization – centralized, decentralized, high-level organizational structure (before and after modifications)
- Please briefly describe the transportation systems technology implementation that required modified processes, organization structure, or management approach.
- Please briefly describe any applicable legislation, rules, regulations, standards, policies or

procedures that either initiated the change, or caused challenges or barriers to the desired organizational change

2. Does your agency have a vision or strategic plan for incorporating new and evolving transportation systems technologies into your business practices?

Consider touching on the following (some may not apply) when answering the question above.

- What are the mobility objectives for the technology implementation?
- What event, change in administration, or enlightened idea was the genesis for the implementation?
- What strategies did your agency utilize to begin the discussions related to the new technology implementation to ensure an advancement in the state of practice?
- How did your agency define the purpose or the scope of the new technology implementation?
- How did your agency begin to identify the new organizational structure and begin to assign financial and human resources to the effort?
- Did your organization incorporate management retreats, capability models, conferences, workshops, or other approaches to assess the gaps in technology, policies, procedures, knowledge, agency efficiencies, required skill sets, and maturity of the institutional capabilities?
- Did your agency seek to gain additional knowledge from successful DOT examples, case studies, or federal guidance?
- Did your agency secure a third-party expert (consultant services) to facilitate development and implementation of the vision?

3. What organization and management changes have occurred or are being planned to support new transportation systems technologies?

Consider touching on the following (some may not apply) when answering the question above.

- How have you modified your organization structure to better implement, support, or prepare for new technology implementation?
- How has the agency's management approach been changed or modified to better implement, support, or prepare for the implementation of new transportation systems technologies?
- What have been the successes and challenges related to the organizational change? Is there anything you would do differently or will change in the future?
- What steps or strategies did you incorporate related to change management to help the organization accept and adapt to the changes?

- How were changes to the organization or to management approach communicated? Did your agency achieve institutional buy-in? If so, what was the turning point or the best strategy for achieving the buy-in or consensus?
- How would you describe the lessons learned by your agency?

4. What is your IT support structure?

Consider touching on the following (some may not apply) when answering the question above.

- Since new transportation systems technologies rely heavily on IT technologies, please elaborate on the following topics:
 - Does your IT support reside within your state agency? If yes, does IT reside within the division or section implementing the new technology? If not, where in the state agency organization does IT reside?
 - If your IT support resides in a different state agency altogether, tell us more about your experiences with the other state agency. Are there policies in place that dictate IT governance?
 - What steps have you taken to improve coordination/collaboration between your organization and the IT support functions?
- How are IT services integrated into the planning and implementation of transportation technology decisions?
- How do you obtain the needed support for IT infrastructure, such as servers and network equipment, with competing demands from other sections or divisions of the agency or state?
- Do you support these systems on a 24x7 basis? What is your IT support process?
- What cybersecurity protocols do you have in place?
- Is there a process for determining what technologies should be interoperable and which should not?

5. What steps have you taken for better internal collaboration within your agency?

Consider touching on the following (some may not apply) when answering the question above.

- How does your agency strike a balance between the individual needs of divisions/districts/regions of the organization versus the standardization of policies, procedures, practices, data formats, and others?
- Did your agency build a new organizational structure as a result of implementing a transportation systems technology or did it repurpose an existing organization?
- How did your agency avoid the turf battles or overcome the worry about how the new organization will hurt “me”?

- Was there, or is there now, a need to incorporate a nontraditional organizational structure, such as a matrix management structure, for some areas of your agency's business processes?
- How did you overcome the traditional DOT silos within your agency (organizational, financial, resource availability, responsibility, accountability, etc.)?

6. What steps has your agency taken for better collaboration external to your organization?

Consider touching on the following (some may not apply) when answering the question above.

- Has your agency taken any steps to improve collaboration with other state agencies, municipalities or private entities?
- Outside of your own state, has your agency taken any steps to enhance collaboration with your neighboring states, with communities of practice, or with user groups?
- What steps has your agency taken to identify new technology partners?
- Given the constraints of government procurement processes, what innovative ways have you found for establishing effective private sector partnerships?
- How will your agency leverage these partnerships to improve and/or maintain the transportation system?

7. What organizational structure do you have in place to collect, store and analyze the large quantities of transportation data you anticipate utilizing the future?

Consider touching on the following (some may not apply) when answering the question above.

- What data systems and analysis tools have you implemented to make use of the data produced by current and future transportation systems?
- How are you using data and performance measures to change how you manage and operate the transportation system?
- Are you now using or are you planning to use the data for policy and planning decision-making purposes?
- How have you begun planning for the potential use of connected vehicle data?
- Do you share or sell any of your data with local agencies and/or private sector partners? If you sell the data, or plan to sell the data in the future, do you see this as a new revenue stream for the operation and maintenance of the technology or transportation system?
- Similarly, but with a different end in mind, what steps have been taken to make the data more accessible to the public and/or private sector? Do you have a data portal? If so, what types of data are being shared?

8. What strategies have you modified or created to prioritize strategic technology investment?

Consider touching on the following (some may not apply) when answering the question above.

- What is your approach to asset management for your roadside ITS, traffic signal, or other advanced technology infrastructure?
- How do you measure whether maintenance and/or capital program funding is sufficient to update the existing and future transportation system technologies infrastructure?
- Do you use any measures for tracking the condition of existing technology infrastructure?
- Do you have established targets for equipment/system/technology up-time or for repair times?
- What is your asset management approach for IT support technologies, such as servers and network infrastructure?
- How does your agency assess the benefits of implementing new transportation technologies?
- How have you communicated the benefits of transportation technology in order to support funding?

9. Please describe for us your agency's workforce capabilities (required training, succession planning, job re-classification, and hiring practices).

Consider touching on the following (some may not apply) when answering the question above.

- Have you created an inventory of skills needed to support the growing use of transportation systems technology?
- Are you able to hire staff with the needed qualifications? If so, how or what did you do to overcome this challenge?
- Has your agency used consultant services to supplement agency personnel resources?
- How do you determine which skills are best to obtain via contractual arrangements and which are best developed and maintained with internal staff?
- Have you developed an employee training program for existing staff?
- Have you developed a recruitment program to support the growing use of technology? Have you created new job classifications?
- Have you discussed an employee retention program? How does this differ from the traditional DOT workforce retention plan in terms of retaining a new generation of workers who may have different values or aspirations?
- Are there any certifications or licensing requirements for employees who repair or troubleshoot transportation systems technologies?

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- Do you offer tuition assistance for college coursework and/or trade schools to your employees who have a desire to become more proficient with the technologies implemented within your agency?

10. What else should we know about modifying agency organizations, management approaches, or required culture changes to facilitate the implementation of new transportation systems technologies?

11. Consider touching on the following (some may not apply) when answering the question above.

- What else would you like to tell us about your experiences in reorganizing your agency or changing your management approach to meet your growing mobility needs?
- In addition to reorganization and changes in management approaches, was there any other significant change within your organization?
- What lessons have you learned along the way that you would like to share with others embarking on implementing new transportation systems technologies?
- What recommendations would you offer to your peers in this regard?

