Organizing for TSMO

Case Study 8: Training for TSMO

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16. Abstract
Given the varying stages of TSMO adoption and advancement, the Federal Highway Administration identified the need for case studies to provide examples of common challenges and best practices for transportation agencies to learn from each other. This is one of 12 case studies developed to support organizing for TSMO. This case study focuses on training for TSMO. Five agencies with advanced training programs were interviewed: California Department of Transportation (Caltrans), AZTech, New Jersey Department of Transportation (NJDOT), Washington State Department of Transportation (WSDOT), and Florida Department of Transportation (FDOT). Each agency provided information on their process to establish training and take advantage of existing opportunities to share information about TSMO.

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List of Abbreviations and Acronyms

AASHTO ....American Association of State Highway and Transportation Officials
ADOT ....Arizona Department of Transportation
Caltrans ....California Department of Transportation
CITE...Consortium for Innovative Transportation Education
CMM.. Capability Maturity Model
FDOT .... Florida Department of Transportation
FHWA..Federal Highway Administration
MPO...Metropolitan Planning Organization
NJDOT.. New Jersey Department of Transportation
SHRP2.. Strategic Highway Research Program 2
TIM .... Traffic Incident Management
TMC...Traffic Management Center
TRB...Transportation Research Board
TSMO .... Transportation Systems Management and Operations
UCF...University of Central Florida
WSDOT .... Washington State Department of Transportation

EXECUTIVE SUMMARY

Transportation systems management and operations (TSMO) provides tools for transportation managers to address safety, system performance, and reliability. TSMO is "an integrated set of strategies to optimize the performance of existing infrastructure through the implementation of multimodal and intermodal, cross-jurisdictional systems, services, and projects designed to preserve capacity and improve security, safety, and reliability of the transportation system.[1]" Through participation in the second Strategic Highway Research Program workshops, transportation agencies are working to better support TSMO programs. Deploying intelligent transportation systems (ITS), hiring internal information technology staff, and using performance measures for data-driven decisions are just a few examples of the many activities a TSMO program can support.

Given the varying stages of TSMO adoption and advancement, the Federal Highway Administration identified the need for case studies to provide examples of common challenges and best practices for transportation agencies to learn from each other. This is one of 12 case studies developed to support organizing for TSMO. This case study focuses on training for TSMO, including:

- Developing partnerships to create effective training materials.
- Customizing training based on audience needs.
- Developing workshops or interactive experiences to enhance training.

Five agencies with advanced training programs were interviewed: California Department of Transportation (Caltrans), AZTech, New Jersey Department of Transportation (NJDOT), Washington State Department of Transportation (WSDOT), and Florida Department of Transportation (FDOT). Each agency provided information on their process to establish training and take advantage of existing opportunities to share information about TSMO. Some of the best practices identified include:

- Caltrans and WSDOT's partnerships with the University of Maryland to develop TSMO training materials.
- AZTech's traffic incident management (TIM) coalition with tabletop training sessions.
- NJDOT's training website for TIM first responders.
- FDOT District 5's outreach to trade schools to help develop candidates for future signal technician workforce needs.

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[1] Source: https://ops.fhwa.dot.gov/tsmo/index.htm

CHAPTER 1 – INTRODUCTION

Historically, transportation agencies have managed congestion primarily by funding major capital projects that focused on adding capacity to address physical constraints such as bottlenecks. Operational improvements were typically an afterthought and considered after the new infrastructure was already added to the system. Given the changing transportation landscape that includes increased customer expectations, a better understanding of the sources of congestion, and constraints in resources, alternative approaches were needed. Transportation systems management and operations (TSMO) provides such an approach to overcome these challenges and address a broader range of congestion issues to improve overall system performance. With agencies needing to stretch transportation funding further and demand for reliable travel increasing, TSMO activities can help agencies maximize the use of available capacity and implement solutions with a high benefit-cost ratio. This approach supports agencies' abilities to address changing system demands and be flexible for a wide range of conditions.

Effective TSMO efforts require full integration within a transportation agency and should be supported by partner agencies. This can be achieved by identifying opportunities for improving processes, instituting data-driven decision-making, establishing proactive collaboration, and developing actionable activities to develop processes that optimize performance.

Through the second Strategic Highway Research Program (SHRP2), a national partnership between the Federal Highway Administration (FHWA), the American Association of State Highway and Transportation Officials (AASHTO), and the Transportation Research Board (TRB), a self-assessment framework was developed based on a model from the software industry. SHRP2 developed a framework for agencies to assess their critical processes and institutional arrangements through a capability maturity model (CMM). The CMM uses six dimensions of capability to allow agencies to self-assess their implementation of TSMO principles[1]:

1. Business processes – planning, programming, and budgeting.
2. Systems and technology – systems engineering, systems architecture standards, interoperability, and standardization.
3. Performance measurement – measures definition, data acquisition, and utilization.
4. Culture – technical understanding, leadership, outreach, and program authority.
5. Organization and workforce – programmatic status, organizational structure, staff development, recruitment, and retention.
6. Collaboration – relationships with public safety agencies, local governments, metropolitan planning organizations (MPO), and the private sector.

Within each capability dimension, there are four levels of maturity (performed, managed, integrated, and optimized), as shown in Figure 1. An agency uses the CMM self-assessment to

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[1] FHWA, Office of Operations, "Organizing for Reliability – Capability Maturity Model Assessment and Implementation Plans Executive Summary," May 2015. https://ops.fhwa.dot.gov/docs/cmmexesum/sec1.htm

identify their level of maturity in each dimension as well as their strengths and weaknesses and to determine actions they can take to improve their capabilities.
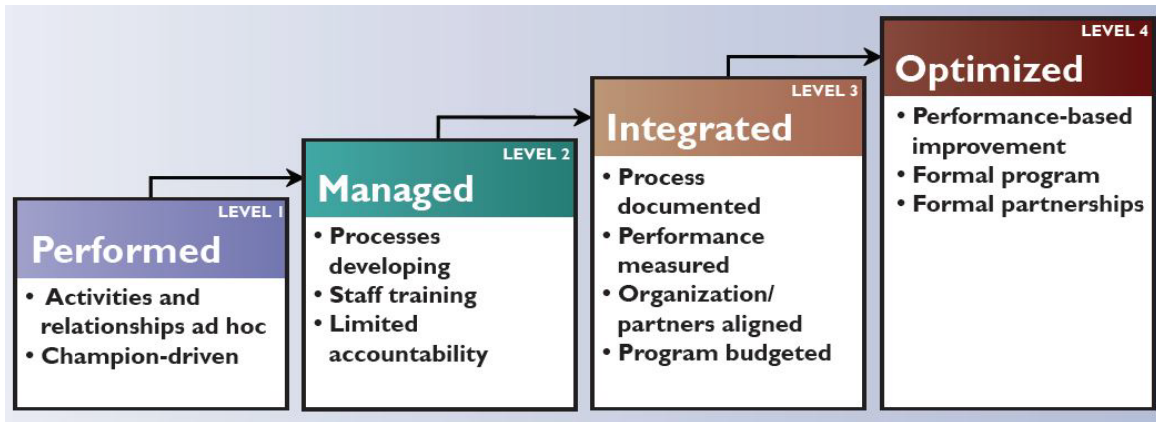

Figure 1. Chart. Four Levels of Maturity

Source: Creating an Effective Program to Advance Transportation System Management and Operations, FHWA Jan 2012

Purpose of Case Studies

In the first 10 years of implementation of the TSMO CMM, more than 50 States and regions used the tool to assess and improve their TSMO capabilities. With the many benefits experienced by these agencies, FHWA identified the need to develop case studies through previous efforts in SHRP2 to showcase leading practices in order to assist transportation professionals in mainstreaming TSMO into their agencies. The purposes of the case studies are to:

- Communicate the value of changing the culture and standard practices towards TSMO to stakeholders and decision-makers.
- Provide examples of best-practices and lessons learned by other State and local agencies during their adoption, implementation, and mainstreaming of TSMO.

These case studies support transportation agencies by showing a wide range of challenges, opportunities, and results to provide proof for the potential benefits of implementing TSMO. Each case study was identified to address challenges faced by TSMO professionals when implementing new or expanding existing practices in the agency and to provide lessons learned.

Identified Topics of Importance

The topic of training for TSMO is important because providing appropriate information to each level of stakeholders is an important aspect in communication of TSMO. TSMO is often a new concept to many agencies, so by developing training activities, the agency can present a clear understanding of TSMO, share expertise, and engage more stakeholders. Some challenges that agencies face when developing training materials for TSMO are developing content that is appropriate for different audiences, reaching as many individuals as possible, and having the resources to develop and deliver training. The agencies highlighted for this case study addressed those challenges by providing online training and resources as well as collaborating with other stakeholders to develop training.

Interviews

Agencies were selected for each case study based on prior research indicating that the agency was excelling in particular TSMO capabilities. Care was taken to include a diversity of geographical locations and agency types (departments of transportation, cities, and MPOs) to develop case studies that other agencies could easily relate to and learn from. Interviews were conducted with selected agencies to collect information on the topic for each case study.

Description of Training for TSMO

Providing training for agency staff and stakeholders is key to a successful TSMO program to establish a common understanding of goals and processes. Staff must be equipped with all necessary information to carry out the processes and procedures for which they are responsible. This helps promote a TSMO culture and integrate activities into other agency processes and programs.

The intended audience is likely to impact the types of training activities and materials developed. The following should be considered:

- **What is the audience's role?** – Stakeholders may receive different types of training depending on their goals and role within TSMO. For example, executive leadership may only need a brief description of the expected program outcomes versus a mid-level manager needing to know the details of plans and functions.
- **What is the best setting for the intended audience?** – Existing standing meetings where a portion of the agenda can be designated to TSMO information may be better received than requesting standalone TSMO meetings. A wider audience may be available if the meeting is regularly occurring. However, if a significant amount of information must be provided, a specific training workshop may be a better option. Webinars should also be considered if there are many attendees or a large geography to cover. An added benefit of webinars is that they can be recorded, which is helpful if detailed information is provided or some individuals are not able to attend at the designated date and time.
- **How will the audience best learn the information**? – Based on the information to be conveyed, a presentation may be appropriate for training. If an in-person or webinar training is developed, interactive elements should be considered to continuously engage attendees. This may include quiz questions at specific points, team activities, or example problems. In addition to, or in lieu of, a presentation to provide the training information, job aides could be considered to enhance learning and provide a reference item after the training. This could be a fact sheet, a workflow, a schematic, or other easily understood reference materials. An additional benefit of providing a job aide is the physical item can help keep the material present in an attendee's thoughts even when working on other tasks.

By considering these elements before developing a training activity, agencies are able to provide appropriate, targeted information to intended stakeholders.

CHAPTER 2 – BEST PRACTICE EXAMPLES

The California Department of Transportation (Caltrans), AZTech, the New Jersey Department of Transportation (NJDOT), the Washington State Department of Transportation (WSDOT), and the Florida Department of Transportation District 5 (FDOT D5) participated in the second Strategic Highway Research Program (SHRP2) capability maturity model (CMM) workshops that helped the agencies understand transportation systems management and operations (TSMO) and how it can be applied to their work. The following subsections highlight several successful initiatives that each agency accomplished, specifically regarding training for TSMO.

California Department of Transportation (Caltrans)

Caltrans supports the diverse transportation needs in the State of California through 12 regional districts. Caltrans manages more than 50,000 miles of highway and freeway lanes, provides rail services, and permits more than 400 public-use airports and special-use hospital heliports for over 30 million residents in the State.

Mobility Academy

Caltrans offers Mobility Academy workshops that are primarily intended for traffic operations but are useful for anyone analyzing data to determine system performance, such as delay and reliability. Caltrans has used these workshops for several years but only recently introduced TSMO into the training program through strategic partnerships as part of the Consortium for Innovative Transportation Education (CITE) program. This has resulted in Caltrans aligning its vision of TSMO with that of the Federal Highway Administration (FHWA). The amount of TSMO training available to Caltrans staff is steadily increasing as resources are added.

Caltrans partnered with the University of Maryland and WSDOT to create a centralized training program. This approach involved the University of Maryland creating an online TSMO training course and Caltrans using that content to incorporate a TSMO training module into their existing Mobility Academy workshops. The course, developed as part of the CITE program, is designed to contain general information that teaches the fundamentals of TSMO to people at any level. It is intended to be used by anyone, not just staff in a transportation department. Caltrans staff use the TSMO training module as a precursor to their Mobility Workshops.

Training Resources

Another medium that Caltrans uses for training and collaboration is the Regional Operations Forum. In these forums, a representative from each district in the State was trained on the basics of TSMO using FHWA publications and reviewing Caltrans' findings in their initial assessment. Figure 2 displays a graphic developed by Caltrans that displays their umbrella philosophy on TSMO. This graphic is used to support training and discussions on TSMO activities.
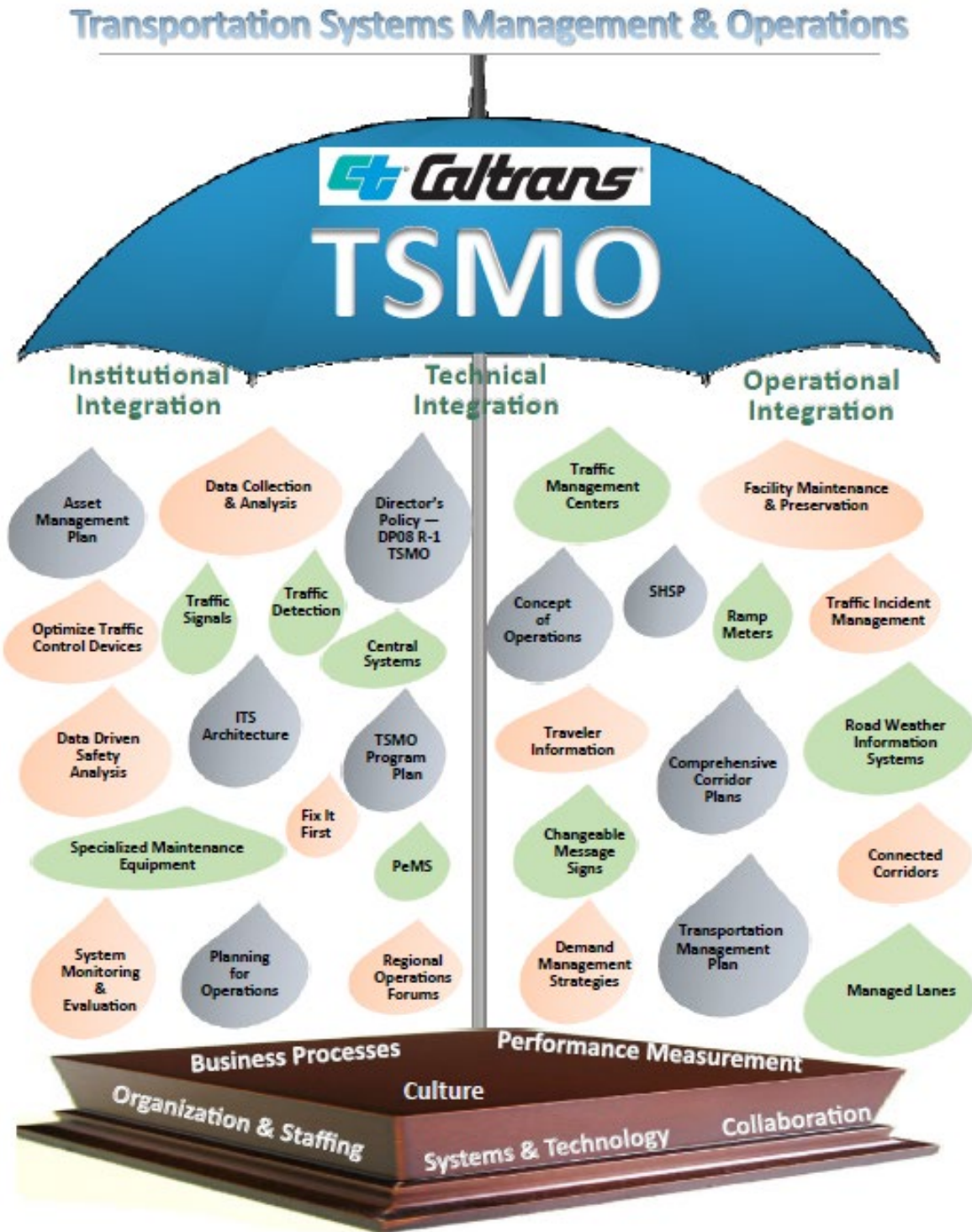
Figure 2. Illustration. Caltrans TSMO Umbrella
Source: TSMO Umbrella, Caltrans, 2018

The umbrella graphic helps Caltrans communicate how TSMO is the overarching philosophy of systems management and operations. It helped with outreach to different departments across Caltrans by showing the different areas that TSMO impacts. One of the lessons learned is that

performing background research on your audience helps determine the right way to create excitement and immediacy about TSMO and maximize the effectiveness of training. Maximizing training is achieved by focusing on methods that promote the best results for specific departments and content that ties TSMO to their applicable areas. These efforts go a long way in preparing people to generally support TSMO philosophies and were evident during a recent Regional Operations Forum facilitated through the Highway Safety Improvement Plan. During this outreach event, local Native American tribes received training on how to fund their TSMO program. Caltrans' familiarity with the needs of the audience enabled them to communicate the process effectively and the forum was successful.

AZTech

AZTech is a regional traffic management partnership in the Phoenix metropolitan area that guides application of intelligent transportation systems (ITS) technologies for managing regional traffic. Six groups make up the partnership, including the executive committee, strategic steering committee, operations committee, Traffic Incident Management (TIM) coalition, Traffic Management Center (TMC) operators working group, and the media communications task force.

Traffic Incident Management Coalition

After creating an action plan from the CMM evaluation, one of the action items was the need for collaborating with first responders to streamline TIM. Prior to implementing the action plan, collaboration with the TIM Coalition was limited to the Department of Public Safety, Arizona Department of Transportation (ADOT), and Maricopa County Department of Transportation participation. As part of the action plan, local police, fire, and towing companies were encouraged to attend the sessions. At first, the coalition was not achieving the level of collaboration they wanted, so they implemented tabletop sessions. The tabletop sessions involved incident responders, TMC operators, signal system operators, and occasionally, public information officers. By increasing the number of tabletop sessions, collaboration between the various departments greatly improved.

Through training, the various agencies and departments realized the benefit of collaboration and how each agency/department can impact the performance of emergency response. The arterial incident response team now assists with non-arterial incidents. The team coordinates with the ADOT Transportation Operations Center, Arizona Local Emergency Response Team (the ADOT incident response team), local traffic agencies, Department of Public Safety, and TMC operators when responding to incidents. TMC operators are able to change signal timing on alternate routes and display information on portable dynamic message signs to maximize capacity and minimize the time needed to clear an incident.

New Jersey Department of Transportation (NJDOT)

The State of New Jersey is divided into three geographical regions – North, Central, and South. NJDOT supports the State's transportation needs. These regions develop, operate, and maintain more than 2,300 miles of public roadways. The Transportation Mobility section of each region is responsible for traffic control during design, construction, operation and maintenance of ITS, emergency response, and more.

Training Website

NJDOT prefers to think of TSMO training as an outreach activity. With this approach, the focus is on getting people to understand TSMO, why it is being adopted, and the benefits of employing TSMO. NJDOT has been engaging with many different groups as a result of their outreach, including colleges and universities, first responders, consulting firms, and metropolitan planning organizations (MPO).

Through FHWA's Every Day Counts initiative, and in partnership with the New Jersey Institute of Technology, NJDOT was able to develop a TIM training website, www.njtim.org. This website is a nationally recognized tool where safety personnel, emergency responders, and others can register for training classes throughout the State. The site has proven to be a very valuable resource as over 30 percent of first responders in the State have used the website for training. Since website users must register online, the website has also been a valuable resource for sending information and communications.

Figure 3. Photo. NJDOT TIM Training Website
Source: njtim.org, NJDOT, 2018

NJDOT's Incident Management program includes a memorandum of understanding with the NJ State Police to provide seven sergeants and one lieutenant to support the NJDOT TIM program. The troopers assigned to the NJ State Police Incident Management Unit are dedicated to assist

NJDOT with TIM training, outreach, and incident management response. When these troopers respond to large scale incidents with the NJDOT, other first responders are able to observe the relationship and benefits it has brought to both departments. Because of this, TSMO is spreading fast and other agencies and first responders are coming to the NJDOT for the training.

In addition, TSMO and TIM training are being incorporated into the State and local police programs and fire training programs. The goal of this training is to make TIM a standard and planned practice rather than an ad-hoc activity.

Washington State Department of Transportation (WSDOT)

WSDOT supports the State of Washington transportation needs through six regional districts. WSDOT operates and maintains more than 18,600 miles of highway lanes, nearly 3,300 bridge structures, and runs a ferry system that moves 24.2 million passengers and 10 million vehicles per year.

Workforce Development

One of the big successes WSDOT had in solidifying TSMO within the agency was the creation of a dedicated TSMO position titled Workforce Development and Traffic Operations Engineer. The Workforce Development and Traffic Operations Engineer is responsible for providing training for staff and elevating TSMO throughout WSDOT.

WSDOT capitalized on this dedicated TSMO position by using a broader definition of TSMO to include multimodal planning and public transportation, as shown in Figure 4. Under this expanded definition, coordination for TSMO involves more organizations and agencies than the standard definition. With the dedicated position, bringing forth these efforts was not only possible but successful.

Figure 4. Chart. WSDOT TSMO Definition Graphic
Source: WSDOT, 2018

Although external training has always been present in WSDOT, there was no process for deciding which staff members went to different events. This was especially true with the Operations Academy. The Operations Academy is designed to train staff on TSMO and includes two parts: an initial pre-study program followed by a two-week total immersion program. The total immersion program uses a mix of classroom instruction, speakers, workshops, and analysis of existing systems to ensure retention of the principles being presented[1]. To maximize this opportunity, a process was put in place for each region in the State to submit candidates for training; candidates are then selected by headquarters. WSDOT recognizes the value of national conferences and has started encouraging attendance of staff. They support this by performing some of the necessary administrative work to attend as well as contributing financially to the costs of attendance. A requirement of attending is for staff to present what they have learned in the form of a presentation, webinar, etc. upon their return. This benefits all staff as the knowledge is shared and can be applied by everyone within the attendee's local working group.

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[1] http://operationsacademy.org/

Florida Department of Transportation District 5 (FDOT D5)

FDOT D5 supports the transportation needs of a nine-county area in Florida, which includes Brevard, Flagler, Lake, Marion, Orange, Osceola, Seminole, Sumter, and Volusia Counties. FDOT D5 also includes seven transit authorities, one passenger rail line, one deep-water port, and 25 public-use and 133 private-use airports. FDOT has a decentralized agency structure.

Technical Training Program

One issue FDOT D5 experienced was that a number of staff were moving into management roles without receiving the optimum level of technical training. As a result, FDOT D5 developed training as part of SHRP2 to meet this need, including material that was requested by partner agencies and MPOs. To make logistics easier, the new training sessions were held immediately after regularly scheduled consortium meetings, eliminating the need for extra travel by staff.

CMM helped FDOT D5 determine the training needs of each agency and department. FDOT D5 engaged with these partner agencies and departments though regular meetings to prioritize needs and content and sent staff to partner agencies to participate in one-on-one and small group training sessions.

Information Technology Training Documentation

Due to high turnover, particularly in information technology positions, FDOT D5 realized that there was heavy reliance on people's memories of their systems and processes without sufficient training or documentation to promote stability after staff departures. To combat this, FDOT D5 began an effort to document their current systems to determine what they needed as well as documenting system upgrades to ensure that all systems were built and maintained properly.

The process for developing documentation involved asking the expert to organize all the necessary information. After this, the expert would bring the documentation to another department and see if a non-expert could correctly interpret the documentation and perform some of the described functions. If anything was unclear or misinterpreted, the documentation was edited. Through several iterations of edits with different people, a final version was created. FDOT D5 continues this iterative process whenever they have a new hire. The documentation is revised and clarified if a new hire is unable to fully understand it.

Higher Education Outreach

Another issue FDOT D5 found through its TSMO implementation was the need to have a larger pool of qualified candidates for signal technician positions. To resolve this issue, FDOT D5 reached out to local universities and trade schools, specifically Orange Technical College in Orlando. After meeting with personnel from the college, FDOT D5 found the curriculum matched their requirements but the college needed electronics for training purposes. FDOT D5 donated old controllers, cabinets, and other equipment to the college and, as a result, the placement rate for Orange Technical College grew to 75 percent.

FDOT D5 also met with the University of Central Florida (UCF) to review its curriculum and discuss future needs. UCF applied for an internal grant to hire new professors with FDOT D5's backing and won the grant. The grant helps expand UCF's future cities and transportation programs and UCF is now recruiting students from other disciplines, including data management, computer vision, and computer science, into transportation. FDOT D5's efforts and work with these schools is establishing a pipeline for qualified candidates to fill their future needs.

CHAPTER 3 – SUMMARY

Each transportation agency has different approaches when addressing training needs. As technology deployments and operational strategies become more common in the transportation design space, the need for enhanced training is apparent. To maximize the broad expanse of transportation systems management and operations (TSMO) philosophy, TSMO training opportunities should be made available to all departments within a transportation agency. Managing the complexities of training for a broad group of people is difficult. The agencies interviewed for this case study shared several key lessons learned that support the advancement of training in their TSMO programs:

- Centralized training is an effective and efficient approach to provide consistent information that can be adapted for different audiences. Training can be more effective if used by multiple agencies or shared between States. Developing and prioritizing training needs through regular meetings of involved parties maximizes the effectiveness of training.
- Creating a website, graphic, or some type of aide can be a valuable resource for TSMO training. A website can be used for many things, such as posting training videos, registering for classes, and disseminating information. The versatility of a website makes it a powerful tool, especially when it provides different mediums for people to learn new information.
- Close collaboration with stakeholders including partner agencies, other State departments, universities, and trade schools is critical to the success of TSMO training. Coordination is an important part of TSMO and it becomes easier when all involved parties receive consistent training. Maintaining relationships through communication advances the success of TSMO.

Training agency staff and regional partners on the role TSMO plays in transportation planning and development sets the stage for a successful TSMO program. Well-informed staff promote an agency's workforce capability and culture, which enables improved development of business processes and programming. The challenges and lessons learned provided in this case study can be used to develop the business case for TSMO training in other agency TSMO programs.

REFERENCES

Information used in this case study was gathered from sources noted throughout the report together with the following websites:

- FHWA's What is Transportation Systems Management and Operations (TSMO)?
  - https://ops.fhwa.dot.gov/tsmo/
- AASHTO's TSMO Guidance
  - http://www.aashtotsmoguidance.org/
- FHWA's Organizing and Planning for Operations
  - https://ops.fhwa.dot.gov/plan4ops/
- FHWA's Organizing for Operations Resources
  - https://ops.fhwa.dot.gov/plan4ops/focus_areas/organizing_for_op.htm
- FHWA's Organizing for Reliability – Capability Maturity Model Assessment and Implementation Plans
  - https://ops.fhwa.dot.gov/docs/cmmexesum/sec1.htm
- FHWA's Creating an Effective Program to Advance Transportation Systems Management and Operations, Primer
  - https://ops.fhwa.dot.gov/publications/fhwahop12003/index.htm
- Florida Department of Transportation
  - http://www.fdot.gov/
- New Jersey Department of Transportation
  - https://www.state.nj.us/transportation/
- AZTech
  - http://www.aztech.org/
- California Department of Transportation
  - http://www.caltrans.ca.gov/
- Washington State Department of Transportation
  - http://fratis.trac.washington.edu/TSMO/

Table 1. Interview Participants and Agencies

Agency	California Department of Transportation (Caltrans)	AZTech	New Jersey Department of Transportation (NJDOT)	Florida Department of Transportation District 5 (FDOT D5)	Washington State Department of Transportation (WSDOT)
Agency Representative Name:	Nicholas Compin	Faisal Saleem	William Kingsland	Jeremy Dilmore	Monica Harwood
Agency Representative Title:	Chief of the Office of Strategic Development	Intelligent Transportation Systems Branch Manager	Assistant Commissioner	TSM&O Engineer	Workforce Development & Traffic Operations Engineer
Agency Representative Email:	Nicholas.Compin@dot.ca.gov	faisalsaleem@mail.maricopa.gov	Cwilliam.kingsland@dot.nj.gov	Jeremy.dilmore@dot.state.fl.us	HarwooM@wsdot.wa.gov
Interview Date:	June 6, 2018	June 19, 2018	June 19, 2018	July 13, 2018	August 13, 2018

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