



# White Paper

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## Transportation Systems Management and Operations (TSMO) Training Best Practices

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# Highlights

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- The benefits from investing in transportation systems and management (TSMO) strategies and technologies can be significant. To maximize the benefits, a diverse, well-trained workforce is required, especially as technology advancements continue to accelerate.
- Several themes emerged when investigating TSMO training best practices that can be applied to other organizations. One example includes actively engaging local universities and technical colleges that specialize in adult learning techniques to develop and deliver curriculum and training materials.
- Several TSMO training examples, categorized by professional and paraprofessional have been included to provide additional perspective on best practices.

## IN THIS WHITE PAPER YOU WILL LEARN:

1. About a variety of themes related successful TSMO training programs for professional and paraprofessional workforce.
2. About specific examples of longstanding and new TSMO Training for professional and paraprofessionals.
3. How training can be used a tool to help retain TSMO staff in very competitive marketplace.

# Introduction

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The rate of technology advancement within transportation systems management and operations area is accelerating. We are in the midst of the fourth industrial revolution, which has included development and rapid transformation of cyber-physical systems. With developments such as machine learning/artificial intelligence, cloud computing, advanced sensor technologies, edge computing, and agile software development all being applied at varying levels of transportation, how transportation agencies manage their infrastructure can benefit significantly when the right tools are used to better understand and solve problems.

With a significant influx of emerging technology into the TSMO space, transportation agencies need to adapt their workforce and associated training to get the most benefit out of its investments. Also, as the divide widens between public and private sector salaries, robust training and develop programs are an area that transportation agencies can leverage as a tool to attract and retain staff.

This white paper highlights the themes around TSMO training best practices, both at professional and paraprofessional levels. The best practices have been gathered through previous NOCoE workforce events, desktop research, conference presentations, and peer information sharing.

# TSMO Training Best Practice Themes

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Several themes related to TSMO training emerged including:

- Partner with academic institutions to develop and design curriculum. Four-year institutions for professional training development and 2-year technical colleges for paraprofessional development seems to offer the best matching of skills, abilities, and domain expertise.
- If possible, use your organization's staff to deliver training as it adds a level of commitment and credibility to the material being presented.
- Integrate training records with organization's learning management system so there is a long-term transcript of work completed.
- Immersion training is the best, but also most costly and time consuming. A combination of interactive, live, remote instructor led training with scaled back in-person immersion training seems to be the best value option.
- There is a pretty significant list of free, or low-cost online training opportunities available, but sustained awareness is limited. However, some organizations use portions of the available training as part of their on-boarding process for new staff.
- There are several examples of how multiple agencies within a region have established working groups and task forces to develop joint training as a way to reduce workforce development costs and encourage consistent practices.
- Many agencies are using training that leads to certification as way to attract and retain staff. Example certifications include Project Management Professional (PMP), Certified Public Manager (CPM), Commercial Driver's License (CDL), and International Municipal Signal Association (IMSA) Signal Technician.

## Professional TSMO Training

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### OPERATIONS ACADEMY SENIOR MANAGEMENT PROGRAM

The Operations Academy™, originally developed by the Eastern Transportation Coalition and dating back to the mid 2000's, is designed to address needs related to the growing emphasis on TSMO. It is based on total immersion in the subject of TSMO, using a mix of classroom instruction, speakers, workshops, and analysis of existing systems to ensure the retention of the principles being presented.

Acceptance for the program is competitive, and requires the nomination of a local, State or Federal transportation agency. It also requires a commitment on the part of those attending the program to satisfy the self-study requirements, and to spend one week participating in person at the Maritime Institute in Maryland and one week virtually focused on Operations Academy activities. Similar to other leadership programs, participants develop a network of life-long colleagues they can call on to discuss TSMO-related issues.

## AZTECH REGIONAL DISCUSSIONS AND TSMO TECHNICAL TRAINING

Led by the Maricopa County Department of Transportation and Arizona Department of Transportation, AZTech is a regional traffic management partnership in the Phoenix Metropolitan area that guides the application ITS technologies for managing regional traffic. The AZTech Operations Committee facilitates regional discussions on emerging topics and TSMO technical training. The goals of technical training include:

- Promote efficient, consistent, and collaborative learning opportunities
- Maintain and supporting new or upgraded technology and keeping well-informed of industry standards
- Foster staff transition, higher productivity, process improvement and challenges due to ITS and other traffic engineering positions that have varying and sometimes cross-over responsibilities
- Impart knowledge and skills through cross-functional training to foster skill redundancy support, a broader variety of competencies, and updates on advanced methods, and
- Provide opportunities for agency sharing of Lessons learned, best practices and processes

**Table 1. AZTech Regional Discussion Topics and Technical Training**

Example Regional Discussion Topics	Example Regional Technical Training
<ul style="list-style-type: none"> <li>• Agency Signal Timing Strategies</li> <li>• Automated Traffic Signal Performance Measures</li> <li>• Private Use of Agency Infrastructure for Telecommunications</li> <li>• ITS Operations Impacts Due to COVID-19</li> <li>• 3rd Party Data</li> <li>• Fiber Management</li> <li>• Wireless systems</li> <li>• ITS Cybersecurity</li> <li>• Emerging Technologies: Connected Vehicles, Work Zone Data</li> </ul>	<ul style="list-style-type: none"> <li>• Adaptive Traffic Signal Systems</li> <li>• Traffic Incident Management Emergency Responder Training</li> <li>• Traffic Signal Timing Manual</li> <li>• IT for ITS - ITS Network Essentials</li> <li>• Video Management</li> <li>• Traffic Signal Timing Software</li> <li>• ITS Cybersecurity</li> </ul>

## CONSORTIUM FOR INNOVATIVE TRANSPORTATION EDUCATION (CITE) TRAINING

Established in 1998, CITE is a unique organization of university and industry partners whose goals include improving transportation system safety and reliability through training and education. CITE's primary mission is to increase the overall number of properly educated TSMO professionals. Training courses for continuing education units are available directly through CITE and for-credit courses are available through its university partners.

CITE offers a variety of learning opportunities including:

- Blended (combination of on-line and-time web conferences with instructor)
- Self-paced Online (many are free)
- Full Semester – with a new TSMO topic every week

- Professional Development Bundles (e.g., TSMO Planning and Implementation, TSMO Project Management, Performance Measures and Management)

Examples of CITE offerings include:

- Communicating the Value of TSMO
- Capability Maturity Model: Assessing Agency Capabilities
- Data Archiving and Analytics for Planning, Operations, and Safety
- Traffic Signal Operations
- Transportation Cyber Security

## **USDOT ITS JOINT PROGRAM OFFICE PROFESSIONAL CAPACITY BUILDING PROGRAM TRAINING**

The USDOT ITS JPO, through its Professional Capacity Building Program has developed a wealth of training and awareness materials. For example, newcomers to ITS and TSMO can view papers and presentations through an ePrimer that covers a wide range of topics. For more advanced learners, ITS JPO offers classroom, blended courses, and webinars on a wide range of topics ranging from ITS standards, ITS Architecture, and TSMO. More recently, the ITS JPO has provided training and awareness on new grant opportunities available through the Bipartisan Infrastructure Law (BIL).

## **FLORIDA DOT STATEWIDE TSMO EXCELLENCE PROGRAM (STEP)**

One of FDOT's biggest challenges in delivering its TSMO Program is related to staff capacity building and associated training that provides for consistent statewide practices and remains current with the latest technology. FDOT has developed over a dozen training courses including communications network design, systems engineering, ITS construction engineering and inspection, and adaptive traffic signal control technologies.

## **WASHINGTON STATE DOT (WSDOT) PARTNERSHIP WITH REGIONAL UNIVERSITY TRANSPORTATION CENTER (UTC)**

WSDOT works closely with the Pacific Northwest Transportation Consortium, the Regional UTC based at the University of Washington, to leverage its network of partner institutions to develop training materials that are required by its staff. Examples of courses developed include human factors, Manual on Uniform Traffic Control Devices (MUTCD), and big data analysis and tools.

# **Paraprofessional Training Examples**

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## **OREGON DOT ITS TECHNICIAN TRAINING**

Oregon DOT was faced with the issue of different practices and ITS equipment being used around the state. Lack of a standardized training program made integrating new technicians difficult, relying heavily on senior technicians to properly demonstrate necessary knowledge, skills, and techniques. Regional differences in equipment and knowledge led to reduced effectiveness when technicians were sent to

other regions to fill staffing shortages. The solution included developing a needs-based training program centered on current and new equipment to expedite development of new technicians.

Senior technicians developed a matrix that identified minimum knowledge and skills requirements for new technicians. The matrix was translated into a module-based training program. The programs were rolled out using a train-the-trainer model and then presented to all staff. Once fully implemented trainers collaborate one-on-one with new technicians through on the job training using well defined sign offs to track success through the training program. Training is designed around the idea of tell/see, show, do and apply allowing new technicians to obtain signoffs on learned skills in a low-pressure environment. The initial success with this training program has prompted the development of additional training programs for key infrastructure systems.

## **NORTH CAROLINA DOT INCIDENT MANAGEMENT ASSISTANCE PATROL (IMAP) TRAINING AND CERTIFICATION**

The IMAP Responder Certification Program was developed to create consistent training for IMAP employees across the state with several goals:

- Risk Mitigation
- Interoperability
- Stronger Partnerships
- Enhanced Abilities
- Safety
- Consistency
- Program Maturation

The training program identifies universal roles and responsibilities of IMAP responders. Over the course of 5-7 weeks, Responder training includes time in the classroom, on the training track, in the TMC control room, and out on the road, all leading to live assessment and certification. Supplemental training on more advanced topics is required for Responder Supervisors.

## **AZTECH ITS & SIGNAL TECHNICIAN TASK FORCE TRAINING**

Started in 2021, the purpose was to identify and/or establish resources and trainings to support ITS and Traffic Signal Technicians and related positions to foster the knowledge, skills and abilities required to succeed in their jobs and adapt to the changing technology environment.

The Traffic Signal Curriculum is still under development. Its purpose is to provide supervisors, foremen and technical leads the tools to train staff by:

- Reinforcing International Municipal Signal Association (IMSA) and Institute of Transportation Engineers (ITE) Certifications
- Offering “Training the Trainer” Sessions Through Workshops
- Providing a “Living Desk Manual”

- Exploring Other Training Opportunities

The traffic signal curriculum is also intended to support and reinforce the application of uniform and consistent practices across jurisdictions throughout the Phoenix Metropolitan Area. Curriculum topics identified for potential inclusion include:

- Phasing assignments
- Ring, barriers, and sequences
- Phase timing intervals and parameters
- Traffic signal cabinet enter and intersection layouts
- Controller types and functionality
- Overlaps

cDetection

- Emergency vehicle preemption
- Ethernet configuration and networks
- Manual on Uniform Traffic Control Devices (MUTCD)
- Coordination/progression concepts
- ATSPMs

## **WASHTENAW COMMUNITY COLLEGE (WCC) EMERGING NEEDS COURSE DEVELOPMENT**

WCC has developed a variety of credit and non-credit courses in anticipation of emerging technologies:

- As part of the University of Michigan Center for Connected and Automated Transportation grant funded by the USDOT, WCC has developed non-credit on-demand online training for Data Analyst Technicians. The training is being offered through global online for-profit providers to deliver Data Analytics Technician training for new hires and incumbent workers.
- WCC offers Fiber Optics training approved for certification by the Fiber Optics Association (FOA) and USDOL to both new hires and incumbent workers.
- WCC has developed and delivered for-credit courses on automotive cyber-security and networking.

## **Summary**

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An important part of creating new pipelines for TSMO workers is building partnerships with groups historically overlooked in the recruiting and hiring process. Agencies need to become familiar with the KSAs offered by each group, what their needs and expectations might be, and the best way to communicate with and recruit from each group. This is done most effectively by building relationships and sharing information about opportunities and needs. Partnerships can be formal or informal and lay the foundation for opening each potential pipeline.

# Resources

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1. Operations Academy Senior Management Program website, [About the Academy](#).
2. NOCoE Workforce Development Peer Exchange AZTech Presentation, May 24-26, 2022.
3. NOCoE Workforce Development Peer Exchange Washtenaw Community College (WCC) Success Stories, May 24-26, 2022.
4. Consortium for Innovative Transportation Education (CITE) website, [Courses](#).
5. USDOT ITS Joint Program Office Professional Capacity Building Program website, [Course Catalog](#).
6. NOCoE Webinar: Best Practices for TSMO Training Programs at all Levels of the Workforce, December 9, 2020.
7. IMAP Program Assessment-Position Evaluation, North Carolina DOT, February 2021
8. NOCoE Workforce Development Peer Exchange Oregon DOT Success Stories, May 24-26, 2022.