



CENTRAL FLORIDA TSM&O CONSORTIUM MEETING SUMMARY

Meeting Date: October 24, 2024 (Thursday) **Time:** 10:00 AM – 12:00 PM

Subject: TSM&O Consortium Meeting

Meeting Location: FDOT District Five RTMC (4975 Wilson Rd., Sanford, FL 32771) and Teleconference

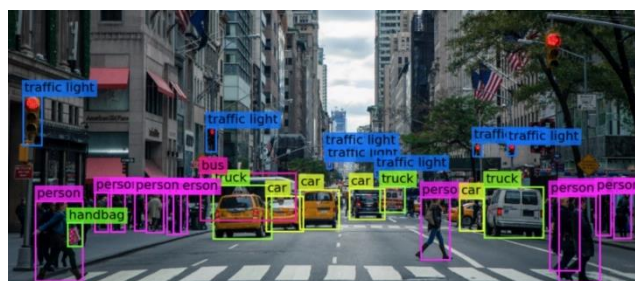
I. OVERVIEW

The purpose of this recurring meeting is to provide an opportunity for District Five FDOT staff and local/regional agency partners to collaborate on the state of the TSM&O Program and ongoing efforts in Central Florida. Jeremy Dilmore gave a short introduction and outlined the meeting agenda.

II. AI-ENABLED CAPABILITY MATURITY MODEL WORKSHOP – RECAP

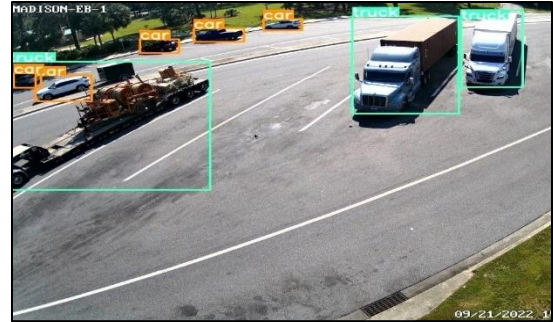
David Williams and Jeremy Dilmore briefly discussed the AI Capability Maturity Model (CMM) Workshop held on August 29, 2024.

- Goals of the AI-enabled ITS Capability Maturity Model Workshop
 - Increase general understanding and awareness of AI in transportation
 - Examine AI-related projects in Central Florida
 - Examine AI policies at FDOT and across the region
 - Establish baseline for the AI-enabled ITS CMM
 - Determine next steps for the region based on CMM/survey results
- Definition of Artificial Intelligence (AI)
 - “the theory and development of computer systems able to perform tasks that normally require human intelligence, such as visual perception, speech recognition, decision-making, and translation between languages”
- David walked through several helpful resources, including natural language processors (NLP) like ChatGPT, as well as YouTube, basic web searches, and online courses
- Common uses for AI (across industries)
 - NLP
 - Translation
 - Code Development
 - Time Series Analysis
 - Computer Vision
- Key Insights
 - Size of the training dataset is very important



- NLPs utilize billions of records and data points
 - For activities like signal retiming, we've only conducted thousands of retimings (multiple magnitudes smaller)
 - Not a large enough dataset
 - Correct labeling is very important
 - Conditions and edge cases matter
 - Results are not deterministic
 - Logic behind AI decision is often unclear
 - It can be hard to determine why AI logic did something wrong
- FDOT AI Policies
 - Human in the loop
 - Supplement/Complement work that is primarily performed by human
 - Humans fully responsible for work and products involving AI
 - Transparency and Accountability
 - AI systems and decision-making processes must be transparent and disclose if products are generated partially/fully by an AI tool
 - Ethics
 - AI systems and decision-making processes must be ethical and comply with all applicable laws, rules, regulations, and policies
 - Privacy and Data Protection
 - AI systems must protect people's privacy and comply with all applicable data protection regulations
 - AI data and outputs must be validated by humans to ensure AI data and outputs are free of personally identifiable information (PII), copyright infringement, and other legal challenges
 - AI systems must protect information that is exempt from public disclosure pursuant to Florida's public records laws
 - Security
 - Employees, vendors, consultants, and contractors are prohibited from attempting to gain access to AI applications not approved by the Department when using Department's systems, networks, computers, phones, or other communication devices, when conducting business under contract for the Department, when using the Department's data
- AI Policies around Central Florida
 - "Elegant Follower" approach; interested in how other agencies will handle AI policies
 - Some AI policies in the works, but lingering questions include:
 - How deep do we go into operational aspects in AI policy?
 - Can FDOT take on a bigger role in crafting a policy?
 - How do we assess risk in applying AI to transportation tasks or issues?
 - How do we use AI in service to our citizens?
 - What if agencies' policies don't comport with one another?
 - Have typically defaulted to the more stringent policy (similar to cybersecurity)

- Some local agencies suggested *GovAI Coalition* as a potential resource for developing AI policy (for all sectors)
 - AI Policy and AI Policy Manual
 - AI Incident Response Plan
 - AI Factsheet
 - Vendor Agreement
 - Use Case Template
 - Vendor Registry
- AI Use Cases within DOTs
 - Computer Vision (data gathering, traffic alerts)
 - Time series (data cleaning, data completion, modeling/prediction/management)
 - Signal Timing Optimization
 - Predictive Maintenance
- Ongoing Activities
 - Crash Prediction / Detection
 - Traffic Unification System Highlighting Arterial Roads (TUSHAR)
 - Goals and objectives: improve incident response times by using ATSPM and/or probe data
 - Outputs and outcomes: detected crash locations appear as icons on a map; used by arterial operators along with travel speeds. Information is then confirmed by CCTV. Working to integrate into SunGuide as a TSS alert for arterial operators
 - UCF Crash Probability on the interstate from MVDS data (ATTAIN Phase IV)
 - Goals and objectives: Reduce response time. Predict crashes and focus operator attention to these areas
 - Outputs and outcomes: software integration to SunGuide in process; not complete
 - Computer Vision
 - PedSafe Phase II
 - Goals and objectives: Improvement in pedestrian safety. Provide DEP with surrogate CV data
 - Osceola County TAPS-LA Project
 - Goals and objectives: provide DEP with surrogate CV data. Safety recommendations.
 - Digital Analytics Notification for Incident and Event Localization (DANIEL)
 - Goals and objectives: stopped vehicle, wrong way driving (WWD), volume, etc.
 - Data Correction
 - High-definition Engineering Intersection Data via Integrative Modeling (HEIDI)
 - Goals and objectives: improve data quality
 - Outputs and outcomes: improved volume and speed for arterials
 - Research



- ATTAIn Phase III – Intersection Signal Prediction and Corridor Traffic Management Based on Big Data Analytics and Cutting Edge Technologies
 - Goals and objectives: determine feasibility of implementing CV for bike/ped detection
 - Outputs and outcomes: requires specific views. Assumptions when implementing for timing are required. Still work in progress.
- Pragmatic Multi-Objective Planning Approach for Medium and Long-Range Projects
 - Goals and objectives: reduce burden of modeling recalibration by integrating prediction from time series analysis of ATSPM data and socioeconomic data
 - Outputs and outcomes: successful prediction for years with data. Looking to move forward a more extensive prediction and connect to planning process
- Pedestrian Upfront LiDAR-based Safety on Edge (PULSE)
 - Goals and objectives: similar to SunGuide, having our own algorithm for LiDAR interpretation
 - Outputs and outcomes: marginal success with training system; looking to expand
- Machine Learning Algorithms for Improved Network Traffic Signal Policy Optimization
 - Goals and objectives: signal timing via AI
 - Outputs and outcomes: suggested plans implemented in the field by hand; led to degraded operations. Suspended further work
- AI-Enabled ITS Capability Maturity Model (CMM)
 - CMM is a process improvement plan that helps stakeholders identify institutional and technical deficiencies at agency and/or regional level
 - Recent CMMs: TSM&O, CAV, Signal Management, Traffic Analysis
 - Central Florida TSM&O Consortium completed CMMs in 2014, 2017, and 2020
 - Standard CMM Dimensions: Business Processes, Organization & Workforce, Culture, Collaboration, Systems & Technology, and Performance Management
 - Scoring from 1.0 (lowest) to 4.0 (highest)
 - AI-Enabled CMM was developed on behalf of USDOT ITS-JPO but the project team (FIU, TrustThink, and Leidos)
 - Enables CMM respondents to identify target CMM scores and determine action plan to achieve those targets

- o Comprised of 7 dimensions and 35 subdimensions

Dimensions	Business and Relationship Dimensions				Technical Dimensions		
	Culture and Organization	Collaboration	Business Processes	Cybersecurity	AI Data and Infrastructure	AI Models and Applications	AI Integration and Operations
Subdimensions	Knowledge, Skills, and Abilities	Peer Cooperation	Business Case and Performance	Threat Awareness	Data Governance	Discovery and Understanding	Requirements Management
	Sponsorship and Leadership	Building Partnerships	Strategy, Policy, and Roadmapping	Scenario Planning	Data Selection and Sources	Model Development	System Design
	Value, Expectation, and Risk	Roles and Responsibilities	Budgeting for AI	Posture and Hygiene	Data Acquisition and Transmission	Model Evaluation	System Integration
	Fostering Innovation	Intra-agency Collaboration	Privacy and Trust	Infrastructure Protection	Data Quality Assurance	Application Deployment	Test and Evaluation
	Ethics and Equity	Effective Data Sharing	Process Transformation	Information Assurance	Data Storage and Curation	Human-AI Interactions	System Launch
	Organizational Structure	Use Case Alignment	Procurement	Resiliency and Recoverability	Data Processing and Enrichment	Application Performance Measures	Operational Feedback

- o Workshop attendees took an in-person survey to identify how the region is performing across the 7 main dimensions
 - Culture and Organization – 1.61 score
 - Collaboration – 1.54 score
 - Business Process – 1.41 score
 - Cybersecurity – 2.46 score
 - AI Data and Infrastructure – 1.54 score
 - AI Models and Applications – 1.39 score
 - AI Integration and Operations – 1.21 score
- o Following the AI workshop, attendees were sent a short survey to identify key ITS CMM activities among the six lowest scoring CMM dimensions to determine the region’s 10 objectives and tasks to prioritize. Below are the tasks given the most votes for prioritization:
 - *The role, value, limitations, risks, and budget related to AI is understood internally*
 - Workforce, Culture, Org – 67% of respondents selected this objective
 - *Staff program is established for Development/Training/Recruitment/Retention of AI-related KSAs*
 - Workforce, Culture, Org – 58%
 - *Allocates annual budget for AI-enabled ITS according to developed action plan and roadmap for AI, data management, and data governance*
 - Business Processes – 58%
 - *AI Championship/Leadership building process*
 - Workforce, Culture, Org – 50%
 - *There are established procedures, applications, agreements between partner agencies and private sector data providers, as needed*
 - Collaboration – 50%

- *AI-enabled ITS use cases selected with consideration of objectives, performance measures, performance targets, and initiatives of all units and at all levels*
 - Collaboration – 50%

III. COMMUNICATING TSM&O RESOURCES

David Williams gave a brief presentation on a variety of resources published by FHWA to help champions and practitioners communicate TSM&O concepts and goals to external stakeholders.

- Range of materials include factsheets, PPT presentations, Frequently Asked Questions (FAQ), and Testimonials
- https://ops.fhwa.dot.gov/plan4ops/focus_areas/communicating_tsmo.htm
- Factsheets describe how TSM&O can integrate with or support other disciplines, such as IT, Design, Environment, HR, Maintenance, Safety, Performance Management, and Construction

The collage consists of three documents from the FHWA:

- Left Document:** Titled "CONSTRUCTION ENHANCING TRANSPORTATION: CONNECTING TSMO AND CONSTRUCTION". It discusses how existing infrastructure ages and demand for travel increases, leading to network disruptions. It lists strategies like providing road users with "up front" information, improving traffic flow through dynamic management, and assisting construction crews.
- Middle Document:** Titled "WHAT IS TSMO?". It defines TSMO as the use of strategies, technologies, mobility services, and programs to optimize safety, mobility, and reliability. It lists various operational issues it addresses, such as bad weather, congestion, and crashes.
- Right Document:** Titled "ENHANCING TRANSPORTATION: CONNECTING TSMO AND CONSTRUCTION". It provides a detailed list of strategies:
 - ITS SYSTEMS IN CONSTRUCTION:** Includes strategies like using ITS for construction management, remote monitoring, and dynamic lane merging.
 - MANAGING WORK ZONES FOR SAFETY, MOBILITY, AND EFFICIENCY:** Lists strategies such as accelerated construction methods, TMCs for monitoring, and traffic incident management (TIM).
 - HOW HAS THIS WORKED IN PRACTICE?:** Cites examples from the Texas Department of Transportation (DOT), Minnesota DOT, and the Transportation Operations Coordinating Committee (TRANSCOM).

- Presentations unpack concepts for TSM&O champions to communicate more effectively to external stakeholders
 - PPT files can be downloaded and modified to suit user’s needs

IV. ONLINE TRAINING OPPORTUNITIES

David Williams briefly discussed several training opportunities available online for stakeholders.

- TSM&O Focused Learning Education & Experience (FLEX) Portal

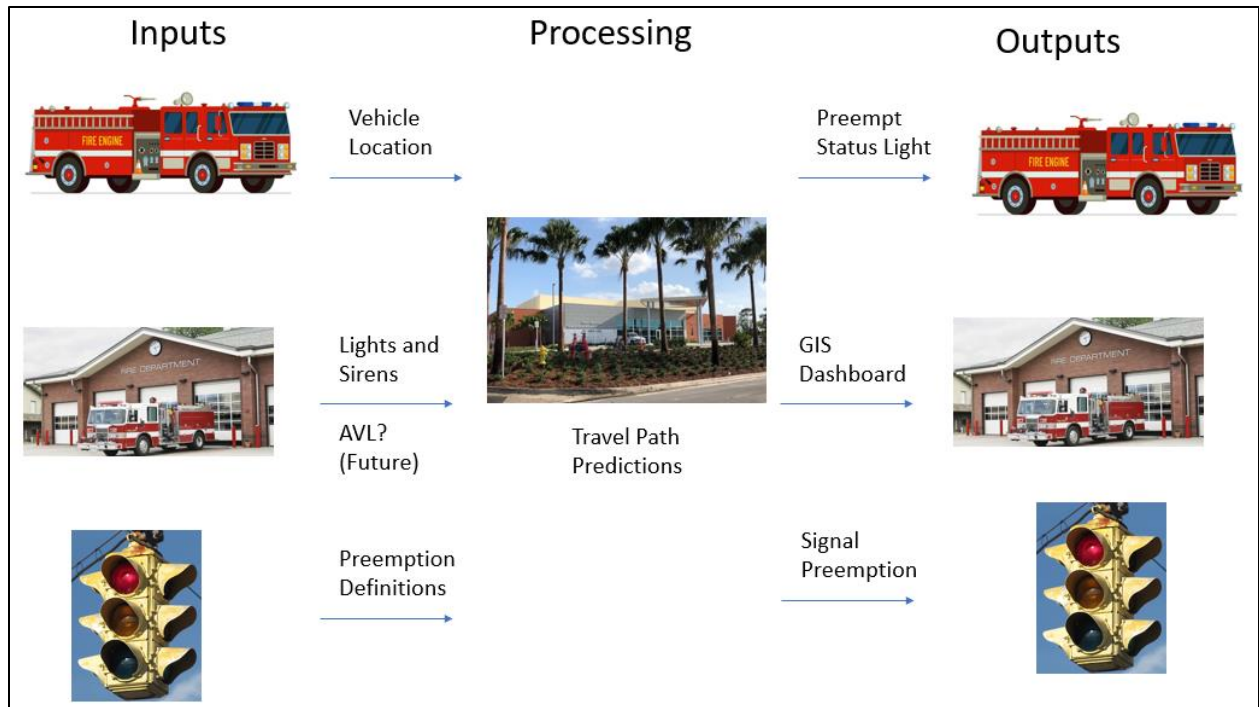
- Available at <https://elearning.cflsmartroads.com/>
- Trainings cover a variety of topics
 - TSM&O concepts (e.g., Intro to Systems Engineering)
 - TSM&O applications (e.g., MIMS Training)
 - Field Equipment (e.g., BlueToad, RSU, etc.)
 - How-to training videos (e.g., Setting Up ATSPM Zones on Iteris CCU)
- FLEX Portal is available with a free account
- Now has Transcript tracking so users and managers can track progress of users
- National Highway Institute (NHI) Courses
 - The NHI has established a learning platform covering a large variety of in-depth courses, including several related to Traffic Operations and TSM&O
 - Planning for TSM&O – Intro
 - Planning for TSM&O – Concepts and Applications
 - Multiple ITS courses (procurement, types of devices, Systems Engineering, etc.)
 - Transportation Cybersecurity
 - Available at fhwanhi.geniussis.com/PublicWelcome.aspx
 - Sign in using the “Alternate Login” option



V. CONNECTED VEHICLES AND THIRD-PARTY CONNECTIVITY

Anne Allan and briefly discussed a pilot deployment to improve preemption connectivity for emergency vehicles.

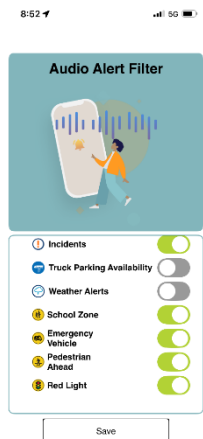
- Pilot project is underway with the Seminole County Fire Department (SCFD) fleet to enable emergency vehicle preemption without using Opticom or Connected Vehicle messaging



- The system uses vehicle GPS data and activated sirens to alert nearby traffic signals for preemption
 - A small light is included in the cab of the firetruck to indicate preemption has been given
- All signals with connectivity to the RTMC could potentially use this system
 - Requires no additional hardware
- Still finetuning business rules for when to activate/deactivate
 - Have been coordinating with SCFD to develop these business rules
- This is not CV2X/5.9ghz; this is cellular/GPS
- As we see success with this system, we will look into how we might expand

Katie King provided updates on the FL511 CV Smartphone project.

- Goals
 - Fill the gap as OEMs work to increase penetration rate for CV technology
 - Provide safety-related TIM messages to the public using smartphones
 - Statewide software working together leveraging each others' efforts into a singular solution for FDOT (FL511, DIVAS, SunGuide, V2X DEP)
- **FL511 CV is now in production**, available on iOS and Android
- Features
 - Audible Drive Mode Alert Filters
 - Travel Safely applications included in the SDK
 - Images have been disabled; only audible available
 - School Zone, Emergency Vehicle Ahead, Ped Ahead, Red Light ahead



- BSM Input/Output
- Route and Mode Choide
 - Specific to D5 area

VI. FLASH AWARD

Kevin Marquez (FDOT) gave a brief presentation of FDOT's FLASH Award to Orlando Traffic Operations team members.

- On July 10, 2023 the City team found severe corrosion and section loss in the upright of the mast arm in the SE corner of SR 526 / Rosalind Ave
- Emergency Response
 - Identified corrosion during routine inspection on July 10
 - On July 11, City staff met with FDOT Structures Maintenance; FDOT requested to remove mast arm
 - Mast arm replacement completed overnight and by noon on July 12, the signal was back up
- Key successes
 - Reliable contractor available 24/7
 - Team expertise in identifying and prioritizing maintenance issues
 - Training staff to communicate and lead contractor
 - Save and store mast arms if they are in good shape; don't scrap everything during replacement projects
 - Mast arm came from an I-4 Ultimate replacement location
 - Have a place to store materials
 - Key staff involved: Steven Jons (Traffic Operations Manager) and John Falango (Traffic Signal Chief)

VII. CURRENT INITIATIVES

Jeremy Dilmore briefly provided an update on the current work efforts throughout District Five.

- Annual Maintenance meeting will be November 19, from 8am to 12pm at the RTMC
- PedSafe Phase II
 - Executed with UCF a research effort relating to the ped countdown that is currently in right-to-experiment review
- High-Definition Engineering Intersection Data via Integrative Modeling (HEIDI)
 - Not currently in production, but getting some results to review shortly
- Digital Analytics Notification for Incident and Event Localization (DANIEL)
 - Has detected stopped vehicles effectively

VIII. NEXT MEETING

- December 12, 2024

IX. ATTACHMENTS

- A – Presentation Slides
- B – Meeting agenda

END OF SUMMARY

This summary was prepared by David Williams and is provided as a summary (not verbatim) for use by the Consortium Members. The comments do not reflect FDOT's concurrence. Please review and send comments via e-mail to david.williams2@dot.state.fl.us so the meeting summary can be finalized.

Welcome to the TSM&O Consortium Meeting October 24, 2024



Meeting Agenda

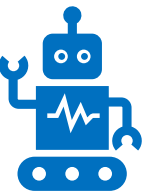
1. AI Capability Maturity Model Workshop – Recap
2. *Communicating TSM&O* Resources
3. Online Training Opportunities
4. Connected Vehicles and Third-Party Connectivity
5. Hurricane Season – Discussion
6. FLASH Award for Emergency Repairs – City of Orlando
7. Current Initiatives



AI-enabled ITS Capability Maturity Model Workshop

David Williams, VHB

AI-enabled ITS CMM Workshop



- Goals of the AI-enabled ITS CMM Workshop
 - Increase general understanding and awareness of AI in Transportation
 - Examine AI-related projects in Central Florida
 - Examine AI policies at FDOT and across the region
 - Establish baseline for the AI-enabled ITS Capability Maturity Model
 - Determine next steps for the region based on CMM/survey results


Artificial Intelligence Defined

“the theory and development of computer systems able to perform tasks that normally require human intelligence, such as visual perception, speech recognition, decision-making, and translation between languages”

Some Helpful Resources

- Web Search
- YouTube
- NLPs
- Online Courses

explain artificial intelligence

 Artificial intelligence (AI) refers to the simulation of human intelligence in machines that are designed to think and learn like humans. It involves the development of algorithms and models that enable computers to perform tasks that typically require human intelligence, such as understanding natural language, recognizing patterns, solving problems, and making decisions.

AI can be categorized into two main types:

1. **Narrow AI:** This type is designed to perform a specific task, such as voice recognition or image classification. Most of the AI applications we encounter today, like virtual assistants and recommendation systems, fall into this category.
2. **General AI:** This theoretical type would possess the ability to understand, learn, and apply intelligence across a wide range of tasks, similar to a human. General AI remains largely a concept and has not yet been achieved.

AI utilizes various techniques, including:

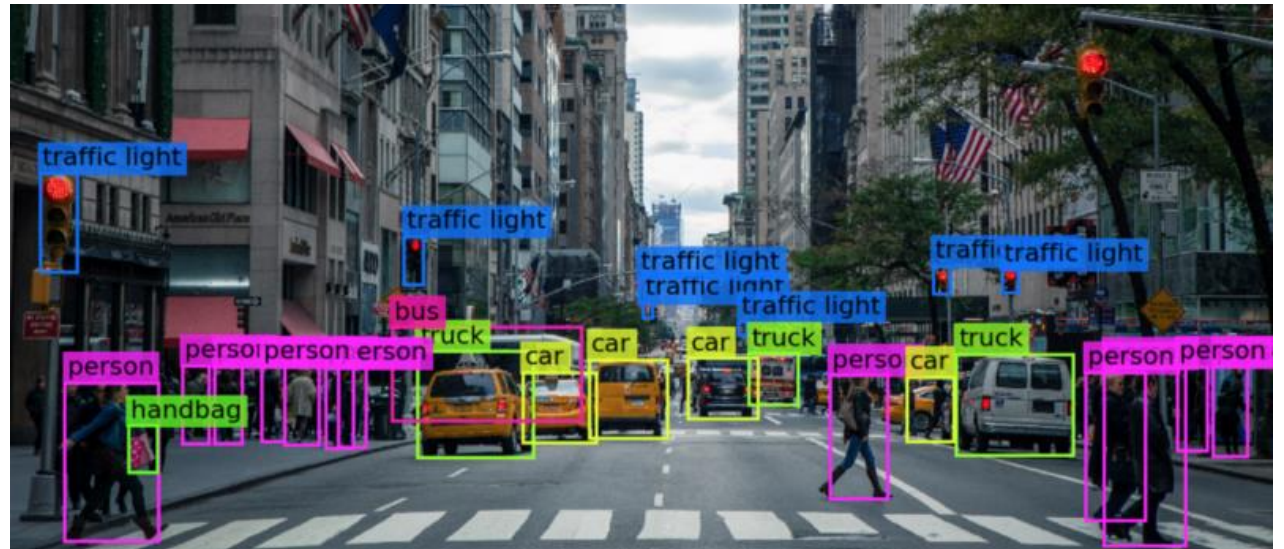
- **Machine Learning (ML):** A subset of AI where systems learn from data to improve their performance over time without being explicitly programmed for each task.
- **Deep Learning:** A more advanced form of machine learning that uses neural networks with many layers to analyze complex data patterns.
- **Natural Language Processing (NLP):** This enables machines to understand and generate human language, facilitating interactions with users.

Don't share sensitive info. Chats may be reviewed and used to train our models. [Learn more](#)

Message ChatGPT

Common Uses for AI (across industries)

- Natural Language Processing
- Translation
- Code Development
- Time Series Analysis
- Computer Vision



Key Insights

- Size of the training dataset is very important
- Correct labelling is very important
- Conditions and Edge Cases matter
- Results are not deterministic
- Logic behind decision likely unclear

Human in the Loop



AI must supplement or complement the work that is primarily accomplished by a human.

AI usage must engage humans throughout the process, with human involvement in reviews and decisions.

Humans are fully responsible for the work and products involving AI.

Transparency and Accountability



AI systems and decision-making processes must be transparent and disclose if the products are generated partially or fully by an AI tool.

Ethics

AI systems and decision-making processes must be ethical and comply with all applicable laws, rules, regulations, and policies.



Privacy & Data Protection

AI systems must protect people's privacy and comply with all applicable data protection regulations.

AI data and the output from all AI-related models must be validated by humans to ensure AI data and its output are free of personally identifiable information and to prevent copyright infringement and other legal challenges.

AI systems must protect information that is exempt from public disclosure pursuant to Florida's public records laws, and must comply with all applicable data protection laws, rules, regulations, and policies.



Security



To ensure the quality and the security of the Department's data and IT systems, employees, vendors, consultants, and contractors are prohibited from attempting to gain access to AI applications not approved by the Department when using Department's systems, networks, computers, phones, or other communication devices, when conducting business under contract for the Department, or when using the Department's data.

AI Policies around Central Florida

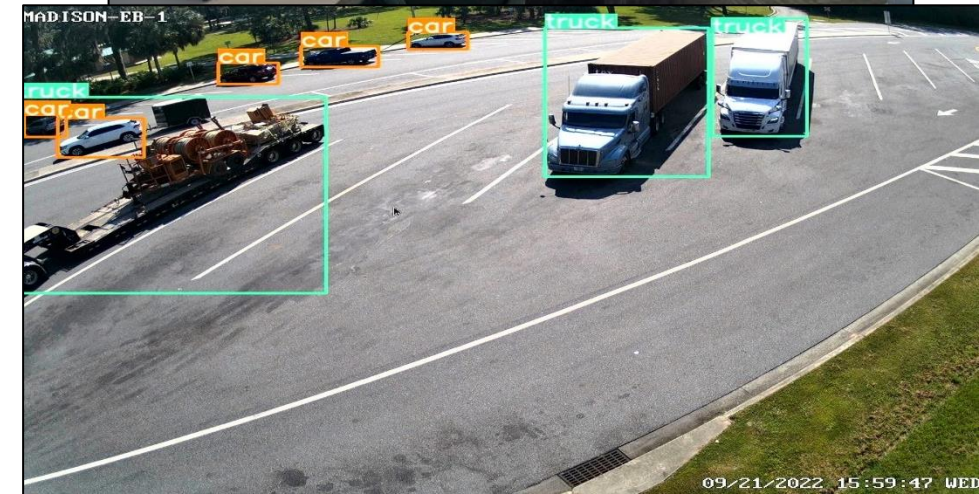
- “Elegant Follower” approach
- Some AI policies in the works; lingering questions include:
 - How deep do we go into operational aspects in AI policy?
 - Can FDOT take on a bigger role in crafting a policy?
 - How do we assess risk in applying AI to transportation tasks or issues?
 - How do we use AI in service to our citizens?
 - What if agencies’ policies don’t comport with one another?

AI Policies around Central Florida

- Local Agency identified *GovAI Coalition* as a potential resource for developing AI policy (all sectors)
 - AI Policy and AI Policy Manual
 - AI Incident Response Plan
 - AI Factsheet
 - Vendor Agreement
 - Use Case Template
 - Vendor registry

Transportation Use Cases within DOTs

- Computer Vision
 - Data gathering
 - Traffic Control
- Time Series
 - Data cleaning
 - Data completion
 - Modelling/Prediction/Management
- Signal Timing Optimization
- Predictive Maintenance



Crash Prediction/Detection

TUSHAR – UF Research for ATSPM interruptions into arterial incident detection

- Title: Traffic Unification System Highlighting Arterial Roads
- Goal and objectives: Improve incident response time by using ATSPM and/or probe data.
- Where is this research implemented: D5 RTMC dashboard
- Outputs and outcomes: Detected crash locations appear as icons on a map, use by arterial operators along with travel speeds. Information is then confirmed by CCTV. Working to integrate into SunGuide as a TSS alert for arterial operators.
- Equipment deployed: Not needed. Software-based solution.

UCF Crash probability on the interstate from MVDS data

- Title: Expanding the Real-Time safety System to include I-4 Ultimate, I75 and I-95, Conflict Analysis and System Migration (ATTAIN Phase IV)
- Goal and objectives: Reduce response time. Predict crashes and focus operator attention to these areas.
- Where is this research implemented: Not complete
- Outputs and outcomes: Software integration to SunGuide in process. Not complete.
- Equipment deployed: None needed. Software-based solution.

Computer Vision

PedSafe Phase 2 – purchasing COTS computer vision (DERQ); under construction

- Title: PedSafe Phase II
- Goal and objectives: Improvement in pedestrian safety. Provide DEP with surrogate CV data. AI in this case captures data for analysis on surrogate safety measures and is running in parallel with APL approved detection devices to see its suitability in this role.
- Project location: OBT Holden to I-4
- Equipment deployed: Not needed. Software-based solution.

Osceola County – TAPS-LA project (DERQ); fully implemented

- Title: Osceola County TAPS-LA
- Goal and objectives: Provide DEP with surrogate CV data. Safety recommendations
- Project location: US 192 and Old Wilson, I-4 and 532, US 17 and Poinciana, JYP and Donegan, 192 and Hoagland, 192 and Entry Point Blvd, 192 and JYP, 192 and Black Lake
- Equipment deployed: Not needed. Software-based solution.

DANIEL – 250 CCTV; Selected and being implemented

- Title: DANIEL (Digital Analytics Notification for Incident and Event Localization)
- Goal and objectives: Stopped Vehicle, WWD, Volume, etc
- Project location: District 5
- Equipment deployed: Not needed. Software-based solution.

Data Correction

HEIDI – data correction of volumes and speeds for ICMS

- Title: High-definition Engineering Intersection Data via Integrative modeling
- Goal and objectives: Improve data quality
- Where is this research implemented: Being implemented in D5 TMC
- Outputs and outcomes: Improved volume and speed for arterials
- Equipment deployed: Not needed. Software-based solution

Research I

Computer Vision for ped movements/actuation – both UCF and UF

- Title: Phase III - ATTAIN: Intersection Signal Prediction and Corridor Traffic Management Based on Big-Data Analytics and Cutting-Edge Technologies
- Goal and objectives: Look at feasibility for implementing computer vision for ped and bike detection
- Outputs and outcome: Requires specific views. Changes on shared ramps. Assumptions when implementing for timings are required. Still work in progress.

Generation of time series prediction of volumes for CMP

- Title: Pragmatic Multi-Objective Planning Approach for Medium and Long-Range Projects
- Goal and objectives: Reduce the burden of modeling recalibration by integrating prediction from time series analysis of ATSPM data and socioeconomic data
- Outputs and outcome: Successful prediction for years with data. Looking to move forward a more extensive prediction and connect to planning process.

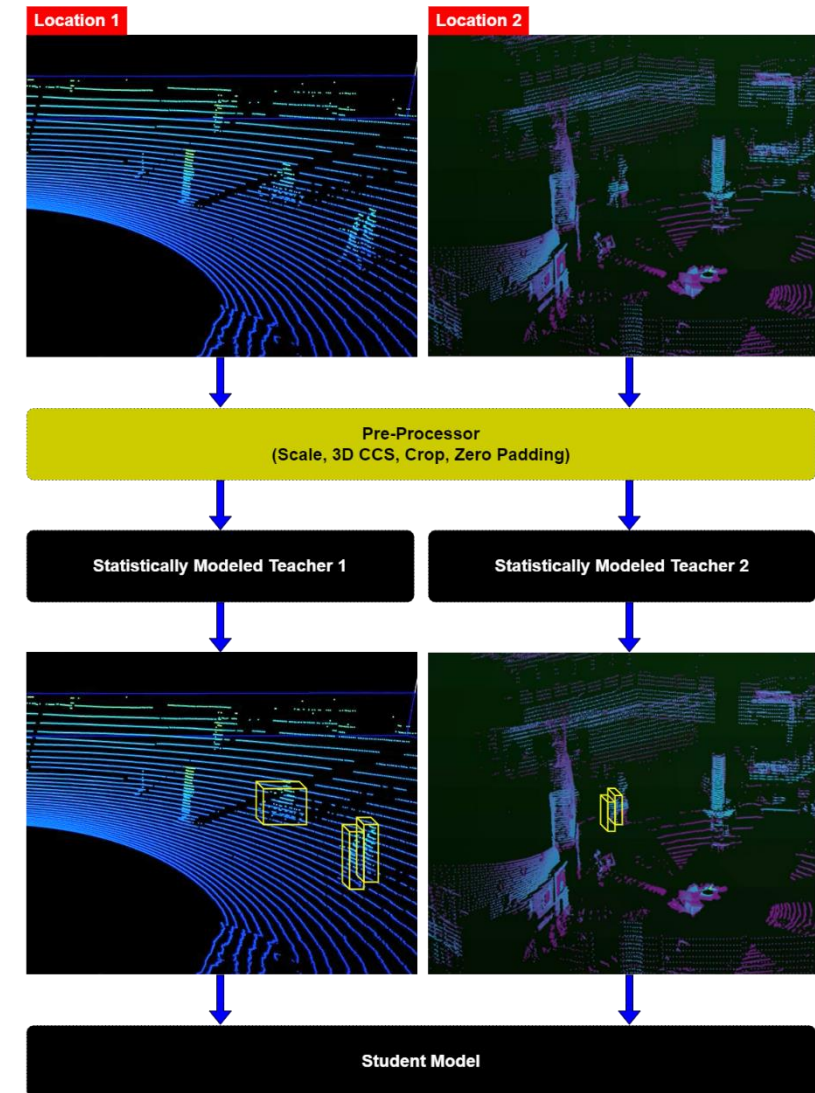
Research II

Generation of generalized interpretation software for LiDAR point cloud data for ped bike

- Title: Pedestrian Upfront LiDAR-based Safety on Edge
- Goal and objectives: Similar to SunGuide, having our own algorithm for LiDAR interpretation. Allowing hardware to become a commodity. If not, then learn about issue with LiDAR based vision products
- Outputs and outcome: Marginal success with training system. Looking to expand

Signal optimization – (FYI it did not end in success)

- Title: Machine Learning Algorithms for Improved Network Traffic Signal Policy Optimization
- Goal and objectives: Signal Timing via AI
- Outputs and outcome: Suggested plans implemented in the field by hand. Degraded operations. Suspended further work



Other District Applications

RADISH: Research on Artificial-Intelligence for Data Integration with State Highways

- University of Florida
- The goal of this project is to improve mobility and safety using data analytics and artificial intelligence applied in active traffic management for arterial freeway interactions. We will develop an integrated system that uses data collected from videos, RSUs and loop detectors and other sensors for this purpose. Using machine learning and artificial intelligence, we will develop techniques that will support real-time traffic management. The system to be developed can be expanded to other locations across Florida.

Application of Dynamic Crash Prediction Methodologies to FDOT Safety and TSM&O Programs

- CUTR, FIU and Gannett Fleming
- Pilot study aims to test and evaluate dynamic crash prediction systems in Florida's roadway environment.
- Objectives of the pilot study include:
 - Identify data needs for implementation of dynamic crash prediction, including sources, items, format, and connection.
 - Determine actions to reduce potential crash risk after receiving alerts from the prediction systems and identify local agencies that will need to be involved in the actions.
 - Evaluate the effectiveness of the crash prediction systems, including prediction performance, benefits, and usability.
 - Assess the integration of the prediction systems with existing Traffic Management Center (TMC) systems (e.g., SunGuide software).
 - Establish guidelines to implement dynamic crash prediction in Florida based on the information above.

Capability Maturity Model (CMM)

- Process improvement plan
- Helps stakeholders identify institutional and technical deficiencies at agency and/or regional level
- Recent CMMs: TSMO, CAV, Signal Management, Traffic Analysis
- Central Florida TSM&O Consortium
 - TSM&O CMM in 2014, 2017, 2020, and[★]2024[★]

Capability Maturity Model (CMM)

- Standard CMM “Dimensions”
 - Business Processes
 - Organization & Workforce
 - Culture
 - Collaboration
 - Systems & Technology
 - Performance Measurement

Capability based on scoring from 1.0 (lowest) to 4.0 (highest)

Capability Maturity Model (CMM)

- Standard CMM “Dimensions”

Regional Self-Assessment
December 2020

- Business Processes 2.80
- Organization & Workforce 2.53
- Culture 2.77
- Collaboration 2.97
- Systems & Technology 2.70
- Performance Measurement 2.57

★ Will conduct a TSMO CMM self-assessment in November/December 2024 ★

AI-enabled ITS CMM

- Developed on behalf of USDOT ITS-JPO
- Project team includes
 - Florida International University (FIU)
 - Dr. Mohammed Hadi, Co-PI
 - TrustThink
 - Brandon Freeman, Co-PI
 - Leidos
 - David Hale, Contracting PM
- Once complete, CMM respondents can identify target CMM scores and determine action plan to achieve those targets

AI-enabled ITS Applications

❖ Regional System Management

- 1) Asset condition monitoring
- 2) Weather prediction and response
- 3) Incident detection and response
- 4) WZ safety and information dissemination
- 5) Data fusion in transportation management centers
- 6) Port operations and planning

❖ Underserved Communities

- 1) AI-enabled routing and wayfinding for pedestrians
- 2) Navigation apps with AR and localized points of interest
- 3) AI interpretation of user input
- 4) Environmental mapping and guidance
- 5) AI-enabled payment assistance
- 6) AI-powered safety monitoring and alerts
- 7) VR for testing
- 8) AI-powered assistive robots

❖ Rural Freeway Corridor

- 1) Crash and Emergency detection
- 2) Wildlife detection
- 3) Emergency planning
- 4) Road-weather management
- 5) Safe asset health inspections
- 6) Predictive asset maintenance
- 7) WZ management
- 8) Smart Truck Parking Information Systems
- 9) Distracted Driver Behavior Detection
- 10) Freight Traveler Information
- 11) Decision Support System

AI-enabled ITS Applications

❖ Urban Arterial Network

- 1) Traffic signal coord. plan optimization
- 2) Real-time traffic signal optimization
- 3) Traffic signal decision support subsystem
- 4) Misbehavior detection system
- 5) Comprehensive traffic modeling
- 6) Pedestrian, Cyclist, Micro-mobility detection
- 7) Safety Metrics Assessment
- 8) TSP optimization
- 9) Demand response transit network optimization
- 10) Identification of unauthorized bus lane usage

❖ Urban Multimodal Corridor

- 1) Interagency collaboration
- 2) Detection of multimodal failures and incidents
- 3) Prediction of multimodal corridor delays
- 4) Personalized dissemination of multimodal travel information
- 5) Multimodal corridor demand management
- 6) Integrated payment for multimodal corridor
- 7) Real-time demand responsive traffic management and control

❖ Remote Sensing

- 1) Remote Asset Management and Condition Analysis
- 2) Remote Incident and Disaster Assessment
- 3) Remote Traffic Analysis
- 4) Remote Roadway Infrastructure Survey and Data Acquisition
- 5) Remote Situational Awareness and Decision Support

AI-enabled ITS CMM

Dimensions	Business and Relationship Dimensions				Technical Dimensions		
	Culture and Organization	Collaboration	Business Processes	Cybersecurity	AI Data and Infrastructure	AI Models and Applications	AI Integration and Operations
Subdimensions	Knowledge, Skills, and Abilities	Peer Cooperation	Business Case and Performance	Threat Awareness	Data Governance	Discovery and Understanding	Requirements Management
	Sponsorship and Leadership	Building Partnerships	Strategy, Policy, and Roadmapping	Scenario Planning	Data Selection and Sources	Model Development	System Design
	Value, Expectation, and Risk	Roles and Responsibilities	Budgeting for AI	Posture and Hygiene	Data Acquisition and Transmission	Model Evaluation	System Integration
	Fostering Innovation	Intra-agency Collaboration	Privacy and Trust	Infrastructure Protection	Data Quality Assurance	Application Deployment	Test and Evaluation
	Ethics and Equity	Effective Data Sharing	Process Transformation	Information Assurance	Data Storage and Curation	Human-AI Interactions	System Launch
	Organizational Structure	Use Case Alignment	Procurement	Resiliency and Recoverability	Data Processing and Enrichment	Application Performance Measures	Operational Feedback

Level 4 – Systematic
Level 3 – Operational
Level 2 – Readiness
Level 1 – Exploration

AI-enabled ITS CMM

Table 21. High-Level CMM Assessment – Cybersecurity: Scenario Planning

Cybersecurity: Scenario Planning	
Level	High-Level Assessment Criteria
1	Awareness of specific cyberattack scenarios that pertain to AI and ITS systems and their possible points of vulnerability.
2	Sufficient understanding of AI and ITS cyberattack scenarios, as well as the potential attack surface of the organization’s own systems. The organization has begun developing planning processes to prepare for cyberattacks.
3	Detailed procedures for each identified cyberattack scenario. High level of workforce awareness regarding these protocols.
4	Consults experts to analyze potential ongoing and emerging vulnerabilities and identify most likely scenarios to prepare for.

Table 22. High-Level CMM Assessment – Cybersecurity: Posture and Hygiene

Cybersecurity: Posture and Hygiene	
Level	High-Level Assessment Criteria
1	Researched potential cyberattacks of vulnerable AI-ITS systems and cybersecurity practices to prepare for and prevent cyberattacks.
2	Good understanding of the potential cyberattacks that AI and ITS systems may encounter, and has begun developing and implementing internal processes for maintaining an ongoing defensive posture against these threats.
3	Aware of the specific potential cyberattack vectors. Developed defense, response, and mitigation protocols based on these threats.
4	Established a select group of individuals responsible for monitoring potential cyberattack vectors, as well as for management and implementation of internal cybersecurity infrastructure and processes as cyberthreats evolve.

Table 23. High-Level CMM Assessment – Cybersecurity: Infrastructure Protection

Cybersecurity: Infrastructure Protection	
Level	High-Level Assessment Criteria
1	Up-to-date inventory of AI and ITS infrastructure and aware of specific potential points of vulnerability in these assets.
2	Conducting a cybervulnerability assessment and remediation plan for AI-ITS infrastructure. Integrating cybersecurity processes (e.g., software update checks) into its asset maintenance activities.
3	Routine AI-ITS asset inventory maintenance. Implementing IT/operational technology (OT) architecture to protect infrastructure assets.
4	Implemented processes and tools to preemptively respond to cyberthreats against its infrastructure. Invests resources to ensure that infrastructure management workforce is kept up to date with evolving cyberthreats and resulting vulnerabilities in infrastructures.

Dimensions

Subdimensions

Dimensions

Subdimensions

Level 4 – Systematic
Level 3 – Operational
Level 2 – Readiness
Level 1 – Exploration

AI-enabled ITS CMM

Business Processes Readiness Checklist

Subdimension	Readiness Checklist Items	Complete	Maturity Level Percentage		Subdimension Score	Dimension Score
Business Case and Performance	1. Information from previous research on the benefits of AI is used by individual implementers when deciding to use AI.		1	0.00	0.00	
	2. Measures reported in AI literature are used by individual implementers in pre-deployment evaluation of AI.					
	3. Organization starts a formal effort to collect information of the impacts of AI on their ITS applications.		2	0.00		
	4. Organization starts a formal effort to identify the best methods for pre-deployment evaluation of AI.					
	5. Organization starts a formal effort to identify the best methods for post-deployment evaluation of AI.					
	6. Organization has an approved tool or document to estimate the AI impacts for each use case.		3	0.00		
	7. AI projects are goal-driven, based on specific organizational goals, the business case, and key performance indicators.					
	8. Organization has an outreach plan to communicate the business case for AI.					
	8. Organization has a documented procedure for pre-deployment evaluation of AI for ITS.					
	9. Organization has a documented procedure for pre-deployment evaluation of AI for ITS.					
	10. Organization has a documented procedure for utilizing the AI business case in AI-enabled ITS investment decisions.		4	0.00		
	11. Processes and tools are in place with clear metrics to measure success of AI projects.					
12. Organization has documented policies and protocols to track the performance and evaluate the cost-effectiveness of AI.						
Strategy, Policy, and Roadmapping	1. ITS application of AI are considered but on a case-by-case basis.		1	0.00	0.00	
	2. Some consideration of AI in ITS system engineering process but the level of consideration varies.					
	3. Organization documents a process for considering AI as part of the system engineering approach to ITS.		2	0.00		
	4. Organization updates their strategic plan and business plan to include AI-enabled ITS.					
	5. Organization starts reviewing policies and procedures that constrain ITS deployments.					
	6. Organization develops and starts implementing an action plan and roadmaps for AI-enabled ITS.		3	0.00		
	7. Organization update the strategic plan, business plan, and investment plan.					
	8. Organization starts revising policies and procedures to reduce the constraints to AI-enabled ITS.					
	9. Organization utilizes the action plan and roadmap for all AI applications.					
	10. Organization optimizes its policies, strategy, and procedures to maximize the effectiveness of AI		4	0.00		
	11. Organization monitors the performance of AI to provide a feedback for revising the roadmap and action plan.					

Dimensions

Subdimensions

- Level 4 – Systematic
- Level 3 – Operational
- Level 2 – Readiness
- Level 1 – Exploration

AI-enabled ITS CMM

- Workshop Self-Assessment

- 30,000ft perspective
- How does the region measure at each Dimension?
- 27-28 responses per dimension
- Weighted average

Level 4 – Systematic
Level 3 – Operational
Level 2 – Readiness
Level 1 – Exploration

Dimensions	Business and Relationship Dimensions				Technical Dimensions		
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Workforce, Culture, and Organization



CMM Score – 1.61

Level 4 – Systematic
Level 3 – Operational
Level 2 – Readiness
Level 1 – Exploration

- **Workforce**

- Is there a workforce development/recruitment program building toward AI-related knowledge, skills, and abilities (KSA)?

- **Culture**

- Are the potential benefits, limitations, and risks of AI in ITS understood?
- How are new technologies viewed at your agency?
- Are there AI champions? How are they supported?

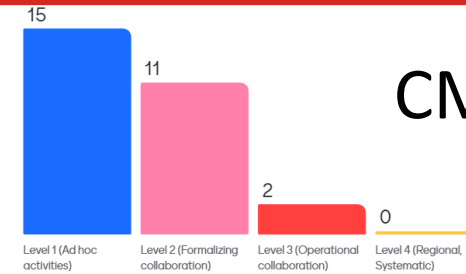
- **Organization**

- Does your agency have an AI policy?

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Collaboration

- Is peer collaboration encouraged and facilitated?
- Do agencies partner together on AI projects?
- Is AI-enabled ITS discussed and supported outside of the TSMO, Traffic Engineering, or Traffic Ops group?
- Is data/resource sharing available?
- Are AI projects and use cases aligned with agency/unit performance measures and goals?



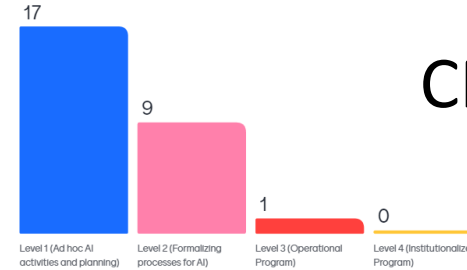
CMM Score – 1.54

Level 4 – Systematic
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Business Processes

- Is there an effort to identify and/or present the business case for AI in ITS?
- Has an AI Vision, Action Plan, or Roadmap been developed? Do AI projects align with it?
- Are internal processes being adapted to leverage AI in ITS planning, design, ops, management?
- Are any resources planned or programmed for AI initiatives?
- Is a system in place to ensure data privacy while using AI?



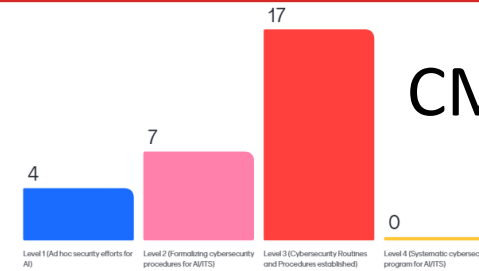
CMM Score – 1.41

Level 4 – Systematic
Level 3 – Operational
Level 2 – Readiness
Level 1 – Exploration

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Cybersecurity

CMM Score – 2.46



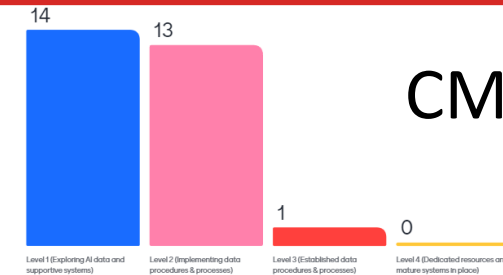
Level 4 – Systematic
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Level 2 – Readiness
Level 1 – Exploration

- Are there processes in place to maintain awareness of cyber threats?
- Have processes been developed to defend against cyberattacks AI/ITS systems? Have specific scenarios been identified?
- Are units/staff aware of potential attack vectors?
- Are routine software/hardware maintenance activities prioritized?
- Are datasets examined and stored securely? Are PII and other sensitive data obfuscated?
- Has a recoverability plan been established?

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AI Data and Infrastructure

- Has a data governance policy been established?
- Is data infrastructure planned/established?
- Have AI-supportive datasets been identified and collected?
- Have data acquisition pipelines been established?
- Is there a process for ensuring data quality?
- Does your workforce include staff with a data engineering skillset?



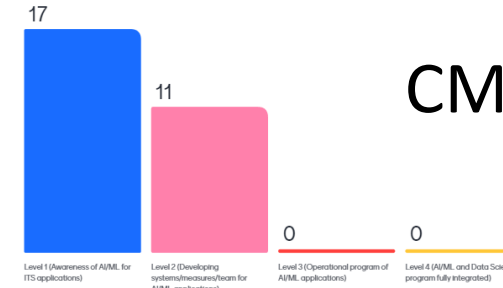
CMM Score – 1.54

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AI Models and Applications

- Has AI been used to automate ITS application(s)?
Are staff/units aware of potential AI-ITS use cases?
- Is an internal or external data science team available for AI-enabled ITS application development?
- Are development/test environments available to deploy pilot AI applications?
- For AI-ITS applications, is the human-AI interface conducive to end user needs?
- For AI-ITS applications, have metrics been developed to assess the AI's performance?



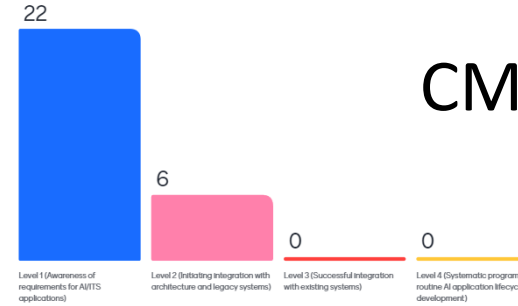
CMM Score – 1.39

Level 4 – Systematic
Level 3 – Operational
Level 2 – Readiness
Level 1 – Exploration

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AI Integration and Operations

- Are business/operational requirements established for AI ITS applications? Are applications designed with the end-user in mind?
- Have potential AI-ITS applications been considered based on current ITS architecture? How might these applications require changes to the ITSA?
- Have system integration capability requirements been identified for AI-ITS applications?
- Are ground-truth datasets available to compare with AI application results?
- Is operational feedback built into your agency's AI deployments?



CMM Score – 1.21

Level 4 – Systematic
Level 3 – Operational
Level 2 – Readiness
Level 1 – Exploration

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AI-enabled ITS CMM Survey

- One-question survey sent out following workshop
- List of all objectives/tasks in AI-enabled ITS CMM
 - Excluding Cybersecurity
- **Which 10 objectives/tasks should the region prioritize?**

AI-Enabled ITS CMM Priorities

Determining AI-enabled ITS Priorities

During the AI-enabled ITS Workshop, the group identified Cybersecurity as the region's highest scoring dimension. For that reason, we are focusing on the six other AI CMM Dimensions. We are asking respondents to identify the **Top 10 objectives/tasks/targets** within those six dimensions that the region should prioritize.

1. Which 10 objectives/tasks of the AI-enabled ITS CMM should the Central Florida region prioritize?

- (Workforce/Culture)** Staff program is established for Development/Training/Recruitment/Retention of AI-related Knowledge, Skills, and Abilities
- (Workforce/Culture)** AI Championship/Leadership building process
- (Workforce/Culture)** The role, value, limitations, risks, and budget related to AI is understood internally
- (Workforce/Culture)** Identification of changes needed to foster innovation and embrace technology
- (Workforce/Culture)** Identification of workforce, culture, organization, and policy/procedural changes needed to ensure ethical and equitable use of AI in ITS
- (Workforce/Culture)** Reorganization of business processes and data processes to facilitate use of AI systems and models
- (Collaboration)** Peer agencies share information about necessary updates to policies, standards, processes, and applications relating to AI-enabled ITS
- (Collaboration)** Agency has processes, MOUs, and agreements in place with peer agencies for AI-enabled ITS

AI-enabled ITS CMM Survey

- 1) The role, value, limitations, risks, and budget related to AI is understood internally
 - Workforce, Culture, Org – 67% of respondents selected this objective
- 2) Staff program is established for Development/Training/Recruitment/Retention of AI-related KSAs
 - Workforce, Culture, Org – 58%
- 3) Allocates annual budget for AI-enabled ITS according to developed action plan and roadmap for AI, data management, and data governance
 - Business Processes – 58%
- 4) AI Championship/Leadership building process
 - Workforce, Culture, Org – 50%
- 5) There are established procedures, applications, agreements between partner agencies and private sector data providers, as needed
 - Collaboration – 50%
- 6) AI-enabled ITS use cases selected with consideration of objectives, performance measures, performance targets, and initiatives of all units and at all levels
 - Collaboration – 50%

AI-enabled ITS CMM Survey

- 7) Developed and implemented AI Strategic Plan, Action Plan, and/or Roadmap base on SE process
 - Business Processes – 50%
- 8) Documented process to evaluate and communicate business case, pre-/post-deployment methods for AI-enabled ITS
 - Business Processes – 42%
- 9) Developed data management policies/procedures that create value for AI-enabled ITS use cases
 - AI Data & Infrastructure – 42%
- 10) Established data QA/QC policies/procedures to ensure routine review of data throughout AI model development and deployment processes
 - AI Data & Infrastructure – 42%
- 11) Developed a process that returns accurate findings when pairing AI models with ground-truthed datasets. Agency takes steps to reevaluate the model against real-world data to validate its performance in operational environment
 - AI Integration & Operations – 42%



Questions?



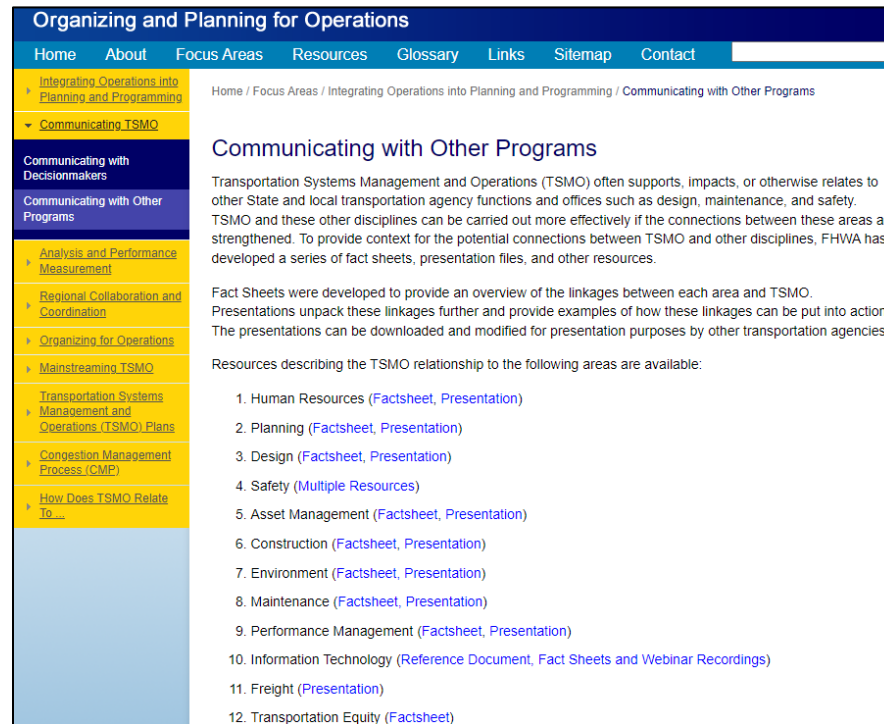
Communicating TSMO Resources

David Williams, VHB

Communicating TSMO

- FHWA developed a range of materials to assist with communicating TSMO to other groups and departments within an agency

- Factsheets
- PPT Presentations
- FAQs
- Testimonials



The screenshot shows a web page titled "Organizing and Planning for Operations" with a navigation menu including Home, About, Focus Areas, Resources, Glossary, Links, Sitemap, and Contact. The left sidebar contains a tree view with categories like "Integrating Operations into Planning and Programming", "Communicating TSMO", "Communicating with Decisionmakers", "Communicating with Other Programs", "Analysis and Performance Measurement", "Regional Collaboration and Coordination", "Organizing for Operations", "Mainstreaming TSMO", "Transportation Systems Management and Operations (TSMO) Plans", "Congestion Management Process (CMP)", and "How Does TSMO Relate To...". The main content area is titled "Communicating with Other Programs" and contains the following text:

Transportation Systems Management and Operations (TSMO) often supports, impacts, or otherwise relates to other State and local transportation agency functions and offices such as design, maintenance, and safety. TSMO and these other disciplines can be carried out more effectively if the connections between these areas are strengthened. To provide context for the potential connections between TSMO and other disciplines, FHWA has developed a series of fact sheets, presentation files, and other resources.

Fact Sheets were developed to provide an overview of the linkages between each area and TSMO. Presentations unpack these linkages further and provide examples of how these linkages can be put into action. The presentations can be downloaded and modified for presentation purposes by other transportation agencies.

Resources describing the TSMO relationship to the following areas are available:

1. Human Resources (Factsheet, Presentation)
2. Planning (Factsheet, Presentation)
3. Design (Factsheet, Presentation)
4. Safety (Multiple Resources)
5. Asset Management (Factsheet, Presentation)
6. Construction (Factsheet, Presentation)
7. Environment (Factsheet, Presentation)
8. Maintenance (Factsheet, Presentation)
9. Performance Management (Factsheet, Presentation)
10. Information Technology (Reference Document, Fact Sheets and Webinar Recordings)
11. Freight (Presentation)
12. Transportation Equity (Factsheet)

- https://ops.fhwa.dot.gov/plan4ops/focus_areas/communicating_tsmo.htm
 - or search: "FHWA Communicating TSMO"

Brochures and Infographics

Why Focus on TSMO?

The transportation world is changing, and doing business the way it was done in the past is no longer effective. Previously, for example, congestion issues were primarily addressed by funding major capital projects (adding lanes or building new interchanges and roads) 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.



Today, transportation agencies are facing trends that create a growing demand for travel with less funding and space to work with. As a result, we can no longer build our way out of congestion. Trends we see today include:

Limited funds

Transportation agencies on the federal, state, and local levels have for years been tasked with doing more with limited resources. State DOTs are always looking for innovative, lower cost ways to get people and goods to their destinations more safely and reliably. TSMO helps do that.

Advances in technology

Transportation agencies can leverage technology and data to develop solutions to address congestion issues. However, given the advancement in consumer technologies (smart phones, apps, GPS, etc.), privately owned mobility services (Uber, Lyft, etc.), shared mobility and the availability of more information, the traveling public expects fast, reliable, and "smart" transportation.

Changing customer needs and expectations

There is a greater demand for accountability for public officials to ensure that public funds are spent to maximize the performance of the transportation system in the most cost-effective way. This creates a trend toward "performance-based" programs. The traveling public is seeking relief from unexpected delays in their trips.

Better Understanding of the Causes of Congestion

Research has shown that while some congestion may be caused by typical morning and evening rush hours, a significant amount comes from non-recurring events, such as crashes, breakdowns, work zones, weather, and special events. There may be opportunities to quickly apply low-cost TSMO improvements that are targeted toward these specific causes to reduce their impacts.

Next Steps

Your agency is likely already implementing some TSMO strategies. A key element in how effective they are is whether they are integrated in a systematic way to accomplish overall system goals and engage all the jurisdictions involved. To do this, leadership is key. State DOT CEO and other senior management support is vital in creating a TSMO-focused culture. That leadership should also empower employees who will inevitably have a hand in getting positive results.

To make sure your organization stays on track, keep asking these questions as they relate to your TSMO program.

- How can we most effectively move people and goods where they need to go?
- What are customer needs, experiences, and expectations?
- What are your current processes for operations?
- How are you tracking and monitoring the performance of your transportation system?
- How can you best utilize the data and metrics you have?
- What are your organizational and staff capabilities?
- Where are you today? Where do you want/need to go? How do you get there?
- How well are you collaborating with external operations partners?
- Do you have processes to evaluate, integrate, and manage emerging technology?

Further Information

To learn more about Transportation Systems Management and Operations, including individual strategies, visit the following websites:

- FHWA Organizing and Planning for Operations**—<https://ops.fhwa.dot.gov/plan4ops>
- National Operations Center of Excellence NOCoE**—<https://transportationops.org>
- AASHTO TSMO Guidance**—<https://transportationops.org/tools/aashto-tsmo-guidance>

For more information, contact Tracy Scriba, FHWA Office of Operations, at Tracy.Scriba@dot.gov or AASHTO Associate Program Manager [Pat.Zelinski](mailto:Pat.Zelinski@aaashto.org) at PZelinski@aaashto.org



www.fhwa.dot.gov

FHWA-HOP-19-085

TRANSPORTATION SYSTEMS MANAGEMENT AND OPERATIONS



Addressing the Nation's Transportation Challenges with Transportation Systems Management and Operations

The role of transportation agencies in transportation, has evolved over the past few decades. Changing realities (funding, space, etc.) make the solution of adding lanes is not effective for other solutions. Initially, state departments on building and preserving their transportation regions and states and to provide greater agencies are still building transportation to build its way out of the transportation challenges. Congestion, physical constraints, and reliability. To better combat these issues, implementing Transportation Systems Management and Operations (TSMO) is a key strategy. While many simply "Operations" or "TSMO", while improving quality of life for the traveler.

TSMO is a set of strategies, services, and improvements and overall system management people and goods. Through use of TSMO, and even restore the performance of the system. The goal is to get the most performance out of DOT already has. This requires knowledge of comprehensive solutions that can be quickly implemented. This may enable transportation agencies to serve more areas and customers. These strategies and demand and provide flexible solutions.

"We've come to realize that with growth in Washington State, the congestion approach with its operational focus investment at the right time in the assets."

An "Integrated Set of Strategies"

Transportation Systems Management and Operations looks at performance from a systems perspective, not just one strategy, project, or corridor. This means that these strategies are coordinated with others across jurisdictions, agencies, and modes. Integration allows us to see the surface transportation network as a unified whole, moving people and goods safely, efficiently, and reliably, making the various transportation modes and facilities work together and ultimately perform better. TSMO not only provides public agencies with a growing toolbox of individual solutions, but also encourages combining them to achieve greater performance on the entire system.

There are various types of TSMO integration, such as data integration, operational integration, technical integration, procedural integration, and others.

Effectively delivering a TSMO program relies on a strong foundation for operations, as outlined in a capability maturity model:

- Business Process**—Plans, programs, procedures, and budgets
- Systems and Technology**—Approach to building systems and using technology
- Performance Measurement**—Using data and measures to guide decisions
- Workforce**—Improving workforce capability
- Culture**—Changing culture and building champions
- Collaboration**—Improving working relationships

"If you look at TSMO as asset management—using what you've already purchased more effectively and efficiently—it's part of the conversation, and it has to be. That's why I think it's so important to the future of transportation."

—Monica Harwood Duncan, Statewide Traffic Operations Engineer, Washington State Department of Transportation

"TSMO is where we're at. It's the future. If you think about safety or mobility—connected and automated vehicle technology is such an opportunity. To be fearful of it is one thing, but to stand in the way of it is another. I've been trying to have those types of conversations. I also like to hold up my phone and say "Uncle Google knows where you are at all times," so why not use that info to get you from Point A to Point B faster?"

—Secretary Jennifer Cohen, Delaware Department of Transportation



Michigan's US-23 Flex Route, opened in 2017 north of Ann Arbor, utilizes active traffic management to address traffic, incident management, and motorist safety. Photo courtesy Michigan DOT

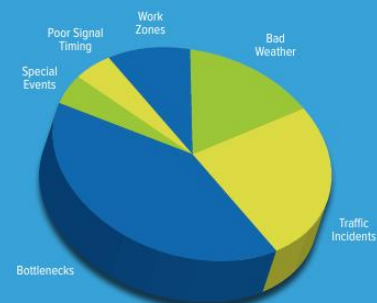
Examples of TSMO Strategies

Work Zone Management	Strategies used during roadwork to minimize traffic delays, maintain motorist and worker safety, complete roadwork in a timely manner, and maintain access for businesses and residents.
Traffic Incident Management	Planned and coordinated multi-disciplinary process to detect, respond to, and clear traffic incidents so that traffic flow may be restored as safely and quickly as possible.
Traveler Information	Information on current roadway conditions such as delays, incidents, weather-related impacts, travel times, emergency alerts, and alternate routes. Providing this information to motorists before and during trips allows them to make more effective travel decisions about routes, modes, departure times, or even destinations.
Road Weather Management	Use of timely, accurate, and relevant information about weather-related impacts through various sources, strategies, and tools to enable transportation managers and travelers to make more effective decisions and mitigate roadway impacts.
Connected and Automated Transportation Readiness	Preparations for connected and automated transportation, including policy, field testing, and the operations and management of the infrastructure along corridors and intersections equipped to support specific connected and automated vehicles (CAV) applications.

"TSMO is not just helping us for today, but it's preparing for tomorrow. When we go to the legislature, when we go to our transportation commission, when we're able to offer this next piece that shows this is how we get the highest return on your investment, there's an enormously positive response to that. We are returning results that really matter to people. So this is one of those opportunities you can't turn down."

—Mark Lowe, former Director, Iowa DOT

Causes of Congestion



Brochures and Infographics

FHWA-HOP-21-054



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TSMO BENEFITS AT A GLANCE



State departments of transportation (DOTs) are using Transportation Systems Management and Operations (TSMO) strategies to get the most out of their existing transportation systems, whether it's to improve safety, reduce delays caused by congestion, save taxpayer dollars, or reduce emissions and their impact on the environment. Here are a few of the many benefits State DOTs have reported from incorporating TSMO strategies and focusing on the broader operational picture.

ARIZONA

Innovative Striping and Signage

66% Reduction in Crashes

1,969:1 Benefit–Cost Ratio

The two-mile segment where westbound US-60 merges with I-10 in the Phoenix metro area had the highest number of serious and fatal crashes on the Arizona DOT (ADOT) system. The ADOT TSMO Division identified, engineered, and implemented a sign redesign that added clarity for drivers and lane restriping project to improve system performance and safety. In the 12 months after completion of the project, there were 385 fewer crashes of all severities than in the previous 12 months. Using data for all crash severities for the full two-mile segment, the project showed a benefit-cost ratio of 1,969:1 just 12 months after project completion.



FLORIDA

Integrated Corridor Management

Up to 40% Reduction in Delays

Up to 22% Emissions Reduction

Florida DOT (FDOT) was grappling with how to keep up with infrastructure needs in Orlando, the second-fastest growing city in the United States. FDOT implemented Integrated Corridor Management (ICM) to improve travel time and reliability for residents and visitors while more efficiently tackling incident management on the system by meshing freeway operations with arterial operations. Through the ICM and its use of transit signal priority and adaptive signal control, FDOT was able to reduce delays by up to 40 percent and improve bus times. Additionally, traffic signal and variable speed displays have substantially reduced emissions.



NEVADA

Traffic Incident Management

12-Minute Reduction in Incident Response Times

Reduction in Secondary Crashes

Nevada DOT worked with several other State agencies to develop a collective platform on which all agencies can share real-time incident data. The platform leverages in-vehicle data and artificial intelligence to help manage traffic and prevent crashes. The program allows for seamless, real-time sharing of incident information across all involved agencies, multi-discipline first responders, and the public, crucial for effective traffic incident management. This solution has significantly improved incident response times and reduced secondary crashes in Southern Nevada by pushing out real-time traffic information to drivers when an incident occurs.



MARYLAND

Traffic and Event Management

\$1.5 Billion Annually in Savings

Event Managed Every 16 Minutes

Described by Maryland DOT as its "entry into the Intelligent Transportation Systems arena," the Coordinated Highways Action Response Team (CHART) is a Statewide comprehensive and advanced traffic management system that covers everything from traffic management to incident management to traveler information (and everything in between). CHART now assists a motorist every 16 minutes on average and manages traffic at a crash/incident every 22 minutes, preventing an estimated 225–250 secondary crashes a year. CHART also saves drivers an estimated \$1.5 billion in fuel and delay costs each year.



MICHIGAN

Active Traffic Management

Improved System Reliability by Up to 56%

Improved Corridor Speeds by Up to 19 mph

After exhausting all short-term solutions for congestion, operations, and incident management on US-23 through Washtenaw and Livingston Counties, the Michigan DOT (MDOT) turned to Active Transportation Management (ATM) strategies to dynamically manage these issues. With the ATM, MDOT uses strategies such as dynamic lane control and shoulder use, variable speed advisories, and queue warning, among others. Commuters now enjoy greater safety while experiencing more reliable travel times and less time sitting in congestion.



For more information, contact Tracy Scriba, FHWA Office of Operations, at Tracy.Scriba@dot.gov; or AASHTO Associate Program Manager Pat Zelinski at PZelinski@aaashto.org



Transportation Systems Management and Operations (TSMO): Getting More from Our Existing System

Expanding Travel Choices to Move More People

49% of shared electric scooter and bicycle trips replaced single-occupant vehicles.¹



80% of people using express lanes in peak hours were riding on buses or carpooling.²

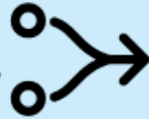


Making Travel Times More Reliable



Increased travel time reliability accounted for 68% of the benefits of using congestion-priced lanes.⁶

Dynamic late lane merging in work zones reduced delays by 67%.⁷



Truck parking and management systems reduced parking search time with a benefit-cost ratio of 4:1.⁸

Keeping Lanes Open Increases the Value of Investments



Freeway Courtesy Patrol³

15:1



Smart Work Zones⁴

10:1



Traffic Incident Management Systems⁵

8:1

Improving Travel Time without Increasing Capacity



Regional signal retiming reduced delays by 23%.⁹



Adaptive signal control reduced travel time by 9.4%.¹⁰



Active Transportation Management Systems may reduce peak period travel times by up to 21%.¹¹

Factsheets

ASSET MANAGEMENT

ENHANCING TRANSPORTATION: CONNECTING TSMO AND ASSET MANAGEMENT

The transportation industry is rapidly evolving with advanced technology and a new emphasis on management and operations. Roadways are becoming increasingly complex, with communications and security technology, sensors and cameras, and other technologies, as well as supporting infrastructure. Travelers and commercial vehicle operators rely on the software, hardware, and people necessary to dynamically manage and operate the system in real-time from virtual and physical transportation management centers. The reliance on transportation assets for TSMO is expected to rise steeply as transportation becomes increasingly automated.

Historically, agencies have prioritized technology deployment in support of TSMO, while maintenance has been an afterthought. With their significant investment in and focus on deploying technology, many agencies have been struggling to keep these assets maintained.

The industry needs a comprehensive approach to asset management that can support these emerging needs and lead transportation agencies into the future.

Asset Management is a strategic and systematic process of operating, maintaining, and improving physical assets, with a focus on engineering and economic analysis based upon quality information, to identify a structured sequence of maintenance, preservation, repair, rehabilitation, and replacement actions that will achieve and sustain a desired state of good repair over the lifecycle of the assets at minimum practicable cost.

Source: 23 U.S.C. 101(a)(2), MAP-21 § 1103.



Photo Source: Getty Images

WHAT IS TSMO?

Transportation systems management and operations (TSMO) is the use of strategies, technologies, mobility services, and programs to optimize the safety, mobility, and reliability of the existing and planned transportation system. A significant cause of congestion and unreliable travel is non-recurring events, such as crashes, and transportation network disruptions, such as bad weather, and special events. TSMO enables agencies to target the underlying operational causes of congestion and unreliable travel through innovative solutions that typically cost less and are quicker to implement than adding capacity. TSMO expands the range of mobility choices available to system users, including shared mobility and non-motorized options.

This Fact Sheet is part of a series that explains how TSMO relates to other State and local transportation agency functions and offices. Other Fact Sheets focus on how TSMO relates to: performance management, maintenance, design, safety, environment, planning, human resources, and construction.

ENHANCING TRANSPORTATION: CONNECTING TSMO AND ASSET MANAGEMENT

TSMO and asset management work toward enhancing system performance with similar processes, but they have different focuses. While asset management is concerned with preserving or improving the condition of assets, TSMO is focused on preserving and maximizing mobility. However, TSMO and asset management programs share a strategic, performance-based approach to monitoring performance and applying actions to reach targets.

Lifecycle planning and risk-based management are two concepts from asset management that hold promise for advancing TSMO programs. TSMO strategies often suffer from a lack of funding to maintain the technology and equipment required to operate the system after the initial deployment. Asset management uses a network-level lifecycle approach for managing assets over their whole life with a focus on minimizing cost while preserving or improving the asset condition. By adopting this approach for the assets supporting TSMO strategies, agencies would estimate the useful life of the technology and the need for upgrades and maintenance during the planning stages of the TSMO strategy, ensuring that there is an ongoing funding source for maintenance activities. Risk-based management as applied to TSMO would lead agencies to plan for, assess, and mitigate, avoid, or accept risks to mobility. For example, agencies could pre-position tow trucks to mitigate the risk of severe congestion caused by an incident in a work zone on a significant arterial in the region.

INCLUSION OF TSMO IN TRANSPORTATION ASSET MANAGEMENT PLANS

The Federal transportation legislation, the Fixing America's Surface Transportation (FAST) Act, requires all State DOTs to develop risk-based Transportation Asset Management Plans (TAMPs) for the pavement and bridge assets on the National Highway System to improve or preserve the condition of the assets and the performance of the system.¹

States are encouraged to add assets beyond pavement and bridges, such as ITS, traffic signals, and other infrastructure that support TSMO, to have a more comprehensive asset management system. States that choose to do so should include risk analyses, life-cycle planning, and condition targets and develop investment strategies based on funding available over a period of at least 10 years. Including details such as field equipment make, model, serial numbers, purchase and installation dates, and routine device maintenance frequency allows for life-cycle costs to be analyzed and future device replacements to be planned and programmed. This would support agencies in replacing these assets on a more consistent and timely basis.

Many State DOTs are now developing TSMO plans. Given the links between TAMPs and TSMO plans, agencies may benefit from connecting both plans on a long-term basis.

HOW HAS THIS WORKED IN PRACTICE?

Caltrans incorporates its ITS assets into an annual Asset Management Performance Report. The report tracks the performance or health of the agency's ITS assets and shows the projected performance or health of the ITS elements for the next 5 years. Caltrans sets a threshold to gauge the performance of its ITS assets and provides explanations and solutions to resolve potential ITS health issues.

¹ 23 U.S.C. 119(e). For more information, see the Federal Highway Administration's Web page on Transportation Asset Management Plans at: <https://www.fhwa.dot.gov/asset/plans.cfm>. Also see the AASHTO Transportation Asset Management Portal at: <http://www.tam-portal.com/>.

Five Core Questions for Transportation Asset Management that Apply to TSMO

- 1 What is the current state of physical assets?
- 2 What are the required levels of service and performance delivery?
- 3 Which assets are critical to sustained performance?
- 4 What are the best investment strategies for operations, maintenance, replacement, and improvement?
- 5 What is the best long-term funding strategy?



FOR MORE INFORMATION

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U.S. Department of Transportation
Federal Highway Administration

Factsheets

CONSTRUCTION

ENHANCING TRANSPORTATION: CONNECTING TSMO AND CONSTRUCTION

As our existing transportation infrastructure ages and demand for travel and moving goods increases, more major rehabilitation and new capacity projects are required. This means that there are more work zones that trigger network disruptions and unexpected travel delays. These delays reduce the reliability of travel and can have a major impact on emergency responders and freight mobility.

TSMO is integral to effective work zone management. For example, TSMO strategies can encourage travelers to use alternate routes during construction, enhancing the safety and efficiency of construction crews by reducing the number of vehicles traveling through an active work zone. More specifically, TSMO strategies can:

- Provide road users with more “up front” information about planned work that will reduce capacity while offering mobility alternatives to help drivers avoid delays due to work zones (e.g., alternate routes, modes, or travel times).
- Improve traffic flow through work zones by using dynamic traffic management technologies and providing real-time data and traveler information to transportation agencies and system users.
- Assist construction crews, heavy equipment operators, and delivery vehicles to enter and exit construction sites safely and efficiently.

Construction staff also need to consider TSMO both when a project includes the installation of intelligent transportation systems (ITS) or when ITS is already installed and needs to be kept operational during construction.

TSMO can increase the available capacity of transportation facilities through better management of demand and flow disruptions. This can delay the need to construct new lanes or roadways. While these decisions are generally made during planning, construction personnel should be aware of this important connection to TSMO.

TRAVELER INFORMATION AND PUBLIC INFORMATION CAMPAIGNS

Encountering an active work zone with no prior warning about travel delays is a major cause of driver frustration. Timely and accurate traveler information is a core function of TSMO programs. Information campaigns include notifying and engaging those who might be affected by route diversions, such as business districts and nearby neighborhoods. Transportation management centers (TMC) send lane closure information



U.S. Department of Transportation
Federal Highway Administration



Source: Getty Images

WHAT IS TSMO?

Transportation systems management and operations (TSMO) is the use of strategies, technologies, mobility services, and programs to optimize the safety, mobility, and reliability of the existing and planned transportation system. A significant cause of congestion and unreliable travel is non-recurring events, such as crashes, and transportation network disruptions, such as bad weather, and special events. TSMO enables agencies to target the underlying operational causes of congestion and unreliable travel through innovative solutions that typically cost less and are quicker to implement than adding capacity. TSMO expands the range of mobility choices available to system users, including shared mobility and non-motorized options.

This Fact Sheet is part of a series that explains how TSMO relates to other State and local transportation agency functions and offices. Other Fact Sheets focus on how TSMO relates to: asset management, performance management, maintenance, design, environment, planning, human resources, and safety.



Source: Getty Images

ENHANCING TRANSPORTATION: CONNECTING TSMO AND CONSTRUCTION

through multiple channels to warn travelers ahead of time and provide routing guidance to travelers prior to and during construction activities.

MANAGING WORK ZONES FOR SAFETY, MOBILITY, AND EFFICIENCY

TSMO offers several important benefits to construction departments in State and local transportation agencies and to contractors working in work zones:

- TSMO strategies support accelerated construction methods that reduce construction time. For example, full closures (in one or both directions) can lead to more efficient project delivery while minimizing extended disruptions to the public. TSMO analytical tools can help assess the feasibility of full closure and evaluate alternate routing.
- TMCs can remotely monitor construction activity and travel mobility through multiple work zones simultaneously. This allows TMC operators to quickly and efficiently identify and address incidents or other issues.
- Arterial work zones can benefit from adjusted signal timing during construction to reduce impacts to automobiles, pedestrians, and bicyclists.
- Traffic incident management (TIM) strategies can provide benefits during construction through expanded motorist assistance patrols, pre-positioned tow and recovery vehicles, and rapid response to incidents near or in the work zone. TIM works to safely and quickly clear incidents and return traffic to its normal flow, reducing congestion and the risks of secondary incidents.
- Strategies such as speed monitoring, speed control, and traveler information in a work zone can improve driver awareness, increasing worker safety.
- TSMO strategies can increase mobility and safety by detecting current traffic conditions and dynamically adjusting to them using real-time traffic control methods such as queue warning systems, dynamic lane merge systems, variable speed limits, lane control signs, and real-time traveler information systems, which have proven highly effective in work zones.¹

ITS SYSTEMS IN CONSTRUCTION

ITS are part of many TSMO strategies. Construction projects often include building and deploying ITS infrastructure, which presents a unique set of challenges to the construction crews that integrate power and communications into the facility and connect ITS field components to a TMC or other facilities. These systems require extensive testing, and the equipment must be field-hardened for weather and maintenance and protected from theft, vandalism, and misuse. Installation crews will need specialized knowledge of TSMO strategies to ensure that they understand the importance of this equipment for managing traffic on new or improved facilities and the potential for disruption if devices fail or are misused. Some equipment may be used for managing reversible lanes, variable speed limits, dynamic message signs, and ramp meters, which can directly affect the mobility and safety of travelers.

HOW HAS THIS WORKED IN PRACTICE?

- The **Texas Department of Transportation (DOT)** used an end-of-queue warning system that reduced crashes up to 45 percent on a construction project to widen 96 miles of an interstate highway.²
- The **Minnesota DOT** successfully used dynamic lane merge systems to help minimize the queue length in traffic work zones.³
- The **Transportation Operations Coordinating Committee (TRANSCOM)** is a coalition of 16 transportation and public safety agencies in the New York/New Jersey/Connecticut region that was founded in 1986 to facilitate coordination of construction projects on a regional basis. TRANSCOM has expanded its role and now its 24/7 operations information center collects and disseminates real-time incident, construction, and special event information to member and non-member agencies.⁴



FOR MORE INFORMATION

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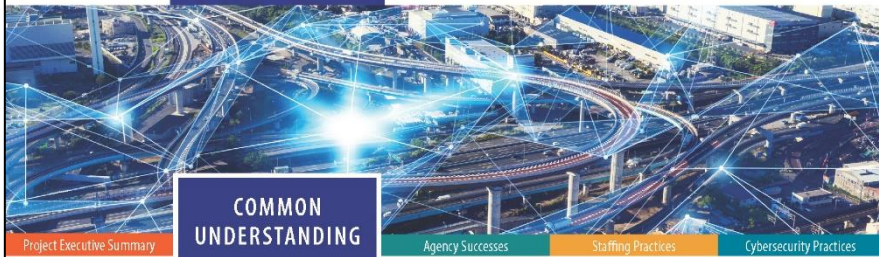
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U.S. Department of Transportation
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Factsheets

Coordination of IT and TSMO



This is one of five fliers that highlight aspects of coordination between Information Technology (IT) and Transportation Systems Management and Operations (TSMO) in transportation agencies. Each flier draws from *Principles and Strategies for Effective Coordination of IT and TSMO, a Reference Document* (<https://ops.fhwa.dot.gov/publications/fhwahop21008/index/htm>).

The role of IT is becoming increasingly central to TSMO. Leading edge TSMO strategies involve increasingly complex and interrelated systems, organizations, and institutions. Real-time and predictive tactics, such as active traffic management, integrated corridor management, and vehicle-to-infrastructure systems, are characterized by high levels of complexity and a dependence on integrating with IT. A principle objective of the FHWA IT-TSMO project was to identify common IT-related challenges experienced by TSMO staff and effective practices that have been implemented to resolve those challenges.

COMMON CHALLENGES

The project identified the following IT-TSMO coordination challenges:

Institutional	Business and Technical Processes
Cultural	Strategic Planning
Staff and Financial Resources	Procurement
Organizational	Systems and Technology
Policy	Risk/Security

EFFECTIVE PRACTICES

Many agencies have had success in overcoming their IT-TSMO coordination challenges by employing practices in the following categories:

- Collaboration
- Program Delivery
- Staffing
- Equipment/Systems
- Planning and Programming

Enhancing Common Understanding Between TSMO and IT Staff

TSMO and IT groups bring distinct perspectives, roles, and practices in seeking to improve business processes for which they are responsible. Often, these two groups may not have extensive exposure to each other's mission or operational responsibilities. Focus areas for targeting improved understanding between the two groups are explained below and summarized in the table that follows.

Governing Principles

Governing principles reflect the values of an organization and are of primary importance in day-to-day activities. For TSMO professionals, those principles are focused on safe and efficient operations. Technology-based systems must be available whenever they are needed, regardless of the time of day or day of week. It is important for IT staff to understand the urgency that TSMO staff view uptime of TSMO assets, and to structure their support to respond accordingly. For IT professionals, those principals are based on ensuring reliable delivery of services, including maximizing uptime and operating IT systems 24/7. They are also focused on protecting IT assets, especially from cybersecurity threats.

Domains Components

Domains include the devices and assets that comprise the networks of interest. For TSMO, the domains consist of field devices and data sources, operations center servers, and communication components that link them. The domain for IT is quite large and can include data centers, databases, back office systems, and the internal and external network communications that links them. Most of the domain is located within office environments. Security is essential. It is important for TSMO staff to understand the IT environment and the desire for consistency across large enterprise networks and systems.

Risk Management

Within TSMO, the most important risks relate to the safety of the transportation system. TSMO elements need to fail safe or "fail soft." The risks are often greatest when these elements are needed most, such as during peak traffic periods, traffic incidents, or emergency situations. Within IT, the biggest risks involve system integrity, and protecting the IT network and other IT assets from unauthorized intrusion. Malicious intrusions can compromise the entire enterprise network, including financial systems and private data.

As a risk management technique, the Michigan DOT (MDOT) invited the Michigan Department of Technology, Management and Budget (DTMB) to help identify vulnerabilities in its ITS communications network. The DTMB cyber security group analyzed MDOT networks, identified cyber risks, and informed MDOT about the vulnerabilities, which MDOT was then able to address.



Factsheets

Standards and Architecture

Core TSMO standards and development models relate to system engineering, ITS Architecture, and ITS devices. It is important for IT staff to understand the background of these standards and the public-facing nature that they serve. IT standards typically revolve around security, technology compatibility, and a variety of hardware and software standards. In addition, IT systems often need to comply with State legislated or Chief Information Officer mandated standards and policies that serve the full range of IT services provided to all their client agencies.

Asset Management

Managing TSMO assets emphasizes the needs and requirements for maintaining and repairing specific devices at specific (often field) locations. TSMO assets generally last longer than most IT assets because of their hardened nature. The result is often a mix of equipment that requires a broad range of troubleshooting and repair skills. Managing IT assets emphasizes strict adherence to asset maintenance levels. IT assets generally have a shorter lifecycle than TSMO assets. Software and technology asset licenses must also be managed to protect against financial or performance risk.

Future Technologies

Future technology trends for both TSMO and IT will likely center around new functionality and increased efficiency. Practitioners expect TSMO systems and processes to utilize expanded data sources, larger quantities of data, and more automation. Newer technologies may include support for connected and automated vehicles, smart cities, mobility on demand, and other emerging concepts. Future technologies that will be incorporated within IT will be driven by evolving business needs across the agency or throughout a centralized IT management approach. Trends include movement toward more cloud storage and cloud computing, mobile access, and reliance on increasingly sophisticated web services.

The Pennsylvania Turnpike runs a large tolling operation that relies on both TSMO and IT staff to operate a safe, reliable, customer-valued toll road system. The Turnpike makes a concerted effort to integrate IT staff into the operation's business to encourage better understanding and collaboration between the two groups. From a leadership perspective, the IT group is aligned with the Turnpike's mission and was included in the operations strategic plan. The IT group has also been included in major efforts, such as the TSMO Capability Maturity Model (CMM) workshop.

Category	What IT professionals need to know about TSMO	What TSMO professionals need to know about IT
GOVERNING PRINCIPALS	<p>Ensuring safe and efficient day-to-day operations through:</p> <ul style="list-style-type: none"> Maximizing system "uptime," especially during critical demand. Operating systems whenever conditions dictate, 24/7. Interfacing with outside parties to share information and control. 	<p>Ensuring reliable business-focused delivery of services through:</p> <ul style="list-style-type: none"> Maximizing IT system "uptime," especially during peak use. Operating IT systems and networks according to business demands 24/7. Ensuring cybersecurity.
DOMAIN COMPONENTS	<p>Multiple domains that must work together:</p> <ul style="list-style-type: none"> Traffic operations center/data center. Data sources from third parties and field devices. Communications to link centers and data sources. 	<p>Multiple domains that must work together:</p> <ul style="list-style-type: none"> Data center/back office. Database. Security. Internal and external network communications.
RISK MANAGEMENT	<p>Considered from transportation system operations perspective:</p> <ul style="list-style-type: none"> Transportation systems are operational 24/7. Systems need to fail safe or fail soft. Troubleshooting should occur with minimal impact to system operation. 	<p>Considered from software/hardware and network resilience perspective:</p> <ul style="list-style-type: none"> System outages can affect enterprise-wide business continuity. Unauthorized intrusions can jeopardize network wide operations. Inconsistent systems and applications can increase repair time and cost.
STANDARDS AND ARCHITECTURE	<p>The range of standard practices include:</p> <ul style="list-style-type: none"> Systems engineering and ITS architecture. ITS device standards. Hardened equipment (maximum availability). 	<p>The range of standard practices include:</p> <ul style="list-style-type: none"> Enterprise architecture. Technology compatibility standards. Hardware/software standards.
ASSET MANAGEMENT	<p>Managing TSMO assets emphasizes:</p> <ul style="list-style-type: none"> Needs/requirements for maintaining and repairing traffic management specific devices at specific locations. Relatively longer lifecycle than IT assets. Highly reliable legacy devices with limited capabilities. 	<p>Managing IT assets emphasizes:</p> <ul style="list-style-type: none"> Strict adherence to current maintenance levels. Relatively shorter life cycle than TSMO assets. Technology asset and license management. Newer devices with greater flexibility.
FUTURE TECHNOLOGIES	<p>Technology considerations include:</p> <ul style="list-style-type: none"> Using emerging technologies and data sources are critical to meet growing transportation needs and challenges. Many of the new technology are market-related and come out of the private sector. 	<p>Technology considerations include:</p> <ul style="list-style-type: none"> Managing ever evolving advances in hardware/software with business needs. Movement toward more cloud computing and web services.

For More Information:

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Presentations

- Fact Sheets were developed to provide an overview of the linkages between each area and TSMO.
- Presentations unpack these linkages further and provide examples of how these linkages can be put into action
 - PPT files can be downloaded and modified for presentation purposes



Questions?



Online Training Opportunities

David Williams, VHB

TSM&O Focused Learning Education & Experiences (FLEX) Portal

- Types of training in FLEX Portal
 - TSM&O concepts
 - TSM&O applications
 - Field equipment
 - How-to training videos
- FLEX Portal is available with a **free** account



TSM&O Focused Learning Education & Experiences (FLEX) Portal

- New courses available
 - Setting up ATSPM Zones (Iteris CCU)
 - Railroad Preemption
 - ReadyOp Basic Training
- New Transcript Tracking for users



All Courses

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Transportation Systems Management and Operations (TSM&O) are planning processes and performance of existing multimodal infrastructure through the implementation of systems, preserve capacity and improve security, safety, and reliability of the transportation system. one-stop shop for all your on-demand training needs related to TSM&O!

<https://elearning.cflsmartroads.com/flex-suggestions/>

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ON-DEMAND TSM&O TRAINING

FLEX

SIGN UP ▶ **SIGN IN**

FDOT TSM&O
Transportation Systems Management & Operations

FLEX offers eLearning and blended learning courses to provide complete, flexible training solutions. Users are able to complete online training at their own pace, while individuals and organizations can overcome obstacles such as scheduling, reaching remote employees, and diverse learning styles.

- Consistency**
eLearning training ensures all users learn all topics necessary while allowing for consistency in eLearning training.
- Knowledge**
Users can take courses on topics difficult to them and complete the course at their own pace.
- Convenience**
Users can complete online courses anytime and anywhere with internet access. Courses can be completed at home or on the go, on any preferred desktop or tablet device.


Study at Your Own Pace

A valuable tool to support the TSM&O workforce development

▶ **REGISTRATION**

Need Technical Support? **Have a Course Suggestion?**

Open a Support Ticket Submit a Course Suggestion



All Courses

Get ready to FLEX!

Don't see a course, webinar, or topic you are looking for...

Suggest it!



Home All Courses Flex Profile **ALL COURSES**

Suggestion

We are excited to hear about your course suggestions!
Please do not request technical support through this form.

Name *

First Last

Email *

Enter Email Confirm Email

Suggestion *

Would you like us to contact you regarding this suggestion? *

Yes
 No

SUBMIT

Home All Courses Flex Profile **ALL COURSES**

Complete, flexible training solutions. Users are able to overcome obstacles such as...

Study at Your Own Pace

A valuable tool to support the TSM&O workforce development

► REGISTRATION

<https://elearning.cfls>

a Course Suggestion?

TSM&O Focused Learning Education & Experiences (FLEX) Portal



- Troubleshooting – Request Support button
- For more information, visit: <https://elearning.cflsmartroads.com>
 - Google: “FDOT FLEX Portal”

National Highway Institute

- National Highway Institute courses
 - Planning for TSMO – Intro
 - Planning for TSMO – Concepts and Applications
 - Multiple ITS courses (procurement, types of devices, systems engineering, etc.)
 - Transportation Cybersecurity
- fhwanhi.geniussis.com/PublicWelcome.aspx
 - or search: “NHI Blackboard”



National Highway Institute



Sign in

Access with Login.gov

Catalog

Forgot your login and/or Password? [Recover your password.](#)

If you are a new user, you should start by creating your account.

Create Account

Contact Us:
nhihd@edusupportcenter.com

Call Us At: (833) 506-3437



Alternative Login



Questions?



Connected Vehicles and Third-Party Connectivity

David Williams, VHB

Inputs



Vehicle
Location



Lights and
Sirens



AVL?
(Future)



Preemption
Definitions



Processing



Travel Path
Predictions

Outputs

Preempt
Status Light

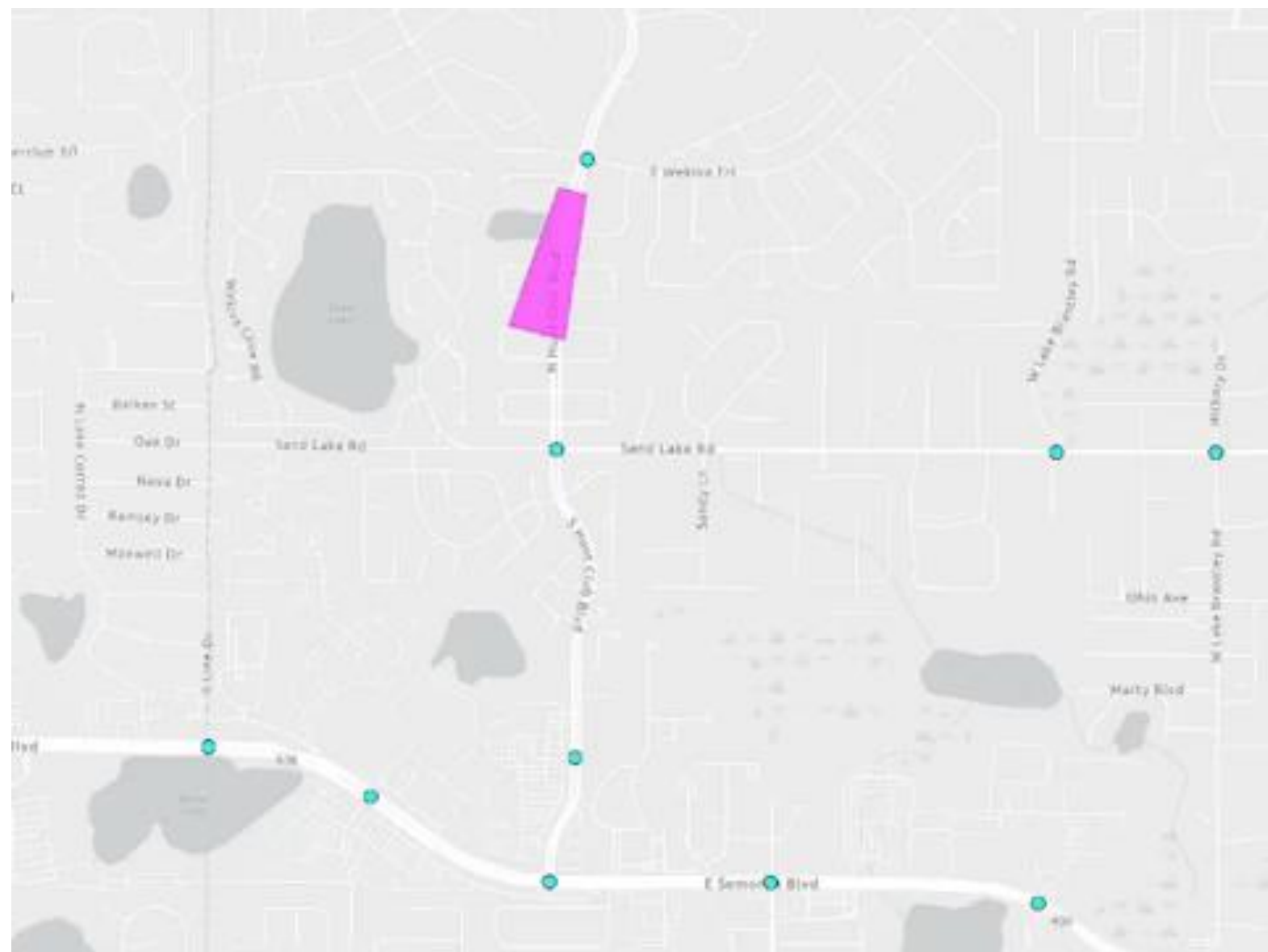


GIS
Dashboard



Signal
Preemption





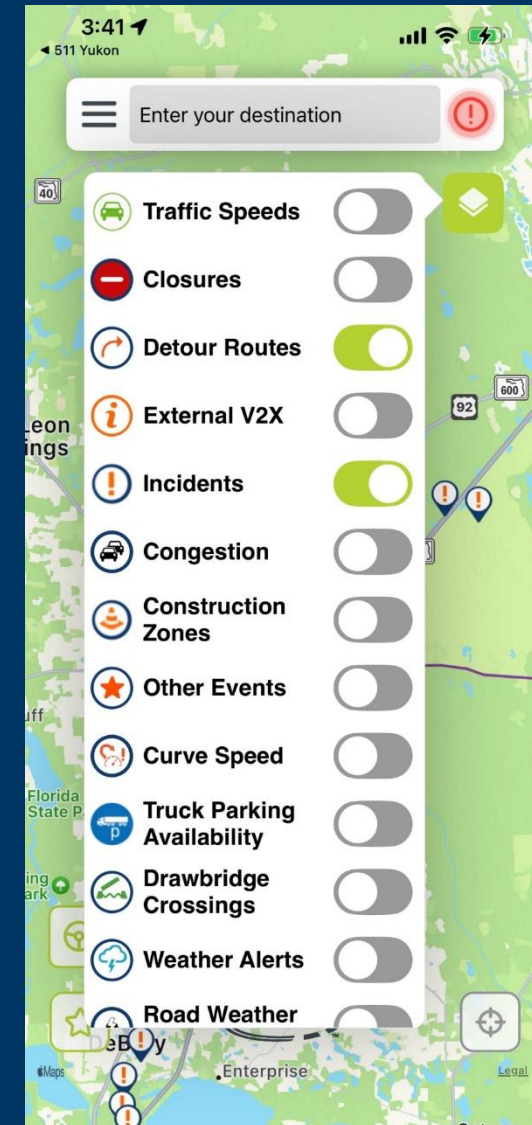


Florida 511 – CV Smartphone

Status Update

Goals Refresher:

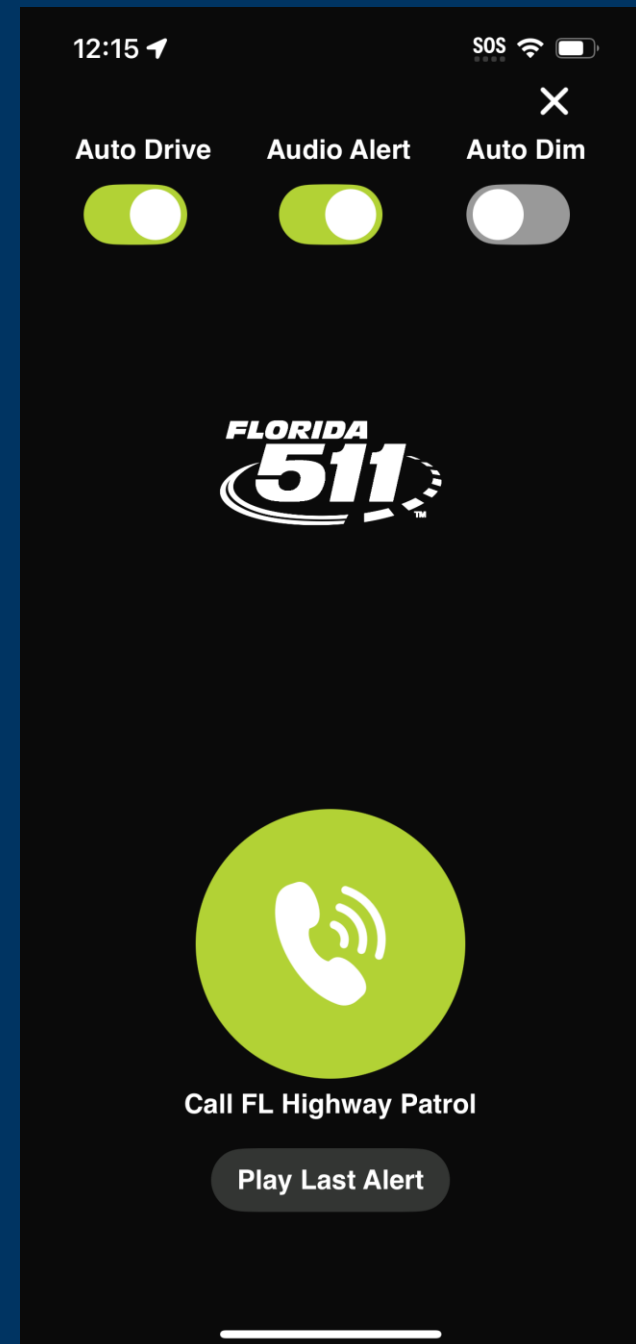
- Fill the gap as OEMs work to increase penetration rate so we can leverage CV technology benefits now.
- Provide safety related TIM messages to the public now using the FL511 Mobile Application.
- Statewide software working together leveraging each others' efforts into a singular solution for FDOT. FL511, DIVAS, SunGuide, and V2X DEP



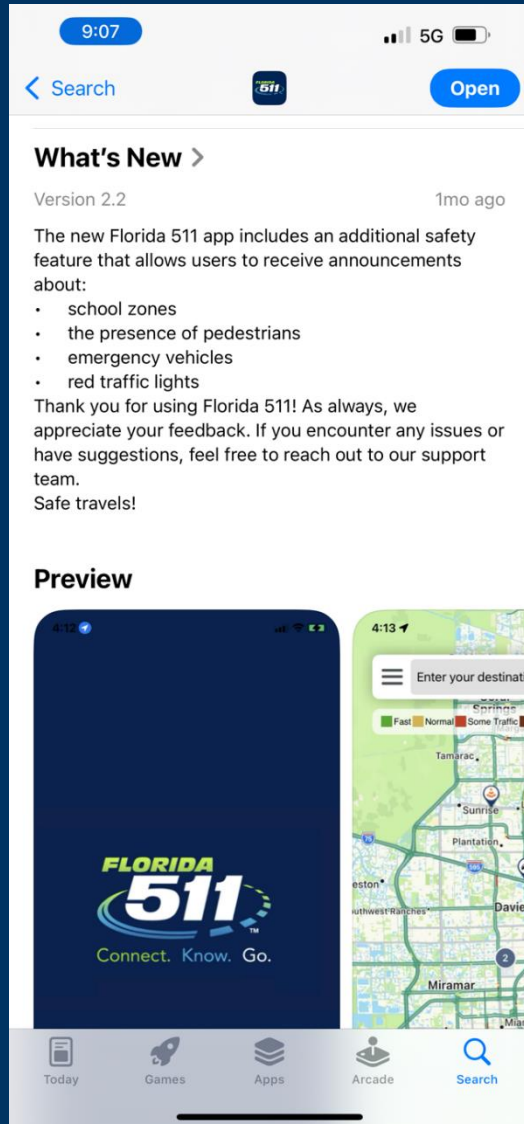
FL511 Project Update

Project Status Update:

- This is in production. It's available in iOS and Android. I know it went live in the iOS App Store on August 26th.
- Recommend if you already have the FL511 app on your phone delete it and reinstall from the app store for a clean latest build.



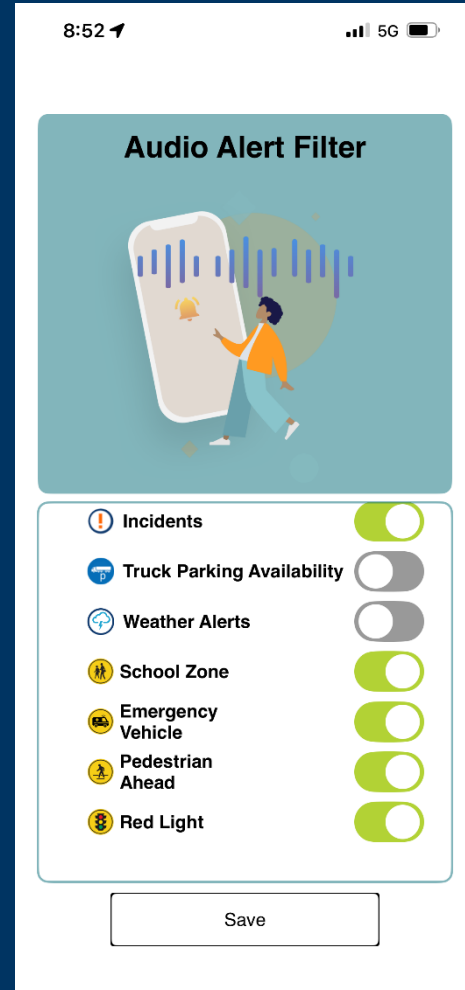
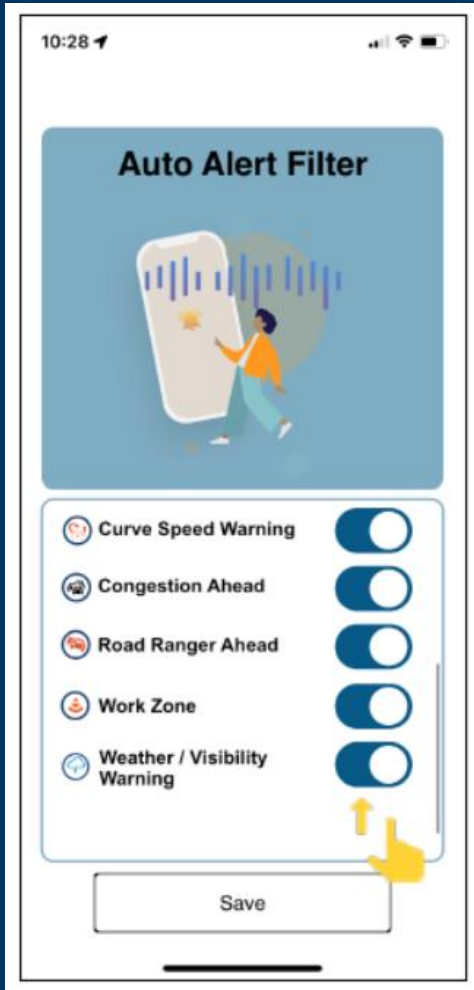
What's New



- You can see the What's New description in the App Store.
- It lists out the Travel Safely CV message types.
- The Safety related TIM message fall under traditional categories already for sorting.

Features

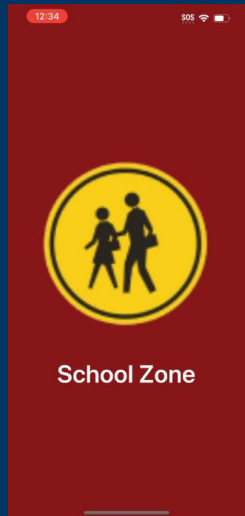
- Audible Drive Mode Alert Filters



- Curve Speed was created but disabled and not pushed to the app store.
- Safety Related TIM messages fall in the Congestion Ahead, Work Zone, Incidents categories
- TravelSafely device alerts are the 4 at the bottom.

Features - Travel Safely Applications included in the SDK

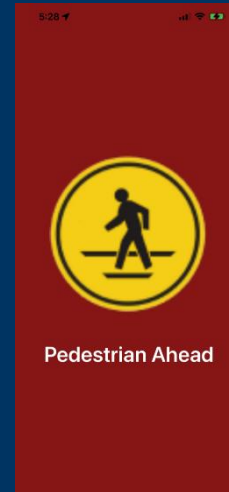
- Images have been disabled for only audible.
- School Zone we standardized the verbal message. It attempting to report end device configured speed limits that may or may not have been set up by each agency since I was getting a lot in units of meters.



Caution, School Zone Ahead



Caution, Emergency Vehicle Ahead



Warning, Pedestrian Ahead



Caution, Red Light ahead

Features - BSM Input/Output

BSM Input data

```
ta511-test.lbigrouppmobile.com/ext_api/fl511/v1/alert_report/list?api_key=FLGZZAIBDCMOU1RQ&startDate=2023-11-08

[
  {
    "metadata": {
      "id": "750c1771-9d5a-40f7-bb1f-8a9579553bb0",
      "schemaversion": "v1",
      "time": {
        "occurred": "2023-11-08 02:24:02.000",
        "duration": null,
        "ingested": "2023-11-08 02:24:03.000",
        "generated": "2023-12-07 13:27:37.959",
        "processed": null
      },
    },
    "locations": [
      {
        "points": [
          {
            "absolute": {
              "latitude": 51.06755446999998,
              "longitude": -114.17414854999996,
              "elevation": 0,
              "radius": null
            },
            "relative": null
          }
        ],
        "relative": null
      }
    ],
    "source": {
      "producer": {
        "name": "iOS",
        "model": "iPhone",
        "type": "mobile device",
        "version": "16.5.1"
      }
    }
  }
]
```

BSM Output

-This feature was created and tested but has not gone to the app store for approval.

-We need to fully define the use case between V2X DEP and FL511 to be able to show Apple how it works since it gathers a significant amount of location data.

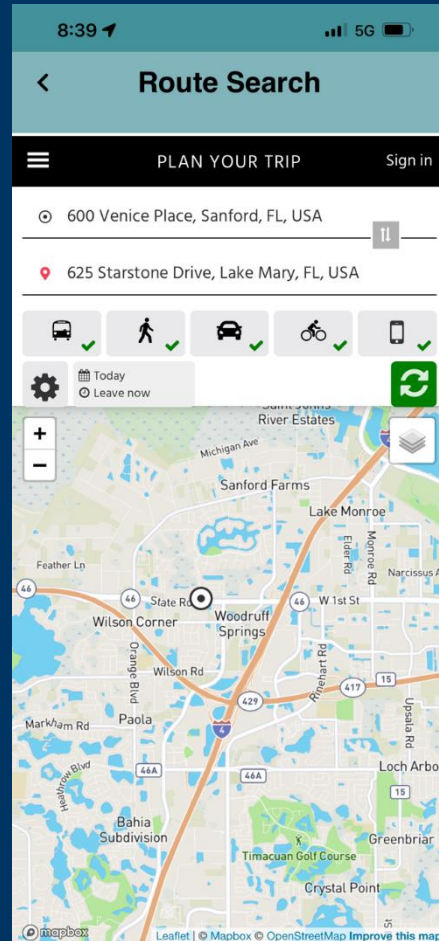
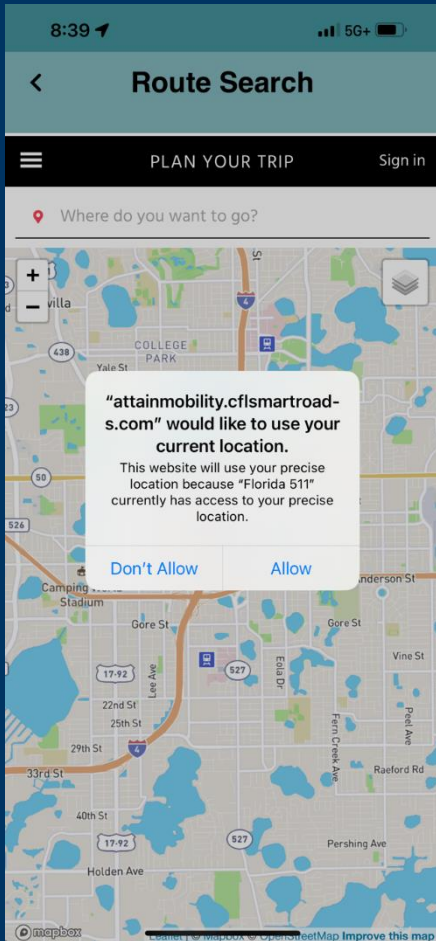
Features - BSM Output Cont'd

The FL511 mobile app will be configured to include the following attributes:

- Data Capture Delay – Value (seconds) used to determine how long to wait before collecting general telemetric data based on the configurable polling interval. The intent of this attribute is to anonymize the start of a user route.
- Polling Interval – The frequency (seconds) that will be used to capture general telemetric data (default set to 30 seconds).
- Collection Bin- The bin side of the date that is collected locally within the app before transmission to the API endpoint (default set to 5 minutes).

This will allow us a configurable mechanism to use as more connected vehicle use cases are ready to go through the approval process while allowing the V2X DEP to gather anonymized probe data information for DEP applications and dashboards.

Features - Route and Mode Choice



This feature is specific to the D5 area. Where this shows up available is based on a geofence in the back end. You can link in and plan a multimodal trip using the Route and Mode Choice Engine.



Hurricane Season

Jeremy Dilmore, FDOT District Five

Hurricane Season

Discussion

- Lessons Learned
- Successes
- Challenges and Issues



FLASH Award

Kevin Marquez, FDOT District Five

FLASH AWARD

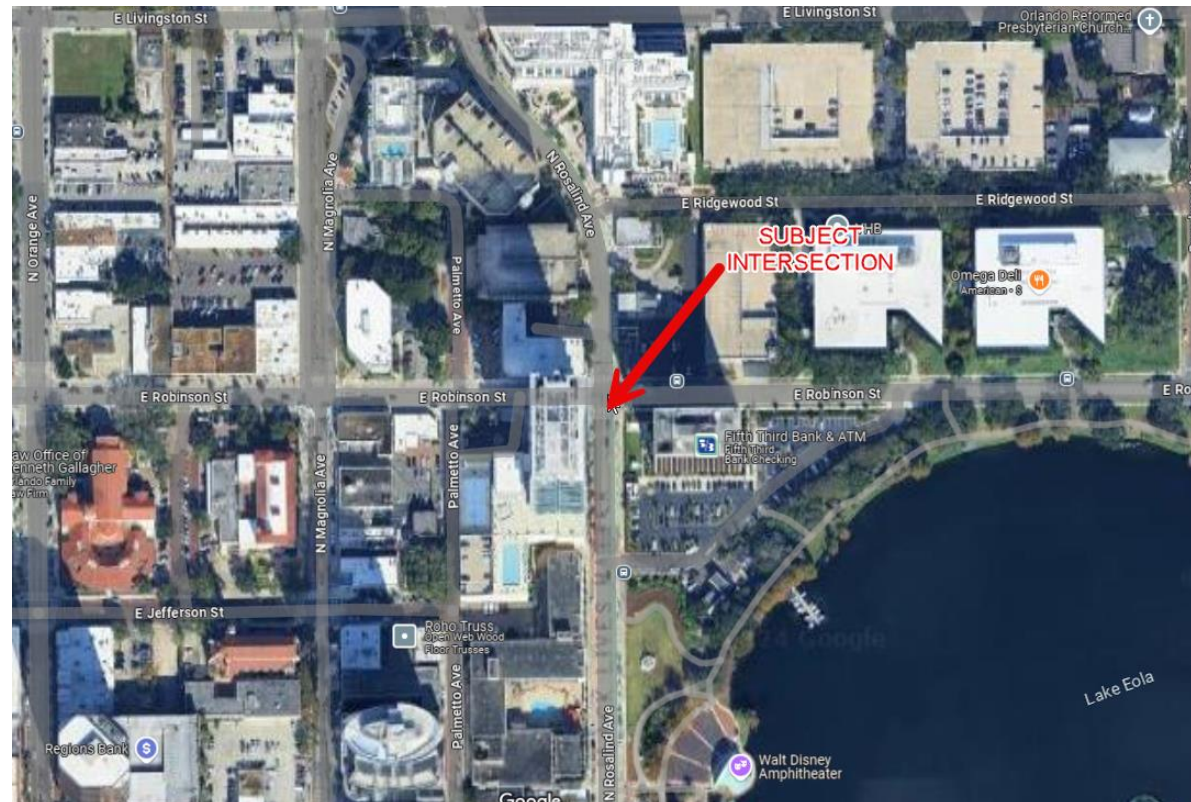
- D5 TSM&O's recognition program for outstanding maintaining agency response for traffic signal emergencies
- Focuses on showcasing specific efforts throughout D5
- Discuss processes, best practices, lessons learned, etc.



SR 526 at Rosalind Avenue City of Orlando



- On July 10th, 2023 the City of Orlando team found severe corrosion and section loss in the upright of the mast arm in the SE corner.



SR 526 at Rosalind Avenue City of Orlando

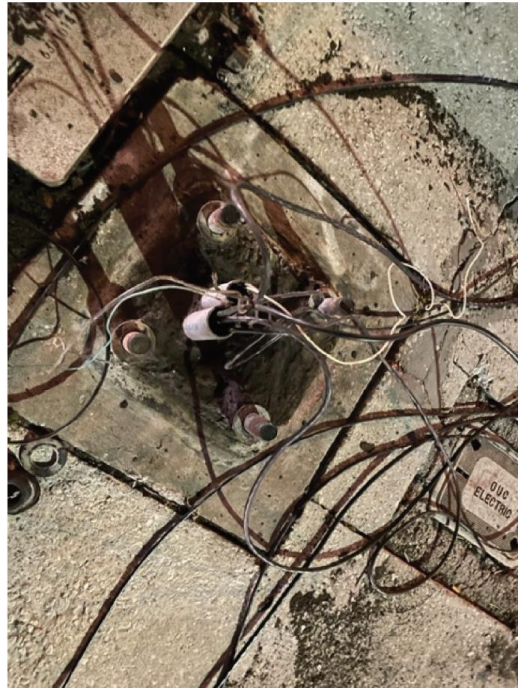


SR 526 at Rosalind Avenue City of Orlando



- Emergency Response details
 - City of Orlando staff noted advanced deterioration during routine inspection on July 10th, 2023. information was passed on to FDOT immediately.
 - On July 11th, the City of Orlando met with FDOT Structures Maintenance at the intersection, and the Department requested to remove the mast arm
 - On July 11th, the City Staff began searching for mast arm replacement, coordinating with their signal contractor (TCD) and with their MOT contractor (ACME)
 - Mast arm replacement was completed overnight and by 12:00pm on July 12th the signal was back up

SR 526 at Rosalind Avenue City of Orlando



SR 526 at Rosalind Avenue City of Orlando



- New condition



SR 526 at Rosalind Avenue City of Orlando



- Key successes

- Reliable contractor that is available 24/7
- Team expertise in identifying and prioritizing maintenance issues
- Training staff to communicate and lead contractor
- Save and store mast arms if they are in good shape, don't scrap everything during replacement projects.
 - Mast arm used came from an I-4 Ultimate replacement location
- Have a place to store materials

SR 526 at Rosalind Avenue City of Orlando

Key Staff Involved – City of Orlando:

- Steven C Jones – Traffic Operations Manager
- John W Falango – Traffic Signal Chief





Current Initiatives

Jeremy Dilmore, FDOT District Five

Annual Maintenance Meeting

- November 19, 2024, from 8:00a to 12:00p at the District 5 RTMC
- Bringing back the annual meeting to discuss:
 - ITS maintenance activities,
 - Lessons learned,
 - Best practices
- Developing agenda next few weeks
 - If you have any suggestions, please reach out to Tricia or David

Annual Maintenance Meeting

- Intended audience is maintaining agency staff:
 - Senior traffic signal technicians
 - Traffic signal technician managers
 - Traffic Engineering staff
 - Traffic Operations staff

Current Initiatives

- I-4 Express Lanes
- I-4 FRAME
- OBU Deployment

Current Initiatives

- DANIEL (Digital Analytics Notification for Incident and Event Localization)
- HEIDI (High-Definition Engineering Intersection Data via Integrative Modeling)

Current Initiatives

- PedSafe II
- CRISI Grant 2023-2024
 - Award announcements anticipated in October



Current Initiatives

- Kiosks at UCF

Current Initiatives

- Smart Work Zone
 - Mobilized in late November





THANK YOU!

Next Consortium – December 12, 2024



TSM&O Consortium Meeting

MEETING AGENDA

Teleconference or
FDOT District 5 RTMC (4975 Wilson Rd, Sanford, FL 32771)

October 24, 2024

10:00 AM-12:00 PM

- 1) AI-ENABLED ITS CAPABILITY MATURITY MODEL WORKSHOP – RECAP
 - David Williams, VHB
- 2) COMMUNICATING TSM&O RESOURCES
 - David Williams, VHB
- 3) ONLINE TRAINING OPPORTUNITIES
 - David Williams, VHB
- 4) CONNECTED VEHICLES AND THIRD-PARTY CONNECTIVITY
 - Anne Allan, AECOM
 - Katie King, Metric Engineering
 - Jeremy Dilmore, FDOT District Five Traffic Operations
- 5) FLASH AWARD FOR EMERGENCY REPAIRS – CITY OF ORLANDO
 - Kevin Marquez, FDOT District Five Traffic Operations Pushbutton Program
- 6) CURRENT INITIATIVES
 - Jeremy Dilmore, FDOT District Five Traffic Operations