

Request for Research Funding for FY 2022-2023

SPR Subpart B Project: TEO-23-23

Requesting Office	State Traffic Engineering and Operations Office	Priority	23 of 23
Proposed Title	Strategies for Transportation System Management and Operational Enhancement of Arterial Roadways		

Justification	<p>The Florida Department of Transportation (FDOT) is committed to delivering a reliable and congestion-free multimodal transportation system that moves people and goods faster, safer, and cleaner through integrated mobility solutions. Florida has experienced tremendous growth over the last few decades. As this growth continues, integrated mobility solutions are essential to keep up with our 21 million citizens and more than 131 million annual visitors. FDOT is redefining capacity, investing approximately \$10 billion per year and funding more mobility projects than ever before, including premium transit, operational improvements, and technology to improve mobility.</p> <p>Arterials play a critical role in Florida’s mobility. Of 12,130 State Highway System (SHS) miles, 4,894 miles are arterials. FDOT and local agencies are investing in SHS arterial management through technologies such as Intelligent Transportation Systems (ITS) infrastructure, communication infrastructure improvements, and upgraded traffic signal controller technologies. Additional investments are being made in Transportation Systems Management and Operations (TSM&O) strategies on over 900 miles of priority corridors, including Active Arterial Management (AAM), Integrated Corridor Management (ICM), traffic signal retiming, and traffic signal maintenance programs. Members of the Statewide Arterial Management Program (STAMP) Team are working toward developing a shared vision to support FDOT Districts and their local agencies in improving arterial safety and mobility through achievement of performance-based goals.</p> <p>This research project aims to evaluate appropriate corridor selection and arterial strategies to be selected for implementation. Specific objectives include:</p> <ol style="list-style-type: none"> 1. National overview of strategies for arterial Management & Operations (M&O) and Operations & Maintenance (O&M) 2. District survey of strategies 3. Development of guidance materials <p>Objective 1: National Overview</p> <ul style="list-style-type: none"> • Active Arterial Management (AAM) • Adaptive Signal Control Technologies (ASCT) • Integrated Corridor Management (ICM) • Automated Traffic Signal Performance Measures (ATSPM) • Managed Lanes (ML) • Emergency Vehicle Preemption (EVP) • Arterial Traffic Incident Management (ATIM) • Transit Signal Priority (TSP) • Dynamic Lane Assignment (DLA) • Freight Signal Priority (FSP) • Vision Zero with Efficient and Reliable Operations (VZERO) • Vulnerable Road Users (VRUs) Technologies • Vehicle-to-Everything Communication (V2X) • Signal Retiming • Traffic Responsive Signal Control (TRSC) • Traffic signal maintenance <p>Objective 2: FDOT District and Local Agency Survey of Strategies:</p> <ol style="list-style-type: none"> 1. Investigate maturity between entities; compare resources, experience, level of partnership. 2. Determine technologies that entities are using to monitor effectiveness of traffic operations strategies such as ASCT, ATSPM, LPIs, etc.; discuss use cases. 3. Determine how FDOT Districts partner with local agencies.
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	<ol style="list-style-type: none"> 4. Investigate traffic incident management (TIM) strategies on special signal timing plan development and implementation during interstate route diversion to major arterials due to major freeway incidents. 5. Identify key pain points of these entities such as funding, resource, and training needs during special events or emergency evacuations. 6. Identify key challenges and needs of local transportation agencies to assist FDOT to operate and maintain state roads and their major arterials. 7. Investigate components of strategies, including design, construction, signal operations, maintenance, and Complete Streets offices. 8. Determine TMC staffing layout setups for arterials. <p>Objective 3: Develop Guidance Materials:</p> <ol style="list-style-type: none"> 1. Develop characteristics of a corridor that demonstrates need for action and would support the successful implementation of enhancement strategies (e.g., context classification, traffic characteristics, etc.) and considerations for implementing strategies such as staffing within an arterial management program for selected strategies. 2. Describe and organize all arterial strategies that can be selected for implementation on selected corridors. 3. Develop performance reporting goals, such as what should be reported for safety and mobility performance to monitor the management and operations, including safety and mobility measures of effectiveness (MOEs).
Impact	<p>FDOT is redefining and reinventing the future of mobility and connectivity. The agency understands that customer needs are changing and that as these needs change, it must meet those demands with holistic and innovative solutions. This research will develop a guidance document that will assist the Central Office and Districts with coordinating with local maintaining agencies regarding TSM&O.</p> <p>There are sometimes challenges to implementing innovative TSM&O strategies on arterials, one of which relates to the ability of some local agencies to operate and maintain advanced transportation management systems and traffic control signals for FDOT Districts, especially when advanced systems such as smart intersections are involved. The Central Office and Districts are seeking priority arterial corridors where the Department may consider enhanced O&M responsibilities with maintaining agencies through a hybrid approach to further support the management, operations, and/or maintenance of the selected corridors.</p>
Affected Offices	State Traffic Engineering and Operations Office; District Traffic Operations Offices; Safety Office
Existing Work	<p>A. Mellisa, P. Mark, "Transportation System Management and Operation (TSM&O): Laying the Groundwork for Active Arterial Management in Southeast Florida," 18th ITS World Congress, 2011.</p> <p>H. Abou-Senna, E. Radwan, A. Navarro, H. Abdelwahab, "Integrating Transportation Systems Management and Operations into the Project Life Cycle from Planning to Construction: A Synthesis of Best Practices," <i>Journal of Traffic and Transportation Engineering</i>, 5(1), 2018, 44-55.</p> <p>J. H., Kodi, A. E. Kitali, M. S. Ali, P. Alluri, T. Sando, "Estimating Safety Impacts of Adaptive Signal Control Technology Using a Full Bayesian Approach," <i>Transportation Research Record</i>, 2021.</p> <p>W. Jin, M. S. Salek, M. Chowdhury, M. Torkjazi, N. Huynh, P. Gerard, "Assessment of Operational Effectiveness of SynchroGreen Adaptive Signal Control System in South Carolina," <i>Transportation Research Record</i>, 2021.</p> <p>Y. Gong, M. Abdel-Aty, J. Park, "Evaluation and Augmentation of Traffic Data Including Bluetooth Detection System on Arterials," <i>Journal of Intelligent Transportation Systems</i>, 25(6), 2021, 561-573.</p> <p>S. A. Shayeb, N. Dobrota, A. Stevanovic, N. Mitrovic, "Assessment of Arterial Signal Timings Based on Various Operational Policies and Optimization Tools," <i>Transportation Research Record</i>, 2021.</p> <p>M. Hadi, M. S. Iqbal, T. Wang, Y. Xiao, M. Arafat, S. Afreen, "Connected Vehicle Vehicle-to-Infrastructure Support of Active Traffic Management, Florida Department of Transportation, 2019.</p> <p>M. T. Tariq, "Data Analytic Approach to Support the Activation of Special Signal Timing Plans in Response to Congestion," Florida International University, 2020.</p> <p>T. Li, N. Ruiz Juri, J. Liu, H. W. Ross, R. B. Machemehl, J. Nevaes, A. Kaliszewski, "A Dynamic Traffic Assignment Approach to Evaluating Incident-Induced User Delay Costs with Integrated Corridor Management: A Case Study in Austin, Texas," International Conference on Transportation and Development, 2021, 168-180.</p>

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T. Sando, P. Alluri, R. Ponnaluri, M. A. Ackert, "States' Existing Practices in Mainstreaming TSMO in the Project Development Process," Transportation Research Board 97th Annual Meeting, 2018.

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FHWA-HOP-19-016: "Integrated Corridor Management (ICM) Program: Major Achievements, Key Findings, and Outlook."

FHWA-HOP-17-001: "Leveraging the Promise of Connected and Autonomous Vehicles to Improve Integrated Corridor Management and Operations: A Primer," 2017.

X. Lu, J. Yu, S. Pan, "Locating Continuous Exclusive Bus Lanes: A Corridor-Based Network Optimization Model," Transportation Research Board 96th Annual Meeting, 2017.

H. Hashemi, K. F. Abdelghany, "Real-time Traffic Network State Estimation and Prediction with Decision Support Capabilities: Application to Integrated Corridor Management," *Transportation Research Part C: Emerging Technologies*, 73, 2016, 128-146.

FHWA-HOP-16-042: "Integrated Corridor Management, Managed Lanes and Congestion Pricing: A Primer," 2016.

FHWA-JPO-16-396: "Integrated Corridor Management: Analysis, Modeling, and Simulation for the US-75 Corridor in Dallas, Texas – Post-Deployment Assessment Report," 2016.

J. Wallace, B. Hoefl, J. Lambert, K. Martin, N. Spiller, S. Takigawa, B. Smith, "Successful Intermodal Corridor Management Practices for Sustainable System Performance, NCHRP Project 20-68A, Scan 14-02, 2016.

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FHWA HOP-13-041, "Operations Benefit/Cost Analysis TOPS-BC User's Manual: Providing Guidance to Practitioners in the Analysis of Benefits and Costs of Management and Operations Projects," 2013.

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	<p>M. H. Morris, "How to Take Adoption of Transportation Systems Management and Operations to the Next Level," <i>ITE Journal</i>, 78(9), 2008, 18-22.</p> <p>FHWA-JPO-08-038, <i>ITS/Operations Resource Guide 2008</i>, 2008.</p> <p>Cambridge Systematics Report, "Traffic Congestion and Reliability: Linking Solutions to Problems," 2004.</p> <p>S. Qian, "Design and Demonstration of an Arterial-friendly Local Ramp Metering Control System," National University Transportation Center for Improving Mobility (Mobility21), 2021.</p> <p>T. Chase, "Identification of Unpredictable Sources of Non-recurring Congestion and Mitigating Strategies (Project A4)," Southeastern Transportation Research, Innovation, Development and Education Center (STRIDE), 2018.</p> <p>E. Tufuor, L. Rilett, S. Murphy, "Validating and Calibrating the Highway Capacity Manual Arterial Travel Time Reliability Methodology," <i>Transportation Research Record</i>, 2021.</p> <p>Y. Gong, M. Abdel-Aty, J. Park, "Evaluation and Augmentation of Traffic Data Including Bluetooth Detection System on Arterials," <i>Journal of Intelligent Transportation Systems</i>, 25(6), 2021, 561-573.</p> <p>E. O. Tufuor, L. R. Rilett, "New Travel Time Reliability Methodology for Urban Arterial Corridors," <i>Transportation Research Record</i>, 2021.</p> <p>G. Guo, Y. Wang, "Eco-Driving of Freight Vehicles with Signal Priority on Congested Arterial Roads," <i>IEEE Transactions on Vehicular Technology</i>, 70(5), 2021, 4225-4237.</p> <p>Z. Liang, Y. Xiao, Y. P. Flötteröd, "Overlapping Phase Approach to Optimize Bus Signal Priority Control under Two-Way Signal Coordination on Urban Arterials," <i>Journal of Advanced Transportation</i>, 2021.</p>
<p>Keywords Used in Existing Work Search</p>	<p>Transportation System Management and Operations, TSM&O, Adaptive Traffic Control, Active Arterial Management, AAM, Integrated Corridor Management, ICM, Arterial, Mobility, Safety</p>
<p>Related Contracts (Give contract numbers)</p>	<p>FDOT Contract No. BE548: "Application of Dynamic Crash Prediction Methodologies to FDOT Safety and Transportation System Management and Operational (TSM&O) Programs."</p> <p>FDOT Contract No. BDV29-977-46: "Developing Florida-specific Mobility Enhancement Factors (MEFs) and Crash Modification Factors (CMFs) for TSM&O Strategies."</p> <p>FDOT Contract No. BDV29-977-41: "Connected Vehicle to Vehicle-to-Infrastructure Support of Active Traffic Management."</p> <p>FDOT Contract No. BDV31-977-44: "Evaluation of Arterial Corridor Improvements and Traffic Management Plans in Florida."</p> <p>FDOT Contract No. BDV29-977-38: "Data and Modeling Support of Off-Line and Real-Time Decisions Associated with Integrated Corridor Management."</p> <p>FDOT Contract No. BDV25-977-50: "Commercial Heavy Vehicle Impacts on Signalized Arterial Corridor Performance."</p> <p>FDOT Contract No. BDV24-977-22: "Integrated Freeway/Arterial Active Traffic Management."</p> <p>FDOT Contract No. BDV27-977-12: "Development of a Traffic Map Evaluation Tool for Traffic Management Center Applications."</p> <p>FDOT Contract No. BDV34-977-10: "Evaluation of Incident Response Improvements for Statewide Application: Learnings from the New Regional Traffic Management Center in Jacksonville, FL."</p> <p>FDOT Contract Number No. BDV29 977-64: "Performance Evaluation of Connected Vehicle (CV) and Transportation Systems Management and Operations (TSM&O) Projects in Florida."</p> <p>FDOT Contract No. BDV34-977-07: "Evaluation of Project Processes in Relation to Transportation Systems Management and Operations (TSM&O)."</p> <p>FDOT Contract No. BDV32-977-05: "Before-and-After Implementation Studies of Advanced Signal Control Technologies in Florida."</p> <p>FDOT Contract No. BDV24-977-08: "Expanding Transportation Systems Management and Operations (TSM&O) from Planning to Construction Primer."</p> <p>FDOT Contract No. BDV24-977-09: "Evaluating Transportation Systems Management & Operations (TSM&O) Benefits to Alternative Intersection Treatments."</p> <p>FDOT Contract No. BDV29-977-09: "Decision Support Systems for Transportation System Management and Operations (TSM&O)."</p> <p>FDOT Contract No. BDV31-977-111: "Timely, Dynamic, and Spatially Accurate Roadway Incident Information to Support Real-Time Management of Traffic Operations."</p> <p>FDOT Contract No BDV25 TWO 977-73: "Development of Crash Modification Factors for Speed Management of Traffic Signal Progression."</p>

	<p>TRB Contract Number: Project 20-07, Task 408: “Research for AASHTO Standing Committee on Highways, Task 408, Transportation System Management and Operations (TSMO) Workforce: Skills, Positions, Recruitment, Retention, and Career Development.”</p> <p>Contract Number: GDOT RP 19-25: “Transportation Performance Management for System Operations: Development of Processes, Tools, Measures and Targets Phase II.”</p> <p>SDDOT Contract Number 311241; HRY406: “SDDOT Transportation Systems Management & Operations Program Plan.”</p>		
Funding Request	\$150,000	Anticipated Duration	15 months
Project Manager	Edith Wong, P.E.	Contracting Method	Direct contract with university (Dr. Lin)
Equipment	N/A	Comments* N/A	
Urgency	1	<p>The proposed research guidance can help in selecting TSM&O enhancement arterial corridors for integration as well as ideal strategies to be performed to improve safety and enhance mobility in time for upcoming project programming within the Department supporting the Vital Few. FDOT has adopted the Vital Few to improve safety, enhance mobility, inspire innovation, and foster talent for achieving its mission and vision of providing a congestion and fatality free transportation system. Reliability is the precondition for trust. FDOT is enhancing the reliability of the system by improving connectivity, optimizing incident management, creating smart work zones, increasing system throughput using technology, and by managing travel demand using a wide range of strategies while improving system safety. Specific activities FDOT is working on as part of the Vital Few include TSM&O enhancement arterial corridors.</p>	
Implementability	1	<p>The Vital Few initiative includes efforts to enhance operations and maintenance on arterial corridors. There are no specification, equipment, or legislative changes that need to be developed for the Districts to implement.</p>	
Project Benefits (Succinct, complete explanation)			
<p>Florida’s enhanced operation and maintenance corridors will transform transportation by providing holistic solutions at the local and regional levels. These corridors will integrate emerging technology and arterial management strategies to improve safety and mobility. FDOT will leverage partnerships with maintaining agencies to implement these emerging technology and arterial management strategies to the communities we serve. Districts will work with local agencies to identify corridors of mutual interest and determine the O&M needs along with implementation strategies and sustainable funding sources. These initiatives will increase system throughput, enhance multimodal operations, reduce delay, improve traffic and bicycle/pedestrian safety, and increase system uptime, resulting in enhanced mobility along Florida’s arterials.</p>			
Project Benefits (Select all that apply and explain)	Quantifiable Benefits (units, dollars, etc....if applicable)	Methodology or Data Sources Used to Determine Quantifiable Benefits. If not applicable, please give justification of project benefits	
○ Materials Enhancement	N/A	N/A	
○ Materials Savings	N/A	N/A	
○ Time Savings	<p>Reduced project planning time with maintaining agencies</p> <p>Total annual of reduction on travel delay in person-hours, truck congestion cost, and fuel consumption in Florida can save \$610M</p>	<p>Project outcomes include guidance materials and a strategic outline of aspects that the Districts may consider when deciding on the best method(s) to enhance O&M on their arterial corridors.</p> <p>The 2021 Urban Mobility Report provides annual congestion costs including both 2020 and 2019. Due to COVID-19 outbreak, the congestion cost in 2020 is much smaller than that in 2019. To estimate the reduction of congestion cost from future implementations of TSM&O enhancement of arterial roadways in major urban corridors, the congestion cost in 2019 is used here. There are one very large, three large, two median and one small urban area in Florida. Based on the report, there was a total of \$12.19B (2020-dollar value) congestion cost in 2019. On average, about 50% of total travel delay in these seven major Florida urban areas was on urban arterials. It is anticipated that the implementation of TSM&O</p>	

		enhancement in Florida urban corridors in the future can reduce 10% of existing traffic congestion. Therefore, the estimated saving on congestion reduction from the implementation could reach \$610M ($=\$12.19B \times 50\% \times 10\%$) in 2020-dollar value. This proposed research project is essential for the future implementation of TSM&O enhancement in Florida urban corridors.
○ Lives Saved/Injuries Prevented	Reduce fatalities and serious injuries of all road users on arterial roadways.	The project outcomes include guidance materials and a strategic outline of strategies that could be applied for both safety and mobility and measures of effectiveness that can be used to monitor change.
○ Other (Explain)		