Request for Research Funding for FY 2023-2024			
Project Number (Research Center Use Only): TEO-24-07			
Requesting Office	D5 Traffic Operations	**Priority** High	7 of 11
Proposed Title	Safety Performance Evaluation of the Transportation Systems Management and Operations (TSM&O) strategies		
Justification	Transportation Systems Management and Operations (TSM&O) strategies aim to improve traffic operations and safety of roadway networks by integrating Active Traffic Management (ATM) strategies and Intelligent Transportation Systems (ITS) applications. In Florida, TSM&O strategies have been adopted to improve safety and mobility on freeways and arterials. For instance, High Occupancy Vehicle (HOV) lanes, High Occupancy Toll Lanes (HOT), Road Rangers, Ramp Metering Systems (RM), and Dynamic Message Signs (DMS) were implemented along multiple freeways in Florida. The primary goal of this research is to evaluate the safety performance of TSM&O strategies on different types of crash types and severities in Florida and other states in the United States. This research will focus on expanding the safety evaluation to a microscopic level and explore the impact of combination of two or more TSM&O strategies along the same roadway segments. In the literature, most of the analysis was carried out using limited data from one or two states only to evaluate a certain strategy. Hence, aiming to bridge the research gap, this research will consider evaluating the safety impacts of TSM&O strategies including Variable Speed Limits (VSL), Variable Advisory Speed Limits (VAS), High Occupancy Vehicle (HOV) Lanes, Express Lanes (EL), and Ramp Metering (RM) on all crash types and severities. The team will utilize high-resolution traffic data along with crash data and active traffic management data in the safety evaluation. The team collected and archived traffic data, crash data, and active traffic management data from nine states including Arizona, California, Colorado, Florida, Georgia, Kansas, Michigan, Missouri, North Carolina, Oregon, Texas, Virginia, Washington, and Wisconsin. Thus, in this research data from multiple states will be utilized to explore the safety effects of different traffic management strategies considering different traffic patterns, geometric characteristics, driving behavior in different states. Further, this research will evaluate the effect of combined TSM&O strategies and compare it to the effect of implementing only one strategy along roadway segments. For instance, the safety and mobility effects of implementing both ramp metering and HOV lanes along the same roadway segments will be explored. Another example is to evaluate the safety impacts of implementing Express Lanes and Variable Speed Limit Signs along the same roadway segments. Multiple combinations of strategies could be considered based on the availability of the data. An extensive comparison will be conducted to compare between the impact of different strategies and multiple combinations of strategies on all crash types and severities. On the other hand, in this research, roadway segment types also will be considered during the analysis. The team will perform the safety evaluation of the TSM&O strategies considering the segment type (i.e., urban, rural, merge, diverge, weaving, or ramp). In addition, this research will focus on exploring the different exogenous geometric variables (e.g., barrier type, lane width, shoulder width, access points) and the parameters that reflect the driving behavior that might have an influence (positive or negative influence) on safety performance. On the other hand, since there is a limited literature that focused on the safety implications that affect secondary crashes. This research will investigate the effect of different TSM&O strategies on secondary crashes. Hence, high-resolution real-time data will be utilized to explore the effects of different strategies on short-duration safety and on the occurrence of secondary crashes. In order to achieve the research objectives. Before-after analysis or cross-sectional methods along with statistical and/or machine learning modeling will be conducted. Further, if needed the team could conduct driving simulator experiments to evaluate a certain combination of TSM&O strategies. The analysis of this research could enable practitioners and policymakers to better understand the crash risk assessment and safety evaluation of different TSM&O strategies. Thus, this research will recommend the potential effective strategies to enhance safety and reduce the number of crashes as well as crash severities. It will also explore if certain combinations of strategies or specific geometric variables could have a negative influence on crash occurrence. Further, it will enable practitioners to combine between two or more TSM&O strategies to maximize the crash reduction, hence, better improvement to safety.		
Impact	This research will provide recommendations to implement certain TSM&O strategies to improve safety considering different crash severities and crash types. Further, it will provide suggestions to combine two or more strategies along the same roadway segments. It will also give recommendations to avoid implementing certain combinations of strategies if combining them will result in a negative impact on traffic safety. The		

	importance of this research is to reduce the number of crashes on freeways and/or arterials, hence, improve road users' safety and save more lives.		
Affected Offices	State Traffic Engineering and Operations; State Safety Office; District Traffic Operations; District Safety Offices		
Existing Work	Research exist in evaluating few TSMO strategies, however combining strategies could lead to negative safety results or exacerbate safety problems. Previous studies have focused on exploring the safety and mobility effects of Transportation Systems Management and Operations (TSM&O) strategies on freeways and arterials including -but not limited to- High Occupancy Vehicle (HOV) lanes, Express Lanes (ELs), Variable Speed Limits (VSL), Ramp Metering (RM), Dynamic Message Signs (DMS), Hard Shoulder Running, and Transit Signal Priority (TSP). The analysis of the previous research was conducted using statistical methodologies such as Empirical Bayesian (EB) before-after analysis, crash risk models, and statistical t-tests. Further, previous studies were conducted using data from one or two states only (e.g., Florida, California, Virginia, and Texas).		
Keywords Used In Existing Work Search	TSMO, ITS, Variable Speed limit, Ramp Metering, Hard Shoulder Running, HOV lanes, HOT lanes, Express lanes, safety, risk		
Related Contracts (Give contract no)	None		
Funding Request	$350K	**Anticipated Duration**	24 months
Project Manager	Jeremy Dilmore Co-PM: Fred Heery	**Contracting Method**	Direct Contract UCF: Dr. Mohammed Abdel-Aty
Equipment	Estimated equipment cost (or N/A)	N/A	
Urgency	1= highest, most immediate need	Important to consider safety in implementing TSMO strategies and combination	
Implementability	1=greatest likelihood of and proximity to implementing results	New suggestions of TSM&O strategies implementation and combining two or more strategies along the same roadway segments. Change to existing TSM&O strategies or combinations of strategies if it has a negative influence on safety and/or mobility.	

Project Benefits (Succinct, complete explanation)
This research will provide recommendations to implement certain TSM&O strategies to improve safety considering different crash severities and crash types. Implementation of TSMO strategies will be coupled with their safety impact. Thus, we will be able to avoid safety concerns and achieve both efficiency and safety in implementing one or more TSMO strategies.

Project Benefits	**Quantifiable Benefits (units, dollars, etc)**	**Methodology or Data Sources Used to Determine Quantifiable Benefits. If not applicable, please give justification of project benefits**
o Materials Enhance		
o Materials Savings		
o Time Savings	✓	Enhancing the mobility of road users, hence, reducing their travel time.
o Lives Saved/Injuries Prevented	✓	Evaluating the safety performance of single and combined TSM&O strategies will lead to improving safety by reducing/preventing hundreds of crashes, hence, lives.
o Other (Explain)	✓	Expedite implementation of successful TSMO strategies

*Comments should explain and support urgency, financial benefit, and implementability scores