

**Request for Research Funding for FY 2019-2020**

<b>Requesting Office</b>	District 7	<b>Priority</b>	# of #
<b>Proposed Title</b>	Data based impact analysis of transit operations with autonomous vehicle technologies		
<b>Justification</b>	<p>Autonomous vehicles are particularly promising for public transit with fixed routes and relatively simple driving environment. Particularly for Florida as a tourist state, multiple cities (e.g., Tampa, St. Petersburg) have been implementing deployment of autonomous shuttles on individual routes. For Example, Pinellas Suncoast Transit Authority (PSTA) plans to deploy an autonomous shuttle in downtown St. Petersburg in Fall 2019. And it is likely in the near future that autonomous fleet will replace a significant portion of traditional bus services. However, there is no study on the impacts of autonomous buses on a transit system when they are deployed widely across the system network. A number of questions concerning future planning and operations of transit authorities are unaddressed without quantitative knowledge on such impacts. For example, how would the introduction of the autonomous buses will affect current operational cost structure, service quality and labor force? How do the planners prepare for the transition from the current fleet to future autonomous vehicle fleet?</p> <p>This research aims to propose a quantitative data-driven framework to analyze such impacts and conduct a case study with data provided by transit agencies in Tampa Bay area (e.g., PSTA). We build the analysis on the disaggregated passenger boarding and alighting data (including locations and time) that reflect the detailed time-space transit demand information, in addition to traditional data such as vehicle fleet and transit infrastructure. Currently, PSTA has been collecting such data and promised to share such data with USF for the research. We will investigate the cost and operational characteristics of existing deployed autonomous vehicles and emerging modular pod technologies (e.g., vehicle pods can dynamically dock and undock to form vehicles of different lengths). Then we will apply the cost and operational characteristics of the autonomous buses to the existing demand data, and quantify the following measures.</p> <ul style="list-style-type: none"> <li>• First, we will measure how much planning cost is needed to replace a certain portion of the existing service coverage with autonomous vehicles. Operational cost savings (e.g., staff, energy and maintenance) compared with the existing system will be quantified. Factors such as autonomous buses' capacity, operational speed and other limits will be considered in this analysis</li> <li>• Second, we will explore with the same budget level, how much improvement on service quality (e.g., in terms of spatial coverage and temporal frequency) can be made with autonomous buses.</li> <li>• Finally, we will analyze how the newer technologies will impact the labor force. We will discuss the reduction on driver-hours, and the increase of other potential jobs (e.g., IT related jobs).</li> </ul>		
<b>Impact</b>	<ul style="list-style-type: none"> <li>• Help agencies understand the cost, benefit and impacts of new autonomous buses.</li> <li>• Enable decision making for future investment and operations on autonomous vehicle technologies in transit systems and related infrastructure.</li> <li>• Provide means of improving existing transit systems with emerging technologies.</li> <li>• Utilize emerging data sources for better planning and operations</li> <li>• Without the research, transit agencies and relevant stakeholders may miss the opportunities of utilizing emerging technologies to enhance existing systems.</li> <li>• While the Tampa Bay study apparently benefits relevant stake holders in District 7, the proposed framework, methods and measures will be generally applicable to most transit agencies and related stakeholders in Florida</li> </ul>		
<b>Affected Offices</b>	Modal Development Office, State Traffic Engineering and Operations, Pinellas Suncoast Transit Authority		
<b>Existing Work</b>	<ol style="list-style-type: none"> <li>1. Nasser, A., Brewer, J., Najm, W., &amp; Cregger, J. (2018). Transit Bus Automation Project: Transferability of Automation Technologies Final Report (No. DOT-VNTSC-FTA-18-02). United States. Federal Transit Administration. Office of Research, Demonstration, and Innovation.</li> <li>2. Chen., Z., Li, X. &amp; Zhou, X., "Operational design for shuttle systems with modular vehicles under oversaturated traffic: Discrete modeling method." Transportation Research Part B, under revision.</li> </ol>		

	<p>3. Sisinnio Concas, Xuehao Chu, Steve Polzin, Economic and Community Benefits of Urban Fixed-Route Transit in Florida FDOT Report.</p> <p>Overall, despite some relevant studies on autonomous shuttle and modular vehicle technologies, no existing study focuses on system operations and impact analysis of an autonomous bus system.</p>		
<b>Keywords Used In Existing Work Search</b> (Cannot leave blank)	Autonomous bus, autonomous shuttles, modular vehicles, data-driven, cost & benefits,		
<b>Related Contracts (Give contract numbers)</b>	N/A		
<b>Funding Request</b>	\$100,000	<b>Anticipated Duration</b>	15 months
<b>Project Manager</b>	Ming Gao	<b>Contracting Method</b>	Through a statewide contract with the university
<b>Urgency</b>	1	As the AV pilot project is anticipated to be implemented by PSTA later this year, we want to take advantage of this opportunity to evaluate the effects of the project while it is in operation.	
<b>Implementability</b>	2	The research result will enable informed decision making by the department and transit agencies for future investment and operations on autonomous vehicle technologies in transit systems	
<b>Project Benefits (Succinct, complete explanation)</b> This research will help the department and transit agencies understand the cost, benefit and impacts of new autonomous buses. It will enable decision making for future investment and operations on autonomous vehicle technologies in transit systems and related infrastructure by providing means of improving existing transit systems with emerging technologies.			
<b>Project Benefits</b> (Select all that apply and explain)	<b>Quantifiable Benefits</b> (units, dollars, etc...if applicable)	<b>Methodology or Data Sources Used to Determine Quantifiable Benefits. If not applicable, please give justification of project benefits</b>	
<input type="radio"/> Materials Enhancement	Enhance transit fleets with autonomous vehicles	Data: Disaggregated boarding/alighting data from PTSA; vehicle specifications from vendors of autonomous vehicles (e.g., NAVYA) and modular vehicles (e.g., NEXT Future Transportation Inc.)	
<input type="radio"/> Materials Savings	Reduce the fleet and driver cost	Data: Disaggregated boarding/alighting data; existing cost structure of the transit fleet from PTSA; vehicle specifications from vendors of autonomous vehicles (e.g., NAVYA) and modular vehicles (e.g., NEXT Future Transportation Inc.)  Methodology: Optimization methods; simulate future scenarios with the demand data and compare them with existing operational cost data	
<input type="radio"/> Time Savings	Improved travel time for transit riders	Data: Disaggregated boarding/alighting data from PTSA; existing bus schedules and routes from PTSA; vehicle specifications from vendors of autonomous vehicles (e.g., NAVYA) and modular vehicles (e.g., NEXT Future Transportation Inc.)  Methodology: Optimization methods; simulation; comparative studies	
<input type="radio"/> Lives Saved/Injuries Prevented			
<input type="radio"/> Other (Explain)	Improve the service coverage and quality	Data: Disaggregated boarding/alighting data from PTSA; existing bus schedules and routes from PTSA; vehicle specifications from vendors of autonomous vehicles (e.g., NAVYA) and modular vehicles (e.g., NEXT Future Transportation Inc.)  Methodology: Optimization methods; simulation; comparative studies	

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