

Request for Research Funding for FY 2021-2022

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| Requesting Office | State Traffic Engineering and Operations | Priority | 8 of 15 |
| Proposed Title | Toward a Florida Automated, Connected, Electric and Shared (ACES) Transportation System Roadmap: Phase II | | |
| Justification | <p>Describe the current situation, why the research is needed, and how the research affects your office’s mission critical focus areas.</p> <p>Current Situation:</p> <p>A dramatic and swift transformation of U.S. transportation through the development and adoption of Automated, Connected, Electric and Shared (ACES) transportation systems is currently underway. The Florida Department of Transportation (FDOT) is leading the way with the Florida Connected Vehicle Initiative and several Transportation Systems Management and Operations (TSM&O) initiatives that incorporate ACES elements. A constantly increasing number of projects are related to ACES and are in various stages of development or underway in Florida.</p> <p>In addition to FDOT, many agencies and transportation industries across Florida play key roles in the advancement of ACES technologies, such as the Tampa Hillsborough Expressway Authority (THEA), Florida’s Turnpike Enterprise (FTE), the Central Florida Expressway Authority (CFX), the Miami-Dade Expressway Authority (MDX), Hillsborough Area Regional Transit (HART), etc. Technologies are evolving quickly, and new ACES-related projects are constantly underway.</p> <p>Significant progress has been made in Phase 1 of FDOT BDV25 TWO 977-64, “Toward a Florida Automated, Connected, Electric and Shared (ACES) Transportation System Roadmap,” which has five major milestones:</p> <ol style="list-style-type: none"> 1. Form a leadership group and establish an initial Florida ACES Roadmap structure. 2. Design and pilot collaboration platforms. 3. Design and pilot a Florida ACES roadmap database and activity viewer. 4. Design and conduct Florida ACES roadmap outreach. 5. Plan and conduct a Florida ACES Roadmap kickoff and a university initiative. <p>CUTR has successfully accomplished the first three major milestones and is working on the fourth and fifth, which are expected to be completed in January and February 2021, respectively. Two important accomplishments in Phase 1 include development of a comprehensive and functional Florida ACES Roadmap database and activity viewer and Florida ACES Roadmap outreach materials.</p> <p>A brief description of the Florida ACES Roadmap database and activity viewer is provided below. CUTR developed a comprehensive and functional Florida ACES Transportation System Roadmap with a user-friendly graphical interface as a web-based portal, which includes a spatial distribution of the Florida ACES effort, an interactive portal with up-to-date project information, and seamless data-sharing. The Roadmap portal was structured with two major components—the Florida ACES Roadmap database and an activity viewer. The database currently includes an initial inventory of past, current, and planned ACES initiatives or projects in Florida with information including project general information, technical summary, ACES category, project type, timeline, products, datasets, images, performance measures, and last update. The activity viewer presents a detailed and multi-layered interface of this project information and accounts for projects at the point, corridor, and larger geographic area levels of spatial distribution.</p> <p>To promote the ACES Roadmap and increase awareness of the statewide transportation workforce on ACES, CUTR developed Florida ACES Roadmap outreach materials to reach Florida stakeholders, FDOT districts, local transportation agencies, university communities, and transportation professionals. The project team is actively conducting outreach activities via online meetings and communications and is working with the</p> | | |

Florida Local Technical Assistance Program (LTAP) Center to conduct a webinar in January 2021 to introduce the Florida ACES Program. It is expected to reach 500–1,000 people from Florida local transportation agencies, the FDOT Central Office and Districts, transportation industries, consulting companies, and major universities as well as participants outside Florida.

Why the research is needed:

ACES technologies have become popular and essential and will continue to impact the development of vehicles, infrastructure, communities, commerce, and the economy; these technologies are evolving quickly. The Phase 1 project focuses on the development of a Florida ACES Roadmap database and activity viewer, statewide outreach and promotion of the Florida ACES program, and initial engagement of Florida ACES stakeholders on project data input. The Phase 2 project is needed to actively engage and collaborate with the Florida ACES Roadmap leadership group and stakeholders, obtain more information on past, existing, and new projects and input them into the Florida ACES Roadmap database, and promote the Florida ACES Program to FDOT Districts and local transportation agencies for use of the Florida ACES Roadmap database and activity viewer and benefit from them.

Specifically, critical needs for the Phase 2 project are to (1) obtain more information on past, existing, and new projects and input them into the Florida ACES Roadmap database, (2) engage Florida ACES stakeholders to regularly update their projects, (3) promote use of the Florida ACES Roadmap database and activity viewer to FDOT Districts and Florida local transportation agencies, (4) enhance the Florida ACES Roadmap database and activity viewer based on input and feedback from users, and (5) expand the initial university initiative to reach more academicians, researchers, and students to use the Florida ACES Roadmap database and activity viewer.

How the research affects your office’s mission critical focus areas:

FDOT’s mission is to provide a safe transportation system that ensures the mobility of people and goods, enhances economic prosperity, and preserves the quality of Florida’s environment and communities. The mission of FDOT Traffic Engineering and Operations is to improve safety and mobility through the efficient application of traffic engineering principles and practices. This proposed project fully supports the mission of FDOT on safety and mobility; the developed Florida ACES Roadmap will serve as a resource hub to share ACES data, findings, and best practices among the public and private sectors and will encourage and expand communication, cooperation, and collaboration among these sectors to facilitate the development, implementation, and evaluation of promising ACES technologies to improve safety and mobility on Florida’s roadway network.

Research Objectives:

The goal of the Phase 2 project is to build on the foundation of the Phase 1 project to actively collaborate with the Florida ACES Roadmap leadership group and stakeholders, produce a comprehensive Florida ACES Roadmap database with high-quality and high-quantity ACES projects, and promote use of the Florida ACES Program and tools to Florida local transportation agencies.

Major objectives of the Phase 2 project include:

- Obtain and input high-quality and high-quantity ACES projects into the Florida ACES Roadmap database through a close collaboration with Florida ACES stakeholders and academic researchers.
- Actively engage Florida ACES stakeholders and academic researchers to regularly update their projects.
- Promote the use of the Florida ACES Roadmap database and activity viewer to FDOT Districts and Florida local transportation agencies.
- Enhance the Florida ACES Roadmap as a resource hub to share ACES data, findings, and best practices among the public and private sectors, and expand communication, cooperation, and collaboration among these sectors.
- Expand the initial university initiative to reach more academicians, researchers, and students to use the Florida ACES Roadmap database and activity viewer.

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| | <ul style="list-style-type: none"> • Raise and share awareness, capabilities, and expertise of transportation professionals in Florida and leverage expertise and funding across multiple jurisdictions and sectors statewide. |
| <p>Impact</p> | <p>How shall the results impact practice? Consequences of not doing the research?</p> <p>Development and adoption of ACES transportation systems continue to impact vehicles, infrastructure, communities, commerce, and the economy. Florida has been a leading state in research and implement of ACES technologies, with a large number of TSM&O initiatives incorporating ACES elements. It is critical to maintain coordination and encourage greater collaboration among these initiatives and other research, development, testing, deployment, demonstration, evaluation, and educational initiatives in the ACES arena. With the success, product, and lessons learned from Phase 1 as a foundation, this proposed Phase 2 project will continue to maintain satisfactory quality of the Florida ACES Transportation Roadmap Initiative database, update existing and collect new project information to enrich the database, improve the interface and functionality of the Florida ACES Roadmap portal, and promote Florida as a leading state in ACES technology development and implementation. The improved Florida ACES Transportation Roadmap portal will serve as an interactive resource hub to share ACES data, findings, and best practices among the public and private sectors, improve communication, collaboration, and coordination, leverage investments, and position Florida as a leader in the planning, development, deployment, and evaluation of emerging technologies to improve the safety and mobility of people and goods. It will also raise and share awareness, capabilities, and expertise of Florida transportation professionals.</p> <p>Consequences of <u>not</u> conducting the research include the following:</p> <ul style="list-style-type: none"> • FDOT will not obtain and maintain a satisfactory quality and quantity of the Florida ACES Roadmap database. • FDOT will not be able to increase the engagement as expected of stakeholders to collect completed, ongoing, and new ACES project information, and timely update the Florida ACES Roadmap database. • FDOT will not be able to assess the existing interface and functionality of the Florida ACES Roadmap Initiative portal, identify key functions to be added or enhanced, or improve the interface and functionality of the portal. • FDOT will not be able to enhance the Florida ACES Roadmap as a resource hub to share ACES data, findings, and best practices among the public and private sectors and encourage and expand communication, cooperation, and collaboration among these sectors; • FDOT will not conduct further ACES outreach to in-state transportation agencies, other state DOTs, and regional and national organizations to promote Florida as a leading state in ACES technology development and implementation. • FDOT cannot continue to raise and share awareness, capabilities, and expertise of the transportation professionals in Florida. |
| <p>Affected Offices</p> | <p>Identify any office that will need to be involved in the scoping or conduct of the research, will be affected by implementation of the results, or will need to participate in the implementation process—including OTIT, if enterprise data/network software application will be a deliverable, and district staff, as appropriate, e.g., through statewide meetings. If the requesting office will not be the implementing office, please identify which office will have to serve in that capacity—has it been involved?</p> <p>FDOT Traffic Engineering and Operations Office</p> |
| <p>Existing Work</p> | <p>Although there have been abundant research projects or studies conducted regarding specific components in ACES areas, such as automated, connected, electric, or shared vehicles, etc., few studies have been conducted on ACES transportation as an integrated topic, database and activity reviewer, as it requires much interdisciplinary knowledge and experience in research and significant coordination and collaboration effort at the national, regional, state, or/and local level. The existing literature provides insight on the development and implementations of autonomous, connected, electric, and shared vehicle technologies, as follows:</p> <p>Ensuring American Leadership in Automated Vehicle Technologies: Automated Vehicles 4.0 (USDOT, 2020) – Unified efforts in automated vehicles across 38 federal departments, independent agencies,</p> |

commissions, and Executive Offices of the President, providing high-level guidance to federal agencies, innovators, and all stakeholders on the U.S. Government's posture towards AVs.

Autonomous and Connected Vehicles: Preparing for the Future of Surface Transportation (HDR, Inc, 2015) – Introduced development of autonomous and connected vehicles, innovative and tech-safety features from automotive industry, and their impacts on transportation safety, mobility and the environment, similar to how the automobile has revolutionized transportation.

The Impacts of Emerging Mobility Options and Vehicle Technologies on Travel Behavior (Xia Jin, Florida International University, BDV29-977-47, January 2019–July 2020) – Investigated potential travel behavior changes that may result from introduction of ACES technologies, provided insights on how the public views autonomous and connected vehicles and what role these vehicles are likely to play in the travel choices.

Autonomous, Connected, Electric Shared Vehicles (ACES) and Public Finance: An Explorative Analysis (Alder, M., Peer, S., and Sinozic, T., Tinbergen Institute Discussion Paper 2019-005/VIII, 2018) – Discusses implications of ACES for public finance, which have so far been widely ignored. The realization of socioeconomic benefits of ACES depends on the implementation of tailored public finance policies; in particular, the introduction of road tolls in line with “user pays” and “polluter pays: principles will become more attractive, and innovation in taxation schemes to fit the changing technological circumstances may alter the (relative) importance of levels of governance in transport policy making, likely shifting power towards local (in particular urban) governmental levels.

Impact of Shared and Autonomous Vehicles on Travel Behavior (Eluru, N., and Choudhury, C.F., Transportation, 46, 1971–1974, 2019) – Summary of how the combination of autonomous vehicle technology and ride-sharing and/or mobility-on-demand services will lead to even more radical changes in travel behavior, based on a TRB Special Issue on transportation, including eight articles on new research questions and challenges by employing innovative and rigorous quantitative approaches that encompass a wide range of behavior models and simulation techniques in different countries and contribute to a smoother transition to the new mobility landscape.

Impact of Automated, Connected, Electric, and Shared (ACES) Vehicles (Shashank Modi, Center for Automotive Research, Ann Arbor, MI, 2018) – Interviewed experts from automakers and suppliers to understand the impact of ACES vehicles on design, materials, manufacturing, and business models. Vehicle design is driven by many factors including function and aesthetics. Interior design will be very important for ACES vehicles, and material selection will be driven by design optimization, durability, safety, lightweighting, ride experience, and needs for connectivity and automation. Revolutionary changes in legacy manufacturing plants are not expected in the near future, but new players starting from scratch have the potential to revamp manufacturing. ACES vehicles will impact business models in numerous ways. MaaS is expected to be an added business model, not a replacement for direct-to-consumer vehicle sales.

Connected Vehicle to Vehicle-to-Infrastructure Support of Active Traffic Management (Mohammed Hadi, Florida International University, BDV29-977-41, February 2018–May 2019) – Investigated CV applications that can be used to support ATM functions for urban streets, studied how CV technologies can meet ATM goals and methods to determine when they are the best choice. It shows that effective design tools and clear guidance for using them can ensure that the right technologies are put in place to make Florida roads safer and more efficient.

Integrated Freeway/Arterial Active Traffic Management. (Mohamed Abdel-Aty, University of Central Florida, BDV24-977-22, April 2017–October 2019) – Developed a decision support system (DSS) to help traffic managers apply integrated active traffic management (IATM) to improve traffic conditions on both highways and associated arterials and proved that the decision support systems can be an invaluable aid in using advanced traffic management tools to improve the efficiency and safety of Florida highway corridors.

Autonomous Vehicle (AV) and Alternative Fuel Vehicle (AFV) Florida Market Penetration Rate and VMT Assessment Study (Sisinnio Concas, University of South Florida, BDV25-977-48, October 2017–

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| | <p>October 2019) – Comprehensive market penetration analysis of autonomous and alternative fuel vehicles and their potential impacts on Florida’s vehicle miles of travel and fuel tax revenues, which will help policy-makers and decision-makers address potential budget shortfalls in fuel tax revenues as alternative fuels displace gasoline and diesel fuel in vehicles in Florida.</p> <p>Enhancing Cybersecurity in Public Transportation (Sean Barbeau, Jay Ligatti, University of South Florida, BDV25-977-51, January 2018–July 2019) – Advanced technologies promise many benefits for road users, and preventing misuse of these systems helps assure that they will successfully and safely deliver these benefits. This research developed guidance to identify and mitigate transit cybersecurity liabilities and to facilitate ongoing information exchange among Florida transit agencies, vendors, and cybersecurity researchers.</p> <p>Exploring the Modified Procurement Framework for Expediting Florida Connected Vehicle (CV) Deployments (Thobias Sando, University of North Florida; Priyanka Alluri, Florida International University, BDV34-977-11, January 2018–February 2019) – Examined CV deployments in Florida and other states to compile lessons learned and develop best practices associated with CV procurement to streamline the process for expediting future CV projects. CV technologies can support traffic management strategies that improve safety and reliability for Florida drivers. Knowledgeable procurement processes will bring these technologies to the driving public sooner and with greater efficiency.</p> | | |
| <p>Keywords Used In Existing Work Search (Cannot leave blank)</p> | <p>ACES, Autonomous vehicle, Connected vehicle, Electric vehicle, Shared mobility, Transportation, Automated driving</p> | | |
| <p>Related Contracts (Give contract numbers)</p> | <p>BDV25-977-64 – Toward a Florida Automated, Connected, Electric and Shared (ACES) Transportation System Roadmap: Phase 1 (May 2019–July 2021)</p> | | |
| <p>Funding Request</p> | <p>\$ 150,000</p> | <p>Anticipated Duration</p> | <p>18 months</p> |
| <p>Project Manager</p> | <p>Dr. Raj Ponnaluri</p> | <p>Contracting Method</p> | <p>Direct contract with USF Center for Urban Transportation Research (CUTR)</p> |
| <p>Urgency</p> | <p>1</p> | <p>Florida is a leading state in the U.S. in implementing and conducting ACES research and incorporating ACES elements in TSM&O programs. In the Phase 1 project, a user-friendly and functional Florida ACES Roadmap portal was developed, education and outreach materials were developed, initial outreach activities were conducted, and a stakeholder engagement and a university initiative were kicked off.</p> <p>As noted, ACES technologies evolve quickly. There is a critical need to (1) obtain and input high quality and high-quantity ACES projects into the Florida ACES database, (2) increase coordination and collaboration among Florida ACES stakeholders, transportation industries, and academic researchers on ACES research, development, testing, deployment, demonstration and educational initiatives, (3) promote the use of the Florida ACES Roadmap database and activity viewer to FDOT Districts and Florida local transportation agencies, and (4) maintain, update and enhance the Florida Roadmap portal. Therefore, it is urgent to conduct this proposed Phase 2 research project after the Phase 1 project to achieve all proposed important project objectives for the Phase 2 project.</p> | |

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| Implementability | 1 | In the Phase 1 project, the developed Florida ACES Roadmap Initiative portal proved to be a success in functionality and informativeness. With achievements made, lessons learned, and gaps identified in Phase 1, implementation of a Florida ACES Roadmap Initiative portal with improved functionality and a more comprehensive database is very high. The improved Florida ACES Roadmap Initiative portal will serve as a resource hub to share ACES data, findings, and best practices among the public and private sectors in Florida as well as out-of-state agencies and will encourage and expand communication, cooperation, and collaboration among these sectors in the future. |
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Project Benefits (Succinct, complete explanation)

- Collect high-quality and high-quantity completed, ongoing, and new ACES project information from stakeholders and academic researchers in Florida, and timely update the Florida ACES Roadmap database.
- Maintain completeness and accuracy of the Florida ACES Roadmap database with regular quality assurance checks.
- Improve and enhance the interface and functionality of Florida ACES Roadmap portal based on the stakeholder feedback.
- Enhance the Florida ACES Roadmap as a resource hub to share ACES data, findings, and best practices among the public and private sectors and encourage and expand communication, cooperation, and collaboration among these sectors.
- Promote Florida as a leading state in ACES technology development and implementation by continuing ACES outreach to in-state transportation agencies, other state DOTs, and regional and national organizations.
- Raise and share awareness, capabilities, and expertise of Florida transportation professionals and leverage expertise and funding across multiple jurisdictions and sectors statewide.

| 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 |
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| ○ Materials Enhancement | | |
| ○ Materials Savings | | |
| ○ Time Savings | (Indirect) Reduction on travel delay in person-hours, truck congestion cost, and fuel consumption Total congestion savings could reach \$99M per year | This proposed Phase 2 project fully supports the mission of FDOT Traffic Engineering and Operations office to improve safety and mobility through the efficient application of traffic engineering principles and practices. The successful implementation of the Florida ACES Roadmap can support FDOT Districts and local transportation agencies to use the ACES roadmap portal as a resource hub to share ACES data, findings, and best practices among the public and private sectors and encourage and expand communication, cooperation, and collaboration among these sectors to facilitate the development, implementation, and evaluation of promising ACES technologies to improve the safety and mobility on Florida's roadway network. According to a 2019 Urban Mobility Report (https://static.tti.tamu.edu/tti.tamu.edu/documents/mobility-report-2019.pdf), there was \$9.9B in total congestion costs in Florida urban areas. Assuming an average of only 1% reduction in traffic congestion by facilitating ACES elements implementation in TSM&O programs or implementing ACES vehicle services in future traffic flow, total congestion savings could reach \$99M per year (= \$9,900M x 0.01). |
| ○ Lives Saved/Injuries Prevented | (Indirect) Reduction on number of | Based on the Florida Traffic Crash Facts Annual Report 2018 published by the Florida Department of Highway Safety and Motor Vehicles, there were 3,135 crash fatalities and 236,157 crash injuries on Florida roads in 2018. Assuming only 1% reduction in traffic crash fatalities and injuries due to the implementation |

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| | <p>fatalities, injuries and crashes</p> <p>Total cost savings of lives and injuries could reach \$699M per year</p> | <p>ACES elements in TSM&O programs or implementing ACES vehicle services future traffic flow, the total number of lives that could have been saved is 31 (= $3,135 \times 1\%$); at a cost-saving of \$10.1M per fatality, the social saving of 31 lives is \$313M per year (= $\\$10.1M \times 31$). The total number of injuries that could have been saved was 2,362 (= $236,157 \times 3\%$); at a cost-saving of \$163,254 per injury, the social saving of 2,362 injuries was about \$386M per year (= $\\$163,254 \times 2,362$); the total estimated cost saving is about \$699M per year for saving lives and injuries.</p> |
| <p>○ Other (Explain)</p> | <p>More comprehensive understanding and benefits from ACES technology innovation and implementation in Florida</p> | <p>In the Phase 2 project, CUTR will continue and expand outreach efforts to get more stakeholders, transportation industries, academia, FDOT Districts and local transportation agencies engaged, and will continue to improve the database by incorporating more ACES project information and data. With implementation, the improved and enhanced Florida ACES Roadmap portal will serve as a resource hub to share ACES data, findings, and best practices among the public and private sectors in Florida as well as out-of-state agencies, and will encourage and expand communication, cooperation, and collaboration among these sectors in the future.</p> |

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