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Recipient Organization (Name and Address)	Florida Atlantic University 777 Glades Road Boca Raton, FL 33431
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Report Term or Frequency	PPPR for FMRI – UTC. This report covers the period from April 1, 2018 to September 30, 2018, per Exhibit B, Grant Deliverables and Requirements for UTC Grants (November 2016)
Signature of Submitting Official	
Part I – Accomplishments: What was done? What was learned?	
The information provided in this section allows the OST-R grants official to assess whether satisfactory progress has been made during the reporting period.	

Reporting Period	04/01/2018 – 09/30/2018
1. What are the major goals of the program?	The FMRI aims to promote strategic transportation policies, investment, and decisions that bring lasting and equitable economic benefits to the U.S. and its citizens. The Center mission is to address critical issues affecting the planning, design, operation, and safety of the nation's intermodal freight transportation system, in order to strengthen our nation's economic competitiveness. Efficient and safe freight movement is inextricably linked to the economic vitality of a local area, state, region, and beyond. In consultation with stakeholders, as well as USDOT's strategic priorities, as expressed in FAST Act Improving Mobility of People and Goods priority and the known exclusive topic areas established by the Secretary of Transportation, we will focus on research and development that *improves freight mobility through information technology, freight network modeling and operations, intermodal logistics, as well as freight and supply chain sustainability* to promote smart cities, improve multimodal connections, system integration, and security, data modeling and analytical tools to optimize freight movements and improve efficiency. Also, to advance regional planning and setting of transportation priorities that deliver higher practice and economic growth and enhance productivity. *Major center activities are as following:* **Advanced & Applied Research Improving Freight Mobility:** Our research activities are multimodal/intermodal and multidisciplinary in scope, with the aims of addressing nationally and regionally significant transportation issues pertinent to economic competitiveness and providing practice-ready solutions. We have assembled top expertise on freight transportation, network modeling, sustainability, and ITS, representing leading universities across the nation with deep connections to local, state, and regional communities. Each of these universities has an established transportation research center/lab with top quality faculty conducting leading edge research. We are motivated to embrace innovative research projects, train the current and future transportation leaders and workforce, and engage with the industry to enhance collaboration between agencies by improving efficiency and safety, sustainably reduce traffic congestion, and develop standards to ensure interoperability today and in the future. FMRI is well-poised to address a variety of issues directly applicable to the US DOT strategic goal of economic competitiveness. In consultation with our respective state DOTs and metropolitan planning organizations, as well as US DOT strategic priorities, our first years of operation will focus on improving freight fluidity in four major research areas: • *Information Technology* • *Freight Network Modeling and Operations* • *Intermodal Logistics* • *Freight and Supply Chain Sustainability* **Education, Workforce Development, Technology Transfer, & Diversity:** The consortium is committed to providing high-quality transportation education and workforce development programs for a broad and diverse audience. The Center's efforts will support the development of a critical transportation knowledge base

	and a transportation logistics workforce that is prepared to design, deploy, operate, and maintain the complex transportation systems of the future. FMRI's effort towards K-12 initiatives include the following: • Increased minority student participation in transportation education. • Workforce development and increased minorities participation in transportation field. • Educated K-12 teacher as well as students in logistics and supply chain management.
2. What was accomplished under these goals?	In the first year, the center developed procedures and documents for inviting proposals. The submitted proposals conducted external reviews and the final projects selected for funding. FMRI research program aims to generate a body of knowledge that makes a significant contribution to solving first- and last-mile transportation problems. Year 1 endeavors were a set of pre-selected launch projects from proposals submitted and reviewed during the proposal preparation process, which has allowed us to begin the research during Fall 2017. As a few of the first year research projects completed, results from the data have been recorded and has been tested and/or deployed by the engaged stakeholders. The first year projects will soon be completed and the final reports will be under review. Please find listed below a brief description of a couple examples of the developing research findings. These findings with the full report will be published on the website after the final reports have been submitted. Please note that some projects have started late due to latent funds and PI transitions. **FMRI Y1R2-17: Eco-Driving Study on Trucks along Signalized Arterial with Significant Freight Traffic. (PI: Zhang, TAMU)** A dynamic optimization model for eco-driving of heavy-duty vehicles at intersections was developed. The results showed that the eco-driving strategies resulted in lower emissions while travel times were slightly increased. **FMRI Y1R7-17: Truck Parking study: unveiling the parking space density and truck volume relationship. (PI: Wang, TAMU)** A truck parking simulation along highways has been developed; as well as signal optimization models to accommodate freight traffic. During this recent period (April 2018 - September 2018), the center has developed their Year 2 RFP for research projects through discussion with the advisory board and the stakeholders. These projects have undergone full external peer reviews, with each project having three to four reviewers. Each project has been revised to reflect the comments from each peer reviewer. Once revised by the PI, these projects have been viewed by the Advisory Board and changed accordingly, if needed. The Year 2 approved research projects have been listed below and are currently in process. <u>Second Year Research Projects:</u> **FMRI Y2R1: Interactive web-based platform for analyzing freight data – Phase I.** (PI: Kaisar, Florida Atlantic University, Subcontractors: Edara, University of Missouri) The efficient movement of goods and timely provision of services is critical to the economic and sustainable development of a region. The freight data are available

from many public and private sources. However, the datasets may vary significantly in terms of collection method, data quality, existence of gaps, availability or timeframe (daily, monthly, and quarterly), format (shape files, documents, tables, etc.) and suitability. The lack of coordination among freight data vendors not only prevents the seamless integration of data sources but also disables data-driven decision making. The need for frameworks that can help integrate and analyze information from existing freight databases is therefore crucial. Under the above context, the proposed research seeks to develop a user-friendly, interactive, web-based prototype platform that takes advantage of recent advances in spatial data analysis, big data and user-centered visualization to integrate freight data across different private and public databases for the purpose of improving freight planning activities and data driven decision making.

FMRI Y2R2: Sustainable Urban Freight Mobility through Optimization of Logistics Facility Locations. (PI: Kaisar, Florida Atlantic University
Co-Investigator: Lili Du, PhD, University of Florida)
The growing mitigation rates towards urban zones, global use of e-commerce and advancing technologies implemented in the logistics operations are the main contributors to the constant increase of product delivery volumes, especially in metropolitan areas. Logistics providers are required to address many strategic operational issues while designing their distribution networks. The main motivation for conducting this research lies on the fact that typically freight operators locate their distribution centers outside the cities and deliver the products using trucks, traveling "door-to-door" to all the downtown destinations. This delivery approach causes many problems in urban areas, ranging from traffic congestion, increasing emissions, to higher delays. This project, considering the need for sustainability and cost-efficiency in city logistics, addresses this matter by developing a multi-objective novel mathematical framework for the capacitated facility location-allocation problem, an NP-Hard optimization problem, with the objectives of minimizing the costs for using the designated locations, the costs associated with the transportation of cargo to the allocated facilities and the distances between the chosen facilities and final destination nodes. T

FMRI Y2R3: Disaggregation of Freight Flows for Tennessee. (PI: Gkolias, University of Memphis)
As freight transportation draws ever increasing attention in the 21st century, freight related data (e.g., commodity flows, truck flows, freight facility economic and establishment data) are becoming critical to conducting transportation planning at state, regional, and local jurisdictional levels and for corridors. The purpose of using commodity flow data is to understand which industries generate the most demand by mode on the transportation system and how to divert movement of certain commodities between various modes optimize freight flows and the use of the existing transportation network. These data provide a key link between economic trade relationships and freight demand and are used in modal diversion studies. The proposed research has the following objectives:
i. Collect and compile a geodatabase with all the available freight flow data (open source and/or proprietary) for the state of TN. In the case of proprietary data, sample data will be used if these data are not purchased by TDOT;
ii. Develop the methodology and tools that can be used to estimate or disaggregate freight flow data;

iii. Apply the developed methodology and tools to estimate and analyze freight flows in the State of TN at different disaggregation levels (e.g., TAZ and ZIP code level);

iv. Develop a comprehensive guidebook for the estimation of commodity flows at a disaggregate level.

Y2R4 - Truck Parking Study: Unveiling the Parking Space Density and Truck Volume Relationship: Phase II. (PI: Wang, TAMU)
The objectives of this research are to provide TDOT with important guidance on truck parking issues and opportunities, by identifying parking needs (i.e., addition of capacity and/or construction of new facilities); developing truck parking violation rates (i.e., truck parking on - and off- ramps) and developing/applying a methodology to identify candidate locations for new truck parking facilities in the State of TN. This study extends the work done by Golias et al. (2017) and Cherry et al. (2017) who used truck GPS and survey data to evaluate the performance of truck parking in TN.

FMRI Y2R5: Optimization of Winter Maintenance Stations for Safe and Efficient Freight Transportation. (PI: Khani, University of Minnesota)
In the northern states, winter maintenance of major transportation corridors is an ongoing issue. Apart from the general cost to the traveling public, freight transport has additional economic considerations as well as operational and safety characteristics. This proposal intends to study the freight fluidity challenges in winter, and narrows it down to optimizing winter road maintenance operations for better freight transportation. We will develop an optimization model for finding the optimal location of stations for new construction or capacity expansion, considering desired service quality for major freight corridors, followed by assignment of stations and trucks to service zones. Two key aspects of the study that distinguishes it from regular station location optimization are 1) determining the freight volume on the state road network and determining critical links or zones for prioritized maintenance, and 2) accounting for stochastic model parameters, e.g. snowfall amount and storm duration, and employing robust optimization to design reliable service for extreme conditions. A decision support system will be developed based on mathematical programing and road network topology in GIS. The decision support system could benefit agencies from a financial perspective by reducing the winter maintenance operations cost, and the freight industry by safe and efficient freight transport in winter. Any software tool created in this research will be shared with local agencies and research community in open source format.

FMRI Y2R6: Modeling the Impacts of Regulations and Safety Constraints on UAVs Costs and Emissions - Phase 2. (PI: Figliozzi, Portland State University)
The integration of more sustainable vehicles in goods distribution and service delivery depends on a number of factors related to vehicle costs, technology, infrastructure, energy sources, and financial incentives (Feng and Figliozzi, 2012). Energy cost fluctuations and the rapid evolution of vehicle types and engine technologies creates a highly uncertain environment. Problems and issues faced by policy makers, transportation planners, and private companies are rapidly evolving over time. In addition, new vehicle technologies such as unmanned aerial vehicles (UAVs) or drones have the potential to disrupt last mile deliveries and supply chains. The comparison of conventional diesel vehicles and cleaner

vehicles is not straightforward because there are substantial tradeoffs regarding vehicles costs, payload, range, and supporting infrastructure. The comparison is even more complex regarding UAVs since this is a new vehicle type and technology. Furthermore, the regulatory framework may significantly affect UAV adoption rates as well as potential cost and environmental efficiencies. There is scant or no research that models the impact of regulations and safety constraints on UAVs last mile deliveries environmental, logistics and cost tradeoffs.

This research proposal builds upon research and models developed in 2017-18 (first phase) that focused on UAVs energy and emissions modeling (Figliozzi, 2017). The main goal of this proposal (phase two) is to develop robust tools and models to analyze the impacts of regulations and/or safety constraints on UAV costs and emissions. More specifically, this research project will: (1) review and analyze UAV regulations in the USA and abroad, (2) review and analyze UAV safety concerns, and (3) model and analyze the impact of regulations on UAVs costs and lifecycle CO2e emissions.

FMRI Y2R7: Next Generation of Freight Planning and Operation Models To Incorporate Emerging Innovative Technologies. (PI: Figliozzi, PhD, Portland State University, Kaisar, PhD, Florida Atlantic University; Miguel; Mihalis Gkolias, PhD, University of Memphis; Sabyasachee Mishra, PhD, University of Memphis)

This project leverages expertise from three universities (FAU, PSU, UoM) and attempts to accomplish the project objectives to (1) quantify adoption of connected and autonomous trucks by freight organizations, (2) incorporate truck platooning in transportation planning and operation models, (3) analyze the emissions impacts of last mile deliveries by delivery robots, (4) study how disruptive technologies are affecting intermodal transportation, and (5) outline future research necessary to address the opportunities and challenges created by disruptive technologies.

FMRI Y2R8: Dynamic Trajectory Control and Signal Coordination for a Signalized Arterial with Significant Freight Traffic. (PI: Zhang, TAMU)

Freight traffic affects the performance of a road network in a more sensitive and significant way compared to other traffic with respect to mobility, environment, and safety. This is due to the complexity of the characteristics of the mixed-class traffic. In this proposed research, multiple trucks dynamic trajectories and their interactions with the conventional cars will be investigated, and an analytical tool of traffic flow performance will be developed. Based on the analytical models, control strategies are developed to schedule the trajectories of trucks/cars dynamically to improve the mobility of a corridor, assisted by the new coordination strategies of signals.

FMRI Y2R9: Truck Parking Needs in Tennessee. (PI: Gkolias, University of Memphis, Subcontractors/Co-PIs: Dan Murray, American Transportation Research Institute; Airton Kohls, University of Tennessee, Knoxville; Chris Cherry, University of Tennessee, Knoxville)

The truck parking issues have caught wide attention as a national concern for many years. The objective of this study is to continue on the success of Phase I of this effort by continuing to study the relation between truck volume and parking space density in a simulation environment as phase I. Our goal in Phase II is to build on the literature reviewed and also utilize the simulation tool developed in Phase I to analytically derive the inherent analytical relationship between truck volume, driving behavior and truck parking capacity need in a

hope that policy makers may use to examine adequacy of truck parking space within their jurisdiction areas.

FMRI Y2R10: Two-lane Highway Analysis Methodology Enhancements Considering Commercial Trucks. (PI: Washburn, University of Florida)
Truck traffic carries the majority of the national freight in terms of commodity values. It is of particular importance to high value commodities such as electronic equipment. Trucking plays a critical role in the modern logistics operations for high economic efficiency such as the just-in-time logistics systems in areas of trucking operations in order not to impede economic activities. In this study will directly contribute to the freight mobility in truck parking area by allowing truckers to make best use of their driving hours. This study also directly contributes to trucking safety by diagnosing sufficiency of truck parking spaces.

Education and Workforce Development
FMRI's education goal is to foster education and training to contribute to the development of the transportation workforce. Our approach is multi-disciplinary, multimodal, under this grant we are developing a series of education activities, from K-12 to graduate level. These programs build on the education and training programs available at the consortium universities.

In the first year we were able to develop new graduate courses, (TTE 6507 Maritime Freight Operations and TTE 6508 Transportation and Supply Chain System), to offer workshops for high school teacher, summer camps for K-12 students and student internships. For our second year educational projects, we have developed an additional project listed below. Our partners who are helping with this effort are Hampton University, University of Florida, and Florida Atlantic University.

Transportation and Workforce Development Project (PI: Maheshwari, Hampton University)
The expanding transportation industry in the U. S. has a growing need for professionals qualified to manage advanced transportation systems. With up to 50% of the current workforce expected to retire in the next ten years, the industry faces a challenge of finding replacements. The overall goal of the proposed Education and Workforce Development Project is to attract and educate the next generation of transportation professionals through well-designed program of coursework, guest lectures, case studies, and experiential learning that reinforces classroom knowledge. The transportation education project will incorporate related programs offered by various departments within the University integrating research results into courses to produce a well-trained, effective, and efficient workforce. The partnerships with the transportation industry will offer students experiential learning through co-ops and internships. Special focus will be placed on K-12 education. Based on First Year connections, the K-12 programs will be expanded.

Curriculum Development for Highway Freight Transportation (PI: Washburn, University of Florida; Co-PIs: Du, University of Florida; Kaisar, Florida Atlantic University)
The objective of this project is to develop curriculum content that can be used for an entire 1-semester course focused on highway freight transportation. The focus of the curriculum will be on providing a fairly high-level overview of the transportation of goods via commercial trucking. The focus leans more towards

	breadth than depth. The primary format of the material will be PowerPoint slides, but a number of example problems and active learning exercises will also be developed.
	
	Continuing the pursuit of the Transportation and Workforce Development Project, FMRI has accomplished the items listed below:
	Major Activities:
	  1. Three new organizations to host student Internships
	  2. Planning of Student Tours to VA Port, Other Org.
	  3. Expansion of K-12 Teacher Seminar to Other High Schools in Virginia and the State of Florida
	  4. Planned K-12 Student Transportation Essay Competition
	  5. Planned Sponsorship ofK-12 Student Transportation Science Fair Project
	Specific Objectives
	  1. Minority student education—1 through 5 above
	  2. Increase minority participation—1 through 5 above
	  3. Increase K-12 participation –3 and 5 above
	Significant results
	  1. Minority student education—1 and 2 above
	  2. Increase minority participation—3 and 3 above
	  3. Increase K-12 participation –3 and 4 above
	Key outcomes or other achievements
	  1. Three new org to host student logistics interns—VA port, Unilever and MZB-USA.
	  2. 8 female and minority students placed in industry as interns. Canon, Inc; Norfolk Southern Corp., Hampton Roads Transit, VA Dept of Transportation, Unilever, MZB-USA, and VA Port.
	  3. Second K-12 workshop planned for high school teachers
	  4. An essay competition among high school student in two different high schools.
	  5. A Science fair among high school student in two different high schools.

3. How have the results been disseminated?	Reports are published to the FMRI website and presented at FMRI lecture series, which are open to the public. Preliminary results are often presented at peer review conferences. All research projects are expected to result in refereed journal publications. In addition, dissemination is via new graduate courses and developed certificate programs, internship assistance, employment opportunities, professional development seminars and distinguish lecture series, and our website. The FMRI research seminars serves as a forum for faculty, industry, and graduate students to present their research and work. Seminars and lecture series take place fall and spring semesters, open to public, and are well-attended. The FMRI has recently established a social media effort, which includes Facebook and Twitter. Facebook and Twitter has been used to share our news, events, and other content. The center is using social media to drive more traffic to the website.

	The center has also recently purchased a subscription to an email distribution platform. This will help further disseminate information, such as our annual reports. The FMRI plans to establish quarterly newsletters sent through the email distribution platform to update stakeholders and other interested parties on the progress of the center.
4. What do you plan to do during the next reporting period to accomplish the goals?	Currently, the final results of the Year 1 projects are being developed. For next reporting period, the center will report on the findings, distributing this information to publications, journals, seminars, lectures, and other educational means. These results will be distributed through our website and email distribution platform. The center will extend the information through social media to drive traffic to the website.
	FMRI Year 2 projects will be fully initiated. These projects will be in the midst of their research. Research findings will be disseminated as needed.
	FMRI Year 3 Research RFP projects will be planned and executed. The third year projects will still undergo a peer-reviewed process to seek guidance on maximizing their uniqueness, value, and applicability. Our consortium research selection goal is to develop a comprehensive program that focuses on solving high-priority freight mobility problems. In subsequent years, the center will establish an annual request for proposals focusing on the stated theme as well as high priority needs expressed by our public and private sector partners.
	The center will continue their relationship with their Stakeholders and State DOTs on cost-share projects and other collaborative efforts in order for the FMRI to successfully deploy their technology transfer to the community. The center will also explore collaborative opportunities with local private and public sector entities in order to develop freight related research needs.
	The FMRI will also develop local community educational and technology transfer efforts to advance the knowledge on freight operations and freight fluidity.
	For the educational initiative, FMRI plans are to: 1) Implement the approved Year 1 projects, --More K-12 involvement through lectures and tour; 2) At least one of more high school teachers' workshops and onsite visits at High Schools; 3) Continue work and complete the Year 2 projects; 4) Continue dissemination of research results via our website, other publications, journal and conference papers, professional presentations, and our monthly seminar series.
Part II – Products: What has the program produced?	

Publications are the characteristic product of research projects funded by the UTC Program. OST-R may evaluate what the publications demonstrate about the excellence and significance of the research and the efficacy with which the results are being communicated to colleagues, potential users, and the public, not the number of publications. Many research projects (though not all) develop significant products other than publications. OST-R may assess and report both publications and other products to Congress, communities of interest, and the public.

Reporting Period	**04/01/2018 – 09/30/2018**
1. Journal publications:	Al-Kaisy, Ahmed, Jafari, Amirhossein, Washburn, Scott S., Luttinen, Tapio, and Dowling, Richard. *Performance Measures on Two-Lane Highways: Survey of Practice*. Research in Transportation Economics. Elsevier. Accepted for publication July 2018. Figliozzi, M., Saenz, J., & Faulin, J. (2018). Minimization of urban freight distribution lifecycle CO_2e emissions: Results from an optimization model and a real-world case study. *Transport Policy*. Miao*, Q., Y. Li, X. Wang. 2018. A Generalized Decomposition Algorithm for Real-time Truck Routing Problems. Pesquisa Operacional, Brazilian Operations Research Society. Accepted. Moreno, Ana Tsui, Llorca, Carlos, Washburn, Scott S., Bessa Jr, José Elievam, and Garcia, Alfredo. *Analysis Procedure for Spanish Two-Lane Highways: Passing Considerations.* Traffic & Transportation. Promet. Accepted for publication April 2018. Simpson, J., Mishra, S., Talebian, A, and Golias, M. Disaggregated prediction of adoption rate of autonomous trucks by freight organizations, Submitted for review in Transportmetrica-A. Wang, X., Y. Li, L. Quadrifoglio and K. Yin*. 2018. Distribution Product Packaging to Maximize the Net Revenue. Computers & Industrial Engineering. Accepted. Wang, B. Truck Parking Study: Unveiling the Parking Space Density and Truck Volume Relationship. Transportation Research Board. Wang, X., K. Yin* and H.X. Liu. 2018. Vehicle Actuated Signal Performance under General Traffic at an Isolated Intersection. Transportation Research Part C: Emerging Technologies. 95 582-598. Zhang, Y. Eco-Driving Study on Trucks along Signalized Arterial with Significant Freight Traffic. Transportation Research Board.
2. Books or other non-periodical, one-time publications	Liao, C. Measure of Truck Delay and Reliability at the Corridor Level. Center for Transportation Studies, University of Minnesota. Figliozzi, M., Tucker C., and Polikakhina P., Drone Deliveries Safety, Logistics, and Sustainability Trade-offs (2018 ILS conference proceedings) Washburn, Scott S., Sun, Wei, and Knight, Matthew. *Commercial Truck Parking Detection Technology Evaluation for Columbia County Rest Areas (Part 2)*. Final Report. Florida Department of Transportation. Tallahassee, FL. April 2018. 48 pages. Washburn, Scott S., Al-Kaisy, Ahmed, Luttinen, Tapio, and Dowling, Richard, Watson, Donald, Jafari, Amirhossein, Bian, Zilin, and Elias, Aaron. *Improved Analysis of Two-Lane Highway Capacity and Operational Performance*. NCHRP Project 17-65. Transportation Research Board. March 2018. 670 pages. DOI: 10.17226/25179

3. Other publications, conference papers and presentations	Charisis, A. Containership Routing and Scheduling with Multiple Time Windows. Fifth Biennial Marine Transportation System Research and Development Conference. June 2018. Charisis, A. Multiobjective Optimization Model for Establishing Logistics Facilities in Urban Congested Areas. FAU Research Showcase. September 2018. Chauhan, D., Unnikrishnan, A., Figliozzi, M., "Maximum Coverage Facility Location problem with Drones", EURO OR Conference, Bologna Italy, Jun. 2018. Figliozzi, M., "How Sustainable Are Drone (UAV) Deliveries?", PSU Transportation Seminar. Portland, OR., Apr. 2018. Figliozzi, M., Tucker C., and Polikakhina P., "Drone Deliveries Logistics, Efficiency, Safety and Last Mile Trade-offs", International Conference on Information Systems, Logistics and Supply Chain, Lyon, France, July 2018. , Lyon France, Jul. 2018. Figliozzi, M. A. (2018) Strategic Drone Network Design, Working paper, under review. Jennings, D., Figliozzi, M. (2018), "A STUDY OF AUTONOMOUS DELIVERY ROBOTS AND THEIR POTENTIAL IMPACTS ON FREIGHT EFFICIENCY AND TRAVEL", Submitted to the 98th Annual Meeting of the Transportation Research Board, Washington DC, January 2019. Kaisar, E. Guidance for Identifying Corridor Conditions that Warrant Deploying Transit Signal Priority and Queue Jump. ITS World Congress, Copenhagen, Demark. September 2018. Kaisar, E. Short Sea Shipping vs. Trucking: A Cost-Benefit Analysis Using Mathematical Modeling. Fifth Biennial Marine Transportation System Research and Development Conference. June 2018. Liao, C. Measure of Truck Delay and Reliability at the Corridor Level. Center for Transportation Studies, University of Minnesota. Cost Share Project final report. Presented to MdDOT staff and stakeholders. Simpson, J., Mishra, S., Talebian, A, and Golias, M. Disaggregated prediction of adoption rate of autonomous trucks by freight organizations, Scheduled for presentation at the 98th Annual Meeting of Transportation Research Board, January 2019. Simpson, J., Mishra, S., Talebian, A, and Golias, M. Prediction of adoption rate of autonomous trucks by freight organizations, Autonomous Vehicle Symposium, San Francisco, CA, July 2018. Washburn, Scott S. *Two-lane highway analysis and simulation*. Semana de Transportes e Transito (Transport and Transit Week) Workshop presentation, Belo Horizonte, Brazil. September 2018. Washburn, Scott S. *Current trends in traffic operations management and analysis in the U.S.* Semana de Transportes e Transito (Transport and Transit Week) Lectern presentation., Belo Horizonte, Brazil. September 2018.

	Washburn, Scott S. *Two-Lane Highway Analysis. NCHRP 17-65 Project*. Workshop presentation to Highway Capacity and Quality of Service committee, Austin, TX. June 2018.
4. Website(s) or other Internet site(s)	In addition to the FMRI website, the center has established a Facebook and Twitter account to further disseminate information: https://www.facebook.com/FreightMobility https://twitter.com/FreightMobility Research: Dr. Scott Washburn's Year 1 project, "Two-Lane Highway Analysis," is resulting in an analysis methodology that combines aspects of network traffic assignment and the freeway facility analysis. The new methodology is being implemented in software by revising two of Washburn's existing software programs (HCM-CALC and XXE). They are currently distributed through my software website, where the revised versions of the software programs will be as well. http://swashware.com/ http://swashware.com/HCMCalc/ http://swashware.com/XXE Liao, C. Measure of Truck Delay and Reliability at the Corridor Level. Center for Transportation Studies, University of Minnesota. Cost Share Project final report. MnDOT 2018-15 URL: http://www.cts.umn.edu/Publications/ResearchReports/reportdetail.html?id=2686
5. Technologies or techniques	The FMRI has created workshop materials for K-12 teachers at Heritage High School. A lesson plan has been developed for a 60-minute lecture for 9th and 10th grade. A dynamic optimization model was programmed to optimize heavy-duty vehicle trajectories under the first year project, "Eco-Driving Study on Trucks along Signalized Arterial with Significant Freight Traffic." The methodology resulting from the Year 1 project, "Two-Lane Highway Analysis" will be available in a software product.
6. Outreach activities	FMRI hosted a 2-hour session for University of Florida's Gator Computing Camp. The lecture focused on computing in transportation engineering to a group of high school students interested in the field. Heritage High School Essay Competition conducted in April at Heritage High School in Virginia.
7. Courses and workshops	The FMRI hosted Summer Transportation Camp in June and July. Two camps were held, each for one week with a total of 14 students. The camp taught the children in an exciting environment about transportation. The transportation camp covered ArcGIS based spatial analysis, VISSIM based intersection simulations, basics of transportation engineering, freight operations, logistics, connected and automated vehicles, and traffic count observations. The campers also took part in debates, quizzes, and fun transportation-related cards games. Research results were presented from the first-year project on eco-driving study in course materials. The center developed a freight workshop to be offered in Spring 2019 at the FedEx Institute of Technology at the University of Memphis.

8. Inventions, patent applications, and/or licenses	"Nothing to Report"
9. Other products	The center created student videos from the interns' workshop experience (1st year). A dynamic optimization model was developed. This model optimizes vehicle trajectories for heavy-duty vehicles going through intersections.

Part III – Participants & Collaborating Organizations: Who has been involved?

OST-R needs to know who has worked on the project to gauge and report performance in promoting partnerships and collaborations.

Reporting Period	**04/01/2018 – 09/30/2018**
1. What organizations have been involved as partners?	The FMRI believes entity collaborations with similar goals can have a great impact on results. Under the research initiative, the center partners have collaborated with each other, as well as outside partners, on second year projects. Please find listed below the project details: **FMRI Y2R1: Interactive web-based platform for analyzing freight data – Phase I.** (PI: Kaisar, Florida Atlantic University, Subcontractors: Edara, University of Missouri) **FMRI Y2R2: Sustainable Urban Freight Mobility through Optimization of Logistics Facility Locations.** (PI: Kaisar, Florida Atlantic University Co-Investigator: Lili Du, PhD, University of Florida) **FMRI Y2R7: Next Generation of Freight Planning and Operation Models To Incorporate Emerging Innovative Technologies.** (PI: Figliozzi, PhD, Portland State University, Kaisar, PhD, Florida Atlantic University; Miguel; Mihalis Gkolias, PhD, University of Memphis; Sabyasachee Mishra, PhD, University of Memphis) **FMRI Y2R9: Truck Parking Needs in Tennessee.** (PI: Gkolias, University of Memphis, Subcontractors/Co-PIs: Dan Murray, American Transportation Research Institute; Airton Kohls, University of Tennessee, Knoxville; Chris Cherry, University of Tennessee, Knoxville) Under the educational initiative, FMRI and FMRI partners have partnered with: Organization Name: • Newport News School District • Hampton University • Canon Virginia, Inc. • Norfolk Southern Corp. • Hampton Roads Transits • VA Dept of Transportation • Unilever • VA Port Authority • Hampton School District

	• Massimo Zanetti Beverage USA • Florida Chambers of Commerce • North Palm Beach Chamber of Commerce • Port Everglades
2. Have other collaborators or contacts been involved?	Dr. Evangelos Kaisar, FMRI Director, is collaborating with University of Missouri researchers on the second year project on web-paged platform. He is also collaborating with the Florida Department of Transportation on cost-share projects. Dr. Yunlong Zhang of Texas A&M University collaborated with TTI (Texas A&M Transportation Institute) researcher, Caoyi Gu, on emission models of heavy-duty vehicles. Dr. Yafeng Yin, University of Michigan, has previously worked at the University of Florida under the FMRI. He is assisting Dr. Scott Washburn of University of Florida with the summary of the first year project, "Enhancement of Transportation Network Analysis Tools for Truck-Related Planning and Operations." Portland State University's Dr. Miguel Figliozzi reviewed growth of ecommerce and urban deliveries and their implications with ODOT planners; as well as having a discussion of urban freight research agenda. Dr. Figliozzi discussed research opportunities related to the growth of ecommerce in China with faculty from Shenzhen Polytechnic University. He also developed an analysis of potential collaboration with TruckTrike (a company based in Portland) and UPS to evaluate a pilot project for cargo delivery in Portland using tricycles.

Part IV – Impact: What is the impact of the program? How has it contributed to transportation education, research and technology transfer?

DOT uses this information to assess how the research and education programs:
- **increase the body of knowledge and techniques;**
- **enlarge the pool of people trained to develop that knowledge and techniques or**
- **put it to use; and,**
- **improve the physical, institutional, and information resources that enable those people to get their training and perform their functions.**

Reporting Period	**04/01/2018 – 09/30/2018**
1. What is the impact on the development of the principal discipline(s) of the project?	The FMRI serves society by advancing transportation expertise through research and education. FMRI capitalizes on diversity to maximize its impact; academic diversity by way of a multidisciplinary team of faculty and research staff; geographic diversity, uniting academic institutions and their local public and private partners that span the nation; future workforce diversity by ensuring participation of underrepresented groups in STEM education and industry internships. During this period, its research, education, technology transfer, and workforce development activities impacted the engineering as follows:

	• Funding has been provided to students affiliated with the FMRI to travel to conferences to present their work to network with transportation professionals, academics, and students. • Students presented their research at events, including conferences and MPO advisory meetings. • Research, and lecture series generated by FMRI is made available on the Center's website for public distribution. • Various workshops have been produced which have been disseminated widely to state DOTs and industry. FAU and Hampton University has worked to increase exposure of transportation to K-12 students, as well as increase minority participation in the field of transportation. In regards to impacts from our research, please find below: The results indicated in the project, "Eco-Driving Study on Trucks along Signalized Arterial with Significant Freight Traffic," show that eco-driving of heavy-duty vehicles can reduce emissions with a marginal increase of travel time. With the consideration of multiple intersections and signal coordination in Year 2, this research will likely produce eco-driving strategies that will reduce emissions while also reducing travel times. A couple members of the FMRI team studied truck parking by developing a simulation and examining analytical models, which has not been explored in literature. Successful carryout of this project will facilitate adequate policy development to improve trucking efficiency and safety along the freight corridors. In addition, the team also conducted traffic control involving freight traffic, which is fundamental in accommodating freight operations especially in urban areas. The Year 1 project, "Enhancement of Transportation Network Analysis Tools for Truck-related Planning and Operations," will result in a methodology that extends the Highway Capacity Manual's freeway facility analysis from the facility level to the network level. This will provide regional and state transportation agencies more capability for evaluating freeway network modifications or additions (e.g., on what facilities within the network should truck-only lanes be placed). The impacts of first year project, "Modeling Adoption of Autonomous Vehicle Technologies by Freight Organizations," include introduction of new methodological approach in modeling diffusion of innovations for freight organizations.
2. What is the impact on other disciplines?	FMRI is a multi-disciplinary research center that includes engineering, computer science, and urban planning and logistics management. Our impact has been on developing interdisciplinary courses and degree programs. At FMRI, most graduate transportation courses are cross-listed between engineering and urban planning. Regarding fields of research, FMRI has contributed to develop a model for adoption of autonomous vehicle technologies by freight organizations. Other disciplines such as computer science, business administration, and economics can take advantage of the models developed. Through our research work, we would like to establish urban freight as a field of research within urban planning/supply chain management.

3. What is the impact on the development of human resources?	FMRI has developed lecture series, workshops, and professional opportunities for all levels, including student support, research opportunities, and educational development. Student Support: At FAU, active FMRI UTC research projects fund 5 student positions. Of those hired, one is a student assistant, four are masters, and one is a research staff. Two additional Graduate Research Assistants have been added to the team in the beginning of the Fall 2018 semester. Students work on a variety of projects including research projects, web management, and workforce development-related programs. The FMRI provides financial and administrative support to allow students from all the campuses to participate in transportation conferences and competition and technology transfer activities. Two PhD students are being educated and supported by the projects under the Texas A&M University, as well. Opportunities for Research: Student support is an important component of research project selection. Faculty of different research backgrounds and more than ten student researchers participate in these projects. Educational Materials and Programs and Opportunities for Teaching: Several additional courses and programs are under development, and offer teaching opportunities for instructors from industry to share their experiences with our students. University of Florida has created an educational project for the second year project for curriculum development. The center has assisted workforce development by increasing students' participation in transportation organization. Seven interns are working in the transportation related organizations due to public- and private- sector collaborations.
4. What is the impact on physical, institutional, and information resources at the university or other partner institutions?	At FAU, research facilities include staff offices, high capacity computing, state-of-the-art laboratory, secure data servers, and variety of simulation, optimization, and statistical software. • Undergraduate students have been made aware of internship opportunities within the FMRI partner institutions. • Graduate students have been aware of assistantships opportunities via FMRI funded projects. • Through the UTC regional conference and FMRI co-sponsored workshops students and academics have been made aware of different research for future collaboration.
5. What is the impact on technology transfer?	Our technology transfer program will provide information on regional intermodal transportation issues and the Center's research and educational activities to transportation professionals. Our partners have an outstanding track record of success, sharing expertise and research results with local, regional, national, and international communities for use in real-world applications that are committed to building on these accomplishments. Information will be disseminated via website, newsletters, reports, workshops, presentations, and seminars. A primary consideration in the technology transfer program will be the timely distribution of information in a format that is user-friendly and supports government, industry, and academic needs. The use and implementation of the center research results and products by practitioners is critical to improving the

| | transportation system and to ensuring public- and private-sector support for future transportation research. FMRI will continue to focus on outreach to the practitioner community and actively seek partners to move research into practice.

Currently, the center is working on cost share projects with local DOTs, such as the Florida Department of Transportation and the Tennessee Department of Transportation. These results and models will be implemented within the counties as the State DOTs have explicit interest in the projects. The knowledge of approaches can be transferred to other public agencies for use in planning purposes and preparation of new smart infrastructure in the future. |
|---|---|
| **6. What is the impact on society beyond science and technology?** | New and improved tools and methods are in progress by FMRI during the first year to enhance mobility, distribution, safety, and security. These results will be disseminated shortly as the final reports are submitted. The educational materials produced by the center have been disseminated and used widely between local high schools and university. Collaboration between academia, public, and private sectors remains strong and FMRI continues to assists in collaborative activities.

An example of our technology transfer is our first-year projects on the Eco-Driving Study. The strategies developed in this project will assist the truck drivers in their decision making, leading to better (safe/efficient/economical) driving behaviors. |
| **7. Additional impacts** | Freight transportation provides significant contribution to our nation's economy. Reliable and accessible freight network enables business in urban areas to be competitive in the nation. Many urban roadways are facing challenges with traffic volumes over capacity during peak periods. As a result, time and money are lost due to traffic congestion. Operational and design constraints such as interchange, steep grade, signalized intersection, work zone, merging, lane drop, and others could contribute additional delays for commercial vehicles.

The outcome of the FMRI first-year projects will allow USDOT, local state agencies, and other stakeholders to identify and monitor the performance of freight mobility and to systematically assess the impact of freight operations. The performance measures at any corridor level can provide recommendations on freight mobility specific needs and to help mitigation strategies to reduce delay, and improve reliability and mobility of all users of the system. In addition, with the growth of freight shipments worldwide, the freight transportation has grown steadily and has been making greater contributions to the development of the country through our efforts with processes and techniques. As most of these planning applications are highly dependent on the freight flow distribution, it is of critical importance to develop a multiclass assignment model to accurately forecast the distribution.

Our main goal is to develop robust tools and models to analyze freight environmental, logistical and cost tradeoffs so we can have better travel time reliability, safety, reduction in emissions, and analyze the potential impacts of widespread new technologies adoption on freight planning models and tools. The impact of our models will improve the county's economic competiveness and make targeted investments to increase freight mobility and fluidity in all the transportation modes. |

	For example, the Eco-Driving Study has potential impacts on the reduction in carbon and other harmful emissions from vehicles, particularly trucks, as well as the reduction in fuel consumption of heavy-duty vehicles while increasing travel time reliability by addressing truck travel issues and truck traffic congestion. Another first-year project, Truck Parking Study, has potential impacts to improve processes, techniques, and skills in addressing transportation issues, as well as an improved body of knowledge; by both the truck parking and signal optimization projects.
Part V – Changes/Problems	
If not previously reported in writing to OST-R through other mechanisms, provide the following additional information or state, "Nothing to Report, if applicable:	
Reporting Period	**04/01/2018 – 09/30/2018**
1. Changes in approach and reasons for change	[If there is nothing significant to report during this reporting period, state "Nothing to Report."] [Describe any changes in approach during the reporting period and reasons for these changes. Remember that significant changes in objectives and scope require prior approval of the OST-R grant administrator.] "Nothing to Report"
2. Actual or anticipated problems or delays and actions or plans to resolve them	[If there is nothing significant to report during this reporting period, state "Nothing to Report."] [Describe problems or delays encountered during the reporting period and actions or plans to resolve them.] "Nothing to Report"
3. Changes that have a significant impact on expenditures	[If there is nothing significant to report during this reporting period, state "Nothing to Report."] [Describe changes during the reporting period that may have a significant impact on expenditures, for example, delays in hiring staff or favorable developments that enable meeting objectives at less cost than anticipated.] "Nothing to Report"

4. Significant changes in use or care of human subjects, vertebrate animals, and/or biohazards	[If there is nothing significant to report during this reporting period, state "Nothing to Report."] [Describe significant deviations, unexpected outcomes, or changes in approved protocols for the use or care of human subjects, vertebrate animals, and/or biohazards during the reporting period. If required, were these changes approved by the applicable institution committee and reported to the agency? Also specify the applicable Institutional Review Board/Institutional Animal Care and Use Committee approval dates.] "Nothing to Report"
5. Change of primary performance site location from that originally proposed	[If there is nothing significant to report during this reporting period, state "Nothing to Report."] [Identify any change to the primary performance site location identified in the proposal, as originally submitted.] "Nothing to Report"
6. Additional Information regarding Products and Impacts	[UTCs are encouraged to consider identifying program results by outputs, outcomes or impacts as suggested by the examples below. Impacts should be linked to National goals expressed in the Secretary's Strategic Goals.] "Nothing to Report"
Part VI– Special Reporting Requirements	
Respond to any special reporting requirements specified in the award terms and conditions, as well as any award specific reporting requirements	
Reporting Period	**04/01/2018 – 09/30/2018**
	"Nothing to Report"