Maritime Transportation Research & Education Center

USDOT Tier 1 University Transportation Center

Program Progress Performance Report #9

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Project Title: Maritime Transportation Research and Education Center (MarTREC)

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Signature:

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Maritime Transportation Research & Education Center (MarTREC)

MarTREC is a USDOT Tier 1 University Transportation Center funded in September 30, 2013 under MAP-21. Our consortium consists of the University of Arkansas (UARK), Fayetteville, AR; Jackson State University (JSU), Jackson, MS; Louisiana State University (LSU), Baton Rouge, LA; and University of New Orleans (UNO), New Orleans, LA. Each institution is strategically located to support the MarTREC theme and consists of renowned maritime transportation researchers dedicated to transferrable research and inclusive education and workforce development.

MarTREC's theme is building economic competitiveness through efficient, resilient, and sustainable maritime and multimodal transportation systems. Our vision is to be recognized as the Nation's premier source for expertise on maritime and multimodal transportation research and education.

1. Accomplishments

1.1 Consortium-Level Accomplishments

1.1.1   Research
Goal: MarTREC will conduct research that contributes to building economic competitiveness through efficient, resilient, and sustainable maritime and multimodal transportation systems.
Objectives:
R1) Conduct research projects related to MarTREC's research goal
R2) Engage a diverse set of faculty and students in MarTREC research activities
R3) Disseminate research findings

Accomplishments:

Metric	Achieved PPPR#9	Objective Addressed
# of ongoing projects in all MarTREC research area	13	R1
# of peer-reviewed journal articles (published, accepted, submitted)	6	R3
# of conference presentations	21	R3
# of tenure track faculty who conduct MarTREC research activities	13	R2
# of external partners involved in center research activities	27	R3
# of research activities that impact diversity through participants and/or outcomes	15	R2
# of UG/G students participating in transportation research projects funded by UTC	20	R2
# of MS/PhD transportation-related advanced degree programs	14	R2
# of MS/PhD graduate students supported by MarTREC	15	R2
# of MS/PhD students supported by MarTREC who received degrees	4	R3

1.1.2   Leadership
Goal: MarTREC will become the premier source for expertise on maritime transportation research, education, and workforce development.
Objectives:
L1) Demonstrate academic leadership towards MarTREC's leadership goal
L2) Demonstrate industry leadership towards MarTREC's leadership goal

Accomplishments:

Metric	Achieved PPPR#9	Objective Addressed
# of national and regional leadership positions held	17	L1
# of conference planning positions held	7	L1
# of invited talks given	3	L1
# of leadership and research awards received	9	L1
# of impactful research citations by stakeholders	1	L2
# of UG/G students participating in transportation research projects funded by UTC	20	L1
# of junior faculty mentored	2	L1
# of leadership workshops held	0	L2
# of external grant proposals submitted	1	L2

1.1.3 Education and Workforce Development

Goal: MarTREC will develop educational resources to elucidate scientific and engineering practices involved in maritime and multimodal transportation systems and practices.

Objectives:

EWD1) Conduct education and workforce development (EWD) projects related to the goal
EWD2) Educate college students within MarTREC theme
EWD3) Conduct workforce development related to MarTREC theme
EWD4) Conduct outreach activities related to MarTREC theme

Accomplishments:

Metric	Achieved PPPR#9	Objective Addressed
# of projects in MarTREC educational and workforce development areas	0	EWD1
# of UG/G transportation-related courses associated with UTC	33	EWD2
# of distinguished lectures & seminars offered	6	EWD3
participant count of distinguished lectures & seminars offered	285	EWD3
# of short courses and workshops offered	10	EWD3
participant count of short courses and workshops offered	183	EWD3
# of *times* technician certification programs are offered	23	EWD3
participant count of technician certification programs offered	377	EWD3
# of educational modules and case studies developed	1	EWD2
# of student-authored publications	6	EWD2
# of student-presented presentations	5	EWD2
# of K-12 programs offered	61	EWD4
participant count of K-12 programs (events) offered	3000	EWD4
% of female participants in K-12 programs	40	EWD4
% of minority participants in K-12 programs	25	EWD4
# of pre-college programs offered	17	EWD4
participant count of pre-college programs offered	1300	EWD4
# of online K-12 educational resources posted	8	EWD4

1.1.4 Technology Transfer

Goal: MarTREC consortium institutions will participate in national, regional, and local education and workforce development outreach to provide state-of-the-art knowledge to private and public transportation organizations and provide a forum where government employees, academic researchers, and private sector can exchange ideas on current issues.

Objectives:

TT1) Transfer MarTREC outcomes into practice

TT2) Develop products in support of MarTREC technology transfer goal

Accomplishments:

Metric	Achieved PPPR#9	Objective Addressed
# of peer-reviewed journal articles (published, accepted, under review)	6	TT2
# of conference presentations	21	TT2
# of technical briefs	0	TT2
# of guidebooks	2	TT2
# of short courses and workshops offered	10	TT1
participant count of short courses and workshops offered	183	TT1
# of conference planning positions held	7	TT1
# of editorial journal positions held	6	TT1
# of technician certification *programs* offered	7	TT1
participant count of technician certification programs offered	377	TT1

1.1.5 Collaboration

Goal: MarTREC will continue our existing partnerships with maritime and multimodal transportation stakeholders and develop new partnerships at the consortium, institution, and project levels to facilitate our planned research, leadership, education, workforce development, and technology transfer activities.

Objectives:

C1) Develop external partnerships related to MarTREC's collaboration goal

C2) Develop collaborative products related to MarTREC's collaboration goal

C3) Engage faculty and students in achieving MarTREC's collaboration goal

Accomplishments:

Metric	Achieved PPPR#9	Objective Addressed
# of collaborative partnerships formed	27	C1
# of collaborative activities conducted	2	C2
# of collaborative deliverables completed	10	C2
# of collaborative team events	10	C1
# of collaborative outreach events held	23	C2
# of faculty involved in collaborative activities	13	C3
# of students involved in collaborative activities	20	C3

1.1.6   Plans for Next Reporting Cycle

The faculty researchers will continue to engage with industry experts to ensure that these projects are making transformational contributions. The consortium will continue to expand our collaborative partnerships to support this.   We will continue to emphasize educational and technology transfer activities. Our next annual Advisory Board meeting is planned for November 16, 2018.

1.2 Project-Level Accomplishments

MarTREC had 13 active research projects during this reporting period. Three completed and one project added during this reporting period.

1.2.1 Maritime and Multimodal Logistics Management Projects

Dynamic Decision Modeling for Inland Waterway Disruptions
Shengfan Zhang, Ph.D.
Heather Nachtmann, Ph.D.
August 2014-December 2016
Accomplishments: Collected and studied lock and dam closure reports, with a focus on unscheduled, weather-related disruptions. Reasons for closure and duration of disruptions were recorded. A Markov Decision Process (MDP) model was developed from the barge owner perspective that considers the uncertainty in the status of the closed or partially closed lock and dam as well as the traffic and safety status of barges remaining on the waterway.
Completed project: Conducted by U of A, this project was completed in December 2016. Final project report was submitted on time and distributed as per grant guidelines.

Economic Impacts of Lock Usage and Unavailability
Justin Chimka, Ph.D.
August 2014-June 2016
Accomplishments: The research objective is to estimate annual tons locked by commodity group and lock, as a function of lock usage and unavailability (1993-2013). Results include effects of lock usage and unavailability on tons locked by commodity group. Twenty-two out of the 42 datasets resulted in at least one useful subset where we could employ our alternative to stepwise regression to find a linear model, which is efficient and practically appropriate according to our definitions of those characteristics. We are currently extending the project to study Climate Impacts on Lock Use and Performance.
Completed project: Conducted by U of A, this project was completed in June 2016. Final project report was submitted on time and distributed as per grant guidelines.

Efficient Dredging Strategies for Improving Transportation Infrastructure Resilience
Kelly Sullivan, Ph.D.
August 2014-December 2016
Accomplishments We developed an optimization model for this problem that incorporates uncertainty due to unpredictable amount of budget required for emergency dredging. We developed a mathematical model to explore inland dredging strategies that are efficient with respect to cost and ensuring minimum disruption to freight transportation. We produced a case study that illustrates the application of our model to the U.S. inland waterway network. We demonstrated how our model and algorithms could be used at a variety of resource levels to allocate maintenance budget to districts. Using these results, we demonstrated the tradeoff between available maintenance budget and system-wide performance. Furthermore, we demonstrated insights, created because of solving our model.

Completed project: Conducted by U of A, this project was completed in December 2016. Final project report was submitted on time and distributed as per grant guidelines.

Multimodal Transport and TransLoad Facilities in Arkansas
Justin Chimka, Ph.D.
July 2014-December 2014
Accomplishments: This project is based on the theory regional and short line railroads are underutilized, and a key to unlocking greater economic value in Arkansas is additional TransLoad Facilities that enable Multimodal Transport. Determined what should be the locations and capabilities of additional facilities, and producing a guidebook for people interested in developing a TransLoad Facility.
Completed project: Conducted by UA, this project, funded by the Arkansas Economic Development Commission as a MarTREC match project, was completed in January 2015. Final project report was submitted on time and distributed as per grant guidelines.

Regional Economic Impact Study of the McClellan-Kerr Arkansas River Navigation System
Heather Nachtmann, Ph.D.
April 2014-August 2015
Accomplishments: The project implemented a multiregional social accounting matrix framework to estimate the economic impacts of the McClellan-Kerr Arkansas River Navigation System (MKARNS) found that the total economic impacts of the MKARNS nationwide are $8.5 billion in sales, $4.3 billion in gross domestic product (GDP), and $2.5 billion in labor income.
Completed project: Conducted by UA, this project, funded by the Arkansas State Highway and Transportation Department as a MarTREC match project, was completed in August 2015. Final project report was submitted on time and distributed as per grant guidelines.

Supporting Secure and Resilient Inland Waterways
Heather Nachtmann, Ph.D.
Justin Chimka, Ph.D.
August 2014-June 2018
Accomplishments: We have developed and tested a linear approach to extend our Cargo Prioritization Terminal Allocation Problem (CPTAP) modeling capability. This new approach allows us to solve realistic response scenarios more quickly
Project plans: Our CPTAP model enhancement is complete, and we are developing the final report. We are preparing to present the work at the upcoming Industrial and Systems Engineering Conference in May 2018.

Supporting Secure and Resilient Inland Waterways Phase Two
Heather Nachtmann, Ph.D.
Justin Chimka, Ph.D.
July 2017-August 2018
Accomplishments: Unexpected disruptions to the inland waterway system due to natural disasters, vessel accidents, or terrorist attacks can cause non-navigable water levels or destroy major navigation infrastructures, resulting in closures of the inland waterway.
Project Plans: We are extending our current CPTAP model to consider uncertainty into the decision. Data and distributions are being defined for four unknown parameters; water transport time, offload time, land transport time, and terminal capacity. The simulation model design is underway. We are preparing to present the work at the upcoming Industrial and Systems Engineering Conference in May 2018.

1.2.2 Building Resilient and Sustainable Multimodal Infrastructure Projects

Climate Impacts on Lock Use and Performance
Justin Chimka, Ph.D.
July 2016-August 2018
Accomplishments: It is the policy of U.S. Army Corps of Engineers (USACE) to integrate climate change preparedness and resilience planning and actions in all activities for enhancing the resilience of our built and natural water-resource infrastructure (USACE Climate Preparedness and Resilience Policy Statement 2014). Inland waterways may experience greater floods due to changing land-use patterns and precipitation, drought can lower vessel drafts, and less ice on navigable waterways could increase seasonal windows for passage. The objective of this work is to integrate resilience planning and climate change preparedness for water-resource infrastructure.
Project plans: New datasets have been created by collecting relevant online climate and water level data and matching them to existing lock unavailability data and newly created spatial and temporal lag variables. We are exploring statistical models of lock unavailability as a function of climate and lagged versions of the response, for different measures of unavailability and different waterways (AR, IL, MS, and OH).

Corrosion-Tolerant Pre-Stressed CFRP Fatigue Retrofits for Improved Waterway Lock Reliability
Gary Prinz, Ph.D., P.E.
Clint Wood, Ph.D., P.E.
July 2016-August 2018
Accomplishments: Fatigue analysis using Miner's Rule determined that section F13 has the highest fatigue damage following one lock drain-fill cycle. In this study, the Greenup Lock and Dam was the lock gate analyzed under a moving hydrostatic pressure using the finite element software package ABAQUS. The experimental setup for the full-scale component testing was completed, the first fatigue test was started, a prototype fatigue retrofit was built, and multiple finite element analyses investigating retrofit effectiveness were conducted.
Project plans: Due to the nature of fatigue testing and the large number of fatigue cycles being required to fracture our laboratory gate specimens. We are working on instrumentation and monitoring of Lock #16 (enhancing the project data gathered), improve the data acquisition for our experimental lab testing with a new amplifier card for connecting our LVDT displacement measuring devices, and allow machined fabrication of additional retrofit design iterations.

Development of a Design Protocol: Sustainable Stabilization of Slope using Recycled Plastic Pin in Mississippi
Sadik Khan, Ph.D., P.E.
May 2016-October 2017
Accomplishments: In Mississippi, the shallow slope failure is induced by the climatic (temperature and rainfall) variation that cause shrink-swell behavior of expansive Yazoo clay soil, and require significant budget to repair. As a cost effective alternative, Recycled Plastic Pins (RPP) can be utilized to stabilize shallow slope failures, to offer a sustainable option and increase the economic competitiveness to maintain multimodal transportation infrastructure. The Recycled Plastic Pin (RPP) can be an attractive choice to stabilize the shallow slope failure in Mississippi. The current study investigated the effect of rainfall on the slope failure, numerically investigates different RPP configuration at 2H: 1V, 3H: 1V and 4H: 1V slopes and developed a design protocol to stabilize Mississippi slopes using RPP. Based on the study, it was observed that there is a high suction at the initial moment before rainfall. With short

duration of rainfall, a decrease in the suction takes place. This decrease in suction is immediate at the shallow surface faster compared to the deeper surface. It was also noticed that with an increase of rainfall intensity does not affect much infiltration, due to the low permeability of the highly plastic clay soil. The total volume of the rainfall plays a major role in the infiltration behavior for highly plastic clay soil. In addition, the successive rainfall can have a significant influence on slope failure in shallow depth in Mississippi due to several rainfall events.

Completed project: Conducted by JSU, this project was completed in October 2017. Final project report was submitted on time and distributed as per grant guidelines.

Effect of Swell-Shrink Characteristics on Landslides in Yazoo Clay
Mohammad Sadik Khan, PhD, PE
July 2017-June 2018

Accomplishments: Slope failures are frequent in highway embankments as well as in waterway infrastructures (levees) on expansive Yazoo clay in Mississippi, which cause significant maintenance problems and require millions of dollars to fix. After construction, the strength of the high plastic clay degrades due to the seasonal temperature and moisture variation, major factor of slope failure.

Project Plans: Develop model that connects the repeated shrink-swell behavior and progressive saturation of Yazoo clay due to rainfall, which will help transportation officials and Levee owners to predict the slope failure before it actually happens and repair it to maximize the system capacity.

Evaluating the Performance of Intermodal Connectors
Sarah Hernandez, Ph.D.
August 2016-June 2018

Accomplishments: This project focuses on evaluating the performance of Intermodal Connectors (IC) - critical "last mile" roadways connecting intermodal freight facilities such as maritime ports to the National Highway System (NHS). ICs account for less than 1% of NHS mileage, but are critical for timely and efficient multimodal freight movements. ICs are currently not well monitored or understood and are frequently missing from statewide planning, programming, and forecasting models. ICs are in relatively poor condition compared to the NHS as a whole. This has cascading effects on the reliability of multimodal freight operations- a 1- or 2-hour delay in a drayage movement can result in a 24-hour holdup in a domestic multimodal shipment. We have made progress on non-obtrusive sensor development based on low cost LIDAR sensors. We carried out an extensive data collection at the Van Buren, AR port area and are in the midst of processing the video data that will become input for our truck body classification model using LIDAR data.

Project plans: We are examining truck GPS data records for each of the ICs in AR. From the GPS records, we will prepare "truck sheds" to show the spatial impact of each port facility.

Exploration of Novel Multifunctional Open Graded Friction Courses for In-situ Highway Runoff Treatment
Yadong Li, Ph.D., P.E.
Lin Li, Ph.D., P.E.
July 2014-June 2016

Accomplishments: The goal of this study was to examine the removal of the major heavy metals Cu and Zn in roadway runoffs through PCP and Modified PCP (MPCP) and by adding innovative additives to Open Graded Friction Courses (OGFC) to create a new material that has high heavy metal removal capacities. The results of this study bring an important conclusion that not only can the pervious concrete pavement bring traffic-related benefits but also environmental benefits because of its long-term removal capacities for Cu and Zn, which are the major heavy metal contaminants in roadway

runoffs. The use of PCP in roadways and parking lots brings positive impacts for the sake of environmental protection.

Completed project: Conducted by JSU, this project was completed in June 2016. Final project report was submitted on time and distributed as per grant guidelines.

Identifying High-Risk Roadways for Infrastructure Investment Using Naturalistic Driving Data
Brian Wolshon, Ph.D., P.E.
October 2013-June 2015
Accomplishments: The final report reveals that clusters of high magnitude jerk events while decelerating were significantly correlated to long-term crash rates at these same locations, and these events can be used as surrogate measures of safety and as a way of predicting safety problems before even a single crash has occurred.
Completed project: Conducted by LSU, this project was completed in June 2015. Final project report was submitted on time and distributed as per grant guidelines.

In-Situ Monitoring and Assessment of Post Barge-Bridge Collision Damage for Minimizing Traffic Delay and Detour
Wei Zheng, Ph.D., P.E.
July 2014-June 2016
Accomplishments: This project developed an efficient in-situ monitoring and data processing scheme for assisting bridge professionals to reliably assess the barge-bridge collision damage and make prompt and informative decision on the operation the bridge and navigation waterways. Once a barge-bridge collision event happens, field dynamic measurements can be collected from the collided bridge structure with the sensor network.
Completed project: Conducted by JSU, this project was completed in June 2016. Final project report was submitted on time and distributed as per grant guidelines.

Innovative Bio-Mediated Particulate Materials for Sustainable Maritime Transportation Infrastructure
Lin Li, Ph.D. P.E.
November 2015-June 2017
Accomplishments: The primary objective of the proposed research project is to develop bio-mediated particulate materials to enhance the resilience and protection of maritime transportation infrastructure elements. All these results indicate that the bio-mediated particulate material based on MICP can provide an effective solution for problematic cases of sandy soil in the coastal area and beach sands. It is recommended that a pilot scale test be further performed to more closely simulate the real-life durability condition of MICP-treated soils in coastal area.
Completed project: Conducted by JSU, this project was completed in June 2017. Final project report was submitted on time and distributed as per grant guidelines.

LNG Bunkering for Marine Vessels at the Port of New Orleans: Siting and Facility Components
Bethany Stich, Ph.D.
April 2014-January 2016
Accomplishments: Develop an assessment of best practices regarding the construction of shore-side Liquefied Natural Gas (LNG) bunkering facilities and the overall feasibility of the LNG fueling facility. The best recommendation is for the Port of New Orleans to join with the International Chamber of Shipping in encouraging the International Maritime Organization (IMO) division of the United Nations to continue taking the lead in globally applied emissions standards. As the shipping industry is committed to the most rapid reduction possible of its share of greenhouse gas emissions, the transfer of the global

shipping fleet to LNG is the most efficacious way to attain this end. The Port is best advised to aggressively support an IMO-derived driven global implementation of policies, which would make this fleet conversion more cost effective than continued reliance upon cheap diesel as a marine fuel.
Completed project: Conducted by UNO, this project was completed in January 2016. Final project report was submitted on time and distributed as per grant guidelines.

Optimal Dredge Fleet Scheduling within Environmental Work Windows
Chase Rainwater, Ph.D.
Heather Nachtmann, Ph.D.
August 2014-August 2016
Accomplishments: After initial success with the base model, maritime professionals were intrigued by the use of operations research to aid in their decision process. The potential of the initial tool was met with concern over the fact that many realistic components were not considered. The main impact of this project is that every concern presented by USACE has now been addressed from a modeling perspective. The decision makers now understand that optimization tools can be flexible and extendable and, with the appropriate amount of attention, complex challenges can be modeled.
Completed project: Conducted by U of A, this project was completed in August 2016. Final project report was submitted on time and distributed as per grant guidelines.

Optimal Dredge Fleet Scheduling - Phase 2 Research
Chase Rainwater, Ph.D.
Heather Nachtmann, Ph.D.
August 2016-September 2017
Accomplishments: The failure to integrate the selection and scheduling process suggests that opportunity exists for significant financial and operational benefits for transportation planners. This research has adapted new quantitative tools that address this need by leveraging the expertise developed in this area by the team of investigators.
Completed Project: Conducted by UofA, this project was completed in September 2017. Final project report is being submitted on time and distributed as per grant guidelines.

Quantifying Resiliency of Maritime Transportation Systems
Brian Wolshon, Ph.D. P.E.
Scott Parr, Ph.D.
October 2015-June 2018
Accomplishments: This research leverages and adapts archival NAIS data for resilience analyses of coastal port operations following disruptive events. As part of this effort, archival vessel position reports will be used to establish a baseline of channel operations under "routine" non-event conditions. Observed losses in system functionality following a major disruption will be used to quantify the resiliency of the waterway using time dependent performance analysis. This type of analysis is critical when investigating the efficacy of the recovery process protocols and management strategies employed in the days and weeks that follow a major disruptive event. The primary contribution of this research is creating a systematic, objective means of measuring commercial port resiliency. The methods developed can be used for future studies of post-disaster operations and protocols, such as evaluations of channel operations after a disruption to better understand characteristics that increase resiliency.
Project Plans: During this reporting period, the research team worked on the preparation of the final report, which are still in progress. The final report submission and project completion is anticipated to be completed on or before the end of the period of performance.

Rapid and Non-Destructive Assessment of Levees for Strength and Liquefaction Resistance
Clint Wood, Ph.D. P.E.
Michelle Bernhardt, Ph.D.
January 2015-June 2017
Accomplishments: A small earthen dam tested using surface wave methods and resistivity in association with Natural Resource Conservation Service (NRCS Overall, the combined use of resistivity and Vs from CCR and surface wave methods provides a rapid and near continuous means to evaluate levees and earthen dams. The methods were shown to be capable of detecting many common defects in levees and earthen dams including the location of soft layers, old river meanders, inclusions or utilities, and internal erosion, any of which could lead to failure of the levee during a high water event.
Completed project: Conducted by U of A, this project was completed in June 2017. Final project report was submitted on time and distributed as per grant guidelines.

1.2.3 Livability and Emergency Management of Coastal and River Valley Communities Projects

Development of a Large-Scale Traffic Simulation Model for Hurricane Evacuation of Mississippi Coastal Region
Feng Wang, Ph.D., P.E.
July 2014-July 2015
Accomplishments: This project studied improved traffic flow assignment within an evacuation network and indicates that implementation of a gate control strategy could effectively decrease the total travel cost and reduce the degree of conflicts related to traffic movements and trip routes inside the network and improve evacuation performance.
Completed project: Conducted by JSU, this project was completed in July 2015. Final project report was submitted on time and distributed as per grant guidelines.

Evaluating Coastal and River Valley Communities Evacuation Network Performance Using Macroscopic Productivity
Scott Parr, Ph.D.
Brian Wolshon, Ph.D., P.E.
May 2015-May 2017
Accomplishments The simulation of mass evacuation traffic processes, while enormously valuable in emergency planning and management presents a number of challenges to transportation modelers and analysts. In conclusion, it is recognized this theoretical approach can present difficulties in actual practice. To meter demand under an actual emergency condition, evacuee entries into the system would have to be restricted, spatially and/or temporally, to prevent sudden surges in demand from overwhelming the network. As a practical matter, this could present operational and ethical dilemmas because some portion of a threatened population would have to be physically prohibited from fleeing.
Completed project: Conducted by LSU, this project was completed in May 2017. Final project report was submitted on time and distributed as per grant guidelines.

Measurement of Traffic Network Vulnerability for Mississippi Coastal Region
Feng Wang, Ph.D., P.E.
November 2015-July 2017
Accomplishments: Potential critical links related to the flooding surges of a hurricane were identified using a probability distribution approach to obtain the risk of an inundation over a road surface. The links that direct from the non-evacuation area to the evacuation area are less critical than links in the opposite directions, and the links with high redundancy are less critical than the links with low

redundancy. This finding confirms the effectiveness of the traffic control strategies are those that make use of the less utilized highway capacities.

Completed project: Conducted by JSU, this project was completed in July 2017. Final project report was submitted on time and distributed as per grant guidelines.

National Inventory and Analysis of Transit Oriented Development (TOD) in Proximity to Coasts and Port Facilities
John Renne, Ph.D.
October 2013-September 2017
Accomplishments: This study quantified and examined the number of jobs and residents in station areas near coastal areas, major rivers and near port facilities across the U.S. and forecasts future development and job potential of underbuilt station areas, which could become TODs.
Completed project: Conducted by UNO, this project was completed in September 2017. Final project report is being submitted on time and distributed as per grant guidelines.

Quantification of Multimodal Transportation Network Vulnerability: A Pilot Study in Mississippi
Himangshu Das, Ph.D., P.E.
May 2016-April 2017
Accomplishments: There are pressing needs to develop a network based quantification framework to assess vulnerability of multimodal transportation and infrastructure network exposed to both natural and fabricated hazards. We have developed a conceptual quantitative framework and database identifying critical transportation infrastructure and their vulnerability to natural hazards using existing data, modeling while incorporating downscaled climate scenario specific to the Mississippi Gulf Coast.
Completed project: Conducted by JSU, this project was completed in April 2017. Final project report was submitted on time and distributed as per grant guidelines.

Road Sign Recognition during Computer Testing versus Driving Simulator Performance for Stroke and Stroke Aphasia Groups
Neila Donovan, Ph.D.
October 2013-June 2015
Accomplishments: Research results show that post stroke aphasia significantly impacted accuracy and response time of road sign interpretation, and as language and symbol complexity increased on road signs, the aphasia-affected drivers performed with less accuracy and required more time indicating that designers of road signs and healthcare professionals should consider this when making decisions related to when those impacted to safely return to driving.
Completed project: Conducted by LSU, this project was completed in June 2015. Final project report was submitted on time and distributed as per grant guidelines.

Statistical Analysis of Vehicle Crashes in Mississippi based on Crash Data
Feng Wang, Ph.D., P.E.
November 2015-July 2017
Accomplishments: Analysis of the MDOT crash data showed that more than 15% of fatalities occurred in the coastal counties in 2013. The high crash frequencies are generally associated with metropolitan areas. The crash distribution in MDOT districts shows that high crash severity is not correlated with high population density in a metropolitan area. The crashes in rural areas are more severe or fatal than the crashes in urban areas. Similarly compared with Jackson Metro area, crashes in the Mississippi Gulf coastal area are significantly more severe.
Completed project: Conducted by JSU, this project was completed in July 2017. Final project report

was submitted on time and distributed as per grant guidelines.

Vulnerability of Fuel Distribution Systems to Hazards in Coastal Communities
John Pardue, Ph.D., P.E.
May 2015-March 2017
Accomplishments: The combined fueling station and road network constructed for this project is the first spatial representation of this system for a Louisiana coastal parish. While the Louisiana Governor's Office of Homeland Preparedness (GOHSEP) has a GIS-based system with spatial fueling data that can be used in an emergency, it has not been used for any pre-event analysis function. Results presented to the state's Supply Chain / Transportation Council.
Completed Project: Conducted by LSU, this project was completed in March 2017. Final project report was submitted and is being distributed as per grant guidelines.

Predicting Soil Type from Non-destructive Geophysical Data using Bayesian Statistical Methods
Michelle Bernhardt, Ph.D., P.E.
January 2018-August 2018
Accomplishments: Electrical resistivity measurements and surface wave methods were determined to be the most advantageous in terms of capturing features of interest; rapid non-destructive geophysical testing that can be used to proactively evaluate levees.
Project Plans:
A more accurate and interpretable predictor of soil type is critically needed in order to assess the many miles of undocumented levees scattered across the United States. The proposed method would allow this information to be gathered non-destructively which would save both time and money.

2. Products

2.1 Publications

Journal Articles
1. Chimka, Justin R, Adrian Fernandez De Luis (student) and Grace W McGee (student), "Statistical Effects of Waterway Lock Unavailability and Commodity Flow," Quality Technology and Quantitative Management (under review).
2. Tong, Jingjing and Heather Nachtmann, "A Tabu Search Approach to the Cargo Prioritization and Terminal Allocation Problem," International Journal of Shipping and Transport Logistics, (under review).
3. Gedik, Ridvan, Gokhan Egilmez, Chase Rainwater, Kenneth Ned Mitchell, and Heather Nachtmann, "A Perspective on Scheduling Optimization for Maintenance Dredging of the U.S. Marine Transportation System." Transportation Research Part E: Logistics and Transportation Review (under review).
4. Wang, N., and F. Wang "Statistical Analysis of Vehicle Crashes on Mississippi Coastal Two-lane Highways," by Ma, Z. (MS student), Civil Engineering Research Journal, Volume 3 Issue 5 - March 2018, DOI: 10.19080/CERJ.2018.03.5556223).
5. Bu, Lei (PhD student), Feng Wang, Lihwa Lin, Haitao Gong (PhD student), and Chuanzhong Yin "Hurricane Surge Vulnerability Study for US Highway 90 along Mississippi Gulf Coastline," Journal of Operational Oceanography (under review).
6. Bu, L. (PhD student), F. Wang, X. Zhou, and C. Yin, "Managed Gating Control Strategy for Emergency Evacuation," Transportmetrica A - Transport Science, (under revision).

Books/Other One-Time Publications

1. P. Murray-Tuite, M. Lindell, B. Wolshon, and E.J. Baker. "Large-Scale Evacuation: The Analysis, Modeling, and Management of Emergency Relocation from Hazardous Areas (working title), in contracted and in development for publication by CRC Press, Taylor and Francis Publishing Group, LLC, September 2018.
2. Bu, L., F. Wang, and M. Thomas. "Data Science Method in Analysis of Flood Risk in Mississippi Gulf Coast Area", Book chapter of "Data Science and Digital Business" by Springer. Editors: Fausto Pedro García Márquez and Benjamin Lev, accepted for publication in February 2018.

Conference Papers

1. Asborno, M. and S. Hernandez, "Using Data from a State Travel Demand Model to Develop a Multi-Criteria Framework for Transload Facility Location Planning", Annual Meeting of the Transportation Research Board, Washington D.C., January 2018.
2. Smith, S., A. Braham, S. Hernandez, and J. Kent, "Development of a Cost Estimation Framework for Potential Transload Facilities", Annual Meeting of the Transportation Research Board, Washington D.C., January 2018.
3. Gaddy, A., S. Hernandez, and S. Nurre, "Incorporating Truck Parking and Hours of Service (HOS) into a Truck Routing Heuristic", Annual Meeting of the Transportation Research Board, Washington D.C., January 2018.
4. Khan, M.S., M. Nobahar, J. Ivoke, and F. Amini, "Rainfall Induced Shallow Slope Failure Over Yazoo Clay in Mississippi", Proc. Pan-AM Unsat, Dallas, TX, October 2017.
5. Wu, D. (PhD student), N. Wang, F. Wang, and S. Hong. "Applying Machine Learning Algorithms to Highway Safety EEPDO", IEEE CPS proceedings, The 2017 International Conference on Computational Science and Computational Intelligence, CSCI'17., Las Vegas, No. 978-1-5386-2652-8/17, pp 1421-1426, DOI 10.1109/CSCI.2017.248 December 2017.
6. Lynn, A. (MS student), H. Gong (PhD student), L. Bu (PhD student), Z. Ma (MS student), and F. Wang., "Characteristics and Factor Analysis of Vehicle Crashes in Mississippi" 97th Annual TRB Meeting, Washington, DC, January 2018.

Conference Presentations

1. Langston, Maggie (student) "Corrosion-Tolerant Pre-Stressed CFRP Fatigue Retrofits for Improved Waterway Lock Reliability", U of A graduate seminar, February 2018.
2. Lozano, Christine (student) "Pre-stressed retrofit strategies for mitigating fatigue cracking in steel waterway lock gate components", MS thesis committee, December 2017.
3. Prinz, Gary "Mitigating fatigue cracking in steel waterway lock gate components", MBTC Advisory Board Meeting, November 2017.
4. Gary Prinz "Recent steel research at the University of Arkansas", BYU graduate seminar, November 2017.
5. Hernandez, S., "Understanding Freight Activity from Anonymized Sources", Missouri University of Science and Technology, Rolla MO, February 2018.
6. Asborno, M. and S. Hernandez, "Using Data from a State Travel Demand Model to Develop a Multi-Criteria Framework for Transload Facility Location Planning", Transportation Research Board Annual Meeting, Washington D.C., January 2018.
7. Smith, S., A. Braham, S. Hernandez, and J. Kent, "Development of a Cost Estimation Framework for Potential Transload Facilities", Transportation Research Board Annual Meeting, Washington D.C., January 2018.

8. Gaddy, A., S. Hernandez, and S. Nurre, "Incorporating Truck Parking and Hours of Service (HOS) into a Truck Routing Heuristic", Transportation Research Board Annual Meeting, Washington D.C., January 2018.
9. Nachtmann, Heather, "Modeling Dynamic Behavior of the McClellan-Kerr Arkansas River Navigation System (MKARNS)," Arkansas Waterways Association Annual Conference, Little Rock, Arkansas, November 2017. (invited)
10. Nachtmann, Heather, Frances Alston, Suzanna Long, and Kim LaScola Needy, "Women in Engineering Management Panel," 2017 American Society for Engineering Management International Annual Conference, Huntsville, Alabama, October 2017.
11. Oztanriseven, Furkan and Heather Nachtmann, "Measuring The Economic Importance of Navigable Waterways," 2017 American Society for Engineering Management International Annual Conference, Huntsville, Alabama, October 2017.
12. Tong, Jingjing, Shengfan Zhang, and Heather Nachtmann, "A Finite-horizon MDP Model for Decision Making during the Inland Waterway Disruptions," 2017 American Society for Engineering Management International Annual Conference, Huntsville, Alabama, October 2017.
13. Delgado, Liliana (student), and Chase Rainwater, and Heather Nachtmann, "Assignment and Scheduling of Disrupted Barges," INFORMS 2017 Annual Conference in Houston, TX, October 2017.
14. Wolshon, Brian, "Research, Planning, and Lessons Learned in Evacuation and Transportation Resilience," Northwestern University Transportation Seminar, Evanston, IL, February 2018. (Invited)
15. Wolshon, Brian, Lectern Session 191: "After the Hurricanes" Transportation Research Board, Washington D.C. January 2018.
16. S. Parr, B. Wolshon, and P. Murray-Tuite, "Unconventional Intersection Control Strategies for Urban Evacuation" Transportation Research Board, Washington D.C. January 2018.
17. B. Wolshon, "Evacuation and Emergency Transportation: Techniques and Strategies for Systems Resilience" Transportation Research Board Meeting, Washington D.C., January 2018.
18. Khan M.S., Pan-AM Unsat Lectern Presentation, "Rainfall Induced Shallow Slope Failure over Yazoo Clay in Mississippi", Dallas TX, November 2017.
19. Khan M. S., M. Nobahar, J. Ivoke, and F. Amini, 97th Annual Meeting of Transportation Research Board, Poster Presentation Title: "Effect of Rainfall on Slope made of Yazoo clay in Mississippi" Washington D.C., January 2018.
20. Severson, Ian (student), Smart Rivers Conference, "Liquefied Natural Gas (LNG): Export Competition in a Well-Supplied, Flow Shifting Global Economy", January 2018, (invited).
21. Severson, Ian (student), TRB, "Liquefied Natural Gas (LNG): Export Competition in a Well-Supplied, Flow Shifting Global Economy," January 2018.

2.2 Websites

Website Title	Web Address
MarTREC	http://martrec.uark.edu/
Institute for Multimodal Transportation	http://www.jsums.edu/imtrans/
Gulf Coast Center for Evacuation and Transportation Resiliency	http://www.evaccenter.lsu.edu/
Merritt C. Becker Jr. UNO Transportation Institute	http://transportation.uno.edu/

2.3 Technologies or Techniques
Nothing to report

2.4 Inventions
Nothing to report

2.5 Other Products
- ARDOT WIM Database and truck GPS database hosted on PI server for project development

3. Participants & Collaborating Organizations

3.1 Partnerships

Organization Name	Location	Collaboration
Arkansas State Highway and Transportation Dept.	Little Rock, AR	$40k fund (match project)
Dr. Dennis Phillip Robinson, University of Arkansas	Little Rock, AR	research collaborator
Mr. Gene Higginbotham, Executive Director, AR Waterways Commission	Little Rock, AR	research collaborator
Ms. Deidre Smith, Waterways Manager, ODOT	Muskogee, OK	research collaborator
Mr. Matthew Tyler Henry, Regional Economist at the U.S. Army Corps of Engineer	Muskogee, OK	research collaborator
Dr. Jingjing Tong, Assistant Professor, Southeast Missouri State University	Cape Girardeau, MO	research collaborator
Dr. Kenneth Ned Mitchell, US Army Corps Engineer	Vicksburg, MS	research collaborator
Guillermo Riveros, US Army Corps of Engineers,	Vicksburg MS,	guidance on lock gates
Brandi Christian, Donnell Jackson, Amelia Pellegrin	Port of New Orleans	outreach
Kristi App, International Freight Forwarders & Customs Brokers Association	New Orleans, LA	advisory board service
Billy App and Caitlin Cain World Trade Center Transportation Committee	New Orleans, LA	advisory board service
Mr. Chad Johnston, Dept. of Homeland Security	Arkansas District	research collaborator
Mr. Glenn Moore, Dept. of Homeland Security	Oklahoma District	research collaborator
Gary LaGrange, Ports Association of Louisiana	New Orleans, LA	research collaborator
Christine Titus, GNO Port Safety Council	New Orleans, LA	research collaborator
RADM Joel Whitehead, Propeller Club of NO	New Orleans, LA	research collaborator
Dawn Lopez and David Fennelly, Turn Services	New Orleans, LA	Board Service, internships
Sharon Leader, Jefferson Parish Transit	New Orleans, LA	research collaborator
Walter Brooks, Regional Planning Commission	New Orleans, LA	research collaborator
Paul Aucoin, Port of South LA	New Orleans, LA	research collaborator
Randy Guillot, Triple G. Express, Inc.	New Orleans, LA	research collaborator
James Baldwin, Coastal Cargo	New Orleans, LA	research collaborator
Kristin G. Palmer, Super Region Rail Authority	New Orleans, LA	research collaborator
David Scoggin, Global Logistics Expert	New Orleans, LA	research collaborator
Douglas Grubbs, Crescent Port Pilots Assn. (ret).	New Orleans, LA	research collaborator
Dr. Rick Leuttich and Dr. Gavin Smith, UNC	Chapel Hill, NC	research collaborator
Dr. Sam Brody, Texas A&M University	Galveston, TX	research collaborator

3.2 Other Collaborators

Organization Name	Location	Collaboration
Dr. Jingjing Tong, Assistant Professor, Southeast Missouri State University	Cape Girardeau, MO	case study development
Dr. Melissa Tooley, Director, TTI	College Station, TX	center collaborator
Professor Chi Li	Inner Mongolia Institute of Tech.	research collaborator
Associate Professor Changming Bu	Chongqing University of Science & Technology	research collaborator
Associate Professor Fan Liang	Chongqing Jiaotong University	research collaborator
Professor Dong Qian	Chongqing University of Science & Technology	research collaborator
Dr. Helen Chen	Johnson C. Smith University, Greensboro, NC	research collaborator
Dr. Barry Keim	Louisiana State University, Baton Rouge, LA	research collaborator
Dr. Sandra Knight	University of Maryland College Park	research collaborator
Dr. Gavin Smith	University of North Carolina, Chapel Hill, NC	research collaborator
Dr. Ismael Pagan and Dr. Ricardo Lopez	University of Puerto Rico, Mayaguez, P.R.	research collaborator
Dr. Meherun Laiju	Tougaloo College, Jackson, MS	research collaborator
Dr. Sam Brody, Dr. Wes Highfield, Dr. Jens Figlis and Dr. William Merrell	Texas A&M University	research collaborator
Dr. Bas Jonkman	Technical University Delft (TU Delft), The Netherlands	research collaborator
Dr. Shahadat Hossain	Department of Civil Engineering, UT Arlington	research collaborator
Florida Atlantic University	Boca Raton, FL	research collaborator
Dr. Lan Liu, Professor of School of Transportation and Logistics	Southwest Jiaotong University	research collaborator
Dr. Chuanzhong Yin	Shanghai Maritime University	research collaborator
Dr. P.C. Yuan and Dr. Jessica Murphy, Jackson State University	Jackson, MS	research collaborator
Dr. Jeffrey Melby, Engineer Research and Development Center	Novato, CA	Guest Lecturer
Mississippi DOT	Jackson, MS	external evaluator
Dr. Chris Massey and Dr. Norberto Nadal, Engineer Research and Development Center	Vicksburg, MS	Partner in NSF funded PIRE Coastal Flood Risk Reduction.
Dr. Jyotishka Datta,	Assistant Professor of Statistics, Department of Mathematical Sciences, University of Arkansas.	Expert in Bayesian methodology and machine learning.

4. Impacts

Stakeholder Citations
- MKARNS project noted as a key input to an ongoing RRAP study by DHS Infrastructure team

4.1 Impacts on Principal Disciplines

Leadership Positions
1. Chair, ASCE methods of design committee
2. Member, ASCE fatigue and fracture committee
3. Conference Chair, Institute of Industrial and Systems Engineering
4. Research Member, Advisory Council for Transportation, ARDOT
5. Chair, Standing Committee on Emergency Evacuation, Transportation Research Board
6. Member, Standing Committee on Emergency Evacuation, Transportation Research Board
7. Member, Standing Committee on Traffic Law Enforcement, Transportation Research Board
8. Technical Member, TRB AFP 30 Soil and Rock Properties Committee
9. Panel Member, NCHRP Project Panel C01-59
10. Member, TRB Intermodal Freight Committee
11. Member, TRB Logistics of Disaster Committee
12. Member, STPA of ASPA
13. Member, Transportation Research Board Committee (ABJ90 - Freight Transportation Data)
14. Sub-committee chair (ABG20- Transportation Training and Education), Institute of Transportation Engineers Diversity and Inclusion Committee Subcommittee on STEM
15. Chair, Highway Division for World Transport Convention (WTC)
16. Member, TRB Intermodal Freight Committee
17. Member, TRB Logistics of Disaster Committee

Leadership Awards
1. Maggie Langston, Dwight David Eisenhower Transportation Fellowship, January 2018.
2. Christine Lozano Jack Buffington Poster Award, MBTC annual meeting November 2018.
3. Brian Wolshon, 2017 James M. Todd Technical Accomplishment Medal, Louisiana Engineering Society - Baton Rouge Chapter.
4. Ian Severson, Dwight David Eisenhower Masters Fellowship, January 2018.
5. Heather Nachtmann awarded Earl J. and Lillian P. Dyess Endowed Chair in Engineering, January 2018.
6. Ayanna A. Lynn, TRB minority research fellow, January 2018.
7. Ayanna A. Lynn, recipient of Eisenhower Fellowship, January 2018.
8. Sarah Hernandez, University of Arkansas, awarded the Private Sector Applicability Award by the TRB Standing Committee on Intermodal Freight Transportation.
9. 1st place of Mississippi in Traffic Bowl competition, Deep South Institute of Transportation Engineers (DSITE), New Orleans, LA, March 2018.

4.2 Impacts on Other Disciplines

Related External Grants
- Khan, M.S. and F. Amini, "Performance Evaluation of Highway Slopes on Yazoo Clay". Submitted to MS DOT on June 2017. Total Budget $196K, Notice to Proceed received February 2018.

4.3 Impacts on Human Resources and Workforce Development

K-12 Programs
- The University of Arkansas Office of Recruitment and Outreach participated in 61 events and engaged 3000 students in the area.

Pre-College and Recruitment
- The University of Arkansas Engineering Career Awareness program (ECAP) is designed to recruit students who are underrepresented in the field of engineering, and to give these students the support they need to feel comfortable, confident and ready to succeed. The ECAP program provides financial assistance to qualifying students, three-week summer bridge program and continued engagement to graduation and beyond.

Internships
1. Spring 2018, Murthy Bhavaraju, Industrial Engineering, University of Arkansas, Logistics, Walmart.
2. Spring 2018, Emily Matlock, Industrial Engineering, University of Arkansas, Logistics, Toyota.

Diversity
1. Women's Transportation Seminar New Orleans Chapter (WTSGNO)
2. Ayanna A. Lynn (African American female) TRB minority research fellow
3. Ayanna A. Lynn (African American female) recipient of Eisenhower Fellowship

4.4 Impacts on Physical, Institutional, and Informational Resources

Physical (also Collaborative Activities)
1. With Dr. Lan Liu, Professor of School of Transportation and Logistics, Southwest Jiaotong University, in collaboration of research paper "The Spatial Partitioning of Traffic Networks for Boundary Flow Control," accepted to China Journal of Highway and Transport.
2. Dr. Chuanzhong Yin, Associate Professor of School of Traffic and Transportation, Shanghai Maritime University, research paper "Just-in-time Railway Transport of Power Plant Coal with Safety Inventory," accepted to the 97th Annual TRB Meeting, Washington, DC, January 2018.

Institutional
- UNOTI hosted "Logistics Career Fair and Summer Learning Program" in coordination with Traffic and Transportation Club of Greater N.O.

Editorial Journal Positions
1. Associate Editor, Stochastics and Quality Control
2. Editor, International Journal of Six Sigma and Competitive Advantage

3. Editor-in-Chief, Engineering Management Journal
4. Area Editor, The Engineering Economist
5. Area Editor, Journal of Transportation Safety System Security
6. Guest Co-Editor, Special Issues of: the Journal of Advanced Transportation and the International Journal of Disaster Risk Reduction

4.5 Impacts on Technology Transfer

Transfer of Results
- Education Modules - GirlTREC learning modules available at sites.uark.edu/sarahvh

4.6 Impacts on Society beyond Science and Technology

Distinguished Lectures
1. Sam Briuglio, VP, Planning & Geospatial, POND Company; October 2017; UNO library; 35 participants.
2. Randy Guillot, President, Triple G. Express, October 2017, UNO, 25 participants.
3. Walter Brooks, Exec. Director, NORPC, March 2018, UNO, 30 participants.
4. Sharon W. Leader, Director of Transit for Jefferson Parish, March 2018, UNO, 20 participants.
5. Gary P. LaGrange, Principal, Gary P. LaGrange and Associates, UNO, October 2017, 25 participants.
6. Dan Flowers Distinguished Lecture Series, Regina Hopper, Senior Vice President Global Public Policy GRIDSMART Technologies, Inc., *Intelligent Next Generation Transportation: Integrated Mobility through Connected and Automated Technologies* November 2017, 150 participants.

Conference Planning Positions
1. Workshop Organizer, Transportation Research Board Committee Member
2. Sub-committee chair (ABG20- Transportation Training and Education)
3. Institute of Transportation Engineers (ITE) MOVITE Section Local
4. Member, 2018 Marine Transportation System Research and Technology Conference
5. Session Co-Chair, Pipeline and Transportation Structures in Unsaturated Soils of PAN-AM UNSAT
6. Conference Chair, Institute of Industrial and Systems Engineering
7. Paper review coordinator of "Waterway transport safety" committee of Waterway Division for World Transport Convention (WTC)

5. Changes/Problems

Nothing to report

6. Special Reporting Requirements
Nothing to report