



USDOT Tier 1 University Transportation Center

Program Progress Performance Report #8

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

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Signature: 

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#8	Objective Addressed
# of ongoing projects in all MarTREC research area	17	R1
# of peer-reviewed journal articles (published, accepted, submitted)	11	R3
# of conference presentations	7	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	21	R2
# of UG/G students participating in transportation research projects funded by UTC	35	R2
# of MS/PhD transportation-related advanced degree programs	14	R2
# of MS/PhD graduate students supported by MarTREC	24	R2
# of MS/PhD students supported by MarTREC who received degrees	3	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#8	Objective Addressed
# of national and regional leadership positions held	15	L1
# of conference planning positions held	10	L1
# of invited talks given	0	L1
# of leadership and research awards received	1	L1
# of impactful research citations by stakeholders	1	L2
# of UG/G students participating in transportation research projects funded by UTC	35	L1
# of junior faculty mentored	2	L1
# of leadership workshops held	0	L2
# of external grant proposals submitted	4	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#8	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	9	EWD3
participant count of distinguished lectures & seminars offered	450	EWD3
# of short courses and workshops offered	0	EWD3
participant count of short courses and workshops offered	0	EWD3
# of <i>times</i> technician certification programs are offered	23	EWD3
participant count of technician certification programs offered	406	EWD3
# of educational modules and case studies developed	0	EWD2
# of student-authored publications	10	EWD2
# of student-presented presentations	2	EWD2
# of K-12 programs offered	4	EWD4
participant count of K-12 programs (events) offered	90	EWD4
% of female participants in K-12 programs	48%	EWD4
% of minority participants in K-12 programs	82%	EWD4
# of pre-college programs offered	21	EWD4
participant count of pre-college programs offered	1323	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#8	Objective Addressed
# of peer-reviewed journal articles (published, accepted, under review)	11	TT2
# of conference presentations	7	TT2
# of technical briefs	0	TT2
# of guidebooks	0	TT2
# of short courses and workshops offered	6	TT1
participant count of short courses and workshops offered	225	TT1
# of conference planning positions held	10	TT1
# of editorial journal positions held	8	TT1
# of technician certification <i>programs</i> offered	8	TT1
participant count of technician certification programs offered	406	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#8	Objective Addressed
# of collaborative partnerships formed	22	C1
# of collaborative activities conducted	5	C2
# of collaborative deliverables completed	5	C2
# of collaborative team events	5	C1
# of collaborative outreach events held	4	C2
# of faculty involved in collaborative activities	12	C3
# of students involved in collaborative activities	24	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 10, 2017.

1.2 Project-Level Accomplishments

MarTREC had 17 active research projects during this reporting period. Eight projects were completed during this reporting period. Two projects were 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 can 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 that can be created as a result 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-October 2017

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: We are currently extending our earlier work through CPTAP model enhancement in order to provide timely knowledge and awareness of what cargoes should be prioritized for offloading during disruption response and what infrastructure exhibits low resiliency in terms of modal capacity to potential attacks or natural disasters against inland waterway transportation systems.

Supporting Secure and Resilient Inland Waterways Phase Two

Heather Nachtmann, Ph.D.

Justin Chimka, Ph.D.

July 2017-June 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 Phase One project by expanding our current model to consider uncertainty into the decision. Future commodities transported, barge traffic, and water and land capacities are all unknown parameters that will be considered.

1.2.2 Building Resilient and Sustainable Multimodal Infrastructure Projects

Climate Impacts on Lock Use and Performance

Justin Chimka, Ph.D.

July 2016-June 2018

Accomplishments: Statistical models of Climate Impacts on Lock Use and Performance will help DOT and USACE integrate Climate Change Adaptation with Lock Operations and Marine Services by quantifying fixed route infrastructure vulnerability. Currently consolidating locks by district / division and / or waterway data for calendar years 1993 – 2015.

Project plans: Create new datasets by collecting relevant online climate data and matching them to existing lock unavailability data and newly created spatial lag variables (lock unavailability in nearby places). These new datasets allow us to begin exploring statistical models of lock unavailability as a function of climate data and spatial lags, for different measures of unavailability (scheduled unavailabilities, scheduled unavailable time, unscheduled unavailabilities, unscheduled unavailable time) and different waterways (Arkansas, Illinois, Mississippi, Ohio).

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-June 2018

Accomplishments: Fatigue analysis using Miner's Rule determined that section F13 (Figure 21), 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: Related to the fatigue retrofit development, a prototype retrofit has been created and is being tested for pre-stress loss, surface preparation requirements, and pre-stress application. In addition to the physical fatigue testing, high-fidelity finite element simulations of the installed retrofit were conducted to evaluate pre-stressing formulas developed during earlier project reporting periods. Preliminary analyses indicate an extension in fatigue life of approximately 10 years using the retrofit strategies.

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.

Project plans: The design can be executed with the following steps: The factor of safety of the unreinforced slope should be determined by using the soil parameters and depth of surficial failure, according to the Equation. The spacing of RPP should be considered. Finally, the factor of safety of the reinforced slope can be determined. If the factor of safety of a reinforced slope is inadequate, the spacing of the RPP should be reduced to increase the factor of safety of the reinforced slope.

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: Intermodal connectors - critical "last mile" roadways connecting intermodal freight facilities such as maritime ports to the National Highway System. Gathered existing traffic, facility (port), and other relevant data to identify major data gaps for ICs in AR.

Project plans: During the past reporting period we have made progress on sensor development. Currently our Lidar based sensor accurately measures vehicle speed and length (i.e. effective vehicle length), and traffic volume. The sensor is bundled with a low-cost video camera. We developed an algorithm to match the Lidar data and video images for each passing vehicle so that we can identify the vehicle type associated with each Lidar data array. We are now in the process of gathering a diverse data set to demonstrate the capability of the Lidar sensor to capture truck body type. During the testing phase we will evaluate different hardware configurations, noting those that provide the most robust classification potential.

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: The work presented in this research uses archival data from the United States Coast Guard's Nationwide Automatic Identification System (NAIS) to quantify the state of resiliency of coastal navigation systems.

Project Plans: Application of this model to quantify the resiliency of port operations on case study areas will be conducted.

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 man-made 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.

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. Lu, Weike, Feng Wang, Lan Liu, and Guojing Hu (student), "Algorithm of Bottleneck Identification for Network in Hurricane Evacuation" ASCE Journal of Transportation Engineering, September 2017 (accepted).
3. Lu, Weike, Feng Wang, Lei Bu (student), and Lan Liu , "Game Theory Approach to Analysis of Vulnerability of Highway Networks in Evacuation", Transportation Research Part C (under review).
4. Lynn, Ayanna (student), Lei Bu (student), Haitao Gong (student), and Feng Wang, "Characteristics and Factor Analysis of Vehicle Crashes in Mississippi", Journal of TRB (under review).
5. Bu, Lei (student), Feng Wang, Lihwa Lin, Haitao Gong (student), and Chuanzhong Yin, "Hurricane Surge Vulnerability Study for US Highway 90 along Mississippi Gulf Coastline", Journal of TRB (under review).
6. Wang, Feng, Lei Bu (student), Xuesong Zhou, and Chuanzhong Yin, "Managed Gating Control Strategy for Emergency Evacuation of Subarea", ASCE Journal of Transportation Engineering (under review).
7. Khan M. S., J. Ivoke, and M. Nobahar, "Numerical Investigation of Slope Stabilization using Recycled Plastic Pin on Yazoo Clay", Transportation Research Record: Transportation Research Board, 2017 (under review).
8. Khan, M., M. Hossain, A. Ahmed, and M. Nobahar, "Simplified Design Method of Slope Stabilization Using Recycled Plastic Pin", Transportation Research Record: Transportation Research Board, 2017 (under review).
9. Khan, M., M. Nobahar, J. Ivoke, and F. Amini, "Effect of Rainfall on Slope made of Yazoo Clay soil in Mississippi", Transportation Research Record: Transportation Research Board, 2017 (under review).
10. Wen, K. (student), Y. Li, S. Liu (student), and L. Li, "Evaluation of Microbial Induced Calcite Precipitation Treatment Efficiency with pH change in Urea Hydrolyzed Process", Geomicrobiology Journal, 2017 (under review).
11. Oztanriseven, Furkan, and Heather Nachtmann, "Economic Impact Analysis of Inland Waterway Disruption Response," The Engineering Economist, Vol. 62, No. 1 (2017), pp. 73-89.

Books/Other One Time Publications

1. Bu, Lei (student), Feng Wang, and Marvin Thomas (student) "Data Presentation Method in Analysis of Flood Risk in Mississippi Gulf Coast Area" chapter in Data Science and Digital Business, published by Springer, editor: Fausto Pedro Garcia (under review).
2. Hossain, M.S., Khan M.S. and Kibria, G., "Sustainable Slope Stabilization using Recycled Plastic Pin", CRC Press, ISBN 9781138636101 - CAT# K32128. 2017.

Conference Papers

1. Li, L., K. Wen (student), C. Li, and F. Amini, "FIB/SEM Imaging of Microbial Induced Calcite Precipitation in Sandy Soil, Microscopy & Microanalysis Proceedings" 23 (Supplement 1), 310-311, doi: 10.1017/S1431927617002239. 2017
2. Li, L., M. Li (student), U. Ogbonnaya, K. Wen (student), Y. Xu, and F. Amini, "Study of a Discrete Randomly Distributed Fiber on the Tensile Strength Improvement of Microbial-Induced Soil Stabilization, Geotechnical Special Publication", No. 280: 12-19, ASCE. 2017.
3. Whalin, Robert, Qing Pang, La Shon Lowe, Josie Latham, "Assessment of a Summer Bridge Program: Seven Years and Counting", Proceedings of 2017 ASEE Annual Conference and Exposition, Columbus, Ohio, June 2017.
4. Ebersole, Bruce, Thomas Richardson, and Robert Whalin "Surge Suppression Achieved by Different Coastal Spine (Ike Dike) Alignments", Hurricanes, Major Disasters, Coastal Protection and Rapid Recovery in Texas and Gulf Coast Region Proceedings of 9th Annual Texas Hurricane Conference, University of Houston, August 2017.

Conference Presentations

1. Li, L., K. Wen (student), C. Li, and F. Amini, "FIB/SEM Imaging of Microbial Induced Calcite Precipitation in Sandy Soil, Microscopy & Microanalysis Proceedings" 23 (Supplement 1), 310-311, doi: 10.1017/S1431927617002239. 2017.
2. Li, L., M. Li (student), U. Ogbonnaya, K. Wen (student), Y. Xu, and F. Amini, "Study of a Discrete Randomly Distributed Fiber on the Tensile Strength Improvement of Microbial-Induced Soil Stabilization, Geotechnical Special Publication", No. 280: 12-19, ASCE. 2017.
3. Whalin, Robert, Qing Pang, La Shon Lowe, Josie Latham, "Assessment of a Summer Bridge Program: Seven Years and Counting", Proceedings of 2017 ASEE Annual Conference and Exposition, Columbus, Ohio, June 2017.
4. Ebersole, Bruce, Thomas Richardson, and Robert Whalin "Surge Suppression Achieved by Different Coastal Spine (Ike Dike) Alignments", Hurricanes, Major Disasters, Coastal Protection and Rapid Recovery in Texas and Gulf Coast Region Proceedings of 9th Annual Texas Hurricane Conference, University of Houston, August 2017.
5. Nachtmann, Heather, "Engineering Research at the University of Arkansas," Beihang University, Beijing, China, June 2017.
6. Oztanriseven, Furkan, and Heather Nachtmann, "Modeling Dynamic Behavior of Navigable Inland Waterways" Institute for Industrial & Systems Engineers Annual Conference, Pittsburgh, Pennsylvania, May 2017.
7. Nachtmann, Heather, and Furkan Oztanriseven, "Systems Analysis of the Behavior and Economic Impacts from the McClellan-Kerr Arkansas River Navigation System" Smart Rivers. Pittsburgh, Pennsylvania, September 2017.

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

Nothing to report

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 at Little Rock	Little Rock, AR	research collaborator
Mr. Gene Higginbotham, Executive Director, AR Waterways Commission	Little Rock, AR	research collaborator
Ms. Deidre Smith, Waterways Branch 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, Corey Winton, and Mark Cowan Research Civil Engineer, US Army Engineer Research and Development Center Coastal and Hydraulics Laboratory	Vicksburg, MS	research collaborator
Guillermo Riveros, US Army Corps of Engineers,	Vicksburg MS,	guidance on lock gates, review of interim reports, and access to lock gate construction documents
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, United States Department of Homeland Security, Office of Infrastructure Protection, Protective Security Advisor	Arkansas District	research collaborator
Mr. Glenn Moore, United States Department of Homeland Security, Office of Infrastructure Protection, Protective Security Advisor	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 New Orleans.	New Orleans, LA	research collaborator
Dawn Lopez and David Fennelly, Turn Services	New Orleans, LA	Board Service, research, internships
Sharon Leader, Jefferson Parish Transit	New Orleans, LA	research collaborator
Walter Brooks, New Orleans 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, Texas Transportation Institute	College Station, TX	center collaborator
Professor Chi Li	Inner Mongolia Institute of Technology	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, MD	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	School of Traffic and Transportation, Shanghai Maritime University	research collaborator
Dr. P.C. Yuan and Dr. Jessica Murphy, Jackson State University	Jackson, MS	collaborated on DHS Scientific Leadership Award to host students in the CRC for Spring/Summer 2017
Dr. Jeffrey Melby, Engineer Research and Development Center	Novato, CA	Guest Lecturer in graduate courses, Spring 2017
Mississippi Department of Transportation	Jackson, MS	serve as external proposal evaluator, March 2017.
Dr. Chris Massey and Dr. Norberto Nadal, Engineer Research and Development Center	Vicksburg, MS	partner in NSF funded PIRE Coastal Flood Risk Reduction.

4. Impacts

4.1 Impacts on Principal Disciplines

Leadership Positions

1. Co-Chair, Roadway Safety and Emergency Management, World Transport Convention
2. Member, ASCE GI Unsaturated soil technical committee
3. Member, ASCE GI Shallow Foundation technical committee
4. Vice chair, AFP-40 committee, TRB
5. Member, Transportation Research Board Committee (ABJ90 - Freight Transportation Data)
6. Sub-committee chair (ABG20- Transportation Training and Education)
7. Chair, AISC/SEI Methods of Design Committee

8. Member, AISC/SEI Fatigue and Fracture Committee
9. Member, TRB Intermodal Freight Committee
10. Member, TRB Logistics of Disaster Committee
11. Chair, Standing Committee on Emergency Evacuation, Transportation Research Board
12. Member, Standing Committee on Emergency Evacuation, Transportation Research Board
13. Member, Standing Committee on Traffic Law Enforcement, Transportation Research Board
14. President, American Society for Engineering Management
15. Member, Advisory Council for Transportation Research, Arkansas DOT

Leadership Awards

- High Grant Award, Jackson State University, April 2017

4.2 Impacts on Other Disciplines

Related External Grants

1. "Coastal Resilience Center of Excellence", Department of Homeland Security
2. "Coastal Flood Risk Reduction Program", National Science Foundation Partnership for International Research and Education
3. "Coastal Resilience Center of Excellence", Texas A&M University
4. "EAGER: SSDIM: Data Simulation to Support Interdependence Modeling in Emergency Response and Multimodal Transportation Network", National Science Foundation

4.3 Impacts on Human Resources and Workforce Development

Diversity

1. MarTREC hosted 35 fifth and sixth grade girls in July 2017 at our new GirlTREC summer camp. 65% of the participants were from underserved populations.
2. UNO National Summer Transportation Institute in July 2017 sponsored fourteen young men ages 13-17 spent the day visiting transportation hubs of New Orleans.
3. LSU Math Circle hosted nine 9th-12th grade underserved students in a four-week program
4. JSU hosted its annual Mississippi Summer Transportation Institute program in June 2017. 32 high school students participated, and of those 100% were African American and 60% female.
5. UNO hosted Women's Transportation Seminar Greater New Orleans Chapter.

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.

4.4 Impacts on Physical, Institutional, and Informational Resources

Physical (also Collaborative Activities)

1. In May, MarTREC hosted a McClellan-Kerr Arkansas River Navigation System meeting, among those in attendance, Chad Johnston and Glenn Moore, United States Department of Homeland Security, Office of Infrastructure Protection, Protective Security Advisors.

2. In July, UNO National Summer Transportation Institute partnered with Son of A Saint Program, New Orleans Union Passenger Terminal, Public Belt Railroad, and New Orleans Lakefront Airport to “Spotlight Transportation Careers”. Fourteen young men ages 13-17 spent the day visiting transportation hubs of New Orleans.
3. In July, MarTREC hosted 35 fifth and sixth grade girls at our new GirlTREC summer camp. The camp focused on hands-on activities related to transportation engineering from roads to rail to waterways and was designed to build courage and interest towards studying STEM fields and considering a career in the transportation industry. 65% of the participants were from underserved populations. This was a collaborative effort of MarTREC, U of A Recruitment Office, U of A faculty, and Springdale Public Schools.

Institutional

- UNO hosted Regional Transit Authority, Strategic Mobility Plan Community Workshops, August 2017.

Informational

- Regional Economic Impact Study of the McClellan-Kerr Arkansas River Navigation System project has been noted as a key input to an ongoing RRAP study by DHS Infrastructure team

Editorial Journal Positions

1. Editor Board Member, Journal of Geotechnical and Geological Engineering
2. Associate Editor, Economic Quality Control
3. Editor, International Journal of Six Sigma and Competitive Advantage
4. Editorial Board, International Journal of Quality Engineering and Technology
5. Area Editor, Journal of Transportation Safety System Security, Highway Transportation System Security & Emergency Response
6. Guest Co-Editor, Special Issues, International Journal of Disaster Risk Reduction and Journal of Advanced Transportation
7. Associate Editor, Engineering Management Journal
8. Area Editor, The Engineering Economist

4.5 Impacts on Technology Transfer

Transfer of Results

1. Interviewed as expert on highway, traffic, and civil engineering for “Super Hurricanes: Inside Monster Storms,” The Discovery Channel. Broadcast date: September 24, 2017. Available On-line at: <https://corporate.discovery.com/discovery-newsroom/science-channel-breaks-down-causes-of-massive-hurricanes-super-hurricanes-inside-monster-storms-premieres-friday-september-22-at-9-pm/>
2. Interviewed as expert on evacuation for “Super Hurricanes: Inside Monster Storms,” The Science Channel. Broadcast date: September 22, 2017. Available On-line at: <https://www.sciencechannel.com/tv-shows/super-hurricanes-inside-monster-storms/>
3. Interviewed and quoted as expert on evacuation for “How researchers map the routes that save lives when disasters loom,” CNBC, September 20, 2017. Available online at: <https://www.cnbc.com/2017/09/20/how-scientists-model-evacuation-routes-for-natural-disasters.html>

4. Interviewed and quoted as expert on evacuation for “ Amid Chaos of Storms, U.S. Shows It Has Improved Its Response,” *The New York Times*, New York, NY, September 12, 2017. Available online at: <https://www.nytimes.com/2017/09/12/us/irma-harvey-hurricane-response.html>
5. Interviewed on evacuation for Hurricane Irma, The Cable News Network (CNN) Headline News Channel (HLN), live broadcast date: September 7, 2017.
6. Interviewed and quoted as expert on evacuation for “Houston Mayor’s No-Win Dilemma: Whether to Tell Residents to Stay or Go” *The New York Times*, New York, NY, August 28, 2017. Available online at: <https://www.nytimes.com/2017/08/28/>

4.6 Impacts on Society beyond Science and Technology

Distinguished Lectures

1. Dr. Gavin P. Smith, DHS Coastal Resilience Center of Excellence and Research Professor, Department of City and Regional Planning, UNC, "Hurricane Matthew Disaster Recovery and Resilience Initiative" Disaster Coastal Studies Research Symposium, Tougaloo College April 2017.
2. Caitlin Cain, CEO World Trade Center of New Orleans, "WTC of New Orleans", August 2017.
3. Kristi App, VP J.W. Allen & Co., "Freight Forwarding Industry", August 2017.
4. Stephen Champagne, Terminal Manager, "Crude Oil Transport", August 2017
5. John Hyatt, VP The Irwin Brown Co., "LGITT" August 2017.
6. Keith Holt, Community Education Manager, "Bike Easy", August 2017.
7. Dr. Brian Wolshon, “Community Alert – We Don’t Know What We Don’t Know About Traffic,” KZSB AM 1290, Santa Barbara, CA, January 2017.
8. Dr. Brian Wolshon, “If another hurricane hits, can the SC coast avoid last year’s re-entry debacle?” *The State*, July 2017. <http://www.thestate.com/news/local/article161556553.html>
9. Dr. Brian Wolshon, “How should law enforcement and other officials prepare for a hurricane? Experts weigh in” *The Island Packet*, July 2017.

Conference Planning Positions

1. Paper Review Coordinator Committee, World Transport Convention, Beijing, China
2. Moderator, Civil, Environmental and Coastal Engineering Session, New Orleans, LA
3. Organizing Committee Member, Southeast Symposium for Contemporary Engineering Topics, Civil, Environmental and Coastal Engineering Session
4. Reviewer of Technical Papers, 2017 American Society for Engineering Education Conference, Columbus, OH
5. Conference Chair, Institute of Industrial and Systems Engineering
6. Member, Transportation Research Board Committee, (ABJ90 - Freight Transportation Data)
7. Sub-committee Chair (ABG20- Transportation Training and Education)
8. Member, Institute of Transportation Engineers, MOVITE Section Local Arrangements Committee
9. Session Moderator, 2017 Southern Plains Transportation Center Summer Symposium
10. Member, 2018 Marine Transportation System Research and Technology Conference Committee

5. Changes/Problems

Nothing to report

6. Special Reporting Requirements

Nothing to report