



USDOT Tier 1 University Transportation Center

Program Progress Performance Report #6

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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#6	Objective Addressed
# of ongoing projects in each MarTREC research area	21	R1
# of peer-reviewed journal articles (published, accepted, submitted)	20	R3
# of conference presentations	24	R3
# of tenure track faculty who conduct MarTREC research activities	13	R2
# of external partners involved in center research activities	17	R3
# of research activities that impact diversity through participants and/or outcomes	6	R2
# of UG/G students participating in transportation research projects funded by UTC	39	R2
# of MS/PhD transportation-related advanced degree programs	11	R2
# of MS/PhD graduate students supported by MarTREC	21	R2
# of MS/PhD students supported by MarTREC who received degrees	8	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#6	Objective Addressed
# of national and regional leadership positions held	16	L1
# of conference planning positions held	8	L1
# of invited talks given	4	L1
# of leadership and research awards received	1	L1
# of impactful research citations by stakeholders	2	L2
# of UG/G students participating in transportation research projects funded by UTC	39	L1
# of junior faculty mentored	12	L1
# of leadership workshops held	0	L2
# of external grant proposals submitted	6	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#6	Objective Addressed
# of projects in MarTREC educational and workforce development areas	12	EWD1
# of UG/G transportation-related courses associated with UTC	78	EWD2
# of distinguished lectures & seminars offered	3	EWD3
participant count of distinguished lectures & seminars offered	130	EWD3
# of short courses and workshops offered	0	EWD3
participant count of short courses and workshops offered	0	EWD3
# of times technician certification programs are offered	25	EWD3
participant count of technician certification programs offered	432	EWD3
# of educational modules and case studies developed	0	EWD2
# of student-authored publications	11	EWD2
# of student-presented presentations	11	EWD2
# of K-12 programs offered	8	EWD4
participant count of K-12 programs (events) offered	308	EWD4
% of female participants in K-12 programs	50%	EWD4
% of minority participants in K-12 programs	32%	EWD4
# of pre-college programs offered	34	EWD4
participant count of pre-college programs offered	2001	EWD4
# of online K-12 educational resources posted	0	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 PPR#6	Objective Addressed
# of peer-reviewed journal articles (published, accepted, under review)	20	TT2
# of conference presentations	24	TT2
# of technical briefs	1	TT2
# of guidebooks	1	TT2
# of short courses and workshops offered	0	TT1
participant count of short courses and workshops offered	0	TT1
# of conference planning positions held	8	TT1
# of editorial journal positions held	5	TT1
# of technician certification programs offered	9	TT1
participant count of technician certification programs offered	432	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 PPR#6	Objective Addressed
# of collaborative partnerships formed	15	C1
# of collaborative activities conducted	23	C2
# of collaborative deliverables completed	7	C2
# of collaborative team events	1	C1
# of collaborative outreach events held	2	C2
# of faculty involved in collaborative activities	15	C3
# of students involved in collaborative activities	5	C3

1.1.6 Plans for Next Reporting Cycle

MarTREC had 21 active research projects during this reporting period. The Center has completed ten projects over the life of the grant. Four projects were completed during this reporting period. Seven projects were approved as new projects during this reporting period. 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 18, 2016.

1.2 Project-Level Accomplishments

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.

Project plans: A district-specific probabilistic model will be developed to quantify the uncertainty associated with inland waterway closure. The MDP model will be improved considering the additional uncertainty in deterioration and security of cargo value, congestion and safety status at the offloading/rerouting point. Any necessary constraints on the delivery due date will be added to the model. We continue to improve closure prediction by studying weather and hydraulic analysis. The decision model and tool will be further improved to reflect the real cases, and structural results will be explored for faster decisions.

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: Developed mathematical modeling approaches to explore cost-efficient maintenance strategies for hardening inland waterway infrastructure against the possible impacts of shoaling,

weather events, and lock degradation are in progress.

Project plans: We are currently running and analyzing experiments on the single-year model, and we plan to perform experiments on the multi-year problem in the coming months.

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 2017

Accomplishments: We have developed a linear approach to extend our Cargo Prioritization Terminal Allocation Problem (CPTAP) modeling capability. This new approach, when validated, may allow us to solve realistic response scenarios more quickly.

Project plans: Our next steps are to test the new approach and compare this with our existing models. We will continue to reach our overall project goal to enhance CPTAP capability to provide real-time decision support for disruption response stakeholders to minimize the total value loss of cargo disruptions on the inland waterways.

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: Reviewing literature.

Project plans: The objective of this work is to integrate resilience planning and climate change preparedness for water-resource infrastructure. 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. The research steps will be to

review literature, consolidate locks by district / division and / or waterway data for calendar years 1993 – 2015 and estimate generalized linear models (GLM) of annual tons locked by commodity group and lock, as a function of lock usage and unavailability, general characteristics of locks, and climate variables.

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: Reviewing literature.

Project plans: The project addresses fatigue issues within lock gates, identifying critical components and exploring methods for preventing fatigue cracks for the entire gate component service life. The use of carbon fiber reinforced polymer plates will be explored along with innovative pre-stress and bonding strategies to fine-tune component stresses and achieve infinite component fatigue life.

Development of a Design Protocol: Sustainable Stabilization of Slope using Recycled Plastic Pin in Mississippi

Sadik Khan, Ph.D., P.E.

May 2016-April 2017

Accomplishments: Reviewing literature.

Project plans: 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.

Evaluating the Performance of Intermodal Connectors

Sarah Hernandez, Ph.D.

August 2016-June 2018

Accomplishments: Reviewing literature

Project plans: 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).

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-October 2016

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. The advanced materials are based on MICP for the sandy soils in the coastal area. We've completed the experimental study of fine grained soils (silt and clay) on the effect of microbial improved sandy soil.

Project plans: Compare the multi-treatment effect with single-treatment, analyze the results and come to conclusions.

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. Therefore the Port is best advised to aggressively support an IMO-derived driven global implementation of policies which would make this fleet conversion ultimately 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-August 2017

Accomplishments: Phase 1 research concluded August 2016

Project Plans: The failure to integrate the selection and scheduling process suggests that opportunity exists for significant financial and operational benefits for transportation planners. This research seeks to provide new quantitative tools that address this need by leveraging the expertise developed in this area by the team of investigators.

Quantifying Resiliency of Maritime Transportation Systems

Brian Wolshon, Ph.D. P.E.

Scott Parr, Ph.D.

October 2015-June 2018

Accomplishments: Collection and analysis of the relevant literature in the related fields of NAIS data, port operations and resiliency analysis are complete. Preliminary development of model capable of processing NAIS data to provide reliable estimates of port operations is complete.

Project Plans: Continued development of a model capable of processing NAIS data to provide reliable estimates of port operations will occur. 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 has been identified and tested using surface wave methods and resistivity in association with Natural Resource Conservation Service (NRCS). Data processing is near completion for the dam. The results will be used to establish the data processing and preliminary statistical framework. Lab work has also been conducted to understand the relationship between resistivity, density, and water content.

Project plans: We plan to conduct the main field study in early summer at levees which were identified in the Midwest during the GEER reconnaissance. We also plan to continue the lab experiments to understand the relationship between resistivity, density, and water content of standardized soil samples.

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-April 2017

Accomplishments: We are currently collecting and statistically analyzing the simulated network results. Initial results from this research project have been accepted for publication in two journals.

Project plans: We will complete collection of simulation results and analysis of these results.

Measurement of Traffic Network Vulnerability for Mississippi Coastal Region

Feng Wang, Ph.D., P.E.

November 2015-October 2016

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.

Project Plans: Measure evacuation network vulnerability and evaluate different evacuation strategies.

National Inventory and Analysis of Transit Oriented Development in Proximity to Coasts and Port Facilities

John Renne, Ph.D.

October 2013-September 2017

Accomplishments: Progress was made on quantifying and examining the number of jobs and residents in station areas near coastal areas, major rivers, and near port facilities across the United States.

Project plans: Efforts will forecast future development and job potential of underbuilt station areas and identify the number and type of jobs located in stations and compare and contrast by typology.

Quantification of Multimodal Transportation Network Vulnerability: A Pilot Study in Mississippi

Himangshu Das, Ph.D., P.E.

May 2016-April 2017

Accomplishments: Reviewing literature.

Project plans: 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. The objective of this study is to identify critical transportation networks and its vulnerabilities to a wide variety of hazard conditions based on real-world data. The objectives will be accomplished through systematic inventory of transportation facilities in Mississippi and prognostic modeling of infrastructure vulnerability using network model.

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-October 2016

Accomplishments: Characteristics of vehicle crashes in Mississippi were indicated. Initial analysis of the MDOT crash data showed that more than 15% of fatalities occurred in the coastal counties in 2013, which means vehicle crashes in this area call for extra attention.

Project plans: Models have been built to analyze the vehicle crashes for major highways in the Mississippi coastal area. We are applying the models to crashes on multiple highway corridors and have developed machine learning algorithms to identify traffic crash hot spots on US 49.

Vulnerability of Fuel Distribution Systems to Hazards in Coastal Communities

John Pardue, Ph.D., P.E.

May 2015-December 2016

Accomplishments: Developed extensive network model of coastal Louisiana communities capturing roads, fueling stations, and bulk terminals. Model captures all details of the lower portion of LA Highway 1, fuel capacities, supply routes and storage types.

Project plans: With model, efforts will assess vulnerability of fuel distribution system to flooding with consequence including immediate loss of fueling capacity, and system capacity after 1, 3 and 6 months based on past recovery periods derived from other flood events.

2. Products

2.1 Publications

Journal Articles

1. Gedik, Ridvan, Chase Rainwater, Heather Nachtman, and Edward Pohl, "Analysis of a Parallel Machine Scheduling Problem with Sequence Dependent Setup Times and Job Availability Intervals," *European Journal of Operational Research*, Vol. 251, No. 2, pp.640-650, June 2016. (published)
2. Tong, Jingjing, and Heather Nachtman, "Cargo Prioritization and Terminal Allocation Problem for Inland Waterway Disruptions," to appear in the *Maritime Economics & Logistics*, 2016. (accepted)
3. Oztanriseven, Furkan (student), and Heather Nachtman, "Economic Impact Analysis of Inland Waterway Disruption Response," to appear in *The Engineering Economist*, 2016. (accepted)

4. Bu, L. (student), F. Wang, X. Zhou, and C. Yin. "Modeling Gate Control Strategy for Traffic Management in Emergency Evacuation", *International Journal of Transportation*, Vol. 4, No.2 (2016), pp.31-46, April 2, 2016. (published)
5. Bu, L. (student), F. Wang, and C. Yin. "Graphical Visualization of Traffic Condition of Mississippi Gulf Coast Area", *Journal of the Pennsylvania Geographical Society*, July 2016. (accepted)
6. Bu, L. (student), F. Wang, and C. Yin. "A Managed Gating Control Strategy for Emergency Evacuation of a Subarea", *Transportation Research Part C*, submitted in September 2016. (under review)
7. Tomas, M. (student), L. Bu (student), H. Das, and F. Wang. "Analyses of Storm Surge Induced Flood Risk in Coastal Areas of Mississippi", *Journal of TRB*, 2016. (under review)
8. Wen, K., U. (student), Ogbonnaya (student), and L. Li, "Effects of Multiple MICP Treated on Sandy Soil with Lower Cementation Media Concentration", *Journal of Materials in Civil Engineering*, ASCE, 2016. (under review)
9. Ogbonnaya, U. (student), K. Wen (student), and L. Li, "The Effects of Fine-Grained Content on Microbial Improved Sandy Materials", *Journal of Materials in Civil Engineering*, ASCE, 2016. (under review)
10. Zheng , Wei and Feng Qian "Probabilistic Based Machine Learning Approach to Promptly Assessing Probability of Barge-Bridge Collision Damage of Piers", *Journal of Civil Health Monitoring*, 2016. (under review)
11. Zheng , Wei and Feng Qian "Discrete Sampling and Entropy-based Algorithm of Sensor Placement for Barge-Bridge Collision Damage Assessment", *Journal of Civil Health Monitoring*, 2016. (under review)
12. Zhang, Z., S. Parr, H. Jiang, and B. Wolshon, "Optimization Model for Regional Evacuation Transportation Systems Using Macroscopic Productivity Function," *Transportation Research, Part B*, Vol 81, No. 2 pp 616-630, 2016. (published)
13. Zhang, Z., Parr, S. and B. Wolshon, "Application of a Productivity Function to Assess Network Performance during Mass Evacuations" *International Journal of Transportation*, 2016. (accepted)
14. Farhadi, N., Parr, S., Mitchell, K., and B. Wolshon, "Use of Nationwide Automatic Identification System Data to Quantify Resiliency of Marine Transportation Systems" *Transportation Research Record, Journal of Transportation Research* 2549, 9 – 18, 2016. (published)
15. Nobrega , Rodrigo A. A., Bethany Stich, Jose I. Ferreira Junior, Leise K. Oliveira, and Marcelo T. Oliveira, "Improving the Transportation Planning Process: GIS-Based Multicriteria Simulations and Discussions Toward the Design of the Belo Horizonte Metropolitan Bypass," *Transportation Review Board*, 8/01/2016. (under review)
16. Stich, Bethany and Peter Webb (student), "Electronic Navigation: The Future of Waterborne Shipping," *Transportation Research Board*, 08/01/2016. (under review)
17. Stich, Bethany, James Amdal, Colin Ash, Brittany Waggenger, and Peter Webb (student), "Incorporating Freight and Trade in the Comprehensive Plan: A Megaregion Case Study", *Transportation Review Board*, 8/01/2016. (under review)

18. Griffith, Kyle (student), Bethany Stich, and Kim Mosby, "The Cuban Effect: What Normalized US-Cuba Relations Men for Economics and Freight Flows in the Gulf of Mexico," Transportation Research Board., 8/01/2016. (under review)
19. Stich, Bethany, James Amdal, Kyle Griffith (student), and Peter Webb (student), "Assessing the Potential for Gulf Coast NAFTA Maritime Trade Corridors," Trans. Review Bd., 8/01/2016. (under review)
20. Stich, Bethany and Jeffrey Cavanaugh, "The U.S. Gulf in a Liquefied Natural Gas Rich World.", Transportation Review Board., 08/01/2016. (under review)

Conference Papers

1. Madadi, M., R. Holmer, (student), S. Zhang, and H. Nachtmann, "Dynamic Decision Modeling for Inland Waterway Disruptions", In Proceedings of the 2016 Industrial and Systems Engineering Research Conference, Anaheim, CA, May 23-30, 2016. (published)
2. Tong, Jingjing, and Heather Nachtmann, "Economic Analysis of Disruptions on the Mississippi River: An Engineering Economy Educational Case Study," American Society for Engineering Education Annual Conference Proceedings, June 26-29, 2016. (under review)
3. Delgado Hidalgo, Liliana, and Heather Nachtmann, "A Survey of the Inland Waterway Transportation Planning Literature," Proceedings of the 2016 Industrial and Systems Engineering Research Conference, May 23-30, 2016. (under review)
4. Bu, L. (student), X. Fu, F. Wang, and C. Yin. "Optimal Resource Allocation of Transit Facilities for Passengers in Emergency Evacuation of a Transit Station", 2017 TRB Annual Meeting. (under review)
5. Wu, D. (student), N. Wang, and F. Wang. "Applying Machine Learning Algorithms to Highway Hot Spot Identification", 2017 TRB Annual Meeting. (under review)
6. Ma, Z. (student), N. Wang, and F. Wang. "Statistical Analysis of Vehicle Crash Severity on Mississippi Two-lane County Highways: 10 Fold Cross Validation Research Design", 2017 TRB Annual Meeting. (under review)
7. Morris, Z. (student), C. Wood, and F. Wang. "Comparison of Photogrammetry Processing", 2017 TRB Annual Meeting. (under review)
8. Tomas, M. (student), L. Bu (student), H. Das, and F. Wang. "Analyses of Storm Surge Induced Flood Risk in Coastal Areas of Mississippi", 2017 TRB Annual Meeting. (under review)
9. Lu, W. (student), L. Bu (student), F. Wang, and L. Liu. "Game-theoretic Analysis of Networks Vulnerability under Hurricane Evacuation", 2017 TRB Annual Meeting. (under review)
10. Lu, W. (student), F. Wang, L. Liu, and G. Hu. "Bottleneck Identification for Network under Hurricane Evacuation", 2017 TRB Annual Meeting. (under review)
11. Whalin, Robert W., "Increasing Retention and Graduation Rates for Engineers", 2016 Southeast Symposium on Contemporary Engineering Topic, Jackson, MS, August 26, 2016. (under review)
12. Whalin, Robert W., Ismael Pagan Trinidad, Evelyn Villanueva, and David Pittman, "A Quarter Century of Resounding Success for a University/Federal Laboratory Partnership", 2016 American Society for Engineering Education Annual Conference, New Orleans, LA, June 2016. (under review)

13. Whalin, Robert W., Samuel Brody, William Merrell, "The Galveston Bay Region as an International Test Bed for Flood Risk Reduction", 7th Texas Hurricane Conference, , University of Houston, Houston, TX, August 5, 2016. (under review)
14. Ebersole, Bruce, Thomas W Richardson, Robert W. Whalin, "Modeling Coastal Storms: Past, Present and Future", 7th Texas Hurricane Conference, University of Houston, Houston, TX, August 5, 2016. (under review)

Conference Presentations

1. Madadi, M., R. Holmer (student speaker), S. Zhang, and H. Nachtmann, "Dynamic Decision Modeling for Inland Waterway Disruptions". Industrial and Systems Engineering Research Conference, Anaheim, CA, May 23, 2016.
2. Khatereh Ahadi (student speaker), "Selecting Inland Waterway Maintenance Projects under Consideration of Random Disruptions", ISERC, May 2016. (Invited Talk)
3. Chimka, Justin "Economic Impacts of Lock Usage and Unavailability," Institute of Industrial and Systems Engineers Annual Conference, May 2016.
4. Tong, Jingjing, and Heather Nachtmann (speaker), "Economic Analysis of Disruptions on the Mississippi River: An Engineering Economy Educational Case Study," American Society for Engineering Education Annual Conference Proceedings, June 26-29, 2016.
5. Delgado Hidalgo, Liliana, (student speaker) and Heather Nachtmann, "A Survey of the Inland Waterway Transportation Planning Literature," Proceedings of the 2016 Industrial and Systems Engineering Research Conference, May 23-30, 2016.
6. Delgado Hidalgo, Liliana, (student speaker) and Heather Nachtmann, "Allocation and Scheduling of Barges for Inland Waterway Disruption Events," Industrial and Systems Engineering Research Conference, May 23-30, 2016.
7. Tong, Jingjing, (speaker) and Heather Nachtmann, "Value-Focused Assessment of Cargo Value Decreasing Rates," Industrial and Systems Engineering Research Conference, May 23-30, 2016.
8. Oztanriseven, Furkan (student speaker) and Heather Nachtmann, "Modeling Investment Impacts of Navigable Inland Waterways," Industrial and Systems Engineering Research Conference, May 23-30, 2016.
9. Adbesh, Fereydoun (student speaker), Chase Rainwater, Heather Nachtmann, Ned Mitchell, and Corey Winton, "Dredging Project Selection and Fleet Scheduling within Environmental Work Windows," ISERC Conference, May 24, 2016, Anaheim, CA.
10. Nachtmann, Heather, "Economic Impact of the River to the Region," Freight Network: Arkansas River (M40)/StrongPorts Workshop, Fort Smith, Arkansas, July 2016. (Invited Talk)
11. Nachtmann, Heather, "Supporting Secure and Resilient Inland Waterways," 4th Biennial Transportation Research Board - Committee on Marine Transportation Systems Conference, Washington, D.C., June 2016. (Invited Talk)
12. Nachtmann, Heather, "Regional Economic Impact Study of the McClellan-Kerr Arkansas River Navigation System (MKARNS)" 4th Biennial Transportation Research Board - Committee on Marine Transportation Systems Conference, Washington, D.C., June 2016. (Invited Talk)

13. Wu, D. (student speaker), F. Wang, and N. Wang. "Applying Machine Learning Algorithms to Highway Hot Spot Identification", 7th Southeast Symposium on Contemporary Engineering Topics (SSCET), Jackson, Mississippi, August 26, 2016.
14. Morris, Z. (student speaker), F. Wang, and C. Wood. "Comparison of Photogrammetry Software", 7th Southeast Symposium on Contemporary Engineering Topics (SSCET), Jackson, Mississippi, August 26, 2016.
15. Bu, L. (student speaker), M. Thomas, F. Wang, and H. Das. "Analyses of Storm Surge Induced Flood Risk in Coastal Areas of Mississippi", 7th Southeast Symposium on Contemporary Engineering Topics (SSCET), Jackson, Mississippi, August 26, 2016.
16. Ma, Z. (student speaker), F. Wang, and N. Ning. "Statistical Analysis of Vehicle Crashes on I-220 in Years 2011 through 2013", 7th Southeast Symposium on Contemporary Engineering Topics (SSCET), Jackson, Mississippi, August 26, 2016.
17. Ma, Z. (student speaker), N. Wang, and F. Wang. "Study of Vehicle Crash Patterns on I-10 in Mississippi using Association Rules of Data Mining", 2016 ICSA APPLIED STATISTICS SYMPOSIUM, Atlanta, GA, June 12-15, 2016.
18. Whalin, Robert W., "Increasing Retention and Graduation Rates for Engineers", 2016 Southeast Symposium on Contemporary Engineering Topic, Jackson, MS, August 26, 2016.
19. Whalin, Robert W., Ismael Pagan Trinidad, Evelyn Villanueva, David Pittman, "A Quarter Century of Resounding Success for a University/Federal Laboratory Partnership", 2016 American Society for Engineering Education Annual Conference, New Orleans, LA, June 2016.
20. Whalin, Robert W., Samuel Brody, William Merrell, "The Galveston Bay Region as an International Test Bed for Flood Risk Reduction". 7th Texas Hurricane Conference, University of Houston, Houston, TX, August 5, 2016.
21. Ebersole, Bruce, Thomas W. Richardson, Robert W. Whalin, "Modeling Coastal Storms: Past, Present and Future", 7th Texas Hurricane Conference, University of Houston, Houston, TX, August 5, 2016.
22. Khan, Mohammad "Sustainable Slope Stabilization Using Recycled Plastic Pin", Southeast Symposium on Contemporary Engineering Topics (SSCET), Jackson, MS, August 26, 2016.
23. Sinha, Divya and Yadong Li, "Removal of Heavy Metals from Roadway Rainwater through Pervious Cement Pavement", Poster presentation at 13th International Symposium on Recent Advances in Environmental Health Research, Jackson, MS, Sept. 11-14, 2016.
24. Stich, Bethany, Energy Council Annual Meeting, "Impacts of Energy and Petro Chemical Exports" Washington D.C., March 2016.

Books/Other One Time Publications

1. Bu, L. and F. Wang. "Evaluation of Evacuation Corridors and Traffic Management Strategies for Short-Notice Evacuation" and "Big Data Management" Chapter 9 Book ISBN: 978-3-319-45497-9. Editors: Fausto Pedro García Márquez and Benjamin Lev, EdS, September 26, 2016. (Accepted)

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
Jose Lopez, Ryan Goetz, and Chris Redell, United States Army Corps of Engineers	St. Louis, MO	Collaborated to collect geophysical data
Dr. Lan Liu, Professor of Southwest Jiaotong University	Sichuan Province, China	technical support
Dr. Xuesong Zhou, Associate Professor of Arizona State University	Tempe, AZ	technical support traffic simulation and modeling
Dr. Fan Liang, Dr. Dong Qian, Dr. Bu Changming	Chongqing University	research collaborator
Gary LaGrange, Paul Matthews, Amelia Pellegrin, Port of New Orleans	New Orleans, LA	research collaborator

Kristi App, International Freight Forwarders & Customs Brokers Assn. of New Orleans	New Orleans, LA	research collaborator
Billy App, Dominic Knoll, World Trade Center Transportation Committee	New York, NY	research collaborator
J. Accardo, Ports Assn. of Louisiana	New Orleans, LA	research collaborator
Christine Titus, GNO Port Safety Council	New Orleans, LA	research collaborator
New Orleans Regional Planning Commission	New Orleans, LA	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
Jonathan Corey, Assistant Professor, University of Cincinnati	Cincinnati, OH	research collaborator
Prof. Ismael Pagan Trinidad; Chair Civil Engineering Department University of Puerto Rico	Mayaguez, Puerto Rico	research collaborator
Dr. David Pittman and Ms. Evelyn Villanueva, U.S. Army Engineer Research and Development Center	Vicksburg, MS	research collaborator
Dr. Hang Chen, STEM College, Johnson C. Smith University	Charlotte, North Carolina	research collaborator
Dr. Meherun Laiju, Chair, Social Science Dept., Tougaloo College	Jackson, MS	research collaborator
Dr. Rick Luettich and Dr. Gavin Smith, University of North Carolina	Chapel Hill, NC	research collaborator
Dr. Samuel Brody and Dr. William Merrell, Texas A&M University	Galveston, TX	research collaborator
Dr. Barr Keim, Professor & Chair of Geography and Anthropology Department, Louisiana State University	Baton Rouge, LA	research collaborator
Dr. Bas Jonkman, Professor, Civil Environmental Engineering Department, Delft Technical	Delft, The Netherlands	research collaborator
Feng Qian and Jinlei Shen, visiting students from Hefei University of Technology	Anhui Province, China	research collaborator
SSPEED Center, Rice University	Houston, TX	research collaborator
Florida Atlantic University	Boca Raton, FL	research collaborator
Weike Lu, visiting PhD student of Southwest Jiaotong University	Sichuan Province, China	research collaborator

4. Impacts

4.1 Impacts on Principal Disciplines

Leadership Positions

1. President, Junior Faculty Interest Group, Institute for Operations Research and Management Sciences (INFORMS).
2. President Elect, American Society for Engineering Management.
3. Member, Advisory Council for Transportation Research, Arkansas State Highway and Transportation Department.
4. Member, National Engineering Economy Teaching Excellence Award Committee, American Society for Engineering Education.
5. Chair, Scholarship Fund Trustee, Institute of Industrial Engineers.
6. Member, Transportation Research Board Committee (Freight Transportation Data).
7. Chair, Sub-committee Transportation Research Board Committee (Transportation Training and Education).
8. Member, TRB Pavement Management committee and TRB Emergency Evacuation committee.
9. Chair, Ocean and Marine Division, American Society for Engineering Education.
10. Past Chair, Ocean and Marine Division, American Society for Engineering Education.
11. Member, Transportation Research Board (TRB), Intermodal Freight Committee.
12. Committee member, TRB, Standing Committee on Emergency Evacuation.
13. Member, TRB, Logistics of Disaster Response and Business Continuity.
14. Board Member (past president), Mississippi Heritage Trust.
15. ASPA Member (past president), Women in Public Administration, Executive Committee Public Administration Research.
16. Past Board Member, Industry Advisory Council Center for Logistics, Trade and Transportation-University of Southern Mississippi.

Leadership Awards

1. Heather Nachtmann, Ph.D., 2016 Fellow of the Institute of Industrial and Systems Engineers, May 2016.

4.2 Impacts on Other Disciplines

Related External Grants

1. "Data-Enabled Security in Cyber, Transportation, Critical Infrastructure, and Food", National Science Foundation (NSF), September 15, 2016.
2. "Improving Traffic Safety Data Analysis Capacities for Local Communities in Mississippi" NSF.
3. "Coastal Resilience Center of Excellence", University of North Carolina, Department of Homeland Security, March 30, 2016-Sept. 30, 2016.
4. "Coastal Flood Risk Reduction", National Science Foundation, Partnership for International Research and Education (PIRE), July 1, 2015 – June 30, 2020.
5. "MRI: Acquisition of a Multi-Beam SEM/FIB for Multidisciplinary Materials Study and Training", National Science Foundation, 2015-2018.
6. "Effect of Climate Change on Slope Failure over Expansive Soil", NSF, July 22, 2016.

4.3 Impacts on Transportation Workforce Development

K-12 Programs

- LSU Math Circle summer enrichment program, 25 middle school and high school students; 50% Female, June 2016.
- Recruiting into Engineering High Achieving Multi-Cultural Students (REHAMS), 30 high school students, 50% female, June 2016.
- Mississippi Summer Transportation Institute (MSTI) project, co-funded by FHWA, MDOT, and MarTREC, 28 high school students, 50% females, 96% African Americans, June 5-25, 2016.
- Explore Engineering Program I, 6th or 7th grade, 45 students, June 2016.
- Explore Engineering Program II, 7th or 8th grade, 45 students, June 2016.
- Engineering Summer Academy, 9th, 10th or 11th grade, 45 students, July 2016.
- Engineering Girl Camp, 7th or 8th grade girls, 45 students, July 2016.
- Robotics Engineering Camp, 3rd, 4th, 5th, or 6th, 45 students, July 2016.

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, but ECAP is much more than a scholarship. Starting with the three-week summer bridge program and continuing through graduation and beyond, ECAP students become part of a family.
- University of Arkansas sponsored a George Washington Carver Summer Internship - The George Washington Carver Research Program is a recruitment initiative to identify superior graduates of Historically Black Colleges and Universities, and Hispanic Serving Institutions for selected undergraduate internship positions.
- LSU Spill Science and Response program attracts students to careers in spill prevention and response science for pipelines, and other forms of transport of hydrocarbons. Industry partner was Kinder Morgan, the largest energy infrastructure company in the US. Half of the 18 students were from underrepresented groups in engineering.
- University of Arkansas, College of Engineering, Office of Undergraduate Recruitment, conducted 25 campus visits and eight classroom visits.

Internships

- Two logistics internships with J.B. Hunt
- One Arkansas State Highway and Transportation Department internship
- One Tennessee Department of Transportation internship
- One George Washington Carver Student internship

4.4 Impacts on Physical, Institutional, and Informational Resources

MarTREC has created a "Maritime Transportation Resource Data Bank". The resource is located via the below URL.

<http://martrec.uark.edu/research/resource-data-bank.php>

4.5 Impacts on Technology Transfer

Technical Brief

Stich, Bethany, James Amdel, and Peter Webb, " Liquefied Natural Gas: A Status Report from Louisiana: Staying Number One" (2016)

Editorial Journal Positions

1. Associate Editor, Operations Research Letters
2. Editor, International Journal of Six Sigma and Competitive Advantage
3. Associate Editor, Economic Quality Control
4. Associate Editor, Engineering Management Journal
5. Area Editor, The Engineering Economist

Transfer of Results

In partnership with the U.S. Army Engineer Research and Development Center, MarTREC project “Optimal Dredge Fleet Scheduling within Environmental Work Windows” has been integrated as part of USACE’s ongoing initiative to take a systems operation research approach to aid in their maritime transportation decision processes. This work has offered a highly generalized dredge scheduling optimization framework for use by dredge planners. The work has already been transferred to USACE computing systems, and various versions of the developed model have been utilized in support of planning efforts on the West and East coast.

4.6 Impacts on Society beyond Science and Technology

Distinguished Lectures

1. Dr. Casey Dietrich, North Carolina State University, “Hurricane Wave and Storm Surge Forecasting for the North Carolina Coast”, May 4, 2016, 29 attendees.
2. Dr. Jeffrey Melby, U.S. Army Engineer Research and Development Center, “Concrete Armor Units for Coastal Protection”, April 5, 2016, 11 attendees.
3. Mr. Robert Sinn, P.E. Principal and Building Structure Practice Leader, Thornton Tomasetti “Jeddah Tower, The Next World’s Tallest Building and the First Man-Made Structure to Reach a Height of One Kilometer” April 14, 2016, 100 attendees.

Conference Planning Positions

1. Track Chair, ISERC Operations Research, 2016.
2. Track Co-Chair, American Society for Engineering Management Conference, 2016.
3. Member, Transportation Research Board Committee (Freight Transportation Data), 2016.
4. Sub-committee chair, Transportation Research Board Committee (Transportation Training and Education), 2016.
5. Session Moderator, Ocean and Marine Technical Session, 2016 American Society for Engineering Education Technical Session, New Orleans, LA Track Organizer, June 2016.
6. Session Chair, Ethics and Engineering Education Track, Southeast Symposium on Contemporary Engineering Topics, Jackson, MS, August 2016.
7. Chair, Civil, Coastal, and Environmental Engineering, 7th Southeast Symposium on Contemporary Engineering Topics (SSCET), Jackson, MS, August 2016.
8. Session chair, Bio-Mediated Soil ASCE GeoChicago 2016 Conference, Chicago, IL, August 2016.

5. Changes/Problems

MarTREC has applied for the 2016 University Transportation Centers (UTC) Program Grant Solicitation.

6. Special Reporting Requirements

Nothing to report