

**MARITIME TRANSPORTATION RESEARCH AND EDUCATION CENTER  
TIER 1 UNIVERSITY TRANSPORTATION CENTER  
U.S. DEPARTMENT OF TRANSPORTATION**



**College of Engineering  
University of Arkansas**

**REQUEST FOR PROBLEM STATEMENTS  
from University of Arkansas faculty**

**Announcement Date: August 28, 2024  
Submission Deadline: September 20, 2024**

Contact Information:

Heather Nachtmann, Center Director  
Peggy Anderson, Research Advancement Specialist

hln@uark.edu; 479-575-3484  
pla002@uark.edu; 479-575-2092

## REQUEST FOR PROBLEM STATEMENTS

### Background

The Maritime Transportation Research and Education Center (MarTREC) is soliciting problem statements for research and education projects related to our center theme of *Preserving the Nation's Transportation System through Sustainable and Resilient Maritime and Multimodal Supply Chains and Infrastructure*. Only University of Arkansas faculty are eligible, and funds may not be sent to an external partner or institution.

MarTREC is a Tier 1 University Transportation Center (UTC) renewed by a 2022 grant from the U.S. Department of Transportation (DOT). The vision of MarTREC is *to be the nation's premier source for expertise on maritime and related multimodal transportation research and education*. MarTREC is led by the University of Arkansas in Fayetteville, Arkansas. MarTREC consortium members include Jackson State University, Louisiana State University, Texas A&M University, Texas Transportation Institute, University of New Orleans, and Vanderbilt University. Additional information including previously funded projects is available at <https://martrec.uark.edu/>. The current DOT Strategic Plan for FY 2022-2026 is located at <https://www.transportation.gov/mission/us-dot-strategic-plan-fy-2022-2026>.

### Areas of Focus

#### Maritime and Multimodal Supply Chain Management

The 2022 DOT Supply Chain Assessment of the Transportation Industrial Base: Freight and Logistics (SC Assessment) report recognizes that resilient and efficient movement of freight across domestic and international supply chains is vital to our nation's economic strength and to maintaining and improving the quality of life for all Americans. Further, when the performance of our supply chain breaks down, it causes delays and cost increases that drive inflation, reduce productivity, and hinder economic competitiveness. The inland waterways are a tremendous and underutilized asset within this system of systems, providing an economical and environmentally sound mode for moving cargo. Nearly 25,000 miles of commercial, navigable U.S. inland and intracoastal waterways serve thirty-eight states and transport approximately 20% of America's coal, 22% of U.S. petroleum products, and 60% of farm exports.

Recent events such as the I-40 bridge between AR and Memphis steel beam crack, Ever Given blocking the Suez Canal, and the COVID-19 pandemic highlight the need for innovative and smart supply chain design models, tools, and technologies. Innovative research is needed to support efficient utilization of our existing and future multimodal supply chain to mitigate congestion, eliminate chokepoints, and facilitate modal shifts. Freight system performance depends on efficient and effective intermodal transfers of goods. The predicted growth in freight will place new demands on port infrastructure and land-side connectors. As land transportation has little capacity to expand, the predicted increase in throughput will lead to delayed shipments, congestion at intermodal transfer points, increased transportation costs, and intensified pollution.

Smart freight logistics can inform private and federal investment in port development and infrastructure improvements, which in turn increases competitive advantages without negatively affecting equity and environmental outcomes. Improved freight routing from intelligent data driven supply chain management can mitigate negative impacts on low socioeconomic communities and better connect these communities to the rest of the country and the world, spurring economic development opportunities. Many rural communities are home to our nation's farms and other industries whose economic viability depends on the inland waterway navigation system. The economic welfare of rural communities depends on a robust and resilient multimodal supply chain.

#### *Example Research Project Objectives*

- Design resilient and sustainable multimodal supply chain networks to optimize resource allocation, minimize congestion points through modal shifts, and maximize transportation system efficacy including container-on-barge, shipping cycle time, reliability, safety, and environmental preservation
- Develop maritime and multimodal freight modeling and fluidity tools to provide strategic and operational decision support, anticipate and resolve next generation freight transportation challenges, and assess freight and supply chain trends and technologies
- Study the feasibility of connecting ports through intelligent transportation systems implementation to manage truck and rail traffic from ports onto regional and interstate land transportation systems and better inform related operational decisions
- Innovate data science approaches and resources to harness, process, analyze, visualize, and disseminate transportation system performance data systems to enable efficient and accessible multimodal transportation
- Conduct economic impact studies to understand adjacent community impacts, complex land use, and freight transport relationships and identify opportunities for companies to locate and grow in rural regions supported by efficient and reliable connections with major markets and ports.

#### **Maritime Sustainable and Resilient Infrastructure**

The DOT strategic plan recognizes that improving and preserving infrastructure at coastal ports, inland ports and waterways, and land ports of entry along the borders is critical to improve safety, prioritize investments, enhance the efficiency and effectiveness of maintenance and preservation efforts, and strengthen our national supply chain. The 2022 DOT SC Assessment report recognizes that the nation's aging inland waterway system is a source of major delay for its users, particularly the agriculture and chemical industries with 47% of vessels that traveled through public locks in 2020 experiencing delays with an average delay greater than two hours. Rapidly growing commerce places a heavy burden on the aging infrastructure of our multimodal transportation system. Infrastructure bottlenecks must be eliminated to mitigate congestion and facilitate freight movement from ports to distribution centers. New infrastructure design must accommodate safe and efficient first- and last-mile urban freight delivery which greatly impacts goods movement efficiency and economy prosperity.

Sustainable infrastructure adapts to changes in demand over time in an ecologically responsible and cost-efficient manner; while robust, resilient systems employ redundant design and are quickly restored to mitigate disruption impacts. Multimodal transportation infrastructure preservation efforts must strive for sustainability and resiliency to maintain performance under normal conditions and unplanned events and recover rapidly from major disruptions. Sustainable and resilient design employs low-impact materials, energy efficiency, quality, durability and recyclability principles, and design impact measures to achieve economy, security, flexibility, and adaptability. Transportation agencies need to know how to estimate and implement the most efficient utilization of existing multimodal transportation systems to minimize environmental impacts, reduce fuel consumption, and mitigate congestion. Preservation of our transportation system requires the design of new multimodal infrastructure to create more sustainable transportation assets.

#### *Example Research Project Objectives*

- Advance high-performance materials to preserve and enhance the durability, longevity, sustainability, and resilience of transportation infrastructure elements

- Innovate repair, rehabilitation, and emerging technologies to enable more rapid and reliable evaluations of critical transportation infrastructure elements under normal conditions and during system disruptions
- Create best practice performance measures and analytical models and tools for infrastructure asset preservation and management, optimal maintenance and rehabilitation strategies for transportation infrastructure, economic life cycle assessment, and material performance management and benchmarking
- Develop multimodal asset management tools to preserve our existing infrastructure and reduce maintenance costs, practice environmental and corridor management, and ensure a state of good repair through cost-effective and socially-just implementation
- Investigate affordable and implementable automation technologies to improve productivity and efficiency of marine transportation and ports and support container-on-barge opportunities along our inland waterways enabling efficient cargo transfer and modal shift opportunities.

### **Disruption Response and Transportation Planning for Coastal and River Valley Communities**

The 2022 DOT SC Assessment report recognizes that climate change and increases in heavy precipitation events, coastal flooding, heat, wildfires, and other extreme weather are creating significant and growing risk to the safety, effectiveness, equity, and sustainability of the nation's transportation infrastructure and the communities it serves. Research is needed to preserve and protect our transportation system from what lies ahead. If sea level continues to rise as projected, miles of coastal highways and maritime port cargo facilities will become increasingly vulnerable to inundation and storm waves. The U.S. has the world's largest transportation network including 25,000 miles of navigable waterways, four million miles of public roads, 140,000 miles of railways, and considerable transportation infrastructure. Meanwhile, only ten ports account for 85 percent of our nation's containerized international trade. This dependence and vast infrastructure make our freight transportation system vulnerable to disruptions and delays due to natural disasters and security incidents. The high demand and frequency of cargo carried by transportation system suggest significant impacts will result from future disrupted freight movement.

Transportation systems under emergency conditions including evacuation, response, and recovery require planning, design, management, operation, and preservation of transportation systems to economically, efficiently, and safely respond to changing conditions and increasing demands. Under emergency conditions, the amount and timing of the travel demand often quickly and overwhelmingly exceeds the ability of the transportation system to serve it. Research has shown that the movement of people, vehicles, and cargo can benefit greatly from the implementation of targeted control and management measures that affect the movement in and out of an area by prioritizing certain vehicles and directing flow.

The nation's vast marine landscape contains urban and rural communities with varying emergency transportation needs. The challenges of evacuation and emergency logistics for rural communities are frequently different from those of urban areas due to limited resources, geographical dispersion, and varying population density. It is because of these challenges that the Federal Emergency Management Agency (FEMA) states that mobilizing, tracking, using, sustaining, and demobilizing physical and human resources require an effective logistics system that supports both residents in need and the teams that are responding to the incident. Low socioeconomic and rural communities are vulnerable to being disproportionately affected as these damaging events disproportionately and adversely impact economically disadvantaged and low-mobility populations as was observed in the evacuation and emergency response to Hurricane Katrina and perhaps even more so during the years of recovery.

### *Example Research Project Objectives*

- Investigate effective use of transportation facilities and modal infrastructure assets to facilitate movements under disruption response, evacuation, and other major events
- Develop modeling and analysis techniques, innovative design and control strategies, and travel demand estimation and planning methods that consider climate change, sustainability, and resiliency and can be used to predict and improve travel under periods of immediate and overwhelming demand
- Develop practical systems engineering and analytical support methods and tools to enable resilience to disruptions and improved emergency logistics preparedness of multimodal transportation systems
- Develop cost-effective risk management tools to preserve, design, operate, and maintain safe, secure, and resilient transportation and assess vulnerability in extreme weather and sea level rise events
- Evaluate cybersecurity risks, cargo scanning at ports and intermodal transfer facilities, and container handling practices to mitigate vulnerability and improve system resilience and ensure continued safe operations
- Focus specific efforts on the historically underserved areas of rural, carless, special needs, and other vulnerable populations in disruption response, evacuation, and emergency logistics planning.

### **Education and Outreach**

In addition to funding research projects in the above areas, MarTREC is accepting problem statements related to maritime and multimodal transportation education and workforce development activities including

- Develop instructional modules and case studies related to the engineering, data science, logistics, planning, and cybersecurity of maritime and multimodal transportation systems and practices
- Develop resource banks of pertinent data sources, publications, organizations, educational programs, and other information pertinent to the study of maritime and multimodal transportation
- Develop and offer short courses and workshops related to the engineering, data science, logistics, planning, and cybersecurity of maritime and multimodal transportation systems and practices
- Develop and provide new online maritime and multimodal transportation information and educational resources for K-12 teachers and students.

### **Application Procedures**

- Eligibility: Faculty at the University of Arkansas may apply as principal investigators of MarTREC projects by responding to this Request for Problem Statements.
- Problem Statements: Applicants must submit problem statements by **September 20, 2024** using the provided form (posted at [martrec.uark.edu](http://martrec.uark.edu)).
- Formal Proposals: MarTREC will review all project problem statements submitted by the date of September 20, 2024. Researchers whose proposed projects are consistent with the theme and goals of MarTREC and whose projects are highly rated by the external evaluators will be invited to submit a formal proposal subject to available funding. Invited high quality formal proposals generally result in awarded projects. However, an invitation to submit a formal proposal in no way obligates the Center to fund the project and should not be interpreted as project approval or pre-approval.

Applicants should email completed problem statement forms by the date of **September 20, 2024** to:

Peggy Anderson  
[pla002@uark.edu](mailto:pla002@uark.edu)

Please address questions to Peggy Anderson via email [pla002@uark.edu](mailto:pla002@uark.edu) or phone 479-575-2092.

### Instructions for MarTREC Problem Statement Form

The MarTREC Problem Statement Form is used to vet proposed projects before formal proposals are invited. This ensures that only those researchers whose projects are determined to be most consistent with the theme and vision of the MarTREC research program will be asked to devote the time and effort required to prepare a full proposal. **Researchers must use the required form to submit Problem Statements.** The numbered instructions below correspond to the required items on the form.

- 1) Date Problem Statement Form is submitted to pla002@uark.edu
- 2) Please select one of the following Project Areas from the dropdown menu:
  - Maritime and Multimodal Supply Chain Management
  - Maritime Sustainable and Resilient Infrastructure
  - Disruption Response and Transportation Planning for Coastal and River Valley Communities
  - Education and Outreach
- 3) Project Title
- 4) Please select from the dropdown menu whether your project is considered applied research, advanced research, or education and workforce development.
  - Applied Research is research accessing and using accumulated theories, knowledge, methods, and techniques for a specific, often client-driven purpose.
  - Advanced Research is research that involves and draws upon basic research results to provide a better understanding of phenomena and develop innovative solutions – sometimes referred to as exploratory research in order to convey its more fundamental character, its broader objectives, and the great uncertainty in expected outcomes compared to problem-solving research.
  - Education and Workforce Development
- 5) Brief description of the project including the challenge/need to be addressed (limited to 1500 characters)
- 6) Outline of the proposed project objectives: What will the investigator accomplish if the project is funded? What is the planned methodological approach? (limited to 1500 characters)
- 7) Contribution of this project to the existing body of knowledge: How will this project affect or enhance the maritime industry? Who are the customers or users of the project findings? How will maritime stakeholders be involved in the project? How will the results benefit industry, society, and/or academia? (limited to 1200 characters)
- 8) The total requested funds are the sum of the MarTREC (DOT) funds being requested plus the matching funds to be provided by **non-federal source(s)**. The total will be used to determine whether the project's cost is reasonable in relation to its potential benefits. Historically, the average funded project budget is supported by \$100,000 in federal funds. Subawards are not permitted.

For “MarTREC Funds Requested,” enter the anticipated DOT federal funding necessary to

complete the project. All DOT funds expended in the MarTREC DOT Tier 1 UTC program require 50% matching funds from at least one source (*non-federal*).

Enter the anticipated individual sources and associated amounts of matching funds for the proposed project. Documentation of matching funds commitment will need to be provided at the full proposal phase.

Enter requested project start date and end dates. **Project start dates must fall between January 1, 2025 and August 1, 2025.** Projects are generally between 12 and 18 months in duration.

- 9) Name(s) of principal investigator (PI) and any co-principal investigators. Correspondence from MarTREC will be sent to the PI. Organization is the institution and department of the investigators. The PI email address and phone number must be included.
- 10) Explain what evidence you have that your proposal work is novel and will make a contribution to the maritime and multimodal body of knowledge? (limited to 1500 characters)
- 11) Describe what data will be used for and generated from this proposed research. Verify that you know the required data is available or can be generated and list the data sources that you plan to use to collect the data necessary to complete this research (include web links whenever possible). (limited to 1500 characters)
- 12) Review the provided MarTREC Data Management Plan and confirm that you will adhere to the plan's requirements, and you understand that your final data set and all project deliverables will be publicly shared as per federal guidelines. You will be required to develop a project-level data management plan in accordance with the center's plan if you are invited to submit a full proposal. (limited to 500 characters)
- 13) List the external stakeholder contact names and agencies that you will work with and describe their role in the proposed work. If you do not have known contacts, what is your plan for developing these relationships and what assistance can MarTREC provide to support this? MarTREC DOT funds cannot be sent to other institutions, so partnership support must be in-kind or shown as match funds. (limited to 1000 characters)