MarTREC
Maritime Transportation Research & Education Center

MarTREC Tier 1 UTC Project Request Form
MarTREC Project 7034
Completed form cannot exceed 2 pages

Submission Date *(select from calendar)*: 5/1/2026
Lead Recipient/Grant Number: University of Arkansas / 69A3552348331
Principal Investigator Institution *(select drop down)*: Jackson State University
Center Name: Maritime Transportation Research and Education Center
Research Priority: Preserving the Existing Transportation System
Principal Investigator(s) with ORCID(s) and Contact Information: *Xiaobing Li, 0000-0003-3425-743X, xiaobing.li@jsums.edu*
Project Partners: *None*
Project Type (*select drop down*): Applied Research
Project Research Topic Type (*select drop down*): Maritime and Multimodal Supply Chain Management
Transportation Modes Involved (*check all that apply*): ☐Waterway ☐Road ☐Rail ☒Pipeline ☐Other
Total Funding Requested ($): *$82,500* \| **Federal Funding Requested ($):** $55,000
% of Total for Tech Transfer (%): *2%* | **Non-Federal Match Requested ($):** *$27,500*
Project Start and End Dates (*month/day/year to month/day/year*): 7/1/26-12/31/2028
Project Title: AI-Enabled Spatio-Temporal Risk Assessment and Decision Support for Pipeline Infrastructure Preservation
Project Abstract (Brief Description): *The safe and efficient operation of pipeline systems is essential to the reliability of the United States' energy supply chain and its integration with maritime and multimodal transportation networks. Pipeline failures can lead to significant disruptions, economic losses, and safety risks, particularly under the influence of aging infrastructure, human factors, and extreme environmental conditions. Building upon prior research, this project proposes to develop an integrated, AI-enabled framework to support the preservation and resilience of pipeline infrastructure within maritime and multimodal transportation systems. The proposed research will have model development, but focuses on validation, system integration, and deployment of decision-support tools. The project will enhance existing spatio-temporal models by incorporating machine learning and explainable artificial intelligence techniques to improve predictive accuracy and interpretability of pipeline system failure risk under varying environmental and operational conditions. Multi-source data will be integrated into a unified analytical platform, including pipeline incident records and environmental datasets. A key innovation of this research is the development of a multimodal infrastructure risk framework that links pipeline systems with maritime transportation components such as ports, inland waterways, and freight corridors. Multi-layer network modeling and scenario-based simulations will be used to evaluate the impacts of infrastructure disruptions on system performance, including energy distribution, freight movement, and resilience under hazardous events. Through the integration of advanced analytics and multimodal system modeling, this project will deliver scalable, interpretable analytical solutions to enhance the safety, reliability, and resilience of pipeline and maritime transportation infrastructure systems.*
USDOT Priorities: Section left blank until USDOT's new priorities and RD&T strategic goals are available in Spring 2026
Outputs (results of the work performed): *Key outputs include the development of an AI-enabled spatio-temporal modeling framework that integrates machine learning, explainable AI, and multi-source data*

fusion for predictive risk assessment for pipeline systems. The project will generate new methodologies for multimodal network analysis by linking pipeline systems with maritime infrastructure such as ports, inland waterways, and freight corridors, enabling system-level disruption and resilience evaluation. In addition, a cloud-based decision-support platform with interactive visualization tools will be developed to support infrastructure condition assessment, maintenance prioritization, and scenario-based planning for transportation agencies. The project will also produce datasets, analytical workflows, and software modules that can be shared with stakeholders and the research community. The project is also expected to establish and strengthen partnerships, including collaboration with public agencies such as MDOT and the City of Jackson, as well as private sector partners such as IMS Engineers, Inc. Additional partnerships may be developed with maritime industry stakeholders such as port authorities and logistics operators.

Outcomes/Impacts: *The outcomes can be applied to transportation system management through the development of a cloud-based decision-support platform that integrates AI-driven risk prediction, real-time monitoring data, and multimodal network analysis of pipeline systems. Transportation agencies will be able to use these tools to assess pipeline infrastructure conditions, prioritize maintenance, and implement proactive risk mitigation strategies for pipeline and connected maritime assets. The research will introduce new practices in infrastructure management by shifting from reactive inspection approaches to predictive, data-driven decision-making supported by data fusion and explainable AI models. In addition, the multimodal framework will enable planners and policymakers to better understand how disruptions in pipeline systems affect ports, inland waterways, and freight networks, informing more resilient infrastructure investment and emergency response strategies. The project's output has the potential to inform agency guidelines, asset management practices, and long-term infrastructure planning policies. The development of risk thresholds and early warning indicators may support future regulatory frameworks for monitoring and maintaining critical infrastructure. Overall, this research will improve transportation system safety by reducing the likelihood and severity of pipeline failures, enhance reliability and durability through optimized maintenance planning, and reduce lifecycle costs. By strengthening the resilience of interconnected pipeline and maritime systems, the project will contribute to a safer, more reliable, and cost-effective freight transportation network.*

Technology Transfer Activities: *The primary technology transfer product of this project will be an AI-enabled decision-support tool for pipeline infrastructure risk assessment and maintenance prioritization. The project will also produce supporting software documentation and selected datasets (where permitted) to facilitate future research and practical implementation by transportation agencies and infrastructure owners. To support workforce development, the research team will provide a training webinar and instructional materials demonstrating the analytical framework, decision-support tool, and practical applications for pipeline infrastructure preservation. These resources will help researchers, students, and transportation practitioners understand and apply AI-enabled risk assessment methods. Research findings, methodologies, and software capabilities will be disseminated through peer-reviewed journal publications and presentations at national transportation conferences to promote broader adoption within the research and practitioner communities. The project will also develop and deliver a K–12 educational module through the Jackson State University Mississippi Summer Transportation Institute (MSTI). The module will introduce high school students to pipeline infrastructure, transportation resilience, and artificial intelligence through hands-on learning activities, supporting STEM education and helping develop the future transportation workforce.*

Final Research Report: Upon completion of the project, provide a URL link to final report will be provided

Project Deliverables: ☒ PI agrees to submit all deliverables within 4 weeks of the project end date.

Data Management Plan (DMP): ☒ PI has reviewed and agrees to adhere to MarTREC DMP. Proposed project DMP must be submitted with this form.

USDOT Approval Date: 7.20.26