MarTREC
Maritime Transportation Research & Education Center

MarTREC Tier 1 UTC Project Request Form
MarTREC Project 7018

Submission Date: 03.14.25
Lead Recipient/Grant Number: University of Arkansas / 69A3552348331
Principal Investigator Institution: University of Arkansas
Center Name: Maritime Transportation Research and Education Center
USDOT Research Priority: Preserving the Existing Transportation System
Primary USDOT Strategic Goal (*select drop down):* System Resilience
Principal Investigator(s) with ORCID(s) and Contact Information: Haoming Shen, orcid *0009-0003-7965-3302*, 734-926-6937 haomings@uark.edu
Project Partners: *Provide full name of any partner organization(s)*: None
Project Type (*select drop down*): Advanced Research
Project Research Topic Type (*select drop down*): Resilient Maritime Infrastructure
Transportation Modes Involved (*check all that apply*): ☒Waterway ☒Road ☒Rail ☐Pipeline ☐Other
Research Project Funding: Federal: 83,674, Non-Federal Matching: 41,840, Total: 125,514, Tech Transfer: $6,944
Project Start and End Dates: 08/01/25 – 04/01/27
Project Title: Resilient Multimodal Transport Systems via Container-on-Barge
Project Abstract (Brief Description): Recent events like the crack in the I-40 bridge, California wildfires, and the Dolton, Illinois landslide have revealed vulnerabilities in transportation systems, causing closures, delays, freight rerouting, and congestion. Traditional resilience measures such as redundancy and infrastructure strengthening help mitigate some disruptions but often fall short against natural disasters and lack long-term impacts. Container on barge (CoB) transport, although currently underutilized in our nation and less explored in academic research, can alleviate the pressure on the existing system during disruptions and offer a more flexible, cost effective solution. Therefore, in this project, we propose to conduct a holistic study examining the integration of CoB into intermodal freight transportation systems, focusing on system resilience. Specifically, we will first develop a context-aware approach for uncertain disruption quantification, and then design reliable CoB-based strategies to further mitigate disruptions. Additionally, we will perform numerical experiments to validate the effectiveness of the proposed approaches.
USDOT Priorities: This project uniquely integrates CoB transport into resilience planning, addressing a critical gap in U.S. multimodal transportation research by exploring CoB's largely under-examined potential to enhance system resilience, which most studies overlook in favor of highways, rail, and public transportation. This aligns well with USDOT's priority in system resilience. This project evaluates the value of CoB transport in improving multimodal transportation resilience. From a methodological standpoint, most previous studies rely on empirical approaches, whereas this project introduces data-driven and contextual-aware methods to quantify the uncertainty in the system disruptions. With this new decision-making framework, this project evaluates the benefits of incorporating CoB into regional transport systems and seeks to optimize the CoB ports selection strategy, providing an actionable framework for policymakers.
Outputs (results of the work performed): In this project, we propose a comprehensive study on the integration of Container on Barge (CoB) transport into intermodal freight transportation systems, with a

focus on enhancing system resilience. Specifically, we will develop a context-aware, data-driven approach to quantify disruption uncertainty, analyze its statistical properties, and derive tractable reformulations. Additionally, we will adapt this methodology to inform planning, pre-disaster preparation, and post-disaster recovery policies for CoB-integrated regional intermodal transport systems. We will also quantify the value of incorporating CoB transport, providing policymakers with the necessary information to determine whether developing CoB is a worthwhile investment. To further support decision-making, we will develop software that automatically analyzes disruptions and generates recommended policies based on revealed contextual information.

Outcomes/Impacts: We anticipate that our proposed methods will facilitate the cost-effective implementation of CoB transport, offering an economic and efficient extension to traditional logistics networks. This will help alleviate system burdens during disruptions and enhance the overall resilience of regional transportation systems. Ultimately, we believe the proposed research will contribute to regional economic development and lay the foundation for the revitalization of American manufacturing.

Technology Transfer Activities: To ensure the practical application of our research on container-on-barge (CoB) operations, we will develop software designed to optimize CoB network design and operational strategies. Specifically, the software will accept inputs such as the network representation of the inland waterway system, historical disruption data, covariate information, and other related data. Depending on the user's intent, the software can assess whether opening new CoB ports is worthwhile; if so, it can recommend optimal locations for them. It can also identify areas where the transportation system should be strengthened. This software will enhance decision-making capabilities, improve operational efficiency, and support strategic planning for CoB services. We plan to disseminate the software through workshops, webinars, and industry conferences, engaging with potential users to demonstrate its benefits and gather feedback for further refinement. Through these efforts, we aim to facilitate effective technology transfer, translating our research into practical solutions that contribute to the advancement of regional freight transportation and economic growth.

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 after the project end date.

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