U.S. Freight Network Resiliency Analysis – Project 1

Deliverables and Reporting Requirements for UTC Grants Awarded in 2023 (June 2023)

Exhibit D

Recipient/Grant (Contract) Number: The University of Tennessee; Texas A&M University, Grant No. 69-A3552348338

Center Name: Center for Freight Transportation for Efficient and Resilient Supply Chain

Research Priority: Improving Mobility of People and Goods

Principal Investigator(s): Bruce Wang (TAMU), Yunlong Zhang (TAMU), Lee Han (UTK), Bo Zou (UIC)

Project Partners: Wal-Mart, Tennessee Department of Transportation, Oak Ridge National Lab

We have included some partners to seek feedback. The project team member had prior research collaborations with project partners and will continue to identify critical research needs and develop solution strategies in year 1 and beyond.

Research Project Funding: $253,618 Federal and $103,659 Non-Federal Funding

Project Start and End Date: 8/1/2023 – 7/31/2024

Project Description: The US freight network, consisting of highway, railway, pipelines, maritime, air, and their intermodal operations, is a complex and dynamic system. Traffic jam at one location pushes freight to alternative freight routes while altering highway and railway freight traffic as a result. The failure of any one of the major Mississippi River crossings, such as the Hernando de Soto Bridge on I-40, can cause major delay not just to local interstate traffic but also long detours and days of delay to the US logistics. This project, as the first installment of a five-year effort, will evaluate existing models, identify capability gaps, set research priorities, assess/acquire relevant freight data, and chart the research roadmap forward to eventually adapt and develop a comprehensive set of models and algorithms representing the Nation's multimodal network. Issues such as larger supply chain locational distribution and uncertainties, resiliency under interruption of services, global impacts and local realities in the wake of geopolitical shifts and climate changes, etc. can be modeled with this set of tools. The goal is to improve freight system efficiency and resiliency to better serve the national economy and security.

This research will develop a set of tools to accurately model US freight operations under a number of scenarios so as to assess vulnerability of key infrastructure elements or resiliency of the transportation infrastructure system. The following objectives will be achieved in year 1:

- Assess the impact of inclement weather events on the duration of impact and the recovery process for intermodal terminals.
- Investigate mode change during the inclement weather events at intermodal terminals involving ports and waterways.
- Study USDOT FAF and TMAS data for higher resolution enhancement potentials.
- Perform one case study on special event freight traffic pattern shift under infrastructure failure, COVID, or inclement weather scenarios involving interstate highways.

US DOT Priorities: The project will directly support the USDOT strategic goal of Improving Mobility of People and Goods by analyzing and improving freight network resiliency. In addition, this project will help the USDOT strategic goal of Climate and Sustainability through analyzing the impact and develop solutions for intermodal facilities under extreme weather conditions. Specifically, the proposed research responds to the RD&T priorities of "Multimodal System Planning," "Network Accessibility," "Rural Transportation Infrastructure," "Mode Shift," and "Resiliency and Climate Adaption."

This project will perform transformative research to study existing datasets for higher resolution enhancement potentials for freight network analysis. Innovative advanced AI models will be developed to assess the impact of and

response to inclement weather events for intermodal facilities including ports and waterways.

Outputs: This project will result in 1) an assessment of available data sets and the potential for high resolution enhancements, 2) an evaluation of existing freight network analysis models, such as FAF 5, and the need for enhancement, 3) an AI model for predicting the duration of impact and the recovery process for intermodal terminals under inclement weather events, and 4) AI-driven model change strategies at intermodal terminals considering different impacts by inclement weather events. All four deliverables will be summarized in the final report. The resulting data and benefit analysis results will be used to promote the solutions among new partners, including ports and waterways, railroads, state DOTs, and logistics companies.

Outcomes/Impacts: The research results will be presented to relevant railroads, logistics companies, port authorities, and state DOTs to develop strategies to improve the resiliency of the freight network, particularly under unpredicted natural and other events and scenarios, and to promote the proposed intermodal transportation solutions. With the adoption and implementation of the developed methods and tools, the routing of freeway traffic involving freight traffic will be performed in more efficient ways, and the impact to ports and waterways will be better predicted and recovery strategies better developed for extreme weather conditions. In addition, intermodal solutions can be developed by better utilizing the modes with lesser impact from these extreme events. Besides the final report and presentations to abovementioned stakeholders, the team will publish the prediction models, intermodal solutions, and benefit analysis results in academic journals and at technical conferences.