

Impact of Multimodal Freight Network on Private Sector Global Distribution (Phase 2) - Project 5

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

Exhibit D

Recipient/Grant (Contract) Number: The University of Tennessee; Oregon State University, Grant No. 69-A3552348338

Center Name: Center for Freight Transportation for Efficient and Resilient Supply Chain (FERSC)

Research Priority: Improving Mobility of People and Goods

Principal Investigator(s): Hector Vergara (OSU), Salvador Hernandez (OSU)

Project Partners: EROAD

Research Project Funding: \$40,000 Federal and \$20,000 non-Federal funding

Project Start and End Date: 10/01/2024 - 09/30/2025

Project Description: Multimodal freight transportation enables a more efficient use of transportation infrastructure by allowing freight to switch between at least two different modes of transport (e.g., truck, rail, water/marine, and air) from the point of origin to the point of destination [1], [2]. The multimodal network affects private sector distribution system planning and operations as the physical infrastructure and policies of the managing organizations impose constraints that are relevant for strategic, tactical, and operational level decisions. At the strategic level, private sector companies develop and adapt their distribution systems through the location of manufacturing plants, distribution centers, and warehouses, largely based on the established multimodal network infrastructure. Accordingly, the private sector's distribution system efficiency depends on the inherent resiliency and efficiency of the multimodal network [1], [3].

This research project will extend prior work completed in Phase 1 to quantify the impact of multimodal network components on the performance of distribution systems. Phase 1 focused on the development and testing of a network model for multimodal freight transportation to assess performance metrics that are relevant for the planning and operation of distribution systems. Phase 2 will focus on the development and testing of a mathematical model to evaluate the impact of potential investments in the multimodal network for improving the performance and resilience of distribution systems. This research is directly aligned with the FERSC goal of advancing research and practice for efficient and resilient supply chains. As the efficiency of distribution systems depends on the inherent resiliency and efficiency of the multimodal network, it is important to develop tools for supporting decision making when allocating limited resources for multimodal freight transportation network improvements planned by service providers (e.g., carriers, terminal operators, etc.).

The following research objectives have been identified:

- Develop an approach to assess what network components in a multimodal transportation network are critical to the performance of distribution systems under different conditions.
- Apply developed approach to a test case for the Pacific Northwest to demonstrate its validity and assess its performance.
- Derive insights from the solutions to the test case for the Pacific Northwest that could be generalizable to other regions and scales.

US DOT Priorities: The research project aligns with several key priorities and strategic goals of the U.S. Department of Transportation (USDOT), as outlined in its strategic plan. Here's how the project supports these priorities and engages in advanced and transformative research:

1. **Climate and Sustainability:** The project contributes to tackling the climate crisis by improving the resilience of the transportation system. By identifying vulnerabilities and developing strategies to mitigate disruptions, it aligns with the goals of infrastructure resilience and climate justice, reducing the environmental impact of transportation.

2. Transformation: The research engages in transformative and purpose-driven innovation. By the development and testing of a mathematical model to evaluate the impact of potential investments in the multimodal network for improving the performance and resilience of distribution systems, the project aligns with the USDOT's emphasis on matching research and policy to advance breakthroughs. It represents an innovative and transformative approach to addressing critical transportation challenges.

Outputs: The results of this research will be available to other researchers and practitioners via a GitHub repository including code and test data. Additionally, we will summarize our research tasks and their outcomes in a project report for FERSC, and a paper that will be submitted for publication in a relevant journal in the field. We will also disseminate our work via conference presentations. Potential venues in addition to the FERSC are the Transportation Research Board Annual Meeting and the Institute of Industrial and Systems Engineers Annual Meeting. In addition, the results of this research will be integrated into examples for class modules for undergraduate and graduate courses in Civil Engineering and Industrial Engineering at Oregon State University.

Outcomes/Impacts: We anticipate the following impacts and applications from the outcomes of this research:

- Better understanding of the relationship between multimodal transportation network design and performance of private distribution systems.
- A framework for evaluation of critical multimodal network components that impact performance of distribution systems in scenarios with and without disruptions. This framework could be applied by multimodal service providers or state DOTs to evaluate potential improvements to the multimodal transportation infrastructure.

U.S. Department of Transportation

Office of the Secretary of Transportation