DRISI

Caltrans Division of Research, Innovation and System Information

Research Notes

Planning, Policy and Programming

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Project Title:
Socioeconomic Dimensions Of Resilience To Seaport And Highway Transportation Network Disruptions

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Examining Impacts Of Port And Transportation Network Disruption And The Effectiveness Of Resilience Tactics

Achieving a comprehensive and more accurate understanding of the economic impacts caused by hazard-induced disturbances in seaports.

WHAT IS THE NEED?

California serving as a critical portal of the nation's supply-chain, seaports and other associated transportation infrastructure, such as bridges and highways, are especially vulnerable to disruptions from various causes, including but not limited to natural disasters, technological accidents, cyber breaches, and terrorist attacks. The economic impacts of these incidents can be extensive well beyond the on-site operations at the port complex, through the supply-chain effects of the disruptions and/or delays of delivering imports and exports from ports to their destinations and vice versa.

Many studies estimated the direct and indirect impacts of transportation network disruptions in general and port disruptions, and found them to be quite significant. However, most of the economic impact analysis methods and models in the existing literature focus on a single infrastructure component, such as airport, seaport, and bridge, and fail to incorporate the spatially distributed and network nature of transportation infrastructures.

In addition, there are only a handful of studies adequately considered and factored in the effect of resilience in the economic impact modeling of port and transportation network disruptions. Moreover, no studies to date have examined the income distribution impacts of more than a selected few resilience tactics. A comprehensive modeling system that links the transportation network model and socioeconomic impact analysis models is needed to adequately address all these research questions.

WHAT ARE WE DOING?

This project will build on prior work in analyzing the impacts of port disruptions and the role of resilience. First, to fill in the important gap in the port and transportation network disruption literature, the research team will examine the impacts of port and transportation network disruption and the effectiveness of resilience tactics not only across economic sectors, but also socioeconomic groups. Thus, the focus will be on how various types of businesses cope with import and export disruptions; and how various consumer income groups cope with supply shortfalls of household goods and associated price increases.

Second, to derive accurate estimates of the socioeconomic impacts of disruptions to the port and associated transportation infrastructure, the research team will establish a formal linkage between the socioeconomic impact model and a transportation network model. The integrated model will be applied to a simulated earthquake scenario that affects the operations at Port of Los Angeles/Port of Long Beach (POLA/POLB) and the associated inland highway transportation network.

The researchers will conduct the following tasks:

Task 1: Construct the Multi-sector Income Distribution Matrix (MSIDM) for the study region.

Task 2: Refine the Transportation Network Model.

Task 3: Establish linkages between The Enormous Regional
Model (TERM), Computable General Equilibrium (CGE) Model, and Transportation Network Model. This task includes the identification of key output variables in the Transportation Network Model that will be used as inputs in the CGE Model, and develop the methodology to achieve the formal linkages between the models.

Task 4: Integrate the TERM Model with the MSIDM.

Task 5: Simulate earthquake scenario for the case study.
This will be based on a deterministic seismic hazard analysis carried out by the team utilizing open source hazard simulation software distributed by the Federal Emergency Management Agency.

Task 6: Apply the integrated transportation-socioeconomic model to estimate the socioeconomic impacts of port and transportation network disruptions and the effectiveness of various resilience tactics.
The integrated analytical model will be applied to estimate the economic and income distributional impacts of the simulated earthquake event, that affects commodity flows in and out of POLA/POLB and the associated inland highway transportation network. The analysis will be performed to analyze the impacts and cost-effectiveness of various resilience tactics to the port disruptions.

Task 7: Write draft final report and research brief.

WHAT IS OUR GOAL?

The goal of this study is to provide insights into the effectiveness of various resilience tactics and their impacts across various consumer income groups, through understanding the economic and distributional impacts of a comprehensive set of resilience tactics to port-related transportation network disruptions; and developing an integrated transportation-socioeconomic modeling system and its application to demonstrate a simulated earthquake scenario that affects the operations at POLA/POLB and the associated inland highway transportation network.

There will be two peer-reviewed journal or conference articles at the end of this research. The first report
will primarily focus on the development of linkages of transportation network model with an economic impact analysis model and formal integration of resilience analysis.

The second report will focus on the income

distribution impact of port and transportation network disruptions; and the effectiveness of alternative resilience tactics across household income groups. The research team will present the research methodology, results, and policy implications in academic conferences related to transportation, regional science, and/or geography.

WHAT IS THE BENEFIT?

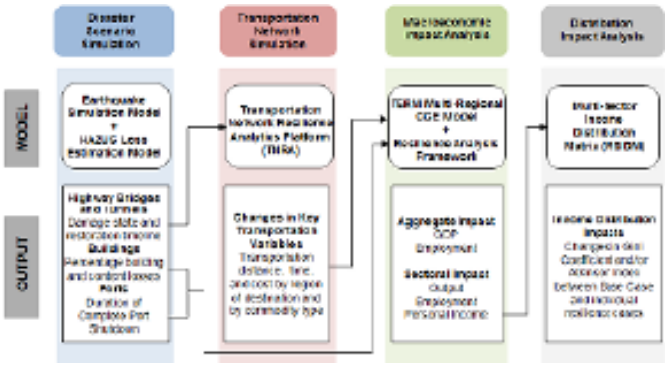
This study will bring benefits to the future assessment of socioeconomic impacts and port resilience to major port-related disruptions in California, by establishing the analytical framework and the integrated transportation-socioeconomic model, which will be readily generalizable to disruptions of other types and at other ports.

Furthermore, the research findings will also provide insights into investment decisions on protecting ports and associated transportation network from and enhancing their resilience to natural and man-made disasters.

WHAT IS THE PROGRESS TO DATE?

Research contract is under preparation.

IMAGES



Overview of the Integrated Transportation-Socioeconomic Modeling System