



Spatio-Temporal Monitoring Tool of Supply Chain Vulnerability, Resilience, and Sustainability

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Project Objective

This translational project developed a dynamic spatio-temporal monitoring and analysis tool to assess supply chain vulnerability, resilience, and sustainability. The tool collects, processes, and analyzes textual and quantitative data to identify disruptions across different supply chain segments. It anticipates potential impacts on logistics, providing insights into how disruptions may influence operations.

Problem Statement

Supply chains are critical for global and national economic growth, ensuring the efficient movement of goods from producers to consumers. However, in recent decades, geopolitical events, pandemics, natural disasters, and shifts in commerce have increasingly disrupted supply chains temporarily or permanently. These disruptions have had substantial economic and societal consequences, including reduced sales, supply chain bottlenecks, labor and material shortages, and diminished production capacities. As a result, consumers face higher prices and longer delivery times for essential goods.

A major challenge in addressing these disruptions is the lack of publicly accessible data, exacerbated by supply chains' complex and dynamic nature. Previous research by our team highlighted the value of news data in identifying and quantifying the impacts of disruptions over time. Building on this, this tool leverages news data, macroeconomic and logistics metrics, inbound cargo data (specifically for California sectors), and operational conditions of California's highways. This combination enables the identification of emerging trends and the extraction of valuable information about supply chain disruptions, supporting informed decision-making. The tool's dynamic nature allows for continuous monitoring and adaptation to changing conditions, thus improving resilience analysis within global supply chains.

Research Methodology

The team employed a modular approach, as shown in Figure 1, to streamline news data collection, processing, and analysis. The approach combines advanced data and text synthesis, and econometrics tools. This approach enhanced the efficiency of data processing and improved replicability, allowing for recurrent text analysis. The flexibility and scalability of this approach enable the tool to adapt to evolving data requirements and sources, ensuring it remains responsive to future needs.

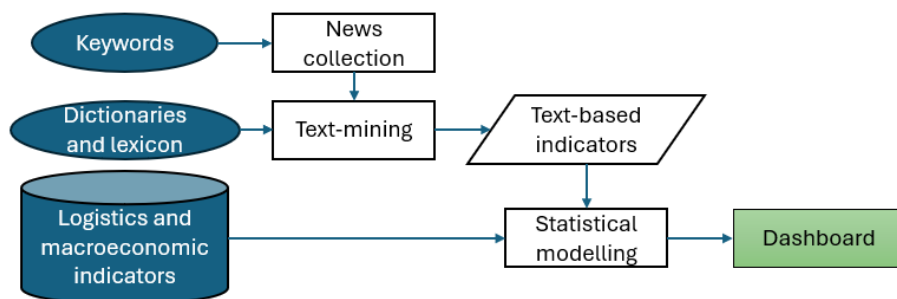


Figure 1. A simplified version of the tool's methodology.

Translational Project Outcome

Acknowledging the complexity of the methodology and envisioning usability, the team developed a dashboard as the visualization component of the tool. The dashboard offers an interactive platform to display insights derived from news, metrics, and predictive models. It is designed to support decision-making by presenting key supply chain information in a clear and accessible manner. The dashboard is organized into five main tabs, as outlined below and shown in Figure 2:

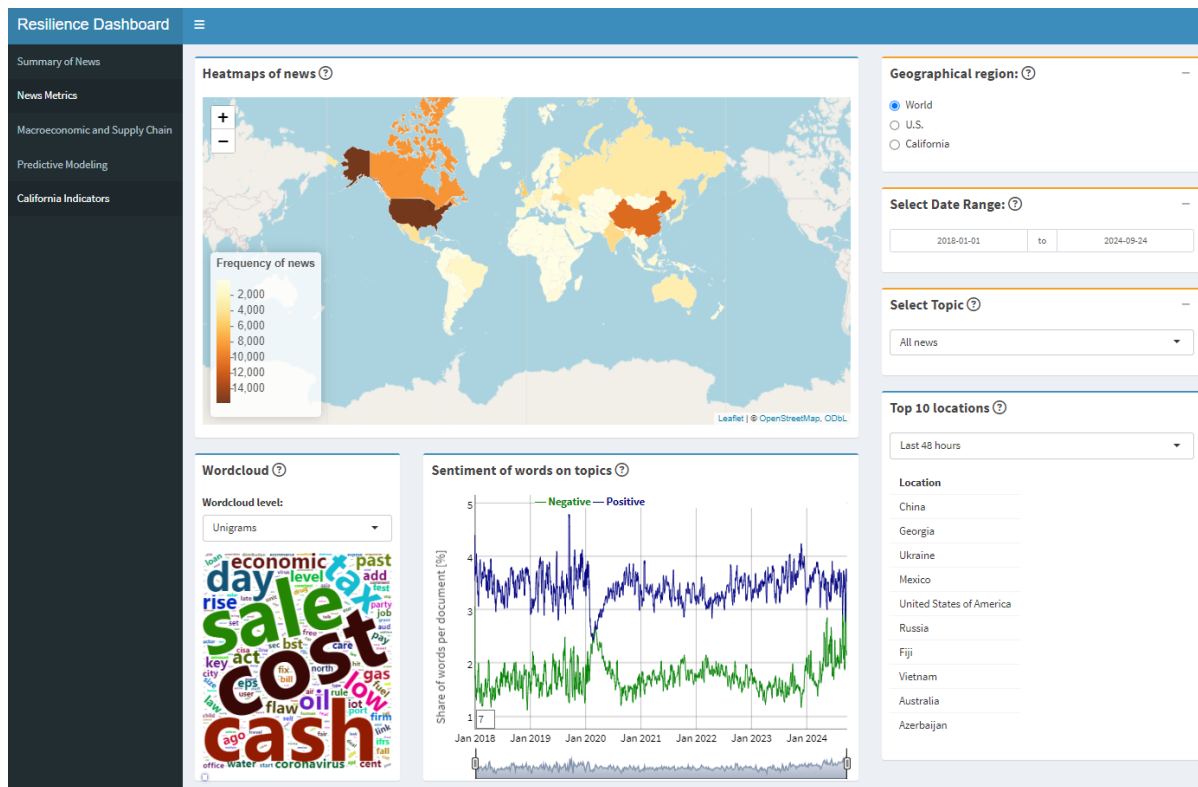


Figure 2. Visualization of the developed dashboard.

Key Dashboard Components and Results

1. **Summary of News:** Provides an overview of news article publications, including the number of articles published in the last 48 hours, 7 days, and 30 days. It also displays the sentiment of the news, the distribution of topics covered, and the California Index, which highlights the state's relevance in supply chain-related news.
2. **News Metrics:** This section presents key outputs from the text-mining analysis of news articles. These include the geographical distribution of news at the global, national, and state levels, word clouds showing the most frequently mentioned terms, and sentiment analysis of the news content.
3. **Macroeconomic and Supply Chain Metrics:** This tool visualizes logistics and macroeconomic indicators for the U.S. and California, providing a comprehensive view of the economic and operational conditions related to supply chains.
4. **Predictive Modelling:** This section displays the predictive models developed for key logistics and macroeconomic indicators. Empirical results show that the statistical model predicts approximately 80% of the variance in some of the most relevant indicators.
5. **California Indicators:** This section focuses on key metrics specific to California, including data on the state's two major seaports, Los Angeles and Long Beach, as well as highway-related information critical to the state's transportation infrastructure.