ResilientNet: Predicting the Impacts of War, Natural Disasters, and Pandemics on Global Production Networks with a GNN-LSTM Hybrid Model

M. DOMINIC SAVIO, ASST PROFESSOR, VELLORE INSTITUTE OF TECHNOLOGY, CHENNAI, dominicsavio.m@vit.ac.in

MOHD ZAID HUSAIN, STUDENT, VELLORE INSTITUTE OF TECHNOLOGY, CHENNAI, mohdzaid.husain2022@vitstudent.ac.in

Abstract

The combination of conflicts together with catastrophes and pandemics creates major interruptions that cause global production networks to breakdown in the same way Texas supply chains do. The text employs machine learning to generate predictive models focused on analyzing disruption effects on supply chain operations and international trade systems as well as economic market stability. The paper uses the COVID-19 pandemic and the Russo-Ukrainian war together with earthquakes and hurricanes as examples for analysis. The study combines information from macroeconomic indicators with supply chain flow data alongside records of the examined events.

The system uses Graph Neural Networks (GNNs) for a total network analysis that investigates both vulnerabilities and propagation pathways. The forecasting of production and recovery lags relies on Long Short-Term Memory (LSTM) networks and several Transformer architecture variants which process time series data. The detection of emerging systemic disruption is performed through anomaly methods which include Isolation Forests together with Autoencoders. Predictive models enable operational supply chains to develop responses that build their resilience through predictive capabilities. Public decision-makers can perform proactive actions through these models as opposed to delaying their responses.