BINGHAMTON UNIVERSITY • SCHOOL OF SYSTEMS SCIENCE AND INDUSTRIAL ENGINEERING

DISSERTATION DEFENSE

RESILIENCE OF INDIAN ELECTRONICS SUPPLY CHAINS UNDER STRUCTURAL FAILURES AND CLIMATE HAZARDS: A NETWORK SCIENCE APPROACH

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Dissertation Committee

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ABSTRACT

This dissertation develops a unified network science framework for studying resilience in India's electronics supply chain under both structural failures and climate-induced hazards. The first study constructs a multilayer supply chain of 171 firms and uses node-failure simulations to quantify how the disruption of one company propagates through an influence network to alter the productivity of others revealing non-linear amplification effects and counterintuitive productivity gains at peripheral nodes. The second study extends this to monsoon flood disruptions, integrating district-level rainfall data from 2020 to 2025 with influence-weighted inter-firm dependencies to simulate cascading economic losses totaling INR 3.8 to 4.1 lakh crores (USD 46 to 50 billion). A third contribution translates these findings into a policy framework for disaster-resilient industrial governance, proposing a National Supply Chain Resilience Dashboard (NSCRD), systemic risk metrics aligned with India's National Disaster Management Plan (NMDP) and public-private partnerships for network-informed resilience planning.

The research focuses on India's electronics manufacturing ecosystem which is a tightly coupled network of manufacturers, suppliers, distributors, logistics providers and retailers concentrated in industrial hubs such as Chennai, Bengaluru, Pune, and Noida. The research investigates how both internal structural failures and external climate shocks interact to generate cascading systemic losses. Among its core contributions, the dissertation introduces an influence network model for quantifying node-level productivity impacts, a flood propagation algorithm linking meteorological hazard data with supply chain structure and three integrated resilience metrics such as the Systemic Loss Index (SLI), Structural Centrality Risk (SCR) and Resilience Gain Potential (RGP). This supports data-driven risk assessment at district, sectoral and national scales. The findings directly inform disaster governance: by proposing the NSCRD under NIDM, recommending redundancy incentives for high-centrality firms and embedding quantitative resilience indices into India's National Disaster Management Plan (NDMP) and the Sendai Framework for Disaster Risk Reduction. The work charts a pathway from reactive hazard response toward anticipatory, network-informed resilience planning.