Assessing Supply Chain Resilience of the Manufacturing Industry in Connecticut

Callia Ricozzi, Dr. Gokhan Egilmez, and Dr. Ridvan Gedik

Department of Mechanical and Industrial Systems Engineering

ASOS RESEARCH GROUP

UNIVERSITY of New Haven

Introduction

Connecticut is home to manufacturing companies and is also well known for its ever changing weather from Hurricanes, to Blizzards, to Tornadoes and more. Following research questions were addressed in this study:

1. What is the status of resilience of CT manufacturing and supporting service organizations to potential disruptions in their operations and supply chains?
2. How are the companies effected by unexpected disruptions such as power loss, severe weather events, transportation disruptions, etc. lines in terms of the relationship between their vulnerabilities and capabilities?

Methods

To complete this research, a human subject research **survey** was developed as a result of a through literature review. After receiving the human subject research approval from the University IRB committee, the survey was deployed.

Research and Problem Statement → Literature Review → Research Survey Design → IRB Approval → Survey deployment → Data collection and statistical analysis → Closing-out the SURF project

Research Survey (RS)

Survey design focuses on two pillars of supply chain resilience: **Vulnerability** and **Capability**.

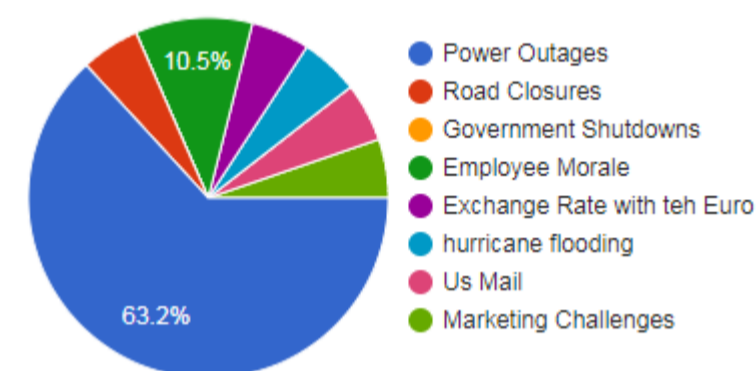| Vulnerability factors	Capability factors
	1-Flexibility in Sourcing
1-Turbulence	2-Flexibility in Order Fulfillment
2-Deliberate Threats	
3-External Pressures	3-Capacity
4-Resource Limits	4-Efficiency
5-Sensitivity	5-Visibility
6-Connectivity	6-Adaptability
7-Supplier/Customer Disruptions	7-Anticipation
	8-Recovery
	9-Dispersion
	10-Collaboration
	11-Organization
	12-Market Position
	13-Security
	14-Financial Strength

The proposed RS consists of
- **3** questions related to organization's **demographics**
- **14** questions to assess the organization's **vulnerability** to external disruptions and threats (Vulnerability factors)
- **14** questions to assess the organization's **capability** to deal with disruptions (Capability factors)

- The RS was deployed **2** times to the members of the New Haven Manufacturing Association, and the Connecticut Technologies Council via email.
- About **one third** of the companies were called to complete the RS, where majority of them were not reached.
- Approximately, **300** manufacturing and service organization representatives received the RS.
- **20** complete responses were received in 1-month, which indicates a 6.7% response rate.
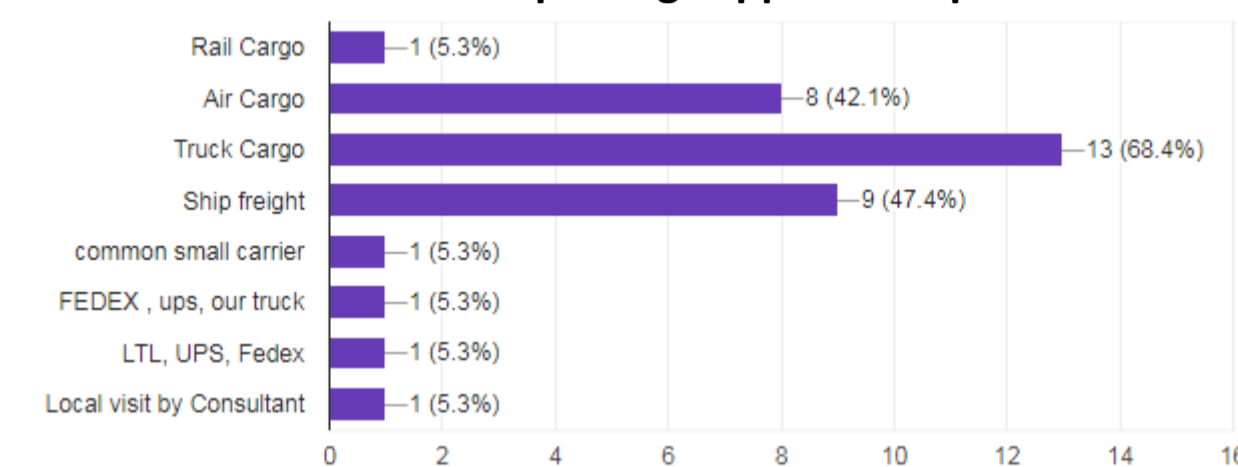- This reveals an 18% sampling error[1] with 90% confidence.

Findings

- 75% of the organizations surveyed was manufacturing and 25% was non-manufacturing, who supports the manufacturing systems.
- 10 small, 5 medium size, and 5 large size organizations participated.
- Majority (60%) of the participants work with 0-100 suppliers

Most Disruptive Events in $

Legend: Power Outages, Road Closures, Government Shutdowns, Employee Morale, Exchange Rate with teh Euro, hurricane flooding, Us Mail, Marketing Challenges

Modes of transporting supplies and products

- Rail Cargo — 1 (5.3%)
- Air Cargo — 8 (42.1%)
- Truck Cargo — 13 (68.4%)
- Ship freight — 9 (47.4%)
- common small carrier — 1 (5.3%)
- FEDEX , ups, our truck — 1 (5.3%)
- LTL, UPS, Fedex — 1 (5.3%)
- Local visit by Consultant — 1 (5.3%)

Most critical vulnerability factors (SE+A)	Most critical capability factors (SE+A)
1- Unpredictable demand shifts (60%)	1- High product variety (75%)
2-Strong price competition in the market (80%)	2- Labor-oriented operations are dominant (75%)
3-Difficulty in recruiting and retaining high-skilled workers (75%)	3-Ability to push the delivery date (65%)
4-Geographically spread suppliers (60%)	4-Having effective quality and maintenance programs (75%)
5- Being part of globally distributed supply chain (60%)	5- Having reliable back-up utility system (only 35%)
6-Continuous information flow is critical for regular op's (75%)	6-Havind adopted continuous improvement programs (85%)
	6-Having a detailed contingency plan to cope with disruptions (only 35%)
	7-Information sharing system with suppliers (only 25%)
	8- Having flexible customers on delivery dates (only 15%)

Conclusion & Future Work

A research survey was developed and deployed to assess the supply chain resiliency of CT manufacturing and supporting organizations.

Power loss, transportation dependency on majorly truck, information flow affected by power outage, and high skilled workforce needs are identified as the most disruptive factors to be improved.

Team advises to improve organizations' contingency plans for disruptive events, adopt advanced prediction models for fluctuating customer demand.

As a future work, the team plan to increase the sample to 50 to reduce the sampling error below 10% and submit it as a conference paper at the Annual Conference of Industrial and Systems Engineering to be held on May, 2019.

References

Petitt,T.J. et al., 2013, "Ensuring Supply Chain Resilience: Development and Implementation of an Assessment Tool", Journal of Business Logistics, 34(1): 46–76