Building Resilient Supply Chains

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Managing Disruptions

- Flexibility vs. redundancy
- Cost vs. risk tradeoffs
- Aligning mitigation across supply chains
- Vulnerabilities in supply networks
- Topology of supply networks
- Supply chain visibility

Managing Disruptions – Flexibility vs. Redundancy

- Flexibility-based strategies
  - Volume flexibility
  - Product-mix flexibility
  - Responsiveness
    - Smart manufacturing (robotics, IoT, AI systems)
- Redundancy-based strategies
  - Inventories
  - Alternative sources of supply
- Flexibility more effective than redundancy (Talluri et al., 2013)*

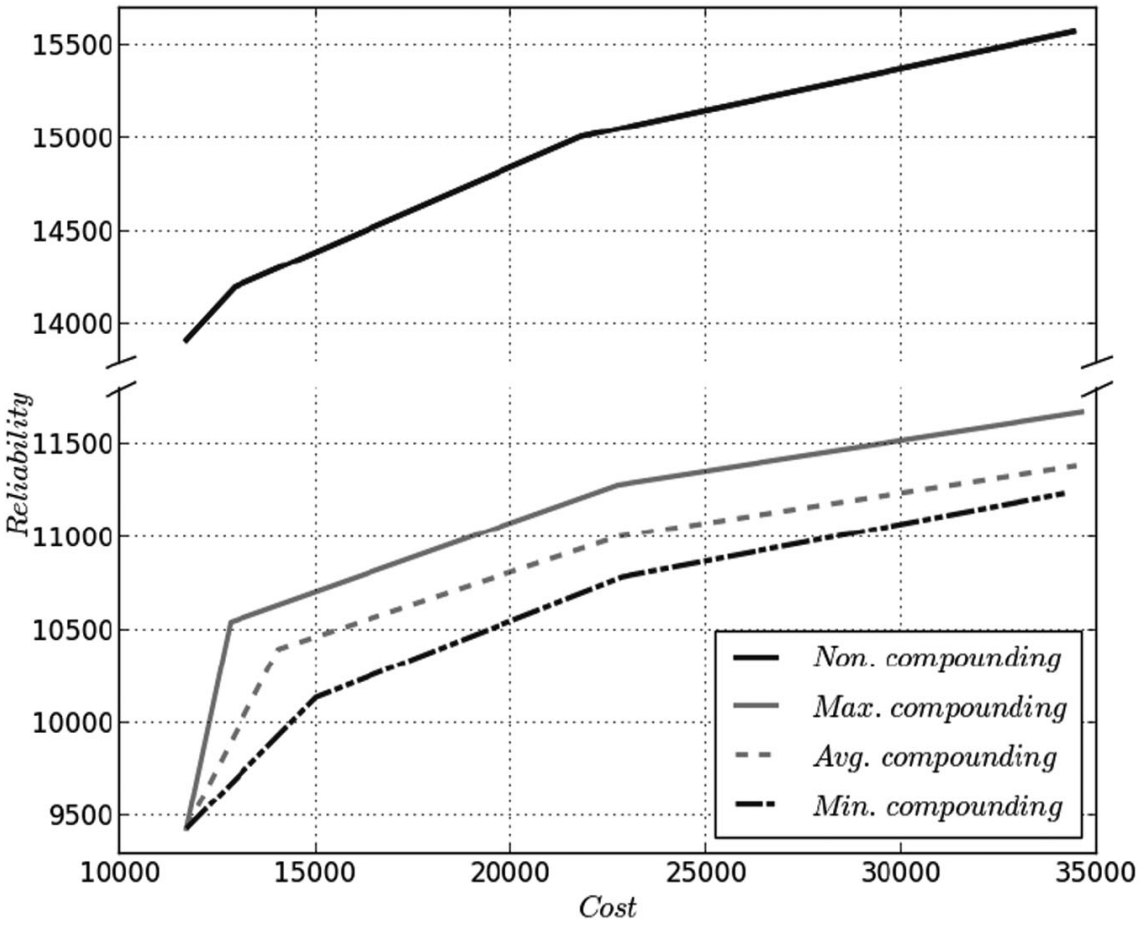
*Talluri, S., Kull, T. J., Yildiz, H., & Yoon, J. (2013). Assessing the Efficiency of Risk Mitigation Strategies in Supply Chains, Journal of Business Logistics, 34(4), 253-268.

Managing Disruptions – Cost vs. Risk Tradeoffs

- Cost vs. risk tradeoffs in designing supply chain networks
- Consideration of dual objectives (Yildiz et al., 2016)*
  - Minimize cost
  - Maximize reliability (minimize risk)
  - Compounding aspects of risk
    - Managing ripple effects

*Yildiz, H., Yoon, J., Talluri, S., & Ho, W. (2016). Reliable Supply Chain Network Design, Decision Sciences Journal, 47(4), 661-698.

Tradeoffs in Network Design



Cost vs. Reliability (risk) Tradeoffs in Network Design (Yildiz et al., 2016)

Managing Disruptions – Aligning Mitigation

- Upstream vs. downstream strategies
- Coordination across supply chains
- Simultaneous consideration of both upstream and downstream mitigation strategies and related alignment (Yoon et al., 2018)*
  - For example: inventory buffers upstream and volume flexibility downstream

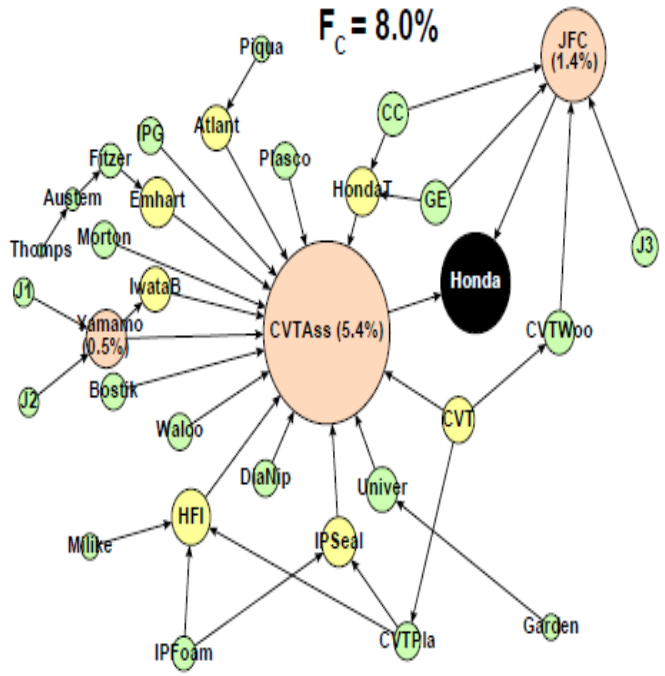
*Yoon, J., Talluri, S., Yildiz, H., and Ho, W. (2018). Models for Supplier Selection and Risk Mitigation: A Holistic Approach, International Journal of Production Research, 56(10), 3636-3661.

Managing Disruptions - Vulnerabilities in Supply Networks

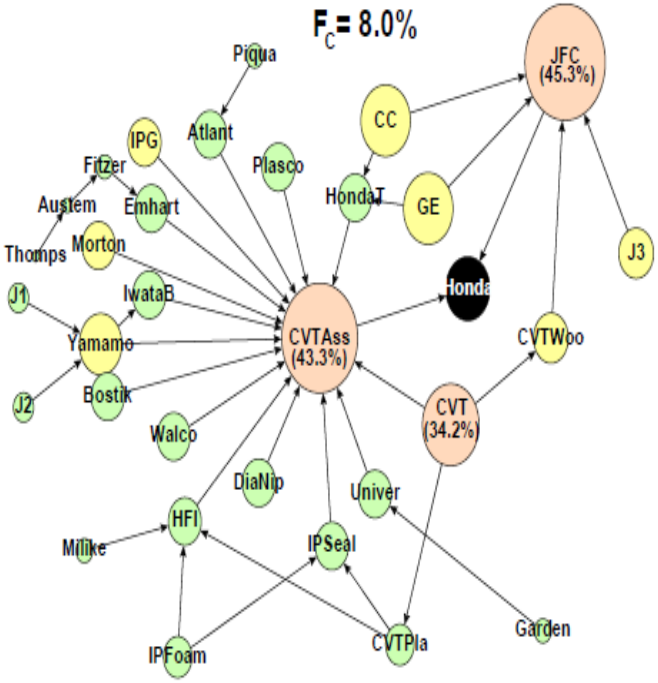
- Node criticality and disruption impact
- Interdependencies among nodes
- What parts of the network to fortify?
- Bayesian Networks for risk assessment in networks (Kaki et al., 2015)*

*Kaki, A., Salo, A., & Talluri, S. (2015). Disruptions in Supply Networks: A Probabilistic Risk Assessment Approach, Journal of Business Logistics, 36(3), 273-287.

Fortification and Disruptive Impact



(a) Supplier fortification impact (SF_I).



(b) Supplier disruption impact (SD_I).

Fortification Impact and Disruption Impact

High SD_I	Supplier is not a big contributor to the overall risk, but disruption can have severe implications; e.g., a supplier of customized screws, or the sole energy supplier in an isolated area.	Supplier is critical and has a big impact on total risk and is important in preventing disruptions; key targets for improvement actions and supply network redesign.
Low SD_I	Supplier is not significant; there is potential to relax reliability; e.g., lower quality requirements for cost savings); a good candidate for supply network redesign.	Supplier is a big contributor for the overall risk, but the system can tolerate its disruption relatively well; a good candidate for reliability improvement actions.
	Low SF_I	High SF_I

*Kaki, A., Salo, A., & Talluri, S. (2015). Disruptions in Supply Networks: A Probabilistic Risk Assessment Approach, Journal of Business Logistics, 36(3), 273-287.

Managing Disruptions - Topology of Supply Networks

- What types of network configurations are robust and resilient to disruptions?*
  - Density
  - Complexity
  - Node criticality

*Kaki, A., Salo, A., & Talluri, S. (2015). Disruptions in Supply Networks: A Probabilistic Risk Assessment Approach, Journal of Business Logistics, 36(3), 273-287.

Supply Chain Visibility

- Mechanisms for improving visibility
  - Supplier relationships
  - Incentive schemes/Information sharing
- Information sharing mechanisms (Yoon et al. 2020)
  - Inventory/capacity levels
- Supply chain visibility software
  - Digital twins

*Yoon, J., Talluri, S., & Rosales, C. (2020). Procurement Decisions and Information Sharing under Multi-tier Disruption Risk in a Supply Chain, International Journal of Production Research, 58(5), 1362-1383.