Collaborative Supply Chain Network Design and Optimization

Thrust area:
Design Optimization

Hector A. Vergara\textsuperscript{1}, J. David Porter\textsuperscript{1}, Zhaohui Wu\textsuperscript{2}
\textsuperscript{1}School of MIME, \textsuperscript{2}College of Business
Problem Statement

- Strategic supply chain network design determines:
  - Number, location and size of facilities, and
  - Optimal flows of products through the facilities

- In practice, no single correct design can be easily obtained due to multiple operational constraints and design requirements
- **80%** of the supply chain costs are locked in with the network design
Problem Statement

- Problem becomes even more difficult when two or more companies/units explore the possibility to collaborate to reduce supply chain costs and improve efficiency.
Approach & Method

- Strategic network design planning requires:
  - Development of a logical mathematical model of the supply chain
  - Use of an efficient optimization method to identify an optimal solution among the very large number of alternatives
  - Analysis of the results of several scenarios to support a good implementable plan
Current State of Practice & Research

- Different efforts related to collaborative distribution have focused on:
  - Back-haul matching
  - Direct shipment
  - Co-loading freight
  - Network design

- Most of the existing work heavily relies on the existence of a third party logistics (3PL) provider that handles the distribution over a fixed network
Benefits & Deliverables

- **Benefits**
  - Decentralized design of collaborative supply chain networks
  - Efficient analysis of alternative scenarios
  - Improved supply chain performance and sustainability

- **Deliverables**
  - A user-friendly web-based computational decision support tool based on optimization models and decision analysis methods
  - A user manual for the web-based computational decision support tool
  - Final report documenting project activities and findings including mathematical models developed
Project Plan

1. Develop a framework to characterize the various components and factors of strategic supply chain network design within a collaborative environment
2. Define how supply chain network design impacts logistics efficiency and organization profitability
3. Develop optimization methodology to analyze the optimal network design and assess the benefit(s) of collaboration
4. Validation of mathematical model using alternative collaborative supply chain network design scenarios
5. Develop web-based computational decision support tool
6. Validation of decision support tool using alternative collaborative supply chain network design scenarios
How Ours Is Different

- **Design approach:**
  - Decentralized approach allows collaborative design of supply chain networks as opposed to a centralized approach
  - Use of mathematical modeling techniques that are able to obtain optimal designs efficiently even for large scale problems
  - Analysis of alternative scenarios for decision support using decision analysis methods

![Decentralized Interface](image)
Industrial Relevance

- A means to perform quantitative analysis and optimization of the strategic network design of collaborative supply chains
- Significant supply chain cost savings due to better utilization of resources and improved efficiency in the movement of goods
- Improved supply chain agility and risk management
- Supply chain sustainability due to reduction of CO$_2$ emissions as compared to traditional non-collaborative distribution methods