An Inventory Replenishment Strategy
Using International Shipment Consolidation

Research Team: Wooseung Jang (PI), James Noble, Na Deng

Sponsor: Legget and Platt, Inc.

Problem in context: Each branch of Legget & Platt places orders to China independently. They have low order frequencies and high inventory. Coordinated inventory replenishment strategy will reduce inventory a lot. The project is to minimize the total cost by consolidating small international shipments when the coordinated inventory policy is taken.

Important/Expected Results
• Coordinated inventory replenishment and shipment policy for international logistics network
  • Shipment assignment
  • Inland transportation mode selection
  • Reduced inventory levels
  • Reduced cycle time
  • Increased flexibility

Technical Approach
• Analyze purchase order history data of each branch
• Improve current logistics network
• Formulate a mathematical model
• Solution algorithms
• Test various scenarios
• Develop feasible implementation practices

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Supply Chain Design for Energy Conservation
Research Team: James Noble (PI), Wooseung Jang, Kara Staub-Bono, Kelsey Kotur, Adam Rubemeyer

Sponsor: The Boeing Company

Problem in context: Overall supply chain performance is impacted by energy cost which has significantly increased in the past 10 years. Supply chain decisions such as supplier and mode selection, routing, inventory profile and load consolidation, can all be impacted by energy cost. This study aims to lay the ground work for addressing this crucial issue.

Important/Expected Results
- Identification of key supply chain trade-offs with respect to energy issues
- Development of supply chain reconfiguration approaches as energy cost changes
- Reduce overall supply chain cost
- Design of more robust supply chains from an energy consumption perspective

Technical Approach
- Supply chain and transportation data collection
- Supply chain evaluation model development
- Formulation of energy based supply chain optimization models
- Solution algorithm development
- Model sensitivity analysis
- Supply chain reconfiguration strategies

University of Missouri

Supplemental data and graphics related to the technical approach and supply chain modeling.
Warehouse Floor Layout Optimization

Research Team: Jim Noble (PI), Alec Chang, Almas Ospanov, Sam Trevino, Sarah Harper, Nichole Hillstrom

Sponsor: Hallmark Cards.

Thrust Area: Distribution

Problem in context: Hallmark Cards operates a very large distribution center (> 80k SKU and 220M items/year). The project objective is to develop a user-friendly warehouse floor layout tool that addresses the trade-offs between picking, stocking, shipping and retail stocking costs in order to reduce overall operating cost.

Important/Expected Results

• Effective and efficient methodology for optimal filling floor layout.
• Significant cost savings through explicit analysis of cost trade-offs between picking/stocking/shipping.
• Effective implementation strategy for filling floor relayout timing.

Technical Approach

• Analyze current Hallmark warehouse picking and stocking practices and supporting data.
• Analyze current filling floor layout practices and develop performance metrics.
• Formulate and analyze an integrated warehouse layout model.
• Develop a user-friendly warehouse floor layout tools and provide database integration support.
Demand Forecasting Models for Dynamic Material Requirements
Research Team: Wooseung Jang (PI), James Noble, Matt Roman, Na Deng

Sponsor: Ameren UE
Thrust Area: Inventory

Problem in context: Thousands of transformers across several different storerooms are used by Ameren every year. These transformers consist of hundreds of different types with widely varying individual demands

Important/Expected Results
• Production of accurate forward looking forecast results
• Creation of a forecast that can be easily applied when scheduling production slots from vendors
• Increase in customer satisfaction by limiting monthly stock outs over a 1 year planning horizon

Technical Approach
• Examine existing problem
• Gather relevant data
• Analysis of historic usage data
• Aggregate similar groups of transformers and choose individuals to forecast
• Review different forecasting techniques used on similar demand
• Create forecasting algorithm
• Evaluate forecast accuracy

![Total Usage Seasonality Chart](chart.png)
Logistics of Using Underground Pipelines for Freight Transportation

Research Team: James Noble (PI), Mustafa Sir, Gaohao Luo
Anna McLaughlin, Nichole Smith

**Sponsor:** Freight Pipeline Company

**Problem in context:** Many large metro areas around the world are highly congested hindering the flow of freight in and out. Underground freight pipelines or tubes can reduce congestion, reduce environmental impact of freight movement and reduce overall transportation cost. Projects are currently in the evaluation stage in New York, Sydney, Shanghai and others.

**Important/Expected Results**
- Tube network design – I/O location, flow path
- Capsule dispatching / control algorithms
- Cargo tracking approaches
- Design of load / unloading processes
- Capacity analysis

**Technical Approach**
- Assess related logistics issues
- Develop object oriented simulation model for analyzing dispatching / control approaches
- Formulate design / operation models
- Development of solution algorithms
- Model sensitivity analysis
- Implementation scenario analysis

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