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MFAC Supply Chain Optimization Workshop

June 10, 2016

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consulting & technology

Agenda

- Introduction to supply chain optimization (10 min)
- Small group discussion of applying optimization to MnDOT's freight planning efforts (30 min)
- Wrap-up and report out (10 min)

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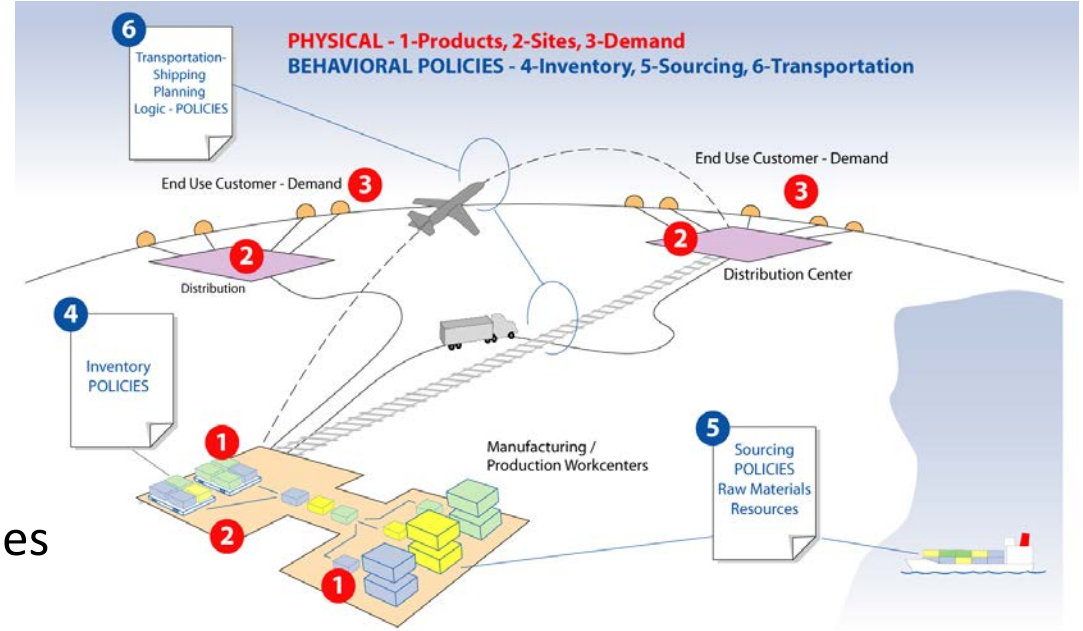
Components of a Supply Chain Network

- **Physical Elements**
  - **(1) Sites**
  - **(2) Products**
  - **(3) Demand**
- Behavioral Elements
  - (4) Sourcing Policies
  - (5) Transportation Policies
  - (6) Inventory Policies



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Examples of Supply Chain Network Design Questions

- From whom should we source?
- How should we flow each product through the network?
- Where and when should we produce each product?
- What is my actual cost to serve demand?
- Where should we stock product?
- How much inventory is enough to meet my service level requirements?
- How much should I buy?
- How should I ship my products?

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Individual vs. Public Network Optimization

- Individual Company Network
  - Sites: Company, and client locations (5-digit zip)
  - Products: Product level data (bill of lading)
  - Demand: Flows based proprietary bill of lading data in company systems
- Public Network Optimization
  - Sites: Demand nodes (county or 3-digit zip)
  - Products: STCC or SCTG commodity level
  - Demand: Flows based on commodity origin/ destination data; e.g. FAF
  - Aggregated bill of lading data from many companies

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Commodity vs. Product Data Example

Commodity

- Example: *04 Animal Feed and Products of Animal Origin*
- SCTG – Standard Classification of Transported Goods
- 43 Commodity groups at the two digit level

Product / SKU

- *04 Animal Feed and Products of Animal Origin*
  - *04110: Cereal straw or husks and forage*
  - *04120: Inedible flours, meals and pellets of meat, fish or seafood and greaves*
  - *04130: Bran, sharps and other residues of cereals or leguminous plants*
  - *04191: Eggs in the shell*
  - *04192: Raw hides and skins*
  - *04193: Shorn or pulled greasy wool….*
  - *04190: Other residues and waste from the food industries used in animal feed*
  - *04210: Dog or cat food put up for retail sale*
  - *04290: Other animal feed preparations*

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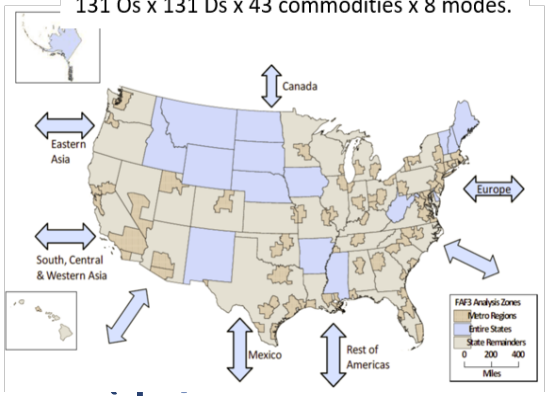
Quetica's Customized Data Solution

Commodity Level →

Commodity Flow Survey (CFS): Conducted every 5 years by the U.S. Census Bureau. Sample size = 100,000 business establishments at a 3-digit NACIS code level. (Companies report on one week of shipments in each quarter)

Freight Analysis Framework (FAF): A derivative of the CFS reports commodity origin/destination (O/D) by tonnage and value for 123 domestic and 8 foreign regions on 43 commodities for 8 modal categories. Matrix dimensions =
131 Os x 131 Ds x 43 commodities x 8 modes.



Commodity data with cost and equipment type

Customized Commodity Flow Data Solutions

More Detailed Commodity Flows	A Focus on Key Commodities	Cost and Performance Benchmarks from Iowa Companies
900 Domestic origin / destination zones (3-digit zip code) and 40 International zones	identify key client industries and conduct a "deep dive." (E.g. 13 commodities accounted for over 60% of Iowa's total tonnage. Each was individually modeled).	Data contributions and business interviews enhance Quetica's cost and performance benchmarks specifically for client

← Product Level

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Quetica's Shipment Data Warehouse: Information from freight shipment invoices and bills of lading. Data fields include origin-destination (city & zip), mode(s), equipment type, commodity description and cost

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Current Business Data and Analytics Once companies learn about the optimization approach – a practice many are familiar with, voluntary contributions are sought for bill of lading samples which are added to the data warehouse. Quetica also conducts interviews to gather supply chain analytics for key industries.

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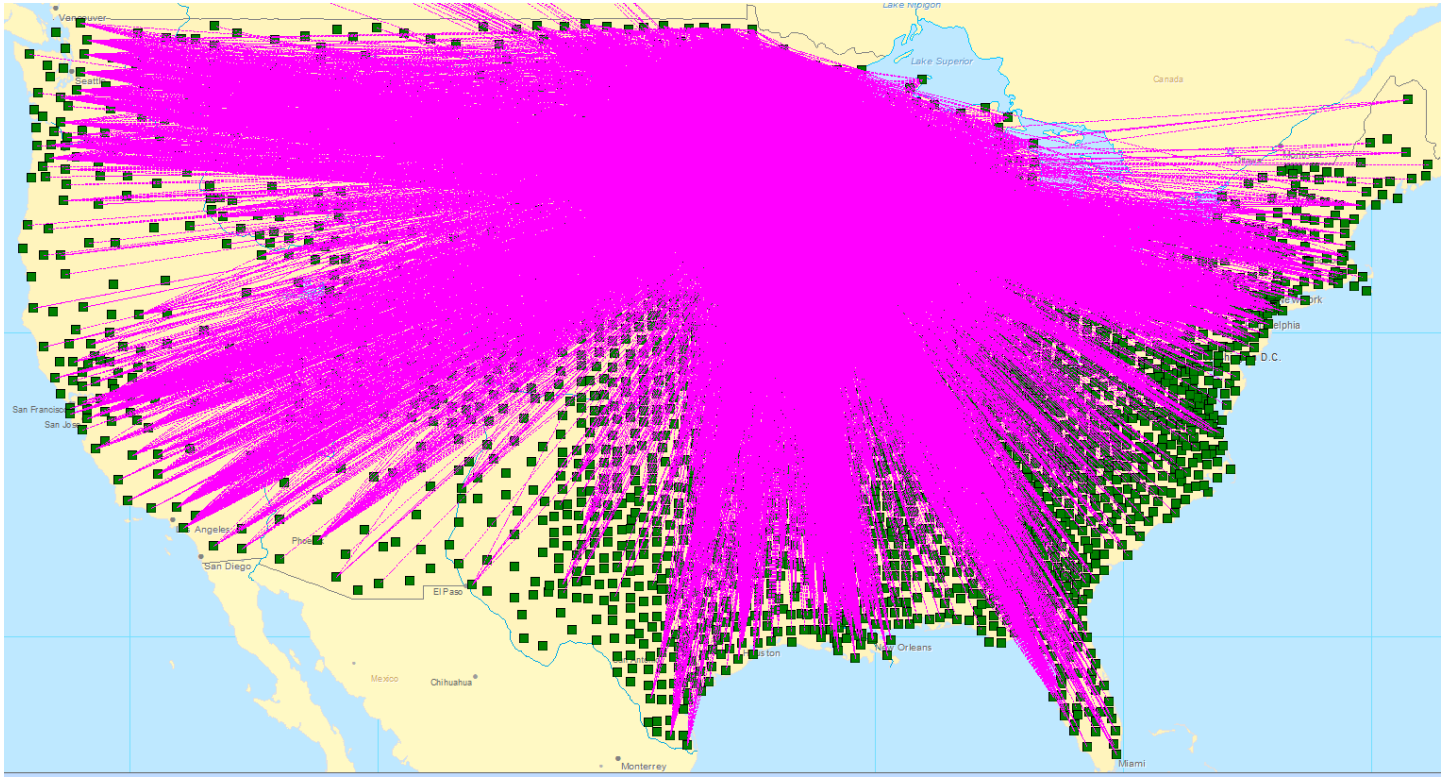
Applying Big Data Analytics Freight

Traffic Lanes with annual volume > 1,000 tons



Source: FAF-3, all surface modes inbound and outbound

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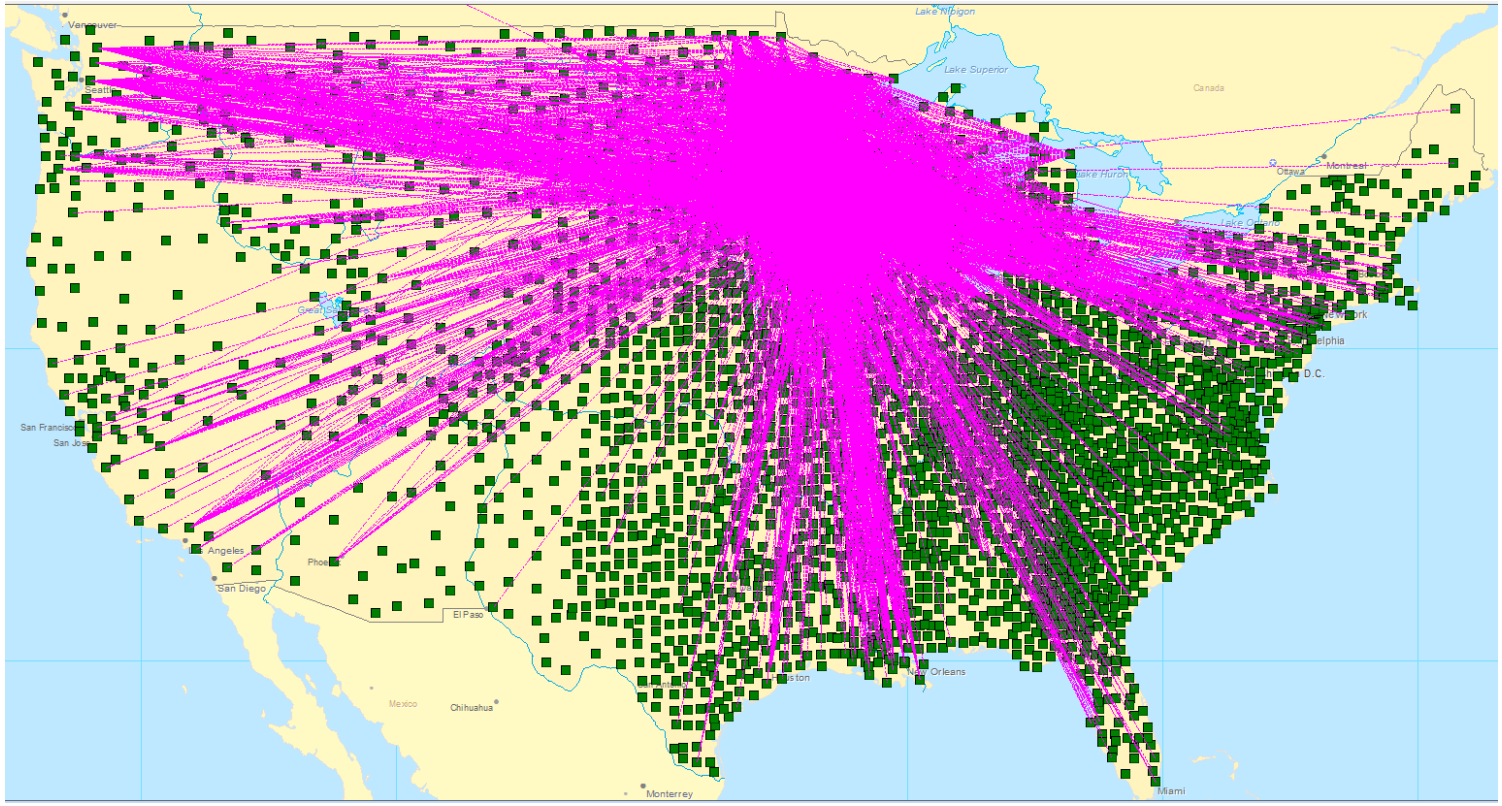
Applying Big Data Analytics to Freight

Traffic Lanes with annual volume > 5,000 tons



Source: FAF-3, all surface modes inbound and outbound

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Traditional Freight Planning vs. Optimization

- **Traditional Freight Plan**
  - Flows: Commodity focus
    - Key industries
    - Key markets (domestic)
    - Mode use / directional flow
  - Nodes:
    - Major market (state/metro area)
  - Networks
    - Multimodal – highway focus
  - Metrics
    - Average truck speed
    - Truck reliability index
- **Optimization Planning**
  - Flows: Supply chain focus
    - Common modes/equipment
    - End to end (international)
    - Mode utilization
  - Nodes:
    - County or 3-digit zip
  - Networks
    - Multimodal – mode neutral
  - Metrics
    - Cost of transport/cost savings
    - Shipper/carrier ROI
    - transit time / delivery reliability
    - Competitive market analysis

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Iowa Results: Cost Metrics

- A substantial volume of truck freight is conducted as small shipments that could be consolidated (~ 10%)
  - A cross dock facility evaluation projected an annual average cost savings of approximately $34 million with a ROI of 0.6 years.
  - Estimated reduction in truck miles: 1.1 billion in 2020
- Significant opportunities exist to leverage railroad transportation in Iowa to reduce freight costs.
  - An intermodal yard analysis projected annual cost savings of $12.8 - $15.5 million, with an ROI of 1.0 to 1.2 years.
  - Estimated mode shift by 2020: Truck ton-miles ↓ 5 billion, Rail ton-miles ↑ 6.6 billion. Cost per ton mile ↓ $.097

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Small Group Discussion

- Paper Mill supply chain example:
  - XYZ paper has at least 5 options for shipping to China
  - Each option has a different cost and level of reliability
  - Missed deliveries = reduced demand
  - What option should XYZ chose to maximize profit?
- Minnesota to China Exports
  - In 2015 Minnesota exports to China valued at $1.8B
  - Since 2005 Minnesota exports to China have grown 142%

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Questions