Estimating Freight Flows in WA State: Case studies in data-poor and data-rich environments

Erica Wygonik, University of Washington

Presented on behalf of Derik Andreoli, Anne Goodchild, Eric Jessup, and Sunny Rose
Research Problem

- Freight supports regional economies
- Desire to justify investments targeting freight
- Evaluate the impacts of network changes
  - Vulnerability to disruptions
  - Improvements and infrastructure needs
- Limited by available data
State of Freight Modeling

- Currently two primary modeling sources:
  - Commodity flow data
  - Gross vehicle volumes
  - Assume industries use infrastructure in the same way

- Existing methods are too coarse for needed analysis
  - Commodity flow data spatially aggregate
  - Vehicle estimates are categorically aggregate
Project Scope

- Improve the representation of freight movement in statewide modeling
- Work within existing data constraints
- Study Washington State due to the frequent disruptions to key freight corridors
  - I-5 (flooding)
  - I-90 (avalanche)
Washington State Topography

Map courtesy of geology.com

SEATTLE  YAKIMA  VANCOUVER  SPOKANE

CASCADES RANGE
Washington State Infrastructure

Only 3 ways across the Cascades

SEATTLE

YAKIMA

VANCOUVER

SPOKANE

Map courtesy of Google maps
Focus on Two Sample Data Sources

- Estimate statewide truck trips required for the operation of industries within Washington State

- Data-rich industry: potato distribution
  - Production
  - Processing
  - Demand
  - Distribution
  - Capacity Ratios

- Data-poor industry: diesel distribution
  - Use estimated origins & destinations
  - How to model flows?

Photo courtesy of WSDOT
Potato Industry Flow Estimation

Courtesy of the WA State Potato Commission
The Potato Value Chain

Growers
(WIDE range of productivity)

Storage Sheds
(Located on or Very Near Farm)

Processed Potatoes

Fresh Potatoes

Out-of-State Markets

Processors
(Frozen, Chips, Dehydrated)

Local Markets & Local Market D.C.'s
Washington Potato Processors

Frozen = (F)  ---  Dehydrated = (D)  ---  Some Dehydrated (d)  ---  Chips = (C)
Shipment Destinations for Lower Basin Potato Production

- States West of Mississippi: 22%
- States East of Mississippi: 24%
- Canada: 9%
- Eastern Washington: 12%
- Western Washington: 14%
- Oregon (2%) and California (15%)
- Lower Basin

Road Classification:
- State Highways
- Local Roads
- Interstate

Potato Production (cwt.):
- 336 - 28,251
- 28,252 - 64,449
- 64,450 - 112,558
- 112,559 - 203,331
- 203,332 - 816,049
Washington Potato Movements
Number of Trucks per Day that Traverse WA’s Mountain Passes

Disruption       Normal
---               ------
0.13 - 1.00      
1.01 - 5.00      
5.01 - 15.00     
15.01 - 25.00    
25.01 - 32.37    
32.38 - 50.36    

Avalanche Closure of Hwy 2 (Stevens Pass), I-90 (Snoqualmie Pass), and Hwy 12 (White’s Pass)
Potato Industry Flows: Summary

- Significant cross-Cascades travel
- Low profit margins on potato shipments
- Cannot afford to take detours
- Waiting or failure to stock products are expensive
- Very vulnerable to long closures
Diesel Industry Flow Estimation
The Diesel Supply Chain

WA Refineries
(Five: process 625,000 bpd)

Out-of-State Refineries

Pipeline: $0.01 per barrel mile
Barge: $0.02 per barrel mile

27 Terminals

Last mile ALWAYS made by TRUCK

400+ Cardlocks
(Automated Fill-Up Stations)
Mapping diesel flows
Diesel Network Flow Map: Pre-Disruption

Page

- Terminals
- Racks

Network Importance:
- 1 - 3
- 4 - 8
- 9 - 14
- 15 - 20
- 21 - 38

Cities:
- SEATTLE
- SPOKANE
- YAKIMA
- VANCOUVER

Route: CASCADES RANGE
Diesel Industry Flows: Summary

- Minimal cross-Cascades travel
- Multimodal network avoids mountain passes
- Distributed terminals provide buffers
- Can estimate network segment importance using known information…
- BUT cannot assess flows because of lack of information

→ Diesel is a higher-value industry, but potatoes are more sensitive to road network disruptions

(diesel distribution is HIGHLY vulnerable to pipeline and/or barge disruption)
Methodological Summary

- Proposed methods evaluate infrastructure use with and without primary flow data
  - Locations of fixed infrastructure are generally available
  - Flow data is much harder to obtain

- Allows evaluation of impact of disruptions
  - Requires two different metrics

- Effectively supplements travel data in a data-poor environment

Photo courtesy of Shell
Thank you

Questions: Anne Goodchild  annegood@uw.edu
Data

- Industry Data
  - Potatoes:
    - Washington State Potato Commission data and expertise
    - Previous work by Dr. Jessup and WSDOT
  - Diesel:
    - Washington State Department of Ecology, Environmental Protection Agency, Department of Revenue
    - CFN and Pacific Pride networks
    - Interviews with Marketers and industry experts

- GIS Model
  - Multimodal representation of the state freight infrastructure
  - Includes impedance factors to travel along links in the transportation system