Evaluating and Forecasting Commodity Flows, Ontario

WSP | Parsons Brinckerhoff
MTO

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Team and Context
Just like it takes a *village* to raise a child — it took a *Team* to build these models.

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Context – **TRESO**: Transportation and Economic Simulator of Ontario

- First generation and first-of-its kind provincial model to forecast passenger, freight, and commodity flows to and from Ontario and the rest of the world.

- Focus on maximizing the use of available data while maintaining behavioral linkages.

- Explicitly models commodity flows, long-distance and short distance truck flows, drayage, empty trucks, commodity mode choice.
Demand and Supply Data
Demand Data...and lots of it

Macroeconomic
- GDP by NAICS
- Make | Use Tables
- CSD
- Canada-wide
- GDP by SCTG2

Firms
- Firm Synthesis
- Six digit postal code

Observed Commodity Flows
- Truck Flows
- Rail
- Marine
- Point
- Rail Zone
- Marine Port
- CSD
- Rail Yard
Supply Data

Road network that covers all of North America with varying level of detail – 120,000 links

- Greatest detail within CMAs (Ontario only) and the GGH area (all road classes except for local roads)
- Outside Ontario but within Canada – Arterial and above
- In the USA – state highways and above

Zone system produced on the “fly”

- Initial attempt – gradual rasterization algorithm (GR) or Quad Tree (6800 zones)
- Final attempt – gradual aggregation (GA) of DA generation algorithm (5400 zones)
Commodity Flow Model
Commodity model flow chart

2011 Transport Canada

- Marine
- Rail
- Truck

2012 CVS

- Disaggregate rail commodities
  - Base-year marine
  - Base year containerized rail
  - Base year bulk rail
  - Base year truck

- GDP Projections
- Make & Use Tables

Forecast future-year commodity flows

- Forecasted marine (Port)
- Forecasted containerized rail (Rail yard)
- Forecasted bulk rail (Rail yard)
- Forecasted truck (CSD)

Lever set - 1

Lever set - 2
Commodity model highlights

- Designed to be a **plug-and-play tool** i.e. multiple scenario evaluation capability

- **Eight degrees of freedom** or levers for scenario analysis
  - GDP by industry (from macro-economic model)
  - Make and use tables
  - Rail/Marine containerization flag (0/1)
  - Rail/Marine bulk flag (0/1)
  - Drayage flag (0/1)
  - Rail yard proportion of commodities within rail zone (0 - 1)
  - Commodity containerization ratio (0 – 1 for each SCTG2 commodity)
  - Relative value-to-weight ratio, by year

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<th>SCTG2</th>
<th>Containerization ratio</th>
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2011 Commodity Flows visualized

Common reporting framework
2011 Commodity Flows visualized - Sankeys

- Truck flows from ROW to Ontario
- Rail bulk flows from Ontario to ROW
Long Distance Model
Long-distance truck model

Non and unobserved SCTG2 trucks

Forecasted using Ontario GDP growth

Disaggregate trucks from CSDs to zones (without SCTG2)

Disaggregate trucks from CSDs to zones (with SCTG2)

Empty truck trip model

Forecasted from CF model flows

Truck

Convert truck tonnage to daily medium / heavy trucks

Convert tonnages to daily trucks at RYs and MPs

Marine

Rail

Disaggregate trucks to and from each RY/MP

Apportion to different times of the day

Lever set - 1

Lever set - 2
Long Distance Truck model highlights

- **Agent-based** (firms) framework
- Designed to be a **plug-and-play tool** i.e. multiple scenario evaluation capability
- **Six degrees of freedom** or levers for scenario analysis
  - GDP ratios
  - Proportion of medium trucks
  - Conversion from source units to days
  - Synthetic firms
  - Empty truck model function decay parameters
    - Breakdown by med/heavy trucks, and domestic/international
  - Time of day profiles by distance via GPS processing
2011 Long Distance truck flows visualized
Forecast Commodity Flows...sneak peek
GDP by NAICS projections
Commodity Growth Projections

Marine

Projected marine commodity growth by SITC2

Rail

Projected rail commodity growth by SITC2
Commodity Growth Projections

Intermodal Rail

Projected intermodal rail commodity growth by SICG2

Bulk Rail

Projected bulk rail commodity growth by SICG2
Commodity Growth Projections

Intra-Ontario

Inter-Ontario

Projected truck (within Ontario) commodity growth by SCTG2

Projected truck (external to from Ontario) commodity growth by SCTG2
Lessons learnt
We are really excited about...

- Increasing the **leverage** of the GPS truck processing by tying it to firms/commodities
- Continuing to **expand** the CVS – amazing dataset
- Continuing to move towards an **agent based framework** – MATSIM is the ultimate goal...TRESO has already made the first forays.

MATSIM - every truck represented as an individual point on the network with **ALL** information
Questions?