Applying the SWIM2 Integrated Model in Freight Planning in Oregon

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Presentation Outline

- Oregon Freight Plan
- Oregon Statewide Integrated Model “SWIM2”
- Methods
- Results
- Findings
- Conclusions
Oregon Freight Plan

Multi-modal statewide freight plan setting context of future needs and guidelines for state/regional freight strategies
Oregon Freight Plan

- First statewide freight plan
- Scope of analysis
  - consider range of likely economic conditions and growth rates and how these impact freight movements
  - illustrate variations in activity and commodity flows statewide
  - provide information to support freight strategies
- Well-matched to SWIM2 as configured
Oregon Freight Plan

• Study Committee
  – ODOT modeling staff included
    • served as internal consultants
    • participated in committee discussions
    • performed and interpreted model runs

• External consultants served as support extension of ODoT staff:
  – Parsons Brinckerhoff
  – HBA Specto
Oregon Statewide Integrated Model “SWIM2”

- Integrated representation of
  - Land use
  - Economy
  - Transportation
  - Year-by-year evolution
- Second generation, after SWIM1
- On-going program of model development and application
  - 15 years
  - ODoT staff, peer-review, external consultants
SWIM2

**SPATIAL**

- Employment by Industry
  - Activity Logsums
- Construction Totals
  - Space Prices Occupied Space Demand
- Occupation
  - Labor
  - Mode Choice Logsums
- Travel Time/Costs

**SYNTHETIC POPULATION**

- HH Labor
- Mode Choice Logsums

**ALLOCATION**

- Labor Flows
  - Commodity Flows (internal, import, export)
- OD Trip Tables

**LAND DEVELOPMENT**

- Travel Time/Costs
- Travel Time/Costs

**TRANSPORT**

- Personal
- Commodities
- External
- Aggregate/Equilibrium
- Micro-simulation

**ASSIGNMENT**

- Next Time Period Feedback
SWIM2

Allocation of Economic Interactions

Production - Exchange - Consumption

- Total consumption
- Commodity flows
- Exchange zone
- Buying allocation process
- Selling allocation process
- Total production
SWIM2
Commodities Transport

Hybrid micro-simulation of freight demand with optimized truck tours

Inputs:
- Economic Commodity Flows (long-distance markets)
- Transport Model time and distance skims
- Economic Activity by type in each transport zone

Outputs:
- Trip List and Trip Tables by Truck Type
- Information on non-truck mode commodities, truck tours

Parameters:
- mode choice by commodity and distance
- Transshipment by commodity and distance
- Commodity attributes (VDF, shipment size, % for hire)
- Truck attributes (GVW, capacity, shift duration, dwell time)
Method

• Use scenarios to evaluate possible futures
• Variation in economic growth rates
  Reference: “business-as-usual” (2.0%)
  Optimistic: more economic growth (2.7%)
  Pessimistic: less economic growth (1.2%)
• Variation in real costs for transportation
  High Transportation Costs: Pessimistic economic growth with 3-fold increase in variable operating costs
  Planned Industry: Reference economic growth with greater increases in specific industries
Method

- Run full model system for simulations going out 20 years for each scenario
  - Consider variation in statewide and regional activity and commodity flows
  - Provide information to support development of freight strategies
  - Participate in committee work on Plan
Method

• Schedule originally 3 months
  – Very tight
  – Proposed limited set of scenarios
  – Presented results in stages and get feedback
    • “business-as-usual”
    • “Optimistic” and “Pessimistic”
    • “High Transportation Cost”
    • “Planned Industry” …. not done
  – Some slippage elsewhere
  – Did not delay process
Results

Managing and Presenting Model Outputs

• Large volume of output (80GB/scenario)
• SWIM VIZ:
  – Single multi-year database (3 GB/scenario)
  – Visualization tool
• Database approach successful
  – allowed access to data without keeping the large set of files associated with run
• Simultaneous VIZ tool development, and freight-plan specific graphics and performance metrics
1) Queries
2) Tables
3) Visuals
Commodity Tree Maps
Variation by commodity type...
Variation by industry sector...
Variation by region...
Significant commodity flows continue on Oregon’s highway system.
Stronger economy generates more commodity flow in terms of value.
Weaker economy generates less commodity flow in terms of value.
Congestion Impacts on Truck Tours

Truck tours get shorter because of congestion, and then more trucks are needed to transport freight, more costs and congestion short-run.
Findings

• Statewide:
  – all scenarios:
    • significant growth in commodity movements
    • limited aggregate variability
  – reduced concern about uncertainty about long-term current economic uncertainty

• Optimistic vs Pessimistic differences
  – as expected relative magnitudes
  – less than expected absolutely

• High Transportation Cost
  – more impact on private travel than commercial travel
  – shifting locations
  – trucks experience less congestion
Findings

• Sub-state:
  – By commodity and industry
    • government and high tech stable
    • resource industries more volatile
  – By region
    • Urban areas stable
    • others per industry mix & access to external markets

• Congestion:
  – Truck tours shorter distances
  – Short-term: More trucks short-term
  – Longer-term: some business relocation, but still more trucks net
Conclusions

• Modeling Analysis:
  - results reinforced need to plan for growth even under current uncertain economic conditions
  - variations across commodities and regions, highlights need to consider variability in plans
  - fuel costs have impacts, but not as much as for private vehicles, less congestion
  - both economic forecasts and fuel costs impact congestion
  - commercial VMT response to congestion not like household VMT response – complex, and more congestion can mean more trucks VMT long-term
Conclusions

• Use of SWIM2 model added value to state freight policy
  – Integrated model structure allowed consideration of commodity flows (tons and value) and truck trip/tours by scenario
  – Visualization database and tools provided essential ability to mine volume of output and discern complex responses

• Direct participation of modelers in committee important part of success
Oregon Freight Plan:
http://www.oregon.gov/ODOT/TD/FREIGHT/FREIGHT_PLAN.shtml

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