Application of Mesoscopic Modeling for Port and Urban Industrial Area Planning

October 2015
Presentation Overview

- Background
- Project Goals
- Truck Model
  - Uses
  - Features
  - Outputs
Project Area

Duwamish Manufacturing and Industrial Center

Also known as “South Seattle”
Ultra Large Container Ships

Larger vessels are being planned & built.

- **5,000 TEU Vessels** Began calling PNW 2000
  - Length: 935’
  - Beam: 131’
  - Draft: 43’
  - Containers high on deck: 9
  - Containers below deck: 5

- **8,000 TEU Vessels** Began calling PNW 2009
  - Length: 984’
  - Beam: 141’
  - Draft: 48’
  - Containers high on deck: 9
  - Containers below deck: 6

- **10,000 TEU Vessels** Began calling PNW 2009
  - Length: 1145’
  - Beam: 150’
  - Draft: 49’
  - Containers high on deck: 10
  - Containers below deck: 8

- **15,000 TEU Vessels** Have yet to call
  - Length: 1230’
  - Beam: 184’
  - Draft: 51’
  - Containers high on deck: 10
  - Containers below deck: 8

- **18,000 TEU Vessels** Have yet to call
  - Length: 1312’
  - Beam: 194’
  - Draft: 51’
  - Containers high on deck: 10
  - Containers below deck: 8
North Harbor Improvement Projects

Dock Strengthening & Berth Deepening

T-5 Modernization Project

Power Upgrades

East Waterway
Deepening -51’ to -55’ MLLW

West Waterway
Deepening -51’ to -55’ MLLW

T-18

T-30

T-46

Duwamish River
Seaport Local Operating Environment

- **Terminal 16**
- **Terminal 30**
- **Proposed Arena**
- **BNSF Rail Yard**

**From North Puget Sound**
- Aircraft parts
- Boeing fuselages

**From the Eastside of Seattle**
- Manufactured goods
- Biotech/biomedical
- Machinery
- Wine

**From Eastern WA and Idaho**
- Fruit
- Hay
- Potatoes
- Wine

**Major Truck Routes**
- Major Rail Line
- Rail Yards
- At-Grade Rail Crossing
- Grade-Separated Rail Crossing

**Notable Capital Investments since mid 1990s**
- Port marine terminals: Over $1 billion
- Railroads: Over $55 million
- Roadways:
  - ANV rehabilitation $2.1B
  - SR 518 $1.5B
  - Spokane St Viaduct $1.0B
  - E Marginal Way $54M
  - Duwamish ITS $9M
Truck Model Uses

• Assist with planning and programming efforts by the Seaport Alliance, such as
  • Modifications to terminal operations
  • Local roadway infrastructure projects
  • Land use and development impacts

• Support the Alliance’s needs in partner agencies’ planning and programming efforts
Mesoscopic Model - Dynamic Traffic Assignment

What is it?

- **Network** - Subarea and city-wide including intersection geometrics.
- **Typical Outputs** – Intersection and corridor speeds, hours of congestion, and system delays by mode.
- **Applications** - Comparable analysis of improvement alternatives in a complex environment.
- **Challenges** - Not widely used due to unfamiliarity of tool.
Truck Model Components

- Transportation Network
  - Roadway System
  - Transportation Analysis Zones (TAZs)
- Travel Demand
  - General Purpose Vehicles
  - Non-Port Trucks
  - Port Trucks
Network Features

Roadways
• Major Arterials/Major Truck Streets
• First/Last Mile Connections
• Freeway Ramps
• Heavy Haul Routes

Key Features
• Terminals
• Rail Yards
• At-Grade Railroad Crossings
• Moveable Bridges

Only models the local roadway network. Model ends at ramp meters or ramp terminals to I-5 and I-90.
Network Details

Added Detail to Better Model Truck Bottlenecks

• Channelization
• Signal Timing
• At-Grade Rail Crossings
• Moveable Bridges
• Ramp Meters

*Example Model Network Plot
## Model Network Assumptions

### At-Grade Railroad Crossing Delays

<table>
<thead>
<tr>
<th>Mainline Crossing Location</th>
<th>Existing 2014</th>
<th>Future 2035</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Closures per Hour</td>
<td>Closure Time (Min)</td>
</tr>
<tr>
<td>S Holgate Street</td>
<td>4.5</td>
<td>2.0</td>
</tr>
<tr>
<td>S Lander Street</td>
<td>3.6</td>
<td>2.5</td>
</tr>
<tr>
<td>S Horton St</td>
<td>3.6</td>
<td>2.5</td>
</tr>
<tr>
<td>S Spokane St</td>
<td>3.6</td>
<td>2.5</td>
</tr>
</tbody>
</table>


### Moveable Bridges

No closures were assumed during the 2:00 to 5:00 PM Peak Period
Model Travel Demand

**Data Sources**

- PSRC and WSDOT
- City of Seattle
- Port of Seattle

![Diagram showing the calculation of total travel demand](image)
# Model Travel Demand - 2014 vs. 2035

<table>
<thead>
<tr>
<th>Type of Vehicle</th>
<th>2014</th>
<th>2035</th>
<th>% Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Purpose Vehicles</td>
<td>103,600</td>
<td>97,900</td>
<td>-5.5%</td>
</tr>
<tr>
<td>Non-Port Trucks</td>
<td>7,700</td>
<td>12,200</td>
<td>58.4%</td>
</tr>
<tr>
<td>Port Trucks</td>
<td>2,135</td>
<td>3,520</td>
<td>64.9%</td>
</tr>
<tr>
<td>Total</td>
<td>113,435</td>
<td>113,620</td>
<td>0.1%</td>
</tr>
</tbody>
</table>

Notes: Does not include I-5 or I-90, assumes AWV tolling and freeway congestion pricing consistent with PSRC long-range plan.
Truck Distribution

• Terminal truck trips summarized into 3 destinations types
  – Intermodal Yard
  – Regional Highway
  – Local (Trans-loader Facilities)

• Data Sources
  – Truck Counts
  – Bluetooth Readers
  – Terminal Entry Volumes
  – MacMillan-Piper Truck Data
  – Field Observations
Truck Distribution

- Defined as “where trucks enter and leave the network”
- Used Bluetooth Readers to capture truck origins and destinations from each terminal
- Positioned readers at 17 locations
- Sample rates 5 to 10%

*Bluetooth Readers were used as only one data source in determining trip distribution patterns.*
Model Calibration & Validation

Based on:

• Screenlines Volumes
• Corridor Volumes
• Corridor Travel Times
• Truck Travel Times by Major Destinations
Evaluation Criteria

Performance Measures (Quantitative)

• **Travel Times** – Average PM Peak Period (3-hour) travel time in minutes for vehicles between each Port terminal and intermodal yard or regional destination.

• **Speeds** – Truck PM peak hour (2:00 to 3:00), general purpose PM peak hour (4:00 to 5:00), and average 3-hour PM peak period (2:00 to 5:00) vehicle speeds in miles per hour for specific corridors.

• **Hours of Congestion** – Percentage of time the PM peak period (2:00 to 5:00) vehicle speeds are less than 70% of the posted speed limit.

• **Heat Maps** –
  - The change in vehicle volumes throughout the study area for each major corridor
  - The arterial segment level-of-service for each major corridor
2014 vs 2035
Change in Vehicle Volumes

2014 to 2035 All Vehicles and Trucks Forecast - Existing
- < -1,000 decrease in vehicles
- -1,000 to -500
- -500 to 0
- 0 - 500
- 500 - 1000
- > 1,000 increase in vehicles

Analysis Time Period: 2-5 PM
Note: Only includes network links, excludes centroid connectors
2014 vs 2035
Change in Truck Volumes

2014 to 2035 Truck Volumes Forecast - Existing
- < -150 decrease in trucks
- -150 to -50
- -50 to 0
- 0 to 50
- 50 to 150
- > 150 increase in trucks

Analysis Time Period: 2-5 PM
Note: Only includes network links, excludes centroid connectors
2014 Roadway and Intersection LOS
2014 PM Peak Trip Percentages by Project Locations
2035
PM Peak Trip Percentages by Project Locations
Thank you!

Questions?