Bi-National Transportation Model for the Paso del Norte Region

Infrastructure on the Border Symposium

September 27, 2017
## Extreme Events

**TX Land Ports of Entry** are vital for trade and will continue to be so..

<table>
<thead>
<tr>
<th>Name</th>
<th>Total Trade Value (Truck)</th>
<th>Export Value (Truck)</th>
<th>Import Value (Truck)</th>
<th>% Export Value</th>
<th>% Import Value</th>
<th>% Total Trade Value</th>
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</thead>
<tbody>
<tr>
<td>Laredo, TX</td>
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<td>54</td>
<td>63</td>
<td>17</td>
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<td>19</td>
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<td>7</td>
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<td>Port Huron, MI</td>
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<td>18</td>
<td>10</td>
<td>6</td>
<td>8</td>
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<td>Otay Mesa, CA</td>
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<td>11</td>
<td>22</td>
<td>3</td>
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<td>5</td>
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<td>Champlain Rouses Pt, NY</td>
<td>24</td>
<td>10</td>
<td>12</td>
<td>3</td>
<td>4</td>
<td>4</td>
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<tr>
<td>Hidalgo, TX</td>
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<td>9</td>
<td>15</td>
<td>3</td>
<td>5</td>
<td>3</td>
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<tr>
<td>Santa Teresa, NM</td>
<td>18</td>
<td>7</td>
<td>10</td>
<td>2</td>
<td>3</td>
<td>3</td>
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<tr>
<td>Pembina, ND</td>
<td>17</td>
<td>12</td>
<td>5</td>
<td>4</td>
<td>2</td>
<td>3</td>
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</tbody>
</table>

Complex Problem

Lots of moving pieces
Complex Problem

How do you model something this complex?
Complex Problem

Multi-Resolution Modeling

There is no “one” modeling platform that can answer all the questions
Concept - What is MRM?

- Model integration - taking the strengths of all model resolutions
  - Macro gives blueprint of network and provides O/D
  - Meso provides region-wide estimation of traffic redistribution
  - Micro - local operational analysis (individual car/lane)
Concept - Why is MRM Important?

• Models are not mutually exclusive
• They are complimentary to one another and can accomplish optimal modeling capabilities
• Retain the best characteristics of each model
  – Incorporate multiple trip purposes
  – Realistic representation of regional traffic
  – Detailed interactions
What we did

- Developed a bi-national travel demand model in TransCAD
- Includes both El Paso and Juarez with POEs
- TAZs compatible with El Paso MPO model
- Separate matrices for cars and trucks
What we did

- Converted the travel demand model to simulation-based DTA
- Time-dependent matrices (24 hours)
- Cars and trucks
What we did

• Developed microscopic models of BOTA and Zaragoza POEs
• Higher details in terms of lane assignments, queuing, delays at inspection booths
• Multiple modes of transport
  – Cars
  – Trucks
  – Transit
  – Pedestrians
  – Bicycles
  – Rail
• Realistic driver behavior
• 2D and 3D graphics
What Tool to Use

• How would we model freight movement?
  – Regional analysis
    • Develop mesoscopic model of region
    • Able to paint a broader picture of traffic patterns
    • Simulate impacts of multiple POEs simultaneously
    • Diversions due to congestion
  – Individual POEs will be modeled using microscopic simulation tools
    • Provides output at a localized level
    • Help front line staff make immediate decisions
Freight Regulatory Plan

Objectives of Juarez Freight Regulatory Plan:

- Develop framework to organize and optimally manage freight vehicle flows
  - Safely, efficiently and clean
  - Adequate for current and future infrastructure
- Propose improvements to regulatory framework
  - Update existing regulations
  - Define official freight routes
  - Define clearly the scope and attributions of authorities
Freight Regulatory Plan

1. Analysis of Best Practices
2. Analysis of Local Conditions
3. Continuous Participative Process with Parties Involved
4. Identification of Urban Freight Problems
5. Definition of Urban Freight Strategies

Methodology for Identifying Urban Freight Optimization Strategies
Freight Regulatory Plan

- Understand freight movement in Juarez
- Focused around maquiladoras
- Use data to calibrate model
Freight Regulatory Plan

- Determine truck route options for Mexican truckers
  - Road closures
  - New routes
  - Departure times
  - Shifted some freight trips to rail
Extreme Events

Aging Infrastructure – Underinvestment or Disinvestment in Critical Links Could be Costly...
Extreme Events

Dynamic Traffic Assignment Modeling Framework to Simulate Traffic Effects of Failures...

Simulation Area: LPOE connecting to I-10 interchange.
Extreme Events

• Impacts of BOTA bridge closure
  – “What if’s”
  – Impact at bridges
  – Capture diversion
  – Short vs. Long-term impacts
  – Determine the economic impact of closure
Extreme Events

Capture Diversion

- Vehicles reroute to alternate border crossing
- Bridge closes for extended time

Locations:
- Santa Teresa POE
- BOTA POE
- Zaragoza POE
Extreme Events

Economic Costs of Critical Infrastructure Failure in the El Paso/Juarez Region
Detailed Bridge Analysis

• Determine the commuting cost of passenger vehicles on El Paso/Juarez border
  – Develop microscopic model of the Bridge of the Americas (BOTA)
  – Simulate various number of inspection stations, inspection times

• Port of Entry Emissions Inventory
  – Develop model of Zaragoza
  – Develop linkage between simulation model and MOVES
  – Calculate freight and passenger car emissions over 24 hour period
Commuting Cost

• Quantify the monetary impact of northbound traffic at BOTA
• Base on number of inspection booths open
• Derive the Value of Travel Time savings
• Calculate the commuting cost
### Commuting Cost

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Total Annual Insurance Cost (2012 US$/Year)</th>
<th>Routine Maintenance, Tires, Repair, and Depreciation Costs</th>
<th>Fuel Costs</th>
<th>Texas Vehicle Inspection or Engomado Ecológico Costs</th>
<th>CO\textsubscript{2} Emission Costs (US$/day)</th>
<th>Total Commuting Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>11 Lanes Opened</td>
<td>$5,602,896</td>
<td>$472,868</td>
<td>$14,972,300</td>
<td>$94,086</td>
<td>$182,482</td>
<td>$21,324,632</td>
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<tr>
<td>12 Lanes Opened</td>
<td>$5,955,924</td>
<td>$502,670</td>
<td>$5,941,105</td>
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<tr>
<td>13 Lanes Opened</td>
<td>$5,956,873</td>
<td>$502,742</td>
<td>$2,561,570</td>
<td>$100,030</td>
<td>$30,715</td>
<td>$9,151,930</td>
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<tr>
<td>14 Lanes Opened</td>
<td>$5,958,771</td>
<td>$502,959</td>
<td>$1,930,485</td>
<td>$100,062</td>
<td>$23,488</td>
<td>$8,515,765</td>
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</tbody>
</table>

**Annual Commuting Cost ($/year)**
Port of Entry Emissions Analysis

• Determine emissions impacts from passenger cars and trucks
• Develop a model of the Ysleta-Zaragoza port of entry
• Test various operational scenarios
  – Inspection time/veh
  – Number of booths open
Port of Entry Emissions Analysis

Number of Inspection Booths in Operation – NB Direction
Port of Entry Emissions Analysis

Average Wait Time—Passenger Vehicles
Port of Entry Emissions Analysis

Average Wait Time — Commercial Vehicles

NB Commercial Vehicles Average Travel Times
# Port of Entry Emissions Analysis

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Vehicle Type</th>
<th>Direction</th>
<th>CO (gm)</th>
<th>CO₂ (gm)</th>
<th>NOₓ (gm)</th>
<th>PM₁₀ (gm)</th>
<th>PM₂.₅ (gm)</th>
<th>PMEC (gm)</th>
<th>THC (gm)</th>
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<tbody>
<tr>
<td>Base</td>
<td>Car</td>
<td>Northbound</td>
<td>284,276</td>
<td>10,116,953</td>
<td>27,657</td>
<td>384</td>
<td>340</td>
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<td>x10</td>
<td>Car</td>
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<td>272,959</td>
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<td>330</td>
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<td>Northbound</td>
<td>225,589</td>
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<td>289</td>
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<td>Northbound</td>
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<td>7,572,766</td>
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<tr>
<td>x25</td>
<td>Car</td>
<td>Northbound</td>
<td>210,950</td>
<td>7,316,178</td>
<td>21,557</td>
<td>308</td>
<td>273</td>
<td>40</td>
<td>12,313</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Vehicle Type</th>
<th>Direction</th>
<th>CO (gm)</th>
<th>CO₂ (gm)</th>
<th>NOₓ (gm)</th>
<th>PM₁₀ (gm)</th>
<th>PM₂.₅ (gm)</th>
<th>PMEC (gm)</th>
<th>THC (gm)</th>
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<td>11,564</td>
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<td>Truck</td>
<td>Northbound</td>
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<td>25,382,394</td>
<td>261,517</td>
<td>12,672</td>
<td>11,658</td>
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<td>22,346</td>
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<tr>
<td>x15</td>
<td>Truck</td>
<td>Northbound</td>
<td>111,955</td>
<td>25,447,076</td>
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<tr>
<td>x25</td>
<td>Truck</td>
<td>Northbound</td>
<td>109,987</td>
<td>24,991,579</td>
<td>257,534</td>
<td>12,486</td>
<td>11,487</td>
<td>5,325</td>
<td>22,012</td>
</tr>
</tbody>
</table>

**Reduction in Inspection Time/Vehicle**
## Port of Entry Emissions Analysis

### Cars

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Vehicle Type</th>
<th>Direction</th>
<th>CO (gm)</th>
<th>CO₂ (gm)</th>
<th>NOₓ (gm)</th>
<th>PM₁₀ (gm)</th>
<th>PM₂.₅ (gm)</th>
<th>PMEC (gm)</th>
<th>THC (gm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base</td>
<td>Passenger</td>
<td>Northbound</td>
<td>210,950</td>
<td>7,316,178</td>
<td>21,557</td>
<td>308</td>
<td>273</td>
<td>40</td>
<td>12,313</td>
</tr>
<tr>
<td>25% Reduction in Capacity</td>
<td>Passenger</td>
<td>Northbound</td>
<td>238,631</td>
<td>8,393,126</td>
<td>23,740</td>
<td>331</td>
<td>293</td>
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<td>14,206</td>
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<tr>
<td>50% Reduction in Capacity</td>
<td>Passenger</td>
<td>Northbound</td>
<td>267,057</td>
<td>9,494,845</td>
<td>26,008</td>
<td>358</td>
<td>317</td>
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<td>16,131</td>
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<tr>
<td>75% Reduction in Capacity</td>
<td>Passenger</td>
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<td>270,667</td>
<td>9,638,504</td>
<td>26,263</td>
<td>363</td>
<td>321</td>
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### Trucks

<table>
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<tr>
<th>Scenario</th>
<th>Vehicle Type</th>
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<th>CO₂ (gm)</th>
<th>NOₓ (gm)</th>
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<td>Northbound</td>
<td>109,987</td>
<td>24,991,579</td>
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<td>11,487</td>
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<tr>
<td>25% Reduction in Capacity</td>
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<td>107,267</td>
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<td>11,197</td>
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<td>75% Reduction in Capacity</td>
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<td>252,978</td>
<td>12,237</td>
<td>11,258</td>
<td>5,190</td>
<td>21,632</td>
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</tbody>
</table>

Number of Inspection Booths Open and 25 Percent Reduction in Wait Time
Bridge of the Americas
Thank You!!