Integrating Statewide and Metropolitan Planning Organization (MPO) Models
I-40/I-81 Corridor Feasibility Study

presented to
TRB Conference on Best Practices in Statewide Planning

presented by
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Cambridge Systematics, Inc.

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Transportation leadership you can trust.
Presentation Overview

- I-40/I-81 Study Background
- Model Refinements and Adjustments
- Deficiency Analysis
- Testing of Alternatives
- Opportunities for Streamlining Approach
- Questions/Comments
I-40/I-81 Study Background

- **Strategic Investment Plan Corridor**
  - I-40, Mississippi River (Memphis) to I-81
  - I-81, I-40 to Virginia State Line (Bristol)

- **Funded and managed by Tennessee DOT (TDOT)**

- **Cambridge Systematics – subconsultant to PB**
  - Travel Demand Forecasting
  - Freight Modeling and Planning
  - ITS Planning
I-40/I-81 Study Background (continued)

- **Study purpose**
  - Identify and address I-40/I-81 deficiencies
  - Consider effectiveness of truck/rail diversion
  - Consider multimodal solutions – HOV/HOT/truck only lanes, increased use of rail, and public transit
  - Identify, evaluate, and prioritize solutions
    - Congestion and capacity
    - Operations and maintenance
    - Safety and security
    - Freight movement and diversion
    - Economic access
    - Commuter patterns
    - Intermodal facilities (freight and/or passenger)
Model Refinements and Adjustments

- Models that include I-40/I-81 corridor
  - Statewide models
    - Passenger
    - Freight
  - Metropolitan Planning Organization (MPO) models
    - Memphis
    - Jackson
    - Nashville
    - Knoxville
    - Morristown
    - Kingsport
    - Bristol
Model Refinements and Adjustments (continued)

- Available model files – (May 2007)
  - Statewide – 2003 and 2030
  - Bristol – 2005 and 2030
  - Jackson – 1999, 2020, and 2035
  - Kingsport – 2004, 2015, and 2030
  - Memphis – 2004, 2017, and 2030
  - Morristown – 2004 and 2030
  - Nashville – 2006 and 2030
Model Refinements and Adjustments (continued)

- **Base-year models**
  - Corrected network coding, where necessary
  - I-40 and I-55 external zones – West Memphis area
    - Originally two separate zones
    - Combined to allow diversion
    - Also connected future bridge crossing here
Model Refinements and Adjustments (continued)

Year 2030 models
- Verified E+C/No Build networks along study corridor
- Adjusted external trips in MPO models to match SWM forecasts
- Work with smaller models discontinued
  - Jackson – new model under development; external trips from SWM
  - Morristown – does not currently operate in batch mode
- Interpolated SE data, external trips, ODME trip tables
  - 2011 and 2016 interpolated and adjusted per SWM at external zones
  - Available 2017 data sets used in place of 2016 for Memphis
### Model Refinements and Adjustments (continued)

#### External Model Adjustments

<table>
<thead>
<tr>
<th>#</th>
<th>Location</th>
<th>Year 2011</th>
<th>Year 2016</th>
<th>Year 2030</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Total Volume</td>
<td>SWM-MPO</td>
<td>Total Volume</td>
</tr>
<tr>
<td>1</td>
<td>SWM (Arkansas State Line)</td>
<td>60,875</td>
<td>63,064</td>
<td>71,465</td>
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<tr>
<td>2</td>
<td>Memphis MPO Model St Line</td>
<td>65,017</td>
<td>-4,142</td>
<td>73,738</td>
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<tr>
<td>3</td>
<td>Memphis MPO Model East</td>
<td>37,837</td>
<td>44,023</td>
<td>64,246</td>
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<tr>
<td>4</td>
<td>SWM (Memphis East)</td>
<td>37,547</td>
<td>-290</td>
<td>39,418</td>
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<tr>
<td>5</td>
<td>SWM (Jackson West)</td>
<td>n/a</td>
<td>39,418</td>
<td>58,148</td>
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<tr>
<td>6</td>
<td>Jackson West</td>
<td>n/a</td>
<td>n/a</td>
<td>53,240</td>
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<td>7</td>
<td>Jackson East</td>
<td>n/a</td>
<td>n/a</td>
<td>49,186</td>
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<tr>
<td>8</td>
<td>SWM (Jackson East)</td>
<td>33,007</td>
<td>34,927</td>
<td>42,673</td>
</tr>
<tr>
<td>9</td>
<td>SWM (Nashville West)</td>
<td>40,926</td>
<td>43,855</td>
<td>56,253</td>
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<tr>
<td>10</td>
<td>Nashville West</td>
<td>40,814</td>
<td>44,800</td>
<td>55,963</td>
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<tr>
<td>11</td>
<td>Nashville East</td>
<td>52,185</td>
<td>58,072</td>
<td>74,558</td>
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<tr>
<td>12</td>
<td>SWM (Nashville East)</td>
<td>49,897</td>
<td>57,101</td>
<td>75,064</td>
</tr>
<tr>
<td>13</td>
<td>SWM (Knoxville West)</td>
<td>45,229</td>
<td>48,089</td>
<td>56,698</td>
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<tr>
<td>14</td>
<td>Knoxville West</td>
<td>44,709</td>
<td>47,813</td>
<td>62,306</td>
</tr>
<tr>
<td>15</td>
<td>Knoxville I-40 East</td>
<td>36,327</td>
<td>42,645</td>
<td>51,003</td>
</tr>
<tr>
<td>16</td>
<td>SWM (I-40 East)</td>
<td>36,327</td>
<td>40,091</td>
<td>51,015</td>
</tr>
<tr>
<td>17</td>
<td>Knoxville I-91 North</td>
<td>51,744</td>
<td>58,422</td>
<td>79,159</td>
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<tr>
<td>18</td>
<td>SWM (Knoxville I-81 North)</td>
<td>51,956</td>
<td>58,203</td>
<td>77,279</td>
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<tr>
<td>19</td>
<td>SWM (Morristown South)</td>
<td>55,032</td>
<td>60,007</td>
<td>78,812</td>
</tr>
<tr>
<td>20</td>
<td>Morristown South</td>
<td>n/a</td>
<td>n/a</td>
<td>65,118</td>
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<tr>
<td>21</td>
<td>Morristown North</td>
<td>n/a</td>
<td>n/a</td>
<td>55,195</td>
</tr>
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<td>22</td>
<td>SWM (Morristown North)</td>
<td>37,363</td>
<td>47,938</td>
<td>58,990</td>
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<tr>
<td>23</td>
<td>SWM (Kingsport South)</td>
<td>31,519</td>
<td>33,558</td>
<td>39,869</td>
</tr>
<tr>
<td>24</td>
<td>Kingsport South</td>
<td>34,542</td>
<td>39,266</td>
<td>39,032</td>
</tr>
<tr>
<td>25</td>
<td>Kingsport North</td>
<td>35,672</td>
<td>40,045</td>
<td>54,570</td>
</tr>
<tr>
<td>26</td>
<td>SWM (Kingsport North)</td>
<td>52,577</td>
<td>55,817</td>
<td>65,002</td>
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<tr>
<td>27</td>
<td>Bristol North Model Boundary</td>
<td>47,574</td>
<td>50,668</td>
<td>59,344</td>
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<tr>
<td>28</td>
<td>SWM (Bristol North Boundary)</td>
<td>50,960</td>
<td>53,390</td>
<td>60,049</td>
</tr>
</tbody>
</table>
Deficiency Analysis

- GIS mosaic prepared
  - Statewide model links outside MPO model areas
  - MPO model networks depicted where available

- GIS mosaic of corridor deficiencies
  - LOS depicted based on model used in given area
Deficiency Analysis (continued)

- GIS mosaic of corridor deficiencies (continued)
  - Several deficiency approaches initially used
    - Model volume/capacity (v/c) ratios – LOS cutoffs per EVE
    - LOS Calculator – used FDOT LOS Handbook lookup table
    - Compared against TDOT Statewide Plan LOS deficiencies
  - Refinements
    - Settled on approach using model/EVE v/c ratios for LOS
    - Added deficiencies where mountainous terrain documented

Note: SWM used for truck forecasts except in Memphis.
Deficiency Analysis (continued)
Deficiency Analysis (continued)
Deficiency Analysis (continued)
Truck/Rail Diversion Analysis

<table>
<thead>
<tr>
<th>Route</th>
<th>General Location</th>
<th>Truck Volumes</th>
<th>Growth</th>
</tr>
</thead>
<tbody>
<tr>
<td>I-40</td>
<td>Memphis-Jackson</td>
<td>10,600</td>
<td>22,600</td>
</tr>
<tr>
<td>I-40</td>
<td>Jackson-Nashville</td>
<td>10,500</td>
<td>22,900</td>
</tr>
<tr>
<td>I-40</td>
<td>East of Nashville</td>
<td>11,100</td>
<td>25,800</td>
</tr>
<tr>
<td>I-40</td>
<td>West of Cookeville</td>
<td>10,600</td>
<td>24,300</td>
</tr>
<tr>
<td>I-40/I-75</td>
<td>West of Knoxville</td>
<td>18,400</td>
<td>41,200</td>
</tr>
<tr>
<td>I-40</td>
<td>West of I-81/ I-40</td>
<td>12,900</td>
<td>29,400</td>
</tr>
<tr>
<td>I-81</td>
<td>East of I-40/ I-81</td>
<td>8,300</td>
<td>19,100</td>
</tr>
<tr>
<td>I-81</td>
<td>At Virginia State Line</td>
<td>7,500</td>
<td>19,000</td>
</tr>
</tbody>
</table>
## Deficiency Analysis (continued)
### Truck/Rail Diversion Analysis (continued)

<table>
<thead>
<tr>
<th>Route</th>
<th>General Location</th>
<th>Truck Percent</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>I-40</td>
<td>Memphis-Jackson</td>
<td>19.9</td>
<td>44.1</td>
<td>37.5</td>
</tr>
<tr>
<td>I-40</td>
<td>Jackson-Nashville</td>
<td>26.9</td>
<td>53.2</td>
<td>44.4</td>
</tr>
<tr>
<td>I-40</td>
<td>East of Nashville</td>
<td>25.4</td>
<td>42.8</td>
<td>35.6</td>
</tr>
<tr>
<td>I-40</td>
<td>West of Cookeville</td>
<td>28.7</td>
<td>43.3</td>
<td>36.9</td>
</tr>
<tr>
<td>I-40/I-75</td>
<td>West of Knoxville</td>
<td>18.4</td>
<td>30.0</td>
<td>25.0</td>
</tr>
<tr>
<td>I-40</td>
<td>West of I-81/ I-40</td>
<td>24.6</td>
<td>30.8</td>
<td>28.1</td>
</tr>
<tr>
<td>I-81</td>
<td>East of I-40/ I-81</td>
<td>24.3</td>
<td>35.5</td>
<td>32.2</td>
</tr>
<tr>
<td>I-81</td>
<td>At Virginia State Line</td>
<td>17.0</td>
<td>29.4</td>
<td>22.5</td>
</tr>
</tbody>
</table>

(1) Weighted Average Truck Percent based on corridor length.
Deficiency Analysis
Truck/Rail Diversion Analysis (continued)
Testing of Alternatives

- Four initial 2030 alternatives
  - Roadway capacity – generally adding 2-4 lanes to I-40/I-81
  - Corridor capacity – add capacity to parallel corridors
  - Operational solutions – ITS and operations strategies
  - Rail-focused – new rail alignments/maximize truck diversion
Testing of Alternatives (continued)

- **Modeling alternatives**
  - Limited to Knoxville, Memphis, Nashville, and statewide models
  - Limited to roadway capacity and corridor capacity alternatives
  - Coded lane additions for *roadway capacity* alternative
    - Additional HOV lanes in Memphis model
    - Express lanes in Knoxville and Nashville (No HOV capability in models)
    - General purpose lanes elsewhere
  - Coded new *corridor capacity* (lane additions on parallel routes)
    - Memphis > new I-40 bridge (2 options – SR 300, SR 385)
    - Nashville > add lanes to SR 840 and extend east past Lebanon
    - Knoxville > add SR-475 connector
    - Elsewhere > add lanes to parallel U.S. highways
## Testing of Alternatives (continued)
### Measures of Effectiveness

<table>
<thead>
<tr>
<th>Evaluation Criteria</th>
<th>2011 Existing + Committed</th>
<th>2030 Existing + Committed</th>
<th>2030 Roadway Scenario</th>
<th>2030 Corridor Scenario</th>
<th>2030 Rail Scenario</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Hours of Auto Travel</td>
<td>412,470</td>
<td>613,653</td>
<td>574,882</td>
<td>562,833</td>
<td>613,653</td>
</tr>
<tr>
<td>Number of Hours of Recurring Auto Delay</td>
<td>149,281</td>
<td>307,783</td>
<td>95,232</td>
<td>272,948</td>
<td>277,526</td>
</tr>
<tr>
<td>Total Auto VMT</td>
<td>25,512,997</td>
<td>30,714,634</td>
<td>34,271,150</td>
<td>29,948,652</td>
<td>30,714,634</td>
</tr>
<tr>
<td>Number of Hours of Truck Travel</td>
<td>149,731</td>
<td>275,201</td>
<td>250,055</td>
<td>252,373</td>
<td>268,531</td>
</tr>
<tr>
<td>Number of Hours of Recurring Truck Delay</td>
<td>56,757</td>
<td>153,050</td>
<td>105,265</td>
<td>135,213</td>
<td>138,003</td>
</tr>
<tr>
<td>Total Truck VMT</td>
<td>9,170,315</td>
<td>14,396,805</td>
<td>14,537,649</td>
<td>13,673,388</td>
<td>13,227,005</td>
</tr>
<tr>
<td>Time to Travel Across Entire Corridor</td>
<td>634</td>
<td>753</td>
<td>649</td>
<td>729</td>
<td>735</td>
</tr>
<tr>
<td>Average Delay Time to Travel Across Entire Corridor</td>
<td>66</td>
<td>189</td>
<td>86</td>
<td>169</td>
<td>172</td>
</tr>
<tr>
<td>Total Number of Accidents</td>
<td>7,700</td>
<td>9,114</td>
<td>8,733</td>
<td>8,560</td>
<td>8,844</td>
</tr>
<tr>
<td>Total Number of Fatalities</td>
<td>77</td>
<td>94</td>
<td>90</td>
<td>87</td>
<td>91</td>
</tr>
<tr>
<td>Total Accidents at High Crash Locations</td>
<td>2,779</td>
<td>3,248</td>
<td>1,321</td>
<td>n/a</td>
<td>n/a</td>
</tr>
</tbody>
</table>

Integrating Statewide and MPO Models – I-40/I-81, Tennessee
Opportunities for Streamlining Approach

**Model standardization considerations**
- Standard model interface
- Consistent input/output file/attribute names/definitions
- Potential model types – nested logit, highway only, etc.
- Consistent TransCAD version/backwards compatibility
- Default model parameters (e.g., auto occupancy rates, etc.)
- Modes/purposes for generation/distribution/assignment
- Time-of-day periods/methodologies

**Regionalism**
- Consider single regional model for Tri-Cities
- Consider adding Morristown to Knoxville or Tri-Cities
Opportunities for Streamlining Approach

• Standardize network coding methodology
  • Visualization standards (colors, layers, etc.)
  • Consistent double-line coding of limited access highways
  • Standard attribute codes/names (area type, facility type, etc.)
  • Speeds and capacities
  • Approach for coding HOV lanes
  • Coding toll plazas
  • Penalties and prohibitors
  • Transit routes
  • Transit access
Q & A

Integrating Statewide and MPO Models – I-40/I-81, Tennessee

Memphis

Outer Nashville

Central Nashville

Jackson

Knoxville

Tri-Cities

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