An Integrated Modeling Approach for 95 Express Phase 3

presented by
Srin Varanasi, The Corradino Group
Andrew Velasquez, URS Corporation

March 26, 2014

Agenda

• Overview of Traffic Forecasting and Analysis Process

• SERPM Corridor Demand Estimation
  – Toll Choice Model Customization
  – Post-Processing Methods
  – Project Model Validation

• VISSIM Model Integration
  – Model Development and Calibration
  – Managed Lane Module Customization
Simulation Methods

- **Macroscopic (SERPM)**
  - Simulation of flow, speed, and density made on a segment-by-segment basis
  - Enhanced toll choice model for route assignment

- **Microscopic (VISSIM)**
  - Simulates detailed movement of individual vehicles throughout the network
  - VISSIM offers dynamic lane choice model (DTA)

Traffic and Revenue Approach

1. **Land Use Review**
2. **Origin-Destination Study**
3. **Stated Preference Survey**
4. **Travel Demand Model**
   - **SERPM**
5. **VISSIM Micro-Simulation**
6. **Probability Model**
7. **Time of Day Model**
8. **Toll Revenue Model**
9. **Step 1**
10. **Step 2**
11. **Step 3**
12. **Step 4**
Traffic Analysis Process

- Revenue Corridor Traffic Forecast
  - Link Volumes
  - O-D Tables
  (URS)

- Design Corridor Traffic Forecast
  - Link Volumes
  - O-D Tables
  (Corradino)

  Unified VISSIM Model

  Corridor Value of Time
  Pricing Policy

  Traffic & Revenue Analysis

  Traffic & Revenue Report
  (URS/Turnpike)

  Corridor Traffic Operations Analysis

  Corridor Traffic Analysis Report and/or
  I-595 PD&E Reevaluation
  (RS&H/HDR)

I-95 Express Phase 3 Forecasting Case Study

Updated: 8/19/13

Southeast Florida
Outline of Demand Forecasting

- Design Traffic Forecasting Needs
- Traditional Approach
- Manual Post-Processing Issues
- Journey to an Alternate Approach
- I-95 Express Phase 3 Forecasting Case-Study

Design Traffic Forecasting Needs

- AADT
- DDHV
- Traffic Factors, K and D

DDHV = AADT * K * D
Traditional Approach

• Select a Travel Demand Model
• Perform Subarea Validation
• Develop Forecasts
• Apply Traffic Factors
• Ad hoc, NCHRP 255-style Post-Processing
• Develop Design Traffic

Traditional Approach Issues

• Manual Errors in Large-Scale projects
• Forecasting Consistency Issues
• Heavy Relying on Traffic Factors- K, D
• Issues with Managed Lanes Modeling Projects
  – Daily-to-Peak Correspondence is Different (K)
Journey to an Alternate Approach

- Use of Peak-Period Model Estimates
- Use of Diurnal Factors (Peak Period-to-Peak Hour)
- Use of CUBE Analyst Matrix Estimation Process
- Increased Confidence in Turning Movement Forecasts

Analysis Years and Alternatives

- 2010/11 – Base and Validation Year
- 2040 – Design Year
  - No-Build
  - Build Phase 3
- 2020 – Opening Year
  - Build with Phase 3A
Corridor Subarea Extraction

Overview of Subarea Forecasting

- SERPM6.5 Regional Model (3 Counties)
- Toll Choice Model Enhancement for I-95 “Big Subarea”
- Tight Subarea Validation for Corridor Demand
- Tight Subarea2 extraction for VISSIM integration
Methodology

2010 Subarea OD Matrix ➔ CUBE Analyst Matrix Estimation ➔ 2010 Adjusted OD Matrix

2010 TOD Counts ➔ 2040 Model Subarea OD Matrix ➔ 2010 Model Subarea OD Matrix

Growth ➔ 2040 Adjusted OD Matrix ➔ 2010 Adjusted OD Matrix ➔ Growth

2010 CUBE Analyst Matrix Estimation

- 2010/11 TOD Traffic Counts-As screenlines
- 2010/11 Prior Tsub Model OD Matrix
- Review Link-Level and Turning Movement-Level Assignment
- Review Trip Lengths Before and After
- Several Iterations of Validation
2040 Forecasts Development

- Main goals
  - Develop O-D matrices for AM and PM
  - Develop DDHV Volumes for Operational Analyses
  - Integrate Forecasts with Micro-Simulation
- Inputs
  - Model Subarea 2040 O-D Matrix (2040 Raw O-D)
  - Model Subarea 2010 O-D Matrix (2010 Raw O-D)
  - Growth = (2040 Raw O-D) – (2010 Raw O-D)
- Target
  - Adjusted 2040 O-D Matrix: 2010 “Validated” O-D + Growth

QC Process

- Independent Peer Review
- Reasonableness Checks
  - Historical Trends and Growth Rates
  - Past Studies and Relevant Corridor Experience
  - Inconsistencies
Summary and Lessons Learned

- Demand Matrices Extraction for Micro-Simulation
- Streamlined Forecasting Approach to Minimize Manual Post-Processing
- Savings in Time and Resources
- Consistency in Forecasts among Alternatives
- Ability to Test Several Alternatives and Develop Design Traffic Forecasts

I-95 VISSIM Model Features

- **Network**
  - 33 Miles of Mainline
  - 24 Existing Interchanges
  - 45 Signalized Intersections

- **Simulation Periods**
  - AM and PM – 4.5 Hours Each
  - Existing - 2011
  - Future - 2020 and 2040

- **Vehicle Classes**
  - Existing – SOV, HOV, Trucks
  - Future – Pay, Exempt, Trucks
    - Exemptions – HOV 3+, Hybrids, Buses, Motorcycles, Non-Revenue
Model Development

- Roadway Geometry
- Traffic Signal Timings
- Balanced Volumes

VISSIM Network Data
- Inputs – Entry Flow
- Routing – OD Matrix
- Vehicle Composition

AM and PM VISSIM Models

I-95 VISSIM Calibration Challenges

- Freeway and arterial congestion
- Extended periods of oversaturation
- Closely spaced interchanges
- Model sensitivity
I-95 VISSIM Model Calibration

Volume Comparison

<table>
<thead>
<tr>
<th>GEH Summary</th>
<th>Northbound</th>
<th>Southbound</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>AM Peak Period</td>
<td>PM Peak Period</td>
</tr>
<tr>
<td>Mainline</td>
<td>2.6</td>
<td>1.6</td>
</tr>
<tr>
<td>Off-ramps</td>
<td>1.0</td>
<td>0.7</td>
</tr>
<tr>
<td>On-ramps</td>
<td>0.5</td>
<td>0.6</td>
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Travel Time Comparison

<table>
<thead>
<tr>
<th>Overall Travel Time</th>
<th>AM Peak Period</th>
<th>PM Peak Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northbound I-95</td>
<td>- 4%</td>
<td>- 2%</td>
</tr>
<tr>
<td>Southbound I-95</td>
<td>0 %</td>
<td>- 4%</td>
</tr>
</tbody>
</table>

VISSIM Managed Lane Components

- Managed Lane Facility Definition
  - General Use Lanes: no toll, no restrictions
  - Managed Lanes: toll and/or occupancy restrictions

- Pricing model
  - Typically depends on dynamic traffic conditions
  - Traffic Responsive
  - COM Script

- Decision model
  - Discrete choice model
  - Utility of the toll computed from travel time savings and current price
  - Logit decision function: 50% on toll lane if utility = 0
  - Unique user classes react differently to same toll
Express Lane Routes

- Route for each ingress and egress pair
- Consists of an express lane route and a general purpose route
- Referenced to an Express Lane Facility
  - Pricing model
  - Decision model
- Choice is made at point of entry

Pricing Model

- COM Script
  - External scripting via VBA
  - VISSIM object links and evaluation metrics accessible
  - User defines pricing logic (speed, volume, density)

<table>
<thead>
<tr>
<th>Level of Service</th>
<th>Traffic Density</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Min</td>
<td>Max</td>
</tr>
<tr>
<td>A</td>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td>B</td>
<td>10</td>
<td>50</td>
</tr>
<tr>
<td>C</td>
<td>20</td>
<td>50</td>
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<tr>
<td>D</td>
<td>30</td>
<td>60</td>
</tr>
<tr>
<td>E</td>
<td>40</td>
<td>100</td>
</tr>
<tr>
<td>F</td>
<td>50</td>
<td>100</td>
</tr>
</tbody>
</table>

\[ \text{Rate} = \frac{\text{Speed}}{\text{Volume} \times \text{Density}} \]
95 Express Pricing Algorithm

- Table lookup based on vehicle density in the express lanes
- Sample Toll Calculation
  - Toll \( (T_{t-1}) = 4.00 \),
  - \( TD_{t-1} = 27 \), \( TD_{t} = 29 \)
  - \( \Delta TD \) of +2 Yields \( \Delta R \) of +$0.50
  - \( R_{t} = R_{t-1} + \Delta R = 4.00 + 0.50 \)
  - \( = 4.50 \)
  - Check Range in LOS Table

<table>
<thead>
<tr>
<th>Delta Table</th>
</tr>
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<tr>
<td>Traffic Density</td>
</tr>
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<td>27</td>
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<td>29</td>
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</tr>
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<td>31</td>
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<td>32</td>
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95 Express Phase 1 Test Model

- Manual vs COM Script Toll Calculation
- \( R^{2} = 0.9437 \)
95 Express Phase 3 Toll Escalation Policy

- Revenue Maximizing
- Traffic Optimization
- 95 Exp. Phase 1 (Step Min)
- 95 Exp. Phase 1 (Step Max)

Volume/Capacity

Lane Decision Model

\[ P_{\text{Managed}} = 1 - \frac{e^{\alpha + \beta \text{Toll}}}{e^{\alpha + \beta \text{Managed}}} = 1 - \frac{1}{1 + e^{\alpha + \beta \text{Toll}}} \]

- Alpha value
- Time coefficient
- Cost coefficient
- Toll Constant (Intercept)
- Decision model is needed for both Traffic Responsive and COM script toll models

Probability Contours for Default Coefficients

Toll Rate Per Mile

Traffic Saving/Week
### BUILD VISSIM SAMPLE OUTPUT

#### Northbound (5:30 pm – 6:30 pm)

<table>
<thead>
<tr>
<th>#</th>
<th>Description</th>
<th>GUL</th>
<th>ML</th>
<th>ML Share</th>
<th>Toll</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Griffin Road to I-595</td>
<td>7,422</td>
<td>2,113</td>
<td>22%</td>
<td>$0.40</td>
</tr>
</tbody>
</table>

#### Southbound (5:30 pm – 6:30 pm)

<table>
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<tr>
<th>#</th>
<th>Description</th>
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<th>ML</th>
<th>ML Share</th>
<th>Toll</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Griffin Road to I-595</td>
<td>5,732</td>
<td>2,522</td>
<td>31%</td>
<td>$0.41</td>
</tr>
</tbody>
</table>
Summary

• Coordination with T&R effort can add value
• Understand that pricing policy can affect operations
• VISSIM managed lane function achieves interim goal for dynamic assignment
• DUE or constrained demand methods could be beneficial

Questions & Answers