A Case Study of Utilizing Data in DTA Modeling

presented to
MTF

presented by
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Why DTA

• Traffic dynamics and thus alternative path performance can be better evaluated
• Policy sensitive traveler behavior can be assessed based on experienced travel time for each period
• Trouble spots in network can be identified
• Impacts of events/incidents and advanced strategies (e.g., ML, ICM, ATDM, TSM&O, IM, other ITS)
Static Ability to Model Congestion

Real-World

Static Default Capacity

Static Modified Capacity

DTA Calibrated

Static vs. real world Delta TT

Real World
Highway 1
Highway 2
Willingness to Pay (Source Phase 1 Report)

Toll Model: Willingness to Pay

Percent Willing to Pay To

Cost/Minute Saved To Use Toll Facility (dollars/hr)

DTA Modeling Process

- Defining analysis scope
- Data collection and processing
- Network coding
- Supply calibration
- Demand calibration
- Iterate between demand and supply calibration
- Test the assignment results and convergence
- Conduct alternative analysis
Example of Network Refinement

Connections between 2 ramps are deleted, short links are removed, nodes are moved as needed, links updated based on true shape, zone connections updated, number of lanes checked, etc.

Data Collection

- Subarea network and associated initial O-D matrices from demand model
- Network geometry and signal control
- Count data (PTMS, TTMS, ITS, previous studies)
- Travel time (ITS data, INRIX data, previous studies)
- Any other estimates of O-D matrices (previous studies, AirSage, etc.)
- Willingness to pay surveys/VOT/VOR
- Pricing (Toll) curves
- Truck percentages from PTMS and TTMS
- Associate with network
**Data Processing**

- Compare ITS detector, PTMS, and manual counts
- Eliminate redundant detectors
- Upstream-downstream data consistency checking
- Filter weekends, special events, incident days
- Cluster days into patterns
- Signal timing/geometry checking

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**I-95 Detector Stations**

<table>
<thead>
<tr>
<th>Detector Station</th>
<th>No. of Stations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Available</td>
</tr>
<tr>
<td>ITS</td>
<td></td>
</tr>
<tr>
<td>General-Purpose Lane</td>
<td>109</td>
</tr>
<tr>
<td>Express Lane</td>
<td>78</td>
</tr>
<tr>
<td>31</td>
<td>31</td>
</tr>
<tr>
<td>PTMS</td>
<td>150</td>
</tr>
<tr>
<td>Mainline</td>
<td>10</td>
</tr>
<tr>
<td>Ramps</td>
<td>99</td>
</tr>
<tr>
<td>Arterial</td>
<td>41</td>
</tr>
<tr>
<td>TTMS</td>
<td>1</td>
</tr>
</tbody>
</table>
Data Consistency Checking

Calibration Process

• Process for calibrating DTA-based models
  – Sequential, iterative, or simultaneous supply and demand calibration
• Iterative calibration is utilized in our effort
Bottleneck Identification

Stations 600561, 600711, and 600921 were recognized as potential bottlenecks.

Bottleneck Cause Identification
Day-to-Day Variation

Free Flow Speed (I-95 in Miami)

- HCM 2000: \( FFS = BFFS - f_{LW} - f_{LC} - f_N - f_{1D} \)
  - (Results in FFS of \( 59.1 \) mph for 11 ft lane width and ramp density of 1.2)

- HCM 2010: \( FFS = 75.4 - f_{LW} - f_{LC} - 3.22TRD^{0.84} \)
  - (Results in FFS of \( 66.9 \) mph for 11 ft lane width and ramp density of 1.2)

* Posted speed for I95 is 55mph over all analyzed segments.
Capacity Estimation

- HCM and SERPM coding overestimates capacity and free flow speed based on real-world results (I-95 in Miami)
- When calculating queue discharge rate, time intervals that contain spillback from downstream bottlenecks was removed
- Queue discharge is lower than pre-breakdown flow (7-8% in this case)
- The effect of modeling capacity drop due to breakdown being investigated
- Capacity coded in SERPM is 2,142 vphpl
- Capacity estimated based on data about 1,850 vphpl before breakdown and 1,750 vphpl after breakdown

<table>
<thead>
<tr>
<th>Different methods</th>
<th>Value</th>
<th>Reference</th>
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</thead>
<tbody>
<tr>
<td>HCM (2% truck, f_c=0.98)</td>
<td>2250</td>
<td>HCM 200 exhibit (16-5)</td>
</tr>
<tr>
<td>HCM (2% truck, f_c=0.85)</td>
<td>1935</td>
<td>HCM 200 exhibit (16-5)</td>
</tr>
<tr>
<td>HCM (5% truck, f_c=0.85)</td>
<td>2200</td>
<td>HCM 200 exhibit (16-5)</td>
</tr>
<tr>
<td>HCM (5% truck, f_c=0.85)</td>
<td>1905</td>
<td>HCM 200 exhibit (16-5)</td>
</tr>
</tbody>
</table>

Effect of Capacity Estimates
Queuing Density

- Queuing density in Avenue is not the same as jam density used in other models.
- Values recommended in Avenue produces unacceptable results (lower speeds and shorter queues).
- The default value is 295 veh/mile/lane. The value calculated based on real-world volume and speed is 100-120 veh/mile/lane.

Effect of Queuing Density Estimate

**Default**

**Modified**
Traffic Flow Model

In Cube Avenue, TFM mostly affected traffic in queue free conditions – Not the case in other tools

Supply Calibration MOP

- Utilize measures of proximity of observed vs. simulated screen line volumes and link speeds
- Visualize using Speed temporal-spatial contours

Average over days

Median day
DTA Demand Calibration

• Test different O-D estimation sequence and parameters
• Estimated O-D should also be consistent with the seed O-D matrix values (generation/attraction rates, trip length distributions, split proportions)
• Our experience to date shows that dynamic Cube Analyst does not produce better results than static Cube Analyst with queue addition

DTA Demand Calibration

• Identified potential improvements to Analysts
• Trip matrix segmentation and VOT variation/randomization based on SHRP 2 and NCHRP research
Support Tools

- SunGuide data (TSS, TVT data, incident, DMS, etc.)
- Central data warehouse
- Weather data
- Managed lane dynamic congestion pricing rates
- Work zones data
- Statistics office data
- Crash data/CAR System
- 511 data
- INRIX data
- Bus AVL
- AVI data

Reliability of GP vs. ML

![Graph showing reliability comparison between GP and ML]

28
L38C Project Tested Products

• L05 guidance to support the use of SHRP 2 products in various business processes of the FDOT
• L02 for assessing reliability performance based on system monitoring
  – Based on point detector and INRIX data
• L08 HCM methodologies for freeways and arterials to assess improvement alternatives
• L07 spreadsheet to assess highway design features to reduce non-recurrent congestion and thus improve reliability