Using Private Sector Probe Data to Examine Work Zone Performance: The Virginia DOT Experience

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Motivation

• FHWA Work Zone Self Assessment Questions:
  – Has the agency established measures to track work zone congestion and delay?
  – Has the agency established work zone performance guidance on maximum queue lengths, maximum traveler delay, etc.?

• VDOT had allowable work hours, but no established program to track performance
Approach

• Work zone safety coordinators met to discuss “ideal” measures
• Desired measures:
  – Queue length
  – Speed/delay/travel time
  – Reliability
• Finishing research project to examine measures and define data sources and management tools
Constraints

• Manpower/cost
• Data availability
  – Are sensors available?
  – Are they functional?
• Project duration
  – Monitoring short term projects
• Project phasing impacts
  – Need to reposition sensors
Private Sector Sources of Travel Time Data: INRIX

• INRIX derives travel times from a variety of sources, including fleet and passenger vehicle probes
• Sells travel time data, does not install sensors
• Speed and travel time only, no volume
INRIX Use by VDOT

• VDOT has statewide real time data from INRIX
• Feeds real time traveler information (VMSs in DC, SE Virginia, soon in Richmond; 511 app)
• Very well received by public
INRIX Data Quality

- VDOT has conducted internal validation using Bluetooth benchmark on over 340 miles of freeway
  - 95% within 10 mph
  - 75% within 5 mph
Work Zone Metrics Being Examined Using INRIX Data

- Research project to examine viability of using INRIX data for WZ performance measurement:
  - Queue length
    - Use INRIX bottleneck definition
    - 60% of speed typically observed at that time of day
  - Speed/delay
  - Reliability measures (95th percentile speed, buffer index, planning time index)
Case Study: I-95 SB, MP 158-162

• Remove cantilever sign structure at 9 PM on 2/17/12
• 2 of 3 SB lanes closed
• Impacts for about 6 hours over 3 miles
<table>
<thead>
<tr>
<th>Time</th>
<th>Historic Speed (mph)</th>
<th>Queue Threshold Speed (mph)</th>
<th>Observed Speed (mph)</th>
<th>Delay (min)</th>
<th>Queue (mi)</th>
</tr>
</thead>
<tbody>
<tr>
<td>9-10 PM</td>
<td>52.6</td>
<td>31.6</td>
<td>22.1</td>
<td>9.7</td>
<td>1.90</td>
</tr>
<tr>
<td>10-11 PM</td>
<td>61.8</td>
<td>37.1</td>
<td>10.1</td>
<td>21.2</td>
<td>3.03</td>
</tr>
<tr>
<td>11-Mid</td>
<td>61.8</td>
<td>37.1</td>
<td>10.5</td>
<td>20.4</td>
<td>2.26</td>
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<tr>
<td>Mid-1AM</td>
<td>61.8</td>
<td>37.1</td>
<td>9.5</td>
<td>22.5</td>
<td>3.03</td>
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<tr>
<td>1-2 AM</td>
<td>61.8</td>
<td>37.1</td>
<td>8.5</td>
<td>25.1</td>
<td>3.03</td>
</tr>
<tr>
<td>2-3 AM</td>
<td>61.8</td>
<td>37.1</td>
<td>22.6</td>
<td>9.5</td>
<td>0.84</td>
</tr>
</tbody>
</table>

5 min vs Hourly Queue Data
Long Term Work Zone Tracking

- **8 Freeway Work Zones:**
  - Lengths: 1.97 to 11.9 miles long
  - 55 to 65 mph speed limit
  - Directional AADT between 4,800 and 25,230
  - Interchange density between 0 to 0.5 interchanges/mile

- **7 Arterial Work Zones:**
  - Lengths: 1.04 to 7.2 miles long
  - 35 to 60 mph speed limits
  - Directional AADT between 1,757 and 9,005
  - Between 0 and 4.6 signals/mile
Work Zone Impacts on Mean Speed and 95\textsuperscript{th} % Travel Rate

- Used entire 24 hours
- Significant degradations in both measures, especially on freeways

<table>
<thead>
<tr>
<th></th>
<th>Mean Speed (mph)</th>
<th>95\textsuperscript{th} % Travel Rate (sec/mi)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Base WZ Δ Base WZ Δ</td>
<td>Base WZ Δ Base WZ Δ</td>
</tr>
<tr>
<td>Freeway</td>
<td>60.08 56.58 -3.50</td>
<td>79.01 104.72 +25.72</td>
</tr>
<tr>
<td>Arterial</td>
<td>38.31 37.68 -0.63</td>
<td>131.16 133.19 +2.03</td>
</tr>
<tr>
<td>Combined</td>
<td>51.12 48.80 -2.32</td>
<td>100.48 116.45 +15.96</td>
</tr>
</tbody>
</table>

Yellow significant at $\alpha=0.05$, orange at $\alpha=0.10$

6/28/2013
Work Zone Impacts on Buffer and Planning Time Index

- Used entire 24 hours
- Significant degradations in both measures, especially on freeways

<table>
<thead>
<tr>
<th></th>
<th>Buffer Index (%)</th>
<th>Planning Time Index</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Base</td>
<td>WZ</td>
</tr>
<tr>
<td>Freeway</td>
<td>26.00</td>
<td>46.33</td>
</tr>
<tr>
<td>Arterial</td>
<td>25.02</td>
<td>26.01</td>
</tr>
<tr>
<td>Combined</td>
<td>25.60</td>
<td>37.96</td>
</tr>
</tbody>
</table>

Yellow significant at $\alpha=0.05$, orange at $\alpha=0.10$

6/28/2013
Lessons Learned

- INRIX real time confidence scores and confidence values
- Data availability
- Issues with spatial match to work zones
- Issues with temporal aggregation
- Treatment around threshold values
- Full road closures
INRIX Confidence Scores/Values

INRIX indicates 3 levels of confidence:
- “10” – Historic data
- “20” – Blend of historic and real time data
- “30” – Purely real time data

Scores > 10 also have a confidence value from 0-100 indicating degree of agreement with past trends and recent data.

Challenge is to weigh responsiveness with accuracy.
INRIX data confidence score threshold changed 8/12 from 85 to 30

Before 8/12: 61.8 min/day
After 8/12: 16.0 min/day
Data Availability

• Real time data availability of 98% or more during daytime periods on freeways
• Data availability sometimes suffers overnight (Midnight to 4 or 5 AM)
• Some data issues on arterial system outside of high volume NHS routes
• Data availability is moving target
Spatial Mismatch Issues

- Data is reported using Traffic Message Channel (TMC) links
- Typically located between major intersections
Matching Private Data to Work Zones

• TMC boundaries often do not precisely align with work zone boundaries/impacts (or DOT roadway inventory links)

• Differences in lengths (TMC-Work Zone, 18 work zones)
  – Freeways: Mean of +1.16 mi
  – Arterials: Mean of +2.42 mi
Temporal Aggregation

• Long aggregation intervals can “wash out” localized impacts
• Short time intervals require more resources to analyze
• Project level vs. programmatic tradeoffs
Case Study: I-81 and US 460/11

Blasting on I-81SB Closes Road

Detour from Exit 132 To Exit 118 on US 460/US 11

TMC at end of detour is 6.3 miles long
Speeds and Queuing Threshold
Full Road Closures

• If there is a full road closure, INRIX will report scores of “10” since they have no data unless they have been notified
• Need to account for this in performance measure calculations
Summary
Private Sector Probe Data

• Advantages:
  – No infrastructure to install/maintain
  – Good data quality on freeways
  – Large coverage area
  – Useful for many other purposes

• Limitations:
  – Spatial granularity
  – Arterial coverage
  – Overnight coverage
  – Does not directly measure queuing
Next Steps

• TMC granularity
  – INRIX indicates improvements are coming to overcome long TMC lengths in rural areas

• VDOT is reviewing data now to try to determine where to set performance threshold values

• Parallel effort to develop system that integrates probe data with detector data in user friendly archive
Questions?

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