Highway Network Congestion Measurement in the Twin Cities

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mndot.gov

MAP-21 System Performance Measures

- **NHS travel time reliability**
  - Percent of person-miles traveled on the Interstate that are reliable (Interstate Travel Time Reliability Measure)
  - Percent of person-miles traveled on the non-Interstate NHS that are reliable (Non-Interstate Travel Time Reliability Measure)

- **Interstate freight reliability**
  - Truck travel time reliability on the Interstate System (Average Truck Reliability Index)

- **CMAQ**
  - Total emissions reductions for CMAQ-funded projects in designated nonattainment and maintenance areas
  - Percent of non-single occupancy vehicle (non-SOV) travel
  - Annual hours of peak-hour excessive delay (PHED) per capita
Peak-Hour Excessive Delay (PHED) Measure: Key Features

- Measured at Urbanized Area (UZA) level
- Measurement Periods
  - Weekdays only
  - AM Peak (6-10 am)
  - PM Peak (3-7 or 4-8 pm)
  - 15-minute intervals
- Threshold for “excessive” delay
  - 60% of posted speed limit or 20 mph, whichever is greater
- Per capita measure
  - Normalized by urbanized area population
- Applies only to “large” UZAs
  - Greater than 1 million population (2010 Census)
  - Non-attainment or maintenance status for at least one EPA criteria pollutant

Source: Anas (2015)
PHED Metric Calculation Steps

Overview: PHED Metric: Example

Source: FHWA

Key Input Values

<table>
<thead>
<tr>
<th>Input</th>
<th>Variable or Parameter Value</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicle Occupancy (cars)</td>
<td>1.7</td>
<td>NHTS (2017)</td>
</tr>
<tr>
<td>Vehicle Occupancy (buses)</td>
<td>9.8</td>
<td>NTD</td>
</tr>
<tr>
<td>Vehicle Occupancy (trucks)</td>
<td>1.0</td>
<td>FHWA</td>
</tr>
<tr>
<td>Traffic Volumes</td>
<td>Varies by link</td>
<td>FHWA (HPMS)</td>
</tr>
<tr>
<td>Vehicle Class Distribution</td>
<td>Varies by link</td>
<td>FHWA (HPMS)</td>
</tr>
<tr>
<td>Temporal Distribution</td>
<td>N/A</td>
<td>FHWA/TTI</td>
</tr>
</tbody>
</table>
Travel Time Data: NPMRDS

National Performance Management Research Data Set (NPMRDS)
Derived from vehicle/passenger probe data (sourced from Global Positioning Station [GPS], navigation units, cell phones)

• Covers the National Highway System (NHS)
• Includes average travel times representative of all traffic and average travel times for freight trucks on segments that are on the Interstate System.
• Individual records represent 15-minute time periods of every day (24 hours) for a travel time segment, measured continuously throughout the year

Source: FHWA

NPMRDS

• Travel times provided by road segments
• Pre-defined road segments are called TMC (traffic message channel) codes and based on the industry standard for traffic reporting
• Travel times provided for passenger, freight, combined values

Source: FHWA
Twin Cities Urbanized Area Boundary

NPMRDS Analytics Platform (CATT Lab)
Boundary Issues for Neighboring State UZAs

Twin Cities PHED by Segment (2017)
PHED Measure: Results and Targets

- Total Excessive Delay (2017)
  - 25.4 million hours
  - 9.2 hours per capita (revised)

- Target (4-year)
  - 8.5 hours per capita
  - Reflects initial, lower estimate (8.65 hours)
  - May be affected by construction delay (e.g. I-35W)
  - Adjustable at midpoint of evaluation period
### PHED Summary Statistics for Large UZAs

<table>
<thead>
<tr>
<th>Statistic</th>
<th>Value</th>
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<tbody>
<tr>
<td>Mean</td>
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<tr>
<td>Sample SD</td>
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<tr>
<td>Median</td>
<td>13.7</td>
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<tr>
<td>Maximum</td>
<td>52.2</td>
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<tr>
<td>Minimum</td>
<td>3.9</td>
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<tr>
<td>N</td>
<td>38</td>
</tr>
</tbody>
</table>

### Population Size and Excessive Delay, 2017

![Graph showing PHED Per Capita vs Population (UZA)](mndot.gov)
PHED Measure: Limitations

- Should be considered a lower bound for delay
  - Only applies to NHS routes
  - Only counts “excess” delay
    - More restrictive definition than most estimates (CMAQ tie-in)
  - Only applies to weekdays
  - Only applies to peak periods
  - Restricted to urbanized area

- Other estimates of delay
  - Inrix – Traffic Scorecard
  - TTI Urban Mobility Report
  - MnDOT Freeway Congestion Report
  - Accessibility reports (e.g. Accessibility Observatory)

PHED vs. Total Delay per Commuter (Inrix), 2017

\[ y = 1.992x + 0.0495 \]
\[ R^2 = 0.6058 \]
PHED vs. Travel Time Index (TTI/Inrix), 2017

PHED vs. Accessibility Loss (2017)
General Remarks and Future Directions

• Comparison With Other Measures
  • General agreement across measures
  • Some differences reflect measurement approach, network and data issues

• Future Directions
  • Validate against other measurements (e.g. loop detectors)
  • Explore sensitivity of results, calibrate to local conditions
    • Vehicle occupancy, traffic volumes, temporal distribution, etc.
  • Examine compatibility between data sets (Inrix, HERE)

Questions
Thank you!

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