Congestion Evaluation
Best Practices

Todd Litman
Victoria Transport Policy Institute
Presented
International Transportation and Economic Development Conference
10 April 2014
<table>
<thead>
<tr>
<th>Indicator</th>
<th>Description</th>
<th>Comprehensive</th>
<th>Multi-Modal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roadway Level-Of-Service (LOS)</td>
<td>Intensity of congestion on a road or intersection, rated from A (uncongested) to F (most congested)</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Multi-modal Level-Of-Service (LOS)</td>
<td>Service quality of walking, cycling, public transport and automobile, rated from A to F</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Travel Time Index</td>
<td>The ratio of peak to off-peak travel speeds</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Avg. Traffic Speed</td>
<td>Average peak-period vehicle traffic speeds</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Avg. Commute Time</td>
<td>The average time spent per commute trip</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Congested Duration</td>
<td>Duration of “rush hour”</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Delay Hours</td>
<td>Hours of extra travel time due to congestion</td>
<td>Yes</td>
<td>No if for vehicles, yes if for people</td>
</tr>
<tr>
<td>Congestion Costs</td>
<td>Monetized value of delay plus additional vehicle operating costs</td>
<td>Yes</td>
<td>No if for vehicles, yes if for people</td>
</tr>
</tbody>
</table>
**Ranking Depend on Indicators**

More compact urban regions (blue) tend to have more intense congestion but lower congestion costs than sprawled, auto-oriented regions (red). Rankings change depending on which indicator is used.
Baseline Speeds

- Roadway capacity tends to decline at speeds above 55 mph on limited access highways, and about 40 mph on urban arterials, so roads typically carry about twice as much traffic at LOS C than at LOS A.

- As a result, traffic engineers generally recommend capacity-maximizing speeds, and economists generally recommend economic efficiency-optimizing speeds, both of which result in level-of-service C or D baseline speeds.

<table>
<thead>
<tr>
<th>Name</th>
<th>Measurement Method</th>
<th>LOS Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Free-flow speeds</td>
<td>Measured off-peak speeds</td>
<td>A</td>
</tr>
<tr>
<td>Speed limits</td>
<td>Maximum legal speeds</td>
<td>A or B</td>
</tr>
<tr>
<td>Capacity-maximizing speeds</td>
<td>Speeds that maximizes traffic capacity</td>
<td>C or D</td>
</tr>
</tbody>
</table>
| Economic efficiency-optimizing    | Users’ willingness-to-pay for faster travel             | C or D     | (also called consumer-surplus maximizing)
Valuing Travel Time

- Most studies conclude that on average motorists are willing to pay 25-50% of wages for reduced delay; a minority, including commercial travelers and travelers with urgent errands, would pay significantly more.

- The value of travel time used for analysis should reflect the travelers affected. A project that reduces delay for all motorists, such as a roadway expansion, should be evaluated based on overall average motorists’ willingness-to-pay, while a project that reduces congestion for a particular group, such as value priced lanes, should be evaluated based on willingness-to-pay by those who would pay the fee.
Fuel economy usually peaks at 40-50 mph, so reducing extreme congestion (such as shifting from LOS E-F to C-D) conserves fuel and reduces emissions, but eliminating congestion (shifting from level-of-service C-D to A-B) tends to increase fuel consumption and emissions.
Safety Impacts

- Total crash rates tend to be lowest on moderately congested roads (V/C=0.6), and increase at lower and higher congestion levels, while casualty rates (injuries and deaths) increase if congestion reductions lead to high traffic speeds.

- Although some interventions, such as roadway grade separation, can reduce both congestion and crash rates, some congestion reduction strategies increase total accident costs by increasing traffic speeds and inducing additional vehicle travel.

- These additional crash costs typically offset 5-10% of congestion reduction benefits.
Generated traffic has these implications for congestion evaluation:

- Traffic congestion seldom becomes as severe as predicted if past traffic growth trends are simply extrapolated into the future.
- Roadway expansion provides less long-term congestion reduction benefits than predicted if generated traffic is ignored.
- Induced vehicle travel increases various external costs including downstream congestion, parking costs, total accidents, and pollution emissions, reducing net benefits.
- The induced vehicle travel provides direct user benefits (it increases consumer surplus), but these benefits tend to be modest because it consists of marginal-value vehicle travel that users are most willing to forego if their costs increase.
On a typical road, users' willingness-to-pay for faster travel varies from very low to very high. If expanding urban roadways cost 30¢ per peak-period vehicle-mile, economic efficiency increases if motorists willing to pay this amount can purchase faster travel, but it would be economically inefficient to spend this amount to increase the travel speed of motorists with lower willingness-to-pay. In some cases motorists might be willing to pay for LOS A or B.
Economic Efficiency Implications

- There are large potential benefits from favoring higher-value travel. A roadway becomes more efficient (it provides more value per lane or vehicle-mile) if regulations, pricing or incentives allow higher value vehicles to avoid congestion.

- A significant portion of motor vehicle travel may have negative net value: its marginal user benefits are less than their total marginal costs, including external costs. It is economically inefficient to expand roads to accommodate such travel.

- Serving latent demand for alternative modes can provide direct and indirect benefits. For example, walking, cycling and transit improvements that increase use of those modes provide direct user benefits, plus indirect benefits from reduced automobile traffic.

- Improving traveler convenience and comfort, for example, by providing better public transit user information and improving comfort, can reduce travel time unit costs (dollars per hour) equivalent in value to increasing travel speed.
U.S. traffic congestion cost estimates range between about $112 and $388 annual per capita, depending on assumptions. These are modest compared with other transportation costs.
Sensitivity Analysis

- The Urban Mobility Report’s $121 billion cost estimate is based on higher baseline speeds and travel time unit costs than most economists recommend.

- The Mid-Range is based on 70% of baseline speeds and the U.S. Department of Transportation’s recommended $12.00 per hour travel time unit costs.

- The lower-range estimate is based on 50% of baseline speed and the USDOT’s lower travel time unit costs.
<table>
<thead>
<tr>
<th>Economic Impacts</th>
<th>Roadway Expansion</th>
<th>Improve Alt. Modes</th>
<th>Efficient Pricing</th>
<th>Smart Growth</th>
<th>TDM Programs</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Labor pools</strong></td>
<td>Expands car commuters' work options.</td>
<td>Expands all commuters' work options.</td>
<td>Expands most commuters' work options.</td>
<td>Improves worker accessibility.</td>
<td>Can improve access.</td>
</tr>
<tr>
<td><strong>Parking costs</strong></td>
<td>Increases parking costs.</td>
<td>Reduces parking costs.</td>
<td>Reduces parking costs.</td>
<td>Increases unit costs but reduces total costs.</td>
<td>Reduces parking costs.</td>
</tr>
<tr>
<td><strong>Vehicle and fuel imports</strong></td>
<td>Increases</td>
<td>Reduces</td>
<td>Reduces</td>
<td>Reduces</td>
<td>Reduces</td>
</tr>
<tr>
<td><strong>Land use accessibility</strong></td>
<td>Causes sprawl, which reduces accessibility.</td>
<td>Encourages compact development which improves accessibility.</td>
<td>Encourages compact development which improves accessibility.</td>
<td>Increases land use accessibility.</td>
<td>Supports more accessible development.</td>
</tr>
</tbody>
</table>
Recommendations

- Measure per capita congestion costs rather than intensity. Congestion intensity indicators do not account for the amount residents drive during peak periods.
- Measure delays to all travelers, not just to motorists. Account for the travel time savings to transit passengers from grade separation, such as bus lanes.
- Use efficiency-optimizing baseline speeds, rather than freeflow speeds. These speeds maximize roadway capacity and fuel economy, and so are more realistic.
- Use travel time values that reflect users’ actual willingness-to-pay for incremental speed gains. Recognize variations in travel time values, and therefore the efficiency gains provided by policies that favor higher value trips over lower-value trips.
- Use accurate fuel efficiency functions. Vehicle fuel efficiency generally peaks at about 50 miles per hour.
- Account for generated and induced vehicle travel when evaluating roadway capacity expansions. Induced travel tends to reduce predicted congestion reduction benefits, provides marginal consumer benefits, and increases external costs.
- Account for increased crash costs that result if congestion reductions lead to high traffic speeds.
- Account for co-benefits when evaluating potential congestion reduction strategies. In addition to reducing congestion some strategies also reduce parking costs, provide consumer savings and affordability, improve non-drivers’ accessibility, increase safety and health, reduce pollution emissions, and support strategic land use objectives.
“Smart Congestion Relief: Comprehensive Analysis Of Traffic Congestion Costs and Congestion Reduction Benefits”

“Transportation Cost and Benefit Analysis”

“Congestion Costing Critique”

“Online TDM Encyclopedia”

and more...

www.vtpi.org