The Economic Cost of Traffic Congestion in Northeastern Illinois
Overview

- PART 1 – Texas Transportation Institute (TTI) Methodology Review
- PART 2 – Methodology Adaptation
- PART 3 – Directions for future research
Part 1 – TTI Methodology Review

- TTI Nationwide Cost of Congestion (TTI, 2009)
  - Typical commuter spent 36 hours per year in traffic in 2007
  - Extra gasoline and diesel fuel = 24 gallons in 2007
  - Congestion cost per capita = $757
  - Congestion cost nation = $87.2 Billion
  - Rare break in near-constant growth
    - TTI found that travelers spent one hour less stuck in traffic in 2007 than they did in 2006 and wasted 1 gallon less of gasoline.
TTI Nationwide Cost of Congestion (TTI, 2009)

Exhibit 3. Hours of Travel Delay per Peak-Period Traveler

Exhibit 4. Gallons of Fuel Wasted per Peak-Period Traveler
TTI Nationwide Cost of Congestion (TTI, 2009)

Exhibit 6. Congestion Growth Trend

Hours of Delay per Traveler

<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>Small</td>
<td>10</td>
<td>12</td>
<td>15</td>
</tr>
<tr>
<td>Medium</td>
<td>20</td>
<td>22</td>
<td>25</td>
</tr>
<tr>
<td>Large</td>
<td>30</td>
<td>32</td>
<td>35</td>
</tr>
<tr>
<td>Very Large</td>
<td>40</td>
<td>42</td>
<td>45</td>
</tr>
</tbody>
</table>

Small = less than 500,000
Medium = 500,000 to 1 million
Large = 1 million to 3 million
Very Large = more than 3 million
TTI Nationwide Cost of Congestion (TTI, 2009)

Exhibit 8. The Jam Clock Shows That It Is Hard To Avoid Congestion in Urban Areas with More than 1 Million Persons

1982 — 2007

Red – Almost all regions have congestion
Yellow – Some regions have congestion
Green Checked – Very few regions have congestion
Gray – Time period not analyzed

Note: The 2009 Urban Mobility Report examined 6 to 10 a.m. and 3 to 7 p.m.
Travel Time Index - The ratio of travel time in the peak period to the travel time at free-flow conditions. A value of 1.30 indicates a 20-minute free-flow trip takes 26 minutes in the peak.

Roadway Congestion Index – A ratio of daily traffic volume to the number of lane-miles of arterial street and freeway-to estimate the length of the peak period. The resulting ratio indicates an undesirable level of areawide congestion if the index value is greater than or equal to 1.0.
The limitations of TTI method:

- TTI just shows individual estimates of urban areas in Illinois;
- TTI does not take into account rural areas;
- TTI does not allow a spatial understanding of congestion; and
- TTI uses national averages of constants and general estimations instead of specific state or local information.
TTI Improvements

- Expand TTI’s method to rural and minor urban areas for CMAP’s seven county region.
  - Use a comprehensive dataset that includes statewide urban and rural traffic figures from IDOT
    - IRIS (Illinois Roadway Information System)
TTI Improvements

- Include state and local information
  - Chicago MSA Vehicle Occupancy for HBW - 1.03 (National Household Travel Survey, 2009).
  - Direction Distribution Factor for specific interstates. 60/40 if data is not available (IDOT Highway Capacity Manual).
    - Hourly volumes from highway sensors where used to calculate a ratio of inbound peak hourly volumes and total peak hourly volumes (inbound + outbound).
  - Truck Factor for links with truck counts. If data is not available than 16/12/6.5 (IDOT Highway Capacity Manual).
Calculation Procedures

- Data Collection
- Percent of Delay Travel in Congested Conditions (≤50%)
- Average Peak-Period Speed
- Average Travel Times
- Travel Delay = Average Travel times – Travel Times at Free Flow Speed
- Delay Related Indices
Visual Representation of Modeling Results
Travel Time Index = \frac{\text{Peak Travel Time}}{\text{Free-Flow Travel Time}}
Annual Passenger Vehicle Delay Cost = Annual Persons-Hours of Delay \* Yearly Avg. cost of time per person hour ($15.47, $2007) \* (1 – percent of commercial vehicles)
Annual Fuel Cost = \[ \frac{\text{Average Speed in Peak Period}}{\text{Fuel Economy}} \] * Daily Vehicle-Hours of Incident and Recurring Delay on FW and AT * Yearly Fuel Cost ($2.94, 2010) * 250 Working Days per year
Annual Commercial Vehicle Cost = Daily Vehicle-Hours of Incident and Recurring Delay on FW and AT * Percent of Commercial Vehicles * Yearly Commercial Vehicle Operating Cost per Vehicle Hour ($102.12, $2007) * 250 Working Days per year
Annual Cost Due to Congestion = Annual Passenger Vehicle Delay Cost + Annual Passenger Fuel Cost + Annual Commercial Vehicle Cost
## Congestion Measurements Comparison

### TTI Report 2007

<table>
<thead>
<tr>
<th>MSA</th>
<th>Roadway Congestion Index (RCI)</th>
<th>Congested Travel (% of peak VMT)</th>
<th>Travel Time Index (TTI)</th>
<th>Freeway Speed (mph)</th>
<th>Arterial Street Speed (mph)</th>
<th>Annual Total Cost (Million)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chicago</td>
<td>1.18</td>
<td>46.4</td>
<td>1.43</td>
<td>41</td>
<td>24.7</td>
<td>$4,207</td>
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</tbody>
</table>

Chicago-Naperville-Joliet, IL, Lake County-Kenosha, IL-WI and Gary, IN

### Disaggregated Model 2010

<table>
<thead>
<tr>
<th>Cook</th>
<th>1.34</th>
<th>41.39</th>
<th>1.34</th>
<th>48.9</th>
<th>29.2</th>
<th>2,048</th>
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<tbody>
<tr>
<td>DuPage</td>
<td>1.35</td>
<td>41.03</td>
<td>1.31</td>
<td>48.8</td>
<td>27.1</td>
<td>554.4</td>
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<tr>
<td>Kane</td>
<td>1.17</td>
<td>37.75</td>
<td>1.22</td>
<td>51.0</td>
<td>30.9</td>
<td>125.2</td>
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<tr>
<td>Kendall</td>
<td>1.26</td>
<td>41.63</td>
<td>1.30</td>
<td>31.0</td>
<td></td>
<td>30.7</td>
</tr>
<tr>
<td>Lake</td>
<td>1.23</td>
<td>40.09</td>
<td>1.25</td>
<td>52.4</td>
<td>29.0</td>
<td>263.6</td>
</tr>
<tr>
<td>McHenry</td>
<td>1.16</td>
<td>38.13</td>
<td>1.25</td>
<td>60.0</td>
<td>31.4</td>
<td>75.4</td>
</tr>
<tr>
<td>Will</td>
<td>1.02</td>
<td>34.02</td>
<td>1.19</td>
<td>48.9</td>
<td>31.8</td>
<td>133.1</td>
</tr>
<tr>
<td>Ave. / Total</td>
<td>1.26</td>
<td>39.83</td>
<td>1.29</td>
<td>49.4</td>
<td>29.7</td>
<td>$3,231</td>
</tr>
</tbody>
</table>
Part 3 - Directions for future research

- Historical Trend Analysis
  - IRIS (Illinois Roadway Information System) 2001-2010

- GO TO 2040 Regional Mobility Projects
  - Projected VMT reduction vs. Dollars saved
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Functional Class (Interstate, Freeway and Expressway, Other Principal Arterial)

VMT (Daily Vehicle-miles of Travel)

NOLANES (Number of Lanes)

LANEMILES (Lane-miles)

ADT (Average Daily Traffic per Section of Road)

AVGDFACT (Average Directional Factor per Section of Road)

AVGTFACT (Average Truck Factor per Section of Road)
Roadway Congestion Index (RCI)

Exhibit. A-1&2

Eq. A-1

Total Freeway (FW) VMT

Total Arterial Street (AT) VMT

Total FW Ln-mi

Total AT Ln-mi

FW VMT

AT VMT

FW Ln-mi

AT Ln-mi

TTI Calculation Procedure
**Total Travel in a Road Section**

- **Off-peak Periods**
  - Not analyzed 50%

- **Peak Periods**
  - 50%

- % of VMT during Uncongested time (determined by RCI)

- % of VMT during Possibly congested time

**Assign road section to congestion level (using ADT/Lane)**

- % of VMT in peak direction (determined by directional factor)
- % of VMT in off-peak direction (determined by directional factor)

**Free-flow speed**

**Estimate peak direction speed**

**Estimate off-peak direction speed**

**TTI Calculation Procedure**
20 categories congested Travel Times in road type/congestion level/direction

20 categories congested VMTs in road type/congestion level/direction

\[ \frac{\text{20 categories congested Travel Times in road type/congestion level/direction}}{\text{20 categories congested VMTs in road type/congestion level/direction}} = \text{Ave. Speed} \]
TTI Calculation Procedure
TTI Calculation Procedure

1. Incident-Related Travel Delay
   - Eq. A-3

2. Annual Person Delay
   - Eq. A-4

3. Travel Time Index
   - Eq. A-5,6

4. Fuel Economy
   - Eq. A-7

5. Wasted Fuel
   - Eq. A-8

6. Congestion Cost
   - Eq. A-9~12
(Eq. A-1)

Roadway Congestion = \[ \frac{\text{Freeway VMT per Ln.Mi.} \times \text{Freeway VMT} + \text{Prin Art Str VMT per Ln.Mi.} \times \text{Prin Art Str VMT}}{14,000 \times \text{Freeway VMT} + 5,000 \times \text{Prin Art Str VMT}} \]
Exhibit A-2. Percent of Daily Travel in Congested Conditions

![Graph showing the relationship between Roadway Congestion Index and Percent of Daily Travel.]

Exhibit A-1. Percent of Daily Travel in Congested Conditions

<table>
<thead>
<tr>
<th>Roadway Congestion Index</th>
<th>PDTCC Estimation Equation</th>
</tr>
</thead>
<tbody>
<tr>
<td>$0 &lt; RCI &lt; 0.75$</td>
<td>$0.333 \times RCI$</td>
</tr>
<tr>
<td>$0.75 \leq RCI &lt; 0.9$</td>
<td>$0.667 \times RCI - 0.25$</td>
</tr>
<tr>
<td>$0.9 \leq RCI &lt; 1.1$</td>
<td>$0.5 \times RCI - 0.1$</td>
</tr>
<tr>
<td>$1.1 \leq RCI &lt; 1.4$</td>
<td>$0.167 \times RCI + 0.267$</td>
</tr>
<tr>
<td>$1.4 \leq RCI &lt; 1.6$</td>
<td>0.5</td>
</tr>
</tbody>
</table>
### Exhibit A-2. Daily Traffic Volume per Lane and Speed Estimating Used in Delay Calculation

<table>
<thead>
<tr>
<th>Facility and Congestion Level</th>
<th>Daily Traffic Volume per Lane</th>
<th>Speed Estimate Equation&lt;sup&gt;1&lt;/sup&gt; Peak Direction</th>
<th>Off-Peak Direction</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Freeway</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Uncongested</td>
<td>Under 15,000</td>
<td>60</td>
<td>60</td>
</tr>
<tr>
<td>Medium</td>
<td>15,001 - 17,500</td>
<td>70-(0.9* ADT/Lane)</td>
<td>67-(0.6* ADT/Lane)</td>
</tr>
<tr>
<td>Heavy</td>
<td>17,501 - 20,000</td>
<td>78-(1.4* ADT/Lane)</td>
<td>71-(0.85* ADT/Lane)</td>
</tr>
<tr>
<td>Severe</td>
<td>20,001 - 25,000</td>
<td>96-(2.3* ADT/Lane)</td>
<td>88-(1.7* ADT/Lane)</td>
</tr>
<tr>
<td>Extreme</td>
<td>Over 25,000</td>
<td>76-(1.46* ADT/Lane)</td>
<td>85.7-(1.6*ADT/Lane)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lowest speed is 35 mph</td>
<td>Lowest speed is 40 mph</td>
</tr>
<tr>
<td><strong>Arterial Street</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Uncongested</td>
<td>Under 5,500</td>
<td>35</td>
<td>35</td>
</tr>
<tr>
<td>Medium</td>
<td>5,501 - 7,000</td>
<td>33.58-(0.74* ADT/Lane)</td>
<td>33.82-(0.59* ADT/Lane)</td>
</tr>
<tr>
<td>Heavy</td>
<td>7,001 - 8,500</td>
<td>33.80-(0.77* ADT/Lane)</td>
<td>33.90-(0.59* ADT/Lane)</td>
</tr>
<tr>
<td>Severe</td>
<td>8,501 - 10,000</td>
<td>31.65-(0.51* ADT/Lane)</td>
<td>30.10-(0.15* ADT/Lane)</td>
</tr>
<tr>
<td>Extreme</td>
<td>Over 10,000</td>
<td>32.57-(0.62* ADT/Lane)</td>
<td>31.23-(0.27*ADT/Lane)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lowest speed is 20 mph</td>
<td>Lowest speed is 27 mph</td>
</tr>
</tbody>
</table>

Note: <sup>1</sup>ADT/Lane in thousands