Use of Cellular, GPS, and Bluetooth for Origin-Destination (O-D) Data

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Comparison of O-D Data by Technology

<table>
<thead>
<tr>
<th>Technology Comparison</th>
<th>Cellular</th>
<th>GPS</th>
<th>Bluetooth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of Travel Collected</td>
<td>estimated device movements</td>
<td>estimated trips traces</td>
<td>trips between device readers</td>
</tr>
<tr>
<td>Data Collection Time Period</td>
<td>min. 1 month</td>
<td>min. 3 months</td>
<td>min. 1 week</td>
</tr>
<tr>
<td>Data Saturation/Penetration</td>
<td>good</td>
<td>poor</td>
<td>fair</td>
</tr>
<tr>
<td>Positional Accuracy</td>
<td>150–1500 meters</td>
<td>5–30 meters</td>
<td>100 meters</td>
</tr>
<tr>
<td>Sample Frequency</td>
<td>minutes, hours</td>
<td>seconds, minutes</td>
<td>seconds</td>
</tr>
<tr>
<td>Continuous Data Stream?</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
</tr>
</tbody>
</table>
Tyler External Survey Study

- Trial O-D travel survey using cell, GPS, Bluetooth (BT)
- Focused on E-E, E-I/I-E trips
- 420 TAZs aggregated to 307
- 18 exterior cell data capture areas created (travelsheds)
- 10 mile GPS buffer area utilized
- BT used to benchmark cell and GPS E-E results
E-E Results
E-I/I-E Results – Total Trips
Saturation/Distribution across Internal TAZs

2004 Survey Data  Cell Data  GPS Data
## Take Aways – Suitability of Data

<table>
<thead>
<tr>
<th>Suitability by Study and Data Type</th>
<th>Cell Data</th>
<th>GPS Data</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>E-E trips</td>
<td>✓</td>
<td>✓✓</td>
<td>GPS more comparable to Bluetooth.</td>
</tr>
<tr>
<td>E-I/I-E trips</td>
<td>✓</td>
<td>✓</td>
<td>Best to use GPS at urban TAZ and smaller geographies, cell accuracy increases with larger geographies</td>
</tr>
<tr>
<td>Commuter information</td>
<td>✓</td>
<td>✗</td>
<td>Valuable information for many urban areas.</td>
</tr>
<tr>
<td>Residency</td>
<td>✓</td>
<td>✗</td>
<td>Resident vs. non-resident splits needed</td>
</tr>
<tr>
<td>Commercial/Freight</td>
<td>✗</td>
<td>✓</td>
<td>GPS splits O-D data into freight and non-freight sources</td>
</tr>
<tr>
<td>Demographic information</td>
<td>✓</td>
<td>✗</td>
<td>Based on census tract of the cell device’s home location</td>
</tr>
<tr>
<td>Route information</td>
<td>✗</td>
<td>✓</td>
<td>GPS can determine route using waypoints</td>
</tr>
<tr>
<td>Within urban areas (operational)</td>
<td>✗</td>
<td>✓</td>
<td>Cell data lacks positional accuracy to do this</td>
</tr>
<tr>
<td>Within urban areas (planning, select link anal.)</td>
<td>✓</td>
<td>✓✓</td>
<td>GPS has better positional accuracy, can provide directionality</td>
</tr>
</tbody>
</table>
Conclusions

• O-D methods/technologies still evolving
• Combination of technologies best approach for external data
• Bluetooth remains E-E benchmark, for time being
• Cell data better suited for larger studies areas
• Third party GPS a new option to consider
• Which technology to use depends primarily on level of spatial and temporal resolution needed
Future O-D Work with New Technology

• Dallas-Ft. Worth External O-D using cell, GPS, BT
  – Spring 2016
  – Much larger geographic area than Tyler
  – Will include ‘long distance’ O-D comparison

• FHWA Synopsis on New Methods/Technologies
  – Guidance to potential purchasers / users
  – capabilities and limitations of each technology
  – Suitability of technology by different study types, sizes
Travel Time & Speed Data for Planning

Shawn Turner, P.E.
Texas A&M Transportation Institute

TxDOT Short Course 2015  ~  College Station, TX
Not so long ago...

3 travel time runs = good enough

<table>
<thead>
<tr>
<th>SEGMENT DESCRIPTION</th>
<th>LENGTH</th>
<th>RUN 1</th>
<th>RUN 2</th>
<th>RUN 3</th>
<th>RUN 4</th>
<th>TOTAL TRAVEL TIME</th>
</tr>
</thead>
<tbody>
<tr>
<td>NORTH LOOP TO MANGUM</td>
<td>0.90</td>
<td>0.80</td>
<td>0.80</td>
<td>0.86</td>
<td>62.79</td>
<td></td>
</tr>
<tr>
<td>MANGUM TO W 34TH</td>
<td>0.80</td>
<td>0.92</td>
<td>0.87</td>
<td>0.77</td>
<td>62.34</td>
<td></td>
</tr>
<tr>
<td>W 34TH TO W 43RD</td>
<td>1.30</td>
<td>1.38</td>
<td>1.32</td>
<td>1.23</td>
<td>63.41</td>
<td></td>
</tr>
<tr>
<td>W 43RD TO PINEMONT</td>
<td>0.80</td>
<td>5.07</td>
<td>0.83</td>
<td>0.78</td>
<td>61.54</td>
<td></td>
</tr>
<tr>
<td>PINEMONT TO TIDWELL</td>
<td>1.30</td>
<td>10.6</td>
<td>7.37</td>
<td>63.93</td>
<td>43.33</td>
<td></td>
</tr>
<tr>
<td>TIDWELL TO FAIRBANKS N HOUSTON</td>
<td>1.10</td>
<td>17.3</td>
<td>3.81</td>
<td>1.33</td>
<td>43.35</td>
<td></td>
</tr>
<tr>
<td>FAIRBANKS N HOUSTON TO LITTLE YORK</td>
<td>1.70</td>
<td>8.08</td>
<td>12.62</td>
<td>2.78</td>
<td>36.69</td>
<td></td>
</tr>
<tr>
<td>LITTLE YORK TO WEST BELT</td>
<td>1.00</td>
<td>2.83</td>
<td>21.20</td>
<td>7.18</td>
<td>8.36</td>
<td></td>
</tr>
<tr>
<td>WEST BELT TO FM29</td>
<td>0.60</td>
<td>2.45</td>
<td>14.69</td>
<td>2.47</td>
<td>14.57</td>
<td></td>
</tr>
<tr>
<td>FM29 TO JONES RD</td>
<td>1.05</td>
<td>2.75</td>
<td>22.91</td>
<td>2.60</td>
<td>24.23</td>
<td></td>
</tr>
<tr>
<td>JONES RD TO SH6</td>
<td>2.70</td>
<td>15.3</td>
<td>10.60</td>
<td>4.73</td>
<td>34.25</td>
<td></td>
</tr>
<tr>
<td>SH6 TO HUFFMEISTER</td>
<td>0.70</td>
<td>1.37</td>
<td>30.66</td>
<td>1.38</td>
<td>30.43</td>
<td></td>
</tr>
<tr>
<td>HUFFMEISTER TO TELGE</td>
<td>1.60</td>
<td>3.13</td>
<td>30.67</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TELGE TO SPRING CYPRESS RD</td>
<td>3.70</td>
<td>7.22</td>
<td>30.75</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SPRING CYPRESS RD TO WARREN RANCH RD</td>
<td>9.60</td>
<td>12.8</td>
<td>44.65</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WARREN RANCH RD TO FM2920</td>
<td>4.50</td>
<td>7.36</td>
<td>36.73</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FM 2920 TO HARRIS/WALLER CO LINE</td>
<td>0.60</td>
<td>0.98</td>
<td>36.73</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| TOTAL/AVG. THIS SECTION                    | 100.5  | 20.27  | 27.51  | 30.43  | 19.96  | 41.93  | 0.00   |
| TOTAL/AVG. THIS PERIOD                     |        |        |        |        |        |        |        |
| TOTAL/AVG. THIS DIRECTION                  |        |        |        |        |        |        |        |
| TOTAL/AVG. THIS HIGHWAY                    |        |        |        |        |        |        |        |

Source: J. Zmud
Today and into the future

- Increasing private sector role
- GPS in fleet vehicles, smart phones, mobile “things”
- Car connectivity (LTE/4G)
Current Activities

• TxDOT 100 Most Congested Roadways
• MPO Activities
• FHWA National Travel Time Dataset (NPMRDS)
• MAP-21 Proposed Rules
Top 100 Congested Roadways

http://maps.dot.state.tx.us/top100/
TxDOT Top 100 Congested Roads

- Not just a cool map
- Statewide licensing of travel time data
- Distribution to and use by multiple MPOs
- TPP tech assistance for performance measures and target setting
- Inclusion in UTP tool
- Ongoing enhancements & improvements to analysis methods and data
MPO Activities

• Several individual uses prior to 2014 (HGAC, CAMPO, etc)

• TxDOT licensing provides unlimited use – free and consistent travel time data statewide to MPOs!
  – Several MPOs already using
FHWA National Travel Time Dataset

• NPMRDS = National Performance Management Research Data Set
• Licensed by FHWA from HERE (Nokia)
• Provided free to DOTs & MPOs
• Passenger, freight, mixed traffic travel times
• ONLY National Highway System, from July 2013
MAP-21 Proposed Rule

• Estimated Nov/Dec 2015
• System Performance Measure(s)
  – Interstate
  – Non-Interstate NHS
• CMAQ Program Measure(s)
  – Traffic congestion
  – *On-road mobile source emissions*
Key Takeaways

• Travel time data becoming inexpensive commodity collected by multiple companies
• Dramatically increases our traffic diagnostics capability
• Need staffing to support data analytics
• Receptive to having better (different) info in decision-making
Transportation Planning Implications of Automated/Connected Vehicles

Tom Williams, AICP
Texas A&M Transportation Institute

TxDOT Short Course 2015 ~ College Station, TX
Transportation Planning Implications of Automated/Connected Vehicles

Assess how the potentially transformative automated/connected vehicle technology can be included in the Texas transportation planning process by defining the technology, surveying potential behavioral response, testing scenarios with travel modeling, and sharing ideas with the transportation planning community.
Tasks

1. Define Current and Future Technology
2. Potential Impacts to Personal Travel
3. Potential Impacts to Commercial Travel
4. Potential Impacts to Travel Forecasting Process
5. Behavioral Preferences Survey
6. Stakeholder Workshops (3)
7. Evaluate Impacts to Transportation Planning Process
AV/CV Will Impact these Areas…and Create More Data

– Mobility/Accessibility
– Natural Environment
– Built Environment
– Safety and Security
– Equity and Transportation Cost Structures (including insurance)
– Public Transportation
– Freight and Commercial Transportation
Automated Personal Mobility Environment

- Internet of Things
- Personal Communications Technology
- Smart Mobility Environment
- Connected/Automated Vehicles
- Sharing Economy

SHARE
At what point should agency leadership have a practical understanding of AV/CV and the potential implications on our transportation system and what is the associated risk of not achieving this?

### Step 1: Time Risk
- **10+ Years**
- **5-10 Years**
- **3-5 Years**
- **0-2 Years**

Implementation will be needed by...

### Step 2: Cost Risk

- Less than $1M
- $1M to $10M
- $10M to $100M
- Greater than $100M

**Total responses = 23**
How has your agency incorporated AV/CV into identification, assessment, and prioritization of projects in statewide and long range plans?

- Specific - List AV/CV projects and potential impacts to Plan document
  - 0
- General - Dedicate a section of Plan document to AV/CV technology
  - 4
- Mention - Discussed potential for general technological impacts at end of Plan document
  - 14
- None - have not considered AV/CV in any Plan documents
  - 6

Total responses = 24
Given the responses to the questions today, what do you perceive as the overall risk for our industry relative to our readiness to plan for AV/CV technology and its implications to transportation infrastructure?

<table>
<thead>
<tr>
<th>Risk Level</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very Low - our industry's understanding is sufficient given the state of AV/CV development and there is no risk of missing...</td>
<td>0</td>
</tr>
<tr>
<td>Low - our industry's understanding is sufficient given the state of AV/CV development and missing out will be minimal</td>
<td>0</td>
</tr>
<tr>
<td>Medium - our industry may miss some future opportunities, benefits, impacts but it will not be severe</td>
<td>12</td>
</tr>
<tr>
<td>High - our industry is likely failing to address immediate or near-term opportunities, benefits, and impacts</td>
<td>11</td>
</tr>
<tr>
<td>Very High - our industry is failing to address opportunities, benefits, and impacts</td>
<td>2</td>
</tr>
</tbody>
</table>

Total responses = 25