NCTCOG External O-D Survey Using Passive Data

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Travel Surveys

Role in the ‘3C’ Process

- Survey Data
- Calibrated Model
- Transportation Plan
- Evaluate / Prioritize Projects
- Develop TIP

Surveys....

✓ allow for use of local model variables, instead of borrowed
✓ improve model accuracy
NCTCOG - Basis for Analytical Tools

- Demographic Inventory
- Counts and Speed Data
- Travel Survey Data
- Models
Travel Survey Data
Agency Cooperation and Partnerships

- Household Travel Survey (NCTCOG, TxDOT, TTI, and FHWA)
- Workplace/Special Generator Survey (NCTCOG, TxDOT, and TTI)
- Commercial Vehicle Survey (NCTCOG, TxDOT, and TTI)
- Airport Travel Survey (NCTCOG, DFWIA, and DLFA)
- Transit Onboard Survey (NCTCOG, DART, DCTA, FWTA)

✓ External Trip Survey (NCTCOG, TxDOT, TTI)
External Station Surveys

History and Evolution

• In past used roadside intercept and video capture methods

• TxDOT External Surveys suspended in 2007

• 2010-2014 research/trials of New Technology
  – Numerous TTI studies test GPS for O-D
  – 2010 Bryan-College Station External Study Using Bluetooth
  – 2014 Tyler External Study Using Bluetooth, Cell, and GPS
  – 2010 – present, dozens of studies in U.S. using cell data for O-D

✓ New technology research transitioning into practice
### Why are External Surveys Important?

**Answer:** High proportion of External VMT to Total VMT

<table>
<thead>
<tr>
<th>Urban Area (*)</th>
<th>Total VMT</th>
<th>External VMT</th>
<th>Percent of Total VMT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amarillo (2005)</td>
<td>6,177,500</td>
<td>1,794,000</td>
<td>29.0%</td>
</tr>
<tr>
<td>Austin (2005)</td>
<td>39,869,000</td>
<td>6,566,100</td>
<td>16.5%</td>
</tr>
<tr>
<td>Dallas-Fort Worth (2005)</td>
<td>168,650,000</td>
<td>14,601,700</td>
<td>8.7%</td>
</tr>
<tr>
<td>Killeen-Temple (2006)</td>
<td>7,338,100</td>
<td>2,391,000</td>
<td>32.6%</td>
</tr>
<tr>
<td>Rio Grande Valley (2004)</td>
<td>18,860,000</td>
<td>2,702,500</td>
<td>14.3%</td>
</tr>
<tr>
<td>San Antonio (2005)</td>
<td>48,893,900</td>
<td>7,172,800</td>
<td>14.7%</td>
</tr>
<tr>
<td>Tyler (2004)</td>
<td>6,207,000</td>
<td>3,084,600</td>
<td>49.7%</td>
</tr>
<tr>
<td>Waco (2006)</td>
<td>6,918,300</td>
<td>3,061,300</td>
<td>44.2%</td>
</tr>
</tbody>
</table>
New Technology in Travel Surveys

- Bluetooth (BT)
- Cellular Data
- GPS
- Validation Tools
  - classification
counts and travel
time

- Trip Tables
- Trip Length Freq.
- Corridor Studies
- Select Link and Zone Analyses
- Residency Status
- Trucks/Feight
## Comparison of O-D Data by Technology

<table>
<thead>
<tr>
<th>O-D Data Element</th>
<th>Technology</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cell</td>
</tr>
<tr>
<td><strong>Data unit</strong></td>
<td>Cell sighting based on event or network hand-over</td>
</tr>
<tr>
<td><strong>Positional accuracy</strong></td>
<td>Ave. 300 meters</td>
</tr>
<tr>
<td><strong>Data saturation/penetration</strong></td>
<td>Good, but varies</td>
</tr>
<tr>
<td><strong>Sample frequency</strong></td>
<td>Varies widely, in minutes to hours</td>
</tr>
<tr>
<td><strong>Continuous data stream?</strong></td>
<td>No, random events</td>
</tr>
<tr>
<td><strong>How trips estimated and defined</strong></td>
<td>Based on activity clusters</td>
</tr>
<tr>
<td><strong>Anonymization</strong></td>
<td>Encrypted to anonymize individual device IDs</td>
</tr>
</tbody>
</table>
DFW External Survey Overview

- O-D study using cell, GPS, Bluetooth (BT)
- NCTCOG 13 County Region
- Top 50 External Stations used
- Focus on
  - E-E, E-I/I-E trips
  - Ave. weekday trips
- BT used to benchmark cell and GPS E-E results
Data Collection/Capture

Time Periods

- **Bluetooth** - 2 weeks, February 14 – February 27
- **Cell** - 4 weeks, February 7 – March 6
- **GPS** - 3 months, January 11 – April 8
Bluetooth Data Collection

- BT and class count data collected at 49 external stations
- MAC addresses matched between external stations and expanded to counts
- Represents samples of actual trip making
- Obtains E-E trips and percent ‘local’ vs. ‘through’ trips by site
Cell O-D Data

What it Represents

- Data from 1 cell carrier
- Estimated device movements, person trips
- Spatio-temporal analysis of device over weeks/months
- Algorithms used to
  - ID activity points and trip ends
  - Impute/derive representative movements of each device
- Data expanded to census tract of device home
Cell Data Capture Areas

- Model TAZs Aggregated to Census Tracts
- 1333 Census Tracts Inside Study Area
- External Travel Sheds
  - Boundary (187)
  - Outer (13)
Cell Data Processing, Analyses

• Acquiring 1 month of data from Airsage for 1533 total zones

• Data review/processing items:
  – Remove trips that did not cross study boundary
  – Check residency

• For E-E: develop trip matrix, counts by station, percent resident vs non-residents by station

• For E-I/I-E: develop matrix, trip length frequency distributions (TLFD)
Details About GPS O-D Data

• Study to use INRIX – ‘Insights Trips’ O-D product because
  – It can estimate E-E trips
  – It can provides waypoints between trip ends

• Data provided in four class categories
  – Consumer vehicles, taxi/shuttle, local/service fleets, for hire trucking fleets

• Data provided in six vehicle weight classes

• Sources: In-vehicle navigation systems, fleet/freight, mobile devices, mobile apps, portable navigation devices
GPS Data
Processing, Analyses

• Acquiring 3 months of data with waypoints
• TTI and NCTCOG will analyze to
  – ensure anonymization did not result in misclassification of E-E, E-I, and I-E trip types
  – to develop E-E, E-I/I-E trip matrices and count totals by station
• Data will be expanded to counts and matrices balanced
• Same E-E time constraints as used for Bluetooth
### Parts of all Technologies to be Used to Develop Results

<table>
<thead>
<tr>
<th>External Surveys</th>
<th>Suitability by Geographic Scale</th>
<th>Cell Data</th>
<th>Third-Party GPS Data</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>E-E trips</td>
<td>limited</td>
<td>✔ ✔</td>
<td></td>
<td>GPS more comparable to Bluetooth. Limited ability to apply E-E travel time constraints with cell.</td>
</tr>
<tr>
<td>E-I/I-E trips</td>
<td>✔ ✔</td>
<td>✔</td>
<td></td>
<td>For large regions cell may be best due to good sample penetration. However, GPS may be better at urban TAZ and smaller geographies.</td>
</tr>
<tr>
<td>Trip purpose</td>
<td>✔</td>
<td>❌</td>
<td></td>
<td>Cell estimates trip purposes based primarily on device’s home and work locations</td>
</tr>
<tr>
<td>Residency</td>
<td>✔</td>
<td>❌</td>
<td></td>
<td>Resident vs. non-resident splits provided by cell data</td>
</tr>
<tr>
<td>Commercial/Freight</td>
<td>❌</td>
<td>✔</td>
<td></td>
<td>GPS can split O-D data into freight and non-freight sources</td>
</tr>
<tr>
<td>Route information</td>
<td>❌</td>
<td>✔ ✔</td>
<td></td>
<td>GPS can determine route between O-Ds using waypoints</td>
</tr>
<tr>
<td>Ability to apply travel time constraint</td>
<td>❌</td>
<td>✔</td>
<td>Typically needed to develop E-E trips/matrices.</td>
<td></td>
</tr>
</tbody>
</table>
Comparisons to be Made in Developing Results

- E-E trips between BT, cell, and GPS
- Commercial/freight E-E trips between BT and GPS
- E-I/I-E matrices between cell, GPS, and NCTCOG model
- Trip length frequency’s (TLFs) between cell, GPS, and NCTCOG model
Comparison Example from 2014 Tyler Study
E-E Results by Technology

![Comparison Example from 2014 Tyler Study](image)
Comparison Example from 2014 Tyler Study

E-I/I-E Results – Total Trips
Saturation/Distribution across Internal TAZs
Other Uses for DFW Cell and GPS Data Purchases

- GPS – Select Link, Corridor Analyses
- GPS – Select Zone Analyses

Through Trips Between Counties Surrounding Moore County


Source: Paul Morris, SRF Consulting Group, I-94/TH 62 Study, 1/20/16 presentation to Met Council
Most Anticipated Answers to Questions...

• How much will the GPS sample penetration increase over the Tyler Study?
• How well will the E-I/I-E distributions across the study area compare between cell and GPS?
• How much will the commercial bias in GPS data be reduced?
• How will the E-E results compare between technologies?
  – Will GPS results be good enough to end use of Bluetooth?
  – Will cell E-E be good enough to be of value?
• How many different ways will TTI, TxDOT, and NCTCOG find to repurpose this data!
Final Thoughts and Conclusions

• Study analyses should be complete by end of 2016
• Final Report should be out in Spring or Summer of 2017
• Combination of technologies and providers is ‘ideal’ approach to capture all type and categories of O-D, plus extra attributes
• New technology O-D
  – can be used many types of O-D studies
  – still evolving and will continue to change
• New FHWA Report coming out soon will provide guidance
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- Zhen Ding
Questions ??
Coming Soon...

Synopsis of New Methods/Technologies to Collect O-D Data

FHWA Study Lead by TTI

Should be out in July or August
Counts and Speed Data

- Traffic Count Data
  - TxDOT Saturation Counts
  - TxDOT District Counts
  - Local Government Counts

- Speed Data
  - National Performance Management Research Data Set (NPMRDS)

- Transit Data