Overview

Joint survey design with MTC, SCAG, SACOG and SANDAG (MPO Partners)

- MTC is contracting agency
- Project has been awarded but not contracted

3 Phase Program

1. Cooperative survey development
2. Ongoing maintenance of survey infrastructure, methodology testing, and refinements
3. Travel survey data collection
Overall Approach
Highlights of Approach

• Novel work for household data collection
• Demonstration of smartphone application
• Improving survey participation
• Providing survey materials
• Targeting hard-to-reach populations
Innovations for travel data collection

Embrace new technologies to retain strengths of existing methods that drive down cost and drive up data quality.

- **Stated Preference Surveys**
  - 1986 RSG leads used of SP for tolling and new modes

- **On-line Surveys**
  - 1995 RSG pioneers on-line surveys, builds rSurvey

- **Smartphone Surveys**
  - 2010 RSG builds rMove, adding features through extensive testing
rMove
A Smartphone Application for Travel Surveys

• Support Website

• Android Store Listing

• Apple Store Listing
The Basics

- Automatically runs in background & on device power-up
- Multiple smartphone sensor utilization (GPS, compass, WiFi)
- Adaptive GPS collection technology to optimize battery life
- Automatic recording of trip path & duration
- Automatic trip start & end/stop detection
How Does it Work?
Steps for Respondents

1. Notification of in-app trip survey, triggered after stop
2. Validation of trip start and end
3. Selection of which vehicle used and persons in HH on trip
4. Ability to give feedback, report errors and
   – Split trips
   – Merge trips
   – Add trips
5. Confirmation of any repeat trips that are matched
Automatic Data Transfer & Communications Reduces Cost

- Automatically encrypted transfer of data to server immediately after each trip is complete (assuming connection)
- Automatic monitoring of hardware: Reminders if GPS/WiFi turned off
- In-app messages indicating start and end of assigned data collection period
Timely Prompted Recall Improves Data Quality

Madison County 7-day Survey
17% of trip surveys answered within 10 minutes of travel
Accurate Trip Recording Reduces Under-reporting

- Fewer no-travel person-days
- More 10+ trip person-days
- Higher trip rates overall

**Distribution of Weekday Trips**

**Trip Rates by Person Day**

<table>
<thead>
<tr>
<th>Day</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Move Day 1</td>
<td>5.64</td>
</tr>
<tr>
<td>Move Day 2</td>
<td>6.29</td>
</tr>
<tr>
<td>Move Day 3</td>
<td>6.17</td>
</tr>
<tr>
<td>Move Day 4</td>
<td>7.25</td>
</tr>
<tr>
<td>Move Day 5</td>
<td>6.14</td>
</tr>
<tr>
<td>Move Day 6</td>
<td>4.81</td>
</tr>
<tr>
<td>Move Day 7</td>
<td>5.51</td>
</tr>
<tr>
<td>Diary-based</td>
<td>4.02</td>
</tr>
</tbody>
</table>
Trip Rates by Age and Income in Seattle

Higher and more stable trip rates among young adults and higher income adults
Households without Smartphones

Cost Tradeoffs

- Smartphone ownership increasing, but still 68% of US adults
  - Most non-owners are older adults, low-income adults
- Lending smartphones to non-owners is expensive (similar to GPS devices)
  - And users may not be tech-savvy (need more support - Ohio pilot data...)
- Recommend...supplement rMove surveys with on-line or phone surveys for children and non-smartphone owners
  - The rMove and diary-based data are compatible and can be used jointly in modeling

Focus on Media of Choice

- Providing smartphones less cost-effective
- On-line or phone offered instead
Multi-day Data
More Data Across Segments

- Better coverage of origin/destination patterns
- More data on rarer modes (transit, walk, bike) which people often use only on certain days
- More data on day & time-specific travel
  - Saturday and Sunday travel patterns
  - Weekly travel patterns, substitution of activities across days
  - Day-to-day variability in peoples’ behavior
  - Travel patterns by time period, effects of congestion

Ohio Leisure/Entertainment Trips By Hour & Day of Week
Supplemental Survey Materials

- Websites
- Website, Postcards, Letters
Successful Surveys

It’s not just about the smartphone app!

**MANAGEMENT**
1. Project
2. Communication
3. Scope
4. Cost
5. Schedule
6. Change
7. Quality
8. Risk
9. Deliverables

**DESIGN AND ADMINISTRATION**
- Sample Frame and Methods
- Convenience Samples
- Cloud Servers
- Quality Control
- Data Monitoring
- Weighting and Expansion
- Data Cleaning and Processing
Reducing Respondent Burden
All-in-One Travel Diary Experience Reduces Respondent Burden

- Provide complete trip data using the same device
- People have phones with them: rarely forget them or leave in the car
- People often check phones: e.g. answer questions while waiting in a line
- Validating and correcting trips on the same device
Burden Reduction Leads to Better Data

Why does this matter?
• Decreasing response rates
  • Recall and non-response biases

Features that reduce burden
• Built in “help” features & prompts/alerts
• Automatic behavior in background
• Automated customization/validation
• In-app ability to edit/add trips
Intelligence (also) Leads to Better Data

Trip Matching Reduces Burden
- Repeat trips matched to reduce respondent burden
  - Example: Same home to work commute
- Answers from matched trips are pre-populated so users can accept or change details for the trip
  - 26% of trip matches are revised

Avoids Data Inconsistencies
- 74% of trip matches are correct
- Continuing to improve trip matching
Future Improvements

Further drive down burden & improve intelligence

- Extend all-in-one experience
- Extend behavioral “nudging” of participants
- More intelligence based on previous trips and reported habitual points of interest
- More machine learning for data cleaning/processing
- Leverage smartphone improvements (new sensors, better battery life, etc.)
Economies of Scale and Optional Features
Economies of scale related to *standardization*

- Questionnaire design
- Questionnaire software programming
- Sampling approaches and data processing
- Outreach recommendations and examples
- Translation of materials to new languages
- Joint pre-testing across multiple regions
- Survey data formats and processing, including QA/QC
Economies of scale related to *improvements*

- “Compensatory oversampling” anticipates non-response bias and accommodates in advance
- “Targeted oversampling” obtains data more efficiently for rare and hard-to-reach segments
- Smartphone-based approach provides multiple travel days and more trips per day, as well as new types of spatial and temporal data (route choice, walk and wait times, etc.)
Accommodations to maintain *agency flexibility*

- Agencies add own set of questions in addition to the core standard questions.
- Agencies set own parameters for sampling—which groups to oversample and to what extent.
- Agencies devise own outreach priorities and strategies using local knowledge and outreach firms.
What are the required core components?

• A sampling plan setting invitation rates by Census block group, with appropriate oversampling

• A recruitment survey, administered by internet or telephone (including smartphone)

• Collection of one or more days of travel data using a mobile app for smartphone owners and internet or telephone retrieval for others.

• Data processing, cleaning and QA/QC
What could be optional?

- Pre-tests in Phase 2 and 3
  - Only as needed to test changes in survey design
- Translating materials into more languages
- Supplemental survey components/markets
  - Long distance survey
  - Visitor survey
  - University student survey (incl. group quarters)
  - Military base survey (incl. group quarters)
  - Special generator surveys (airports, malls, etc.)
  - Attitudinal and stated preference questions
  - Convenience samples for new behaviors
Strategies for Hard-to-Reach Households
RSG will use a multilayered approach to ensure the study is **accessible and engaging** from end to end.

### Targeted Sampling

Use geographic oversampling to send **more invitations** to oversample hard-to-reach populations.

### Targeted Outreach & Communication

- Multi-language translations and help facilities/websites
- Regionally-specific recruit material to increase engagement
- Additional calls or emails to certain participants
- In-person outreach to local communities

### Targeted Incentives

- Proposed incentive design helps target larger HHs
- Incentive design can be targeted several ways. Possible to “delay” differential incentives until the need is evident.
Studies have to overcome many barriers to participation, which are often interrelated.
Who is hard to reach? Language examples

<table>
<thead>
<tr>
<th>Geography</th>
<th>Total HHs</th>
<th>% English</th>
<th>% Spanish and not English</th>
<th>% Other and Not English</th>
<th>% of HHs Speaking English or Spanish</th>
</tr>
</thead>
<tbody>
<tr>
<td>State of California</td>
<td>12,617,280</td>
<td>90.4%</td>
<td>5.6%</td>
<td>4.1%</td>
<td>95.9%</td>
</tr>
<tr>
<td>Los Angeles County</td>
<td>3,242,391</td>
<td>86.0%</td>
<td>8.1%</td>
<td>5.9%</td>
<td>94.1%</td>
</tr>
<tr>
<td>San Diego County</td>
<td>1,083,811</td>
<td>92.2%</td>
<td>4.8%</td>
<td>3.0%</td>
<td>97.0%</td>
</tr>
<tr>
<td>Orange County</td>
<td>1,002,285</td>
<td>90.6%</td>
<td>4.3%</td>
<td>5.2%</td>
<td>94.8%</td>
</tr>
<tr>
<td>Riverside County</td>
<td>690,388</td>
<td>93.2%</td>
<td>5.4%</td>
<td>1.4%</td>
<td>98.6%</td>
</tr>
<tr>
<td>Santa Clara County</td>
<td>614,714</td>
<td>88.7%</td>
<td>3.3%</td>
<td>8.0%</td>
<td>92.0%</td>
</tr>
<tr>
<td>Sacramento County</td>
<td>519,460</td>
<td>93.1%</td>
<td>2.5%</td>
<td>4.3%</td>
<td>95.7%</td>
</tr>
<tr>
<td>San Francisco County</td>
<td>348,832</td>
<td>87.5%</td>
<td>2.2%</td>
<td>10.4%</td>
<td>89.6%</td>
</tr>
</tbody>
</table>

Source: ACS 2010-2014 - Table 16002
## Languages currently available

<table>
<thead>
<tr>
<th>Study item</th>
<th>Languages Currently Available</th>
<th>% of total translation effort (est.)**</th>
</tr>
</thead>
<tbody>
<tr>
<td>rMove</td>
<td>English, Spanish</td>
<td>25%</td>
</tr>
<tr>
<td>Online Recruit Survey</td>
<td>English + Google Translate</td>
<td>25%</td>
</tr>
<tr>
<td>Online Travel Diary</td>
<td>English + Google Translate</td>
<td>15%</td>
</tr>
<tr>
<td>Mail materials</td>
<td>English, Spanish</td>
<td>25%</td>
</tr>
<tr>
<td>All Other Comm. (e.g. emails, calls)</td>
<td>English, Spanish</td>
<td>10%</td>
</tr>
</tbody>
</table>

*Assumes the project would reuse material from the SANDAG HTS.

** “Total translation effort” implies translating all study material and printing/mailing a letter.
Emerging Trends in Travel Behavior
**View of the Future**

- **Exciting times**
  - Datasets have revolutionized fields: Framingham Heart (medicine), Nielsen (media), Knowledge Networks (social science), …
  - Time for a revolution in transportation. Let’s lead in California.

- **Future Key #1: Blending data**
  - Household travel diaries will always play a role
  - Move beyond smartphone as conduit for gathering traditional information
  - Call data records
  - Social Media
  - Real-time transport level of service and land use databases

- **Future Key #2: Blending methods**
  - Econometrics will always play a role
  - Machine learning/CS

- **Future Key #3: Diving deep in dynamics and continuous data collection**
  - Facing key trends now
  - Habit formation and lifestyle choices critical
  - Access behavioral responses to naturalistic and planned experiments
Leveraging “Big data” Resources

• Passive location data (AirSage, Streetlight, Inrix, etc.)
  – OD flows for survey expansion and model calibration

• User transactions data (transit smartcards, toll transponders, bikeshare usage, etc.)
  – Flow and cost data of specific modes for survey expansion and model calibration

• Non-Census socio-demographic data (retail transactions data (Eclipse, Experion, etc.)
  – Useful for targeted sampling and weighting

• Social media (Facebook, Twitter; Craigslist; Yelp, etc.)
  – Useful for convenience sampling and recruitment
  – Useful for data mining and outreach
Emerging Changes in Travel Behavior

• Usage of new types of vehicles (plug-in Evs, future Avs, etc.)
  – Convenience sampling via DMV data (e.g. CEC Vehicle Survey)

• Usage of new sharing systems (CarToGo, Zipcar, Lyft, Uber, bike share, many new types that will arise)
  – Convenience sampling via systems sending out survey invites to their users. (Have done this for paratransit and vanpool systems.)

• New preferences of Millennials and next generation
  – Can add targeted attitudinal and preference questions. (Have done this for a number of recent TRB studies.)

• Others that we don’t know about yet…
  – Leave flexibility for adding new types of questions.
Survey Methods to Efficiently Measure Changes

Sweet Spot
For Cost Savings & Current Data

Design Decisions
- Frequency of Data Collection
- Mix of cross-sectional & panel sample
- Supplemental Surveys
- Mix of technologies
- Mix of geographies

Example Projects
- State of Ohio
- PSRC (Seattle)
- State of Utah
Summary
Summary

• Integrate survey and travel demand modeling needs in survey design
• Set sample size and schedule expectations
• Use innovative technologies & methodologies that have been tested elsewhere
• Pragmatically embrace change as means to increase data quality and decrease costs