Activity-Based Model Future Mobility Experiments
Experiments with AV-Exclusive Facilities

presented by
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October 17, 2017
Outline

• Previous Work
• Scenario: AVs on HOTs
• Implementation
• Results
• Discussion
Background

- **Models** are applied to gauge the demands for and the sizes of new facilities
- **Emerging technologies** will disrupt travel behaviors
- Three phases
  - Review of relevant literature
  - Identify key parameters and data needs
  - Compile regional, national trends, and discuss potential scenario testing

Objectives

- Compile information on emerging technologies from identified sources and case studies
- Gather regional and national trends in a manner to support discussion of potential scenario testing
- Provide definition to specific scenarios that could be tested with the SERPM 7 model to support policy analysis
- The findings can be applied to test and shape policies in regional and MPO LRTPs to achieve their goals and objectives. It can also help to project more accurate demands for projects
- Evaluate the SERPM 7 model’s capability to test future scenarios and inform development of SERPM 8
Scenario Development

Identified Potential Scenarios for Modeling the Travel Behavior Impact of:

- Changing demographics
- Emerging technologies

Focused on How to Model in SERPM 7 ABM Environment

Six Scenarios

- Scenario 1 – Millennials Behave Differently
- Scenario 2 – New Transportation Services Reduce Need for Driving
- Scenario 3 – Emerging Technologies Enhance Transit Systems
- Scenario 4 – Managed Lanes Used Differently
- Scenario 5 – AV Technology Affects How People Travel
- Scenario 6 – Combined
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AVs on HOTs Scenario Motivation

• Mixed fleet limits potential for capacity / speed improvements
  – Maybe even detrimental effects in the near term?
• If an exclusive facility could be dedicated to AVs, would that be a net benefit to the system?
• At what point?
  – Market penetration
  – Travel behavior shifts
  – Capacity increases
Relevant Benefits

- Use facilities more efficiently
- Less onerous in-vehicle travel time
- Reduce the need for paid parking
- Greater mobility for non-drivers
Based on the Generalized Bass diffusion model
- Investigated previous penetration patterns for automobiles (from 1920 to 2014) and hybrid electrical vehicle
- Considered technology acceptance tastes through the usage of internet and cell phones from 2001 to 2014.

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SERPM Overview

• Current model: SERPM 7.0
  – 2010 base / 2040 forecast
  – Activity-based model for residents
  – Tour-based model for visitors
  – Half-hour time periods (5AM – 12AM)
  – 5 Highway assignment Time periods
    • Auto occupancy; Pay / No Pay / HOV
  – 4 Transit assignment time periods
    • Access mode

• Represents 3 counties
  – 2.1M households and 5.5M persons

• SERPM 8.0 Model Update
  – New HH survey and Streetlight data
  – 2015 Base / 2045 Forecast
Implementation approach

• **Where available**: pivot off of existing model parameters or extend existing structures

• **Where not available**: introduce new terms and calibrate the model to reproduce scenario shares

• **Make changes incrementally** – examine results of demand and supply models

• Single-pass model run
  – Capacity increase scenarios seeded with skims from a full model run

• Full model run (speed feedback)
  – Seeded skims used to reduce run time
• Household attributes
  – Household income <75k
  – Number of Vehicles in HH
• Spatial attributes
  – Intersection density
  – Population density
  – Retail density
• Person attributes
  – Long commute (>35 miles)
  – Education (Bachelors or higher)
  – Proportion of drivers under 30
  – Proportion of drivers age (Greater than 49)
  – Male driver in HH
Market Penetration Scenarios

- Assumes earlier adoption by higher income households (>75K annually) and households with 3 or more vehicles.

<table>
<thead>
<tr>
<th>Market Penetration</th>
<th>HH Income</th>
<th>HH Vehicle</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&lt;75K</td>
<td>&gt;=75K</td>
</tr>
<tr>
<td>10%</td>
<td>0%</td>
<td>100%</td>
</tr>
<tr>
<td>30%</td>
<td>20%</td>
<td>80%</td>
</tr>
<tr>
<td>50%</td>
<td>40%</td>
<td>60%</td>
</tr>
<tr>
<td>75%</td>
<td>45%</td>
<td>55%</td>
</tr>
<tr>
<td>90%</td>
<td>50%</td>
<td>50%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Total #HH</th>
<th>HH Income</th>
<th>HH Vehicle</th>
</tr>
</thead>
<tbody>
<tr>
<td>2,801,906</td>
<td>&lt;75K</td>
<td>&gt;=75K</td>
</tr>
<tr>
<td>1,855,857</td>
<td>946,049</td>
<td>2,412,337</td>
</tr>
</tbody>
</table>
Implementation Assumptions

• All HOT facilities become exclusive AV facilities
  – Maintain current toll rate

• All auto travel by persons in an AV household are by AVs
  – And the opposite is true for non-AV households

• ZOV operation is limited
• Previous Work
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### Scenarios Explored (to date)

<table>
<thead>
<tr>
<th>AV Market Penetration</th>
<th>Underage Drivers</th>
<th>IVTT Sensitivity</th>
<th>Parking Costs</th>
<th>Managed Lane Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>10%</td>
<td>&gt;=11 yrs can drive</td>
<td>10% reduction</td>
<td></td>
<td></td>
</tr>
<tr>
<td>30%</td>
<td></td>
<td>20% reduction</td>
<td></td>
<td>90% increase</td>
</tr>
<tr>
<td>50%</td>
<td></td>
<td>50% reduction</td>
<td></td>
<td></td>
</tr>
<tr>
<td>90%</td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>
• **Mobility**: auto ownership, technology, transponder

• **Daily activity pattern**: tours by type, trip chaining, tour rates, intra-household coordinated travel, trips by type

• **Tour** location and time of day distributions

• **Mode choice** by income and region

• **Transit** ridership by submode, area type, region

• **Highway**: trip length; by facility type VMT, VHT, average speed, delay
Impact of AVs on Travel Behavior

AV Household Mode Shift

- drive_alone: Cap 90 / P 10 Iter2
- carpool_2: Cap orig/P 10/ChildDA/IVTT10/Park20
- carpool_3: Cap orig/P 10/ChildDA/IVTT10/Park20
- kissride: Cap orig/P 10/ChildDA/IVTT10/Park20
- parkride: Cap orig/P 10/ChildDA/IVTT10/Park20
- walktotransit: Cap orig/P 10/ChildDA/IVTT50/Park20
- schoolbus: Cap orig/P 10/ChildDA/IVTT50/Park20
- bike: Cap orig/P 10/ChildDA/IVTT50/Park20
- Walk: Cap orig/P 10/ChildDA/IVTT50/Park20
HOT Capacity Increase

Change in Network Delay

Network Delay

AV Market Penetration

- HOTs exclusive to AVs
- HOTs 90% Capacity Increase
Change in Network Delay

- IVTT 10% Reduction

AV Market Penetration

- 10% HOTs exclusive to AVs
- 30% AV Behavior Impact - 10% IVTT Reduction
- 50% AV Behavior Impact - 10% IVTT Reduction
- 90% AV Behavior Impact - 10% IVTT Reduction
IVTT 10% and 50% Reduction

Change in Network Delay

AV Market Penetration

Network Delay

- HOTs exclusive to AVs
- AV Behavior Impact - 10% IVTT Reduction
- AV Behavior Impact - 50% IVTT Reduction
Cumulative and Exclusion

Change in Network Delay

AV Market Penetration

- AV Behavior Impact - 50% IVTT + No HOT Exclusion
- AV Behavior Impact - 50% IVTT Reduction
- AV Behavior - 50% IVTT + 90% Capacity Increase
Cumulative and Exclusion - VMT

Change in VMT

AV Market Penetration

Network Delay

- AV Behavior Impact - 50% IVTT + No HOT Exclusion
- AV Behavior Impact - 50% IVTT Reduction
- AV Behavior - 50% IVTT + 90% Capacity Increase
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Model Challenges/Lessons Learned

• Accessibility feedback

• Run time
  – Single iteration for exploratory analysis
  – Experiment design

• Complexity
  – Checklists!*

*The Checklist Manifesto, Atul Gawande
Future Experiments

• Scenario 1 – Millennials Behave Differently
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Acknowledgements

• FDOT District 4
  – Lois Bush
  – Shi-Chiang Li
  – Larry Hymowitz
  – Hui Zhao

• FIU
  – Xia Jin
  – Seyedmirsajad (Sajad) Mokhtarimousavi
  – Mohammad Lavasani (Caltran Group)

• Cambridge Systematics
  – Jay Evans
  – Jingjing Zang
  – Kazi Ullah
  – Tom Rossi
  – Peter Haliburton
  – Peng Zhu
Questions?

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Other Scenarios
Comparison of Hypothesized and Model Results

Enduring Shift  Ongoing Decline

Change in VMT

-40%  -30%  -20%  -10%  0%

Scenario  Model
AV Scenario: Change in Daily Volume

Highway capacity improvements shifted traffic to major facilities