CHARACTERISTICS OF PREMIUM TRANSIT SERVICES THAT AFFECT MODE CHOICE

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• H-37 research team:
  – RSG
  – University of Texas at Austin
  – Arizona State University
  – Stephane Hess
  – AECOM
  – Parsons Brinckerhoff
Overview of TCRP H-37 study

Research project to understand the range of determinants for mode choice behavior and to offer practical solutions for representing and distinguishing these characteristics in travel demand forecasting models
Principal findings

• Value of non-traditional transit service attributes on travelers’ choice of mode is between 12 and 30 minutes of in-vehicle time

• Awareness and consideration and traveler attitudes may play a role but not definitive and unclear how modeled

• Models with non-traditional attributes coupled with attribute-driven choice structures can reduce arbitrary constants with little impact on model fidelity
Problem statement
Issues with traditional forecasting models used for transit forecasting

• Inadequate validation of:
  – Model inputs
  – Representation of transit trip-making patterns by origin/destination areas, traveler SE characteristics, mode of access, transit path-type

• Even when validated…
  – Time and cost appear to be only part of the picture
  – Poorly understood “silver bullets” (mode-specific constants) required to match observed ridership on fixed guideway routes
  – Transit sub-mode structures don’t always reflect array of choices
Problems with “silver bullets”

When is a fixed guideway mode “better”?  
– Over-the-road coach with Wi-Fi versus standing on crowded subway train?  
– Feeder bus-to-train versus no-transfer bus?  
– Light rail versus commuter rail?  

What about places with very high transit shares (e.g., Seattle) where travelers don’t appear to dislike bus?
Typical choice structure

All Person Trips

Auto

Non-motorized

Transit

Walk-Transit

Walk-Bus
Walk-BRT
Walk-LRT
Walk-CR

Drive-Transit

Drive-Bus
Drive-BRT
Drive-LRT
Drive-CR
Problems with conventional choice definitions

ACCESS MODE DEFINITION
• Conflate kiss-ride and park-ride

MODE DEFINITION AND HIERARCHY
• Typically rail being the highest, bus lowest
• Multimode trips classified at highest level (i.e., bus-rail = rail, often much better than bus-only)

ARBITRARY LABELS AND IMPEDANCES
• Based on vehicle technology, not service attributes
• Not all modes are equal; for example:
  – Premium bus service
  – Crowded, less comfortable rail service

These problems confound analysis of different transit improvement alternatives
Needs

• Understanding of underlying factors that contribute to the “silver bullet”
• Refined modal choice structures
Approach

LITERATURE REVIEW

• Awareness of transit services
• Transit service attributes
• Premium transit services in mode choice models

MARKET RESEARCH

• Surveys conducted in Salt Lake City, Charlotte, and Chicago
• Importance of transit attributes
• Traveler attitudes
• Awareness and consideration of transit services

ANALYSIS AND TESTING

• Model estimation
• Application testing in Salt Lake City
Important non-traditional transit attributes
Research methods for valuing transit service

EXAMPLE TRADE-OFF EXPERIMENT

- Comfort
- Convenience
- Safety

SALT LAKE CITY TRAVEL STUDY

If these were your only choices, which transit option are you MOST LIKELY to use and which are you LEAST LIKELY to use?

Please assume all other aspects of transit service are the same across all of the options.

<table>
<thead>
<tr>
<th></th>
<th>Option #1</th>
<th>Option #2</th>
<th>Option #3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time Riding on Transit</td>
<td>12 mins.</td>
<td>9 mins.</td>
<td>11 mins.</td>
</tr>
<tr>
<td>Transit Fare</td>
<td>$0.80</td>
<td>$1.20</td>
<td>$1.00</td>
</tr>
<tr>
<td>Station/Stop Distance</td>
<td>More than 10 mins. walk of your home/work</td>
<td>Within 10 mins. walk of your home/work</td>
<td>More than 10 mins. walk of your home/work</td>
</tr>
<tr>
<td>Station/Stop Shelter</td>
<td>Effectively protects you from bad weather</td>
<td>Effectively protects you from bad weather</td>
<td>Limited or no shelter</td>
</tr>
<tr>
<td>Route Name/Number Identification</td>
<td>Easy to immediately identify on outside of transit vehicle</td>
<td>Difficult to immediately identify on outside of transit vehicle</td>
<td>Difficult to immediately identify on outside of transit vehicle</td>
</tr>
</tbody>
</table>

(Most Likely) (Least Likely)

(Question 1 of 8)

Next Question

Questions or problems? Please call toll-free 1-888-774-5980 or email TCRP@surveycafe.com
Non-traditional transit service attributes

ON-BOARD AMENITIES

• Seating availability, seating comfort, temperature, cleanliness of a transit vehicle, productivity features.

STATION DESIGN FEATURES

• Real-time information, security, lighting for safety, shelter, proximity to services, cleanliness of the station, benches.

OTHER FEATURES

• Route identification, reliability, schedule span, transit frequency, transfer distance, stop distance, parking distance, ease of boarding, fare machines.
Variations between cities suggest that research might be useful in any new application.
Awareness and Consideration of Transit Options
Awareness of Bus and Rail Modes

Typical models overstate the availability of transit options compared to respondent awareness.

- Charlotte
- Chicago
- Salt Lake City
Consideration of Bus and Rail Modes

- When transit is available, consideration of rail higher than consideration of bus

<table>
<thead>
<tr>
<th>CITY</th>
<th>SURVEY RESPONDENTS</th>
<th>PERCENT OF TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>BUS</td>
<td>TRAIN</td>
</tr>
<tr>
<td>CHARLOTTE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Considered</td>
<td>Chosen</td>
<td></td>
</tr>
<tr>
<td></td>
<td>380</td>
<td>191</td>
</tr>
<tr>
<td></td>
<td>55%</td>
<td>50%</td>
</tr>
<tr>
<td>Not Chosen</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>189</td>
<td>96</td>
</tr>
<tr>
<td>Not Considered</td>
<td>310</td>
<td>102</td>
</tr>
<tr>
<td></td>
<td>45%</td>
<td>50%</td>
</tr>
<tr>
<td>Total Available</td>
<td>690</td>
<td>354</td>
</tr>
<tr>
<td>CHICAGO</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Considered</td>
<td>Chosen</td>
<td></td>
</tr>
<tr>
<td></td>
<td>333</td>
<td>207</td>
</tr>
<tr>
<td></td>
<td>56%</td>
<td>62%</td>
</tr>
<tr>
<td>Not Chosen</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>126</td>
<td>190</td>
</tr>
<tr>
<td>Not Considered</td>
<td>259</td>
<td>126</td>
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<tr>
<td></td>
<td>44%</td>
<td>38%</td>
</tr>
<tr>
<td>Total Available</td>
<td>592</td>
<td>745</td>
</tr>
</tbody>
</table>
Key Findings for Transit Options

• Many travelers are not aware of or do not consider transit options represented by models as “available”

• Travelers are aware of, and consider, rail alternatives more often than bus in 2 out of 3 cases

• Models may be improved by limited choice sets prior to computing modal shares
Traveler Attitudes
Research into Traveler Attitudes

FACTOR ANALYSIS
Incorporate attitudinal factors into
– Awareness and consideration models
– Logit mode choice models

INTEGRATED CHOICE AND LATENT VARIABLES
Simultaneous estimation of attitudes and other latent variables (e.g., walk to transit, informed about transit, etc.) with mode choice
– Allows for forecasting of latent variables

CONCLUSIONS
Attitudes affect transit vs. auto choices but no relationship found for individual transit path choices
Implementation in Travel Models—Salt Lake City Example
## Values of Premium Transit Service Attributes

<table>
<thead>
<tr>
<th>BUNDLED ATTRIBUTE</th>
<th>PREMIUM SERVICE ATTRIBUTE</th>
<th>CRT</th>
<th>LRT</th>
<th>LOCAL</th>
<th>EXP</th>
<th>BRT</th>
<th>VALUE (MIN. OF IVTT)</th>
<th>SCALED VALUE (MIN. OF IVTT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Station Amenities</td>
<td>Shelter</td>
<td>✓</td>
<td>✓</td>
<td>--</td>
<td>✓</td>
<td>✓</td>
<td>0.75</td>
<td>2.88</td>
</tr>
<tr>
<td></td>
<td>Bench</td>
<td>✓</td>
<td>✓</td>
<td>--</td>
<td>✓</td>
<td>✓</td>
<td>0.38</td>
<td>1.45</td>
</tr>
<tr>
<td></td>
<td>Lot Count</td>
<td>✓</td>
<td>✓</td>
<td>--</td>
<td>✓</td>
<td>--</td>
<td>0.00</td>
<td>0</td>
</tr>
<tr>
<td>Onboard Amenities</td>
<td>On-Board Seating</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>--</td>
<td>--</td>
<td>1.81</td>
<td>2.90</td>
</tr>
<tr>
<td></td>
<td>Availability</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>--</td>
<td>--</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Productivity Features</td>
<td>✓</td>
<td>--</td>
<td>--</td>
<td>✓</td>
<td>--</td>
<td>0.82</td>
<td>1.32</td>
</tr>
<tr>
<td></td>
<td>Vehicle Cleanliness</td>
<td>✓</td>
<td>--</td>
<td>--</td>
<td>✓</td>
<td>✓</td>
<td>0.62</td>
<td>0.99</td>
</tr>
<tr>
<td>Other Service Features</td>
<td>Reliability</td>
<td>✓</td>
<td>✓</td>
<td>--</td>
<td>--</td>
<td>✓</td>
<td>5.12</td>
<td>7.79</td>
</tr>
<tr>
<td></td>
<td>Midday Schedule Span</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>--</td>
<td>✓</td>
<td>0.32</td>
<td>0.49</td>
</tr>
<tr>
<td></td>
<td>Evening Schedule Span</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>--</td>
<td>✓</td>
<td>0.32</td>
<td>0.49</td>
</tr>
<tr>
<td></td>
<td>Vehicle Ease of Boarding</td>
<td>✓</td>
<td>✓</td>
<td>--</td>
<td>--</td>
<td>✓</td>
<td>0.14</td>
<td>0.22</td>
</tr>
<tr>
<td></td>
<td>Fare Machines</td>
<td>✓</td>
<td>✓</td>
<td>--</td>
<td>--</td>
<td>✓</td>
<td>0.69</td>
<td>1.06</td>
</tr>
</tbody>
</table>

IVTT with Premium (Percent Reduction in IVT) 21% 21% 0 21% 21%

Premium Benefit (Minutes) 11.0 9.5 2.5 2.6 8.3

Scaled Premium Benefit (Minutes) 19.6 17.3 3.9 6.6 15.4

Relative Non-Premium Service Boarding Penalty 0 2.3 15.7 13 4.2
Path Building Parameters for the Transit Path Choice Model

<table>
<thead>
<tr>
<th>WALK PATH</th>
<th>DRIVE PATH</th>
<th>TRAVELER PREFERENCES</th>
<th>TRANSFER PENALTY</th>
<th>ACCESS/EGRESS TIME</th>
<th>WAIT TIME</th>
<th>NON PREMIUM SERVICE BOARDING PENALTY</th>
<th>PREMIUM SERVICE IN VEHICLE TIME</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>Shorter Access Times, Premium Service</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>0.5</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>Shorter Access Times, Premium Service for Longer Trips</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>0.5</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>Direct, Frequent Service</td>
<td>10</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>Frequent, Non-Premium Service</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>1.5</td>
<td>1</td>
</tr>
</tbody>
</table>
Reducing Impacts of Fixed Parameters

COMPARISON FOR EXAMPLE TRANSIT TRIPS

- Alternative Specific Constants
- Transfer Penalties
- Direct Walk Times
- Boarding Penalties

![Bar Chart](image.png)

- Value of Fixed Parameters in Minutes
- Existing Model vs. Transit Path Choice Model
- Trips: Walk to Local Bus, Walk to Express Bus, Walk to LRT, Walk to Local Bus to LRT, Drive to Local Bus, Drive to Express Bus, Drive to LRT, Drive to CRT
Implementation Lessons Learned

PATH CHOICES

• Enumerating path choices based on observed behavior improved accuracy

• Revising mode choice model nesting structures improved the representation of competitive services and reduced the reliance on modal labels

ALTERNATIVE SPECIFIC CONSTANTS

• Accounting for all transit service attributes reduced the influence of alternative specific constants in the mode choice models
Benefits for Forecasting
Accounting for Non-Traditional Transit Service Attributes

VALUE

• Premium service attributes account for a range of 17-29 minutes of in-vehicle travel time

MODEL STRUCTURE

• Enumerating path choices based on observed behavior improves the choices provided for each access mode
• Revising mode choice model nesting structures improves the representation of competitive services

BIAS

• These improvements effectively reduce the influence of alternative-specific constants in the mode choice models