THE AFFECT OF THE BUILT ENVIRONMENT NEAR FIXED GUIDEWAY TRANSIT SYSTEMS ON MODE SPLIT AND VEHICLE OWNERSHIP

PRESENTED FOR: RMLUI
MARCH 17, 2017

Presented by Anthony Avery
<table>
<thead>
<tr>
<th>What are these data?</th>
<th>What aren’t they?</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Researchable by anyone with a computer</td>
<td>• Statistically significant</td>
</tr>
<tr>
<td>• Meant to stimulate discussion, thought, and research</td>
<td>• Peer reviewed</td>
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<tr>
<td>• Generally follow the scientific method</td>
<td>• Meant to reflect academic standards</td>
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<td>• Analyzed to provide guidance for Aurora moving forward</td>
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</tbody>
</table>
Hypothesis

- The built environment plays a role in how we experience our city.
- Increasing the urban form and development intensity in transit areas will reduce SOV commute mode split and reduce automobile ownership.

Iteration #1

- Higher population densities will result in lower single-occupancy vehicle (SOV) mode split, higher transit ridership, and lower vehicle ownership.
Identification

- Started with just Metro Denver
  - Metro Denver has only 19 stations open >10 years as of 2015. Wanted a larger sample size.
  - Expanded to Salt Lake City, Portland, and Seattle. 165 open stations in 2015 with population figures.
  - Growing metro regions with active populations and proximity to outdoor recreation

Data Collection

- Station Data
  - Trimet.org, rtd-denver.com, rideuta.com, soundtransit.org
  - Identified all stations, park and ride stations w/ parking spaces, year each station opened
  - FOIA requests or public website to get boarding data at each station

- Missouri Census Data Center
  - 2011 – 2015 ACS block groups within ½ mile of LRT stations
  - Population, households, vehicle ownership, income, home ownership, commute mode split
MSA Total and TOD Population

- Denver: 193,548
- Portland: 280,045
- Salt Lake City: 149,409
- Seattle: 97,076

1/2 Mile Population:
- Denver: 4.3%
- Portland: 7.3%
- Salt Lake City: 3.7%
- Seattle: 8.9%

Population Characteristics:
- Denver: 0%
- Portland: 2%
- Salt Lake City: 4%
- Seattle: 6%

Percentage:
- Denver: 10%
- Portland: 12%
- Salt Lake City: 14%
- Seattle: 10%

MSA Commute and Auto Ownership

- SOV Commutes
- Transit Commutes
- Cars Per Household

Comparison between cities:
- Denver vs. Portland vs. Salt Lake City vs. Seattle
Station Area Average and Max Density

Number of Stations by Transit Mode Split
### Parking Spaces and Transit Mode Split

<table>
<thead>
<tr>
<th>City</th>
<th>Parking Spaces</th>
<th>Public Transit</th>
<th>Average Station Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Denver</td>
<td>2,000</td>
<td>10%</td>
<td>2,000</td>
</tr>
<tr>
<td>Portland</td>
<td>4,000</td>
<td>7%</td>
<td>4,000</td>
</tr>
<tr>
<td>Salt Lake City</td>
<td>6,000</td>
<td>4%</td>
<td>6,000</td>
</tr>
<tr>
<td>Seattle</td>
<td>8,000</td>
<td>1%</td>
<td>8,000</td>
</tr>
</tbody>
</table>

### Average Station Population and Mode Split

- **R² = 0.9803**

<table>
<thead>
<tr>
<th>Average 1/2 Mile Population</th>
<th>Transit Mode Split</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>2,000</td>
<td>1%</td>
</tr>
<tr>
<td>4,000</td>
<td>2%</td>
</tr>
<tr>
<td>6,000</td>
<td>3%</td>
</tr>
<tr>
<td>8,000</td>
<td>4%</td>
</tr>
<tr>
<td>10,000</td>
<td>5%</td>
</tr>
</tbody>
</table>
SOV Mode Split by Population within ½ Mile of Station

Auto Ownership Per Household by Population within ½ Mile of Station

R² = 0.2222

0.0% 10.0% 20.0% 30.0% 40.0% 50.0% 60.0% 70.0% 80.0% 90.0% 100.0%

0 5,000 10,000 15,000 20,000

R² = 0.2728

0 5,000 10,000 15,000 20,000

R² = 0.2222
Iteration #1

- Higher population densities will result in lower single-occupancy vehicle (SOV) mode split, higher transit ridership, and lower vehicle ownership

Analysis #1

- Low R-Value suggests lack of strong relationship.
- It appears that there may be an upper limit to SOV mode split and automobile ownership related to density above 7,000 persons per square mile.
  - Lack of data points in SLC and Denver mean this could be regionally dependent.
Collect Additional Data

• Measured walking distance from each station to the Downtown core
• Collected Walkscore for all stations, Transitscore and Bikescore for those available

Iteration #2

• A higher Walkscore or Transitscore will result in a lower SOV mode split and lower automobile ownership
Where are the Walkscores?

Where are the Transitscores?
WALKSCORE AND TRANSITSCORE

Transitscore and SOV Mode Split

Transitscore and Vehicle Ownership

R² = 0.7168

R² = 0.6179
Walkscore and Household Automobile Ownership

Walkscore and SOV Mode Split
**Walkscore and Household Automobile Ownership**

**SOV Rate by Distance from Downtown**

\[ R^2 = 0.5472 \]
Iteration #2

- A higher Walkscore or Transitscore will result in a lower SOV mode split and lower automobile ownership

Analysis #2

- There initially appeared to be an upper limit to auto ownership and SOV mode split when compared to Walkscore. Up on a closer examination, however, the results appear more directly correlated to distance from Downtown. This is a variable that is not controllable by jurisdictions that don’t host the business core.
- It does make a case for providing less parking and more housing in close-in neighborhoods.
Collect Additional Data

- Isolate stations two or more miles away from Downtown
- Identify connectivity index, max block length, max residential walking ratio to station, and number of links.

Iteration #3

- Do the correlations between Walkscore and Transitscore scale to locations outside the Downtown Core and close-in neighborhoods?
- Is ease of access to the station area predictive of transit ridership, SOV use, or vehicle ownership?
WALKSCORE AND TRANSITSCORE

Transitscore and SOV Mode Split

Transitscore and Vehicle Ownership

$R^2 = 0.128$

$R^2 = 0.1196$
WALKSCORE AND TRANSITSCORE

Walkscore and SOV Mode Split

Walkscore and Vehicle Ownership

R² = 0.1939

R² = 0.1152
Population and SOV Mode Split

Population and Vehicle Ownership

\[ R^2 = 0.0913 \]

\[ R^2 = 0.0201 \]
CONNECTIVITY INDEX

[Map showing connectivity index with numbers 261 and 166]
CONNECTIVITY INDEX

- **Connectivity Index**
  - Number of links divided by number of nodes

- **Residential Walking Ratio**
  - Most direct “on-the-ground” walking route divided by “as the crow flies” distance from station

- **Max Block Length**
  - Longest block length between intersecting streets that allow a person to move to a different part of the street grid

- **Number of Links**
  - Used as a proxy for identifying block size
Connectivity Index and SOV

SOV Mode Split

Connectivity Index

R² = 0.1301

Connectivity Index and Vehicle Ownership

Vehicles per Household

Connectivity Index

R² = 0.0789
Number of Links and SOV

R² = 0.2073

Number of Links and Vehicle Ownership

R² = 0.004
Walk Distance Ratio and SOV

Walk Distance Ratio and Vehicle Ownership

CONNECTIVITY
Iteration #3

• Do the correlations between Walkscore and Transitscore scale to locations outside the Downtown Core and close-in neighborhoods?
• Is ease of access to the station area predictive of transit ridership, SOV use, or vehicle ownership?

Analysis #3

• Very high Walkscores may reduce the number of vehicles owned, but any impact is minimal.
• The initial results do not look promising to provide a predictive indicator of SOV mode split, transit mode split, or vehicle ownership.
• The data collection for this analysis is incomplete. Additional data are needed to finalize the results.
Bonus Results

• Do any of the data collected indicate an increase in the number of riders?

• Continued focus beyond two miles from Downtown. No trends emerge between the number of parking spaces provided, ½ mile population, and ridership.
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- Continued focus beyond two miles from Downtown. No trends emerge between the number of parking spaces provided, ½ mile population, and ridership.
Quick Facts

- Proximity to the Downtown Core is the most influential variable identified in reducing SOV mode split and vehicle ownership.
- Population density in proximity of rail stations do not appear to affect either mode split nor vehicle ownership until after approximately 7,500 people per square mile.
- Building a more urban form or having more intense land uses don’t appear to directly result in a lower SOV mode split or lower vehicle ownership.
- High urban form does not predict low vehicle ownership or SOV mode split, but it does appear that less urban form precludes these reductions.
- The most predictive variable identified, Transitscore, had zero locations with a score above 73 beyond 2.0 miles from the Downtown Core.
- Home ownership in station areas was most predictive of vehicle ownership rates.
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