Modeling the Land-use Correlates of Vehicle Trip Lengths for Assessing Transportation Impacts of Land Developments

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The Issue
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Impact measure: 
• Trips
• Intersection Control
• Parking Demand
• Localized Impact
The Issue

Impact measure: Trip Length / VMT
- Energy Consumption
- Emissions
- Regional Impact
Study Objective

Develop a procedure to calculate vehicle trip lengths as a function of land-use to support transportation impact analysis:

• Fits within the conventional “trip based” travel forecasting paradigm

• “Development-centric” approach

• Simplified spreadsheet-based implementation
### What we did

#### Trip-length Calculation Tool

![Excel Sheet](image)
Analysis

- Travel Survey
- Roadway network
- Parcel data

GIS Analysis
- Distance (for each trip)

GIS Analysis
- Land-use Descriptors (at each trip end)

Statistical Analysis
- Formula to calculate trip distance for different types of land use
Data

- Travel Characteristics
  - South-East Florida Household Travel Survey (2000)
- Land-Use
  - Department of Revenue Parcel Files
- Transportation System
  - Roadway Network Characteristics
Data: Travel Characteristics

2000 South-East Florida Household Travel Survey
Data: Travel Characteristics

Trip-end locations → Roadway network → GIS Analysis → Trip Distance (shortest distance)
### Data: Travel Characteristics

<table>
<thead>
<tr>
<th></th>
<th>Home-based Work (HBW)</th>
<th>Home-based Other (HBO)</th>
<th>Non-Home Based (NHB)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Trip Length</td>
<td>LN (Trip Length)</td>
<td>Trip Length</td>
</tr>
<tr>
<td>Number of trips</td>
<td>5327</td>
<td>5327</td>
<td>8257</td>
</tr>
<tr>
<td>Mean</td>
<td>10.31</td>
<td>1.93</td>
<td>5.42</td>
</tr>
<tr>
<td>Median</td>
<td>7.70</td>
<td>2.04</td>
<td>3.30</td>
</tr>
<tr>
<td>Variance</td>
<td>93.04</td>
<td>0.98</td>
<td>39.79</td>
</tr>
<tr>
<td>Minimum</td>
<td>0.10</td>
<td>-2.28</td>
<td>0.10</td>
</tr>
<tr>
<td>5 Percentile</td>
<td>1.09</td>
<td>0.09</td>
<td>0.49</td>
</tr>
<tr>
<td>10 Percentile</td>
<td>1.91</td>
<td>0.65</td>
<td>0.76</td>
</tr>
<tr>
<td>90 Percentile</td>
<td>21.20</td>
<td>3.05</td>
<td>12.79</td>
</tr>
<tr>
<td>95 Percentile</td>
<td>27.99</td>
<td>3.33</td>
<td>17.11</td>
</tr>
<tr>
<td>Maximum</td>
<td>97.75</td>
<td>4.58</td>
<td>85.00</td>
</tr>
</tbody>
</table>
Data: Land Use

Parcel Attributes

- Land Use Characterization (90 categories aggregated to about 6 major categories)
- Parcel Area
- Bldg. Area
- Number of Residential Units
Data: Neighborhoods
Data: Land Use

Neighborhood Attributes

- Four square miles
- Developed Area (total and by land use type)
- Number of Residential Units
- Bldg. Area (by land use type)
- Number of parcels with “convenient commercial” land use
Data: Transportation System

Neighborhood Attributes

- Road miles
- Number of intersections
- Number of Cul De Sacs
- Connected Node Ratio (CNR)

CNR = .96
CNR = .72
Data: Location within Region

Location within Region
- Distance to nearest Regional Activity center
- Distance to farthest Regional Activity center
- Centrality of Location
<table>
<thead>
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</tr>
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<tbody>
<tr>
<td><strong>Home-based Work</strong></td>
</tr>
<tr>
<td>Production-end Model</td>
</tr>
<tr>
<td>Attraction-end Model</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>Home-based Other</strong></td>
</tr>
<tr>
<td>Production-end Model</td>
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<tr>
<td>Attraction-end Model</td>
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<tr>
<td></td>
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<tr>
<td><strong>Non-Home Based</strong></td>
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<td></td>
</tr>
</tbody>
</table>
Complementary land-uses, number of “convenient-commercial” parcels, network connectivity, distance to regional activity centers, … all affect trip lengths

Time of day of travel and vehicle occupancy ….affect trip lengths

Age, employment status, presence of children, car ownership, income, …. affect trip length

Statistical Analysis
Trip Length Calculation Tool
Applications

HBW: 19.61
HBO: 8.68

HBW: 6.72
HBO: 3.85

HBW: 4.21
HBO: 2.23
Applications
Summary

- Trip-volume is not an adequate traffic-impact measure
- Developed a procedure to determine the length of trips associated with different types of land uses
- Used Florida-specific data for analysis
- Implemented procedure in easy-to-use spreadsheet
Next Steps

- Models explain no more than 10% of the variation in the logarithm of trip lengths
  - Disaggregate trip purposes
  - Further characterization of land use
  - Beyond log-liner specifications
  - Better treatment of space
  - Trip chaining effects
CMS Project Final Report (on CMS web site)
http://cms.ce.ufl.edu/research/Steiner_CMS_2008-007_final.pdf