Non-Motorized Model Development
General Information and DCHC MPO Project

presented to
North Carolina Model Users Group
Raleigh, North Carolina

presented by
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Non-Motorized Model Enhancement Objectives

- Improve ability to capture impacts of land use and infrastructure enhancements on non-motorized travel

- Demonstrate air quality and congestion mitigation impacts of investments that expand bike trails, improve pedestrian and bicycle safety, and provide or improve sidewalks

- Benefit in developing Transportation Improvement Programs (TIP), air quality conformity analysis, and other studies and programs

DCHC MPO’s Metropolitan Transportation Improvement Program (MTIP) Regional Priority List for fiscal years 2007-2013 lists more than 75 potential projects in which bike/pedestrian infrastructure improvements are a primary or prominent feature of the improvement project.
Non-Motorized Model Enhancement
Application Areas

- Mode Choice
- Analysis of TDM and Other Measures to Reduce Auto Travel
- Analysis of Effects of Alternative Land Use Patterns
- Transit Access
Non-Motorized Model Enhancement
Example Projects

**Central Artery Project (Boston, MA)**
- Pedestrian trip generation uses three trip types: walk only trips; transit access/egress trips; and parking access/egress
- Pedestrian origin-destination flows and link volumes are estimated through a process of walk trip generation; trip distribution; and assignment

**LUTRAQ (Portland, OR)**
- Incorporated pedestrian environment variable in existing models.
- Showed that pedestrian environment and density variables can be statistically significant variables in models of auto ownership and mode choice

**DVRPC (Philadelphia, PA)**
- Incorporated PEV into trip generation model
- Mode choice model was developed to separate motorized from non-motorized trips
Pedestrian Environment Variables

**Typical**
- Sidewalk availability
- Ease of street crossing
- Street connectivity
- Availability of bicycle infrastructure
- Building setbacks
- Terrain

**DVRPC Example**
- \( PEV = 0.25 \times (\text{Sidewalk Availability}) + 0.30 \times (\text{Ease of Street Crossing}) + 0.45 \times (\text{Building Setbacks}) \)
- Range for variable is 1-3
Variables Affecting Non-Motorized Travel

<table>
<thead>
<tr>
<th>Variable Type</th>
<th>Descriptions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land Use</td>
<td>Density, mixed use/pedestrian-oriented development</td>
</tr>
<tr>
<td>Roadway</td>
<td>Speeds, lanes, street density, connectivity, grade</td>
</tr>
<tr>
<td>Intersection</td>
<td>Signals, crosswalks, medians</td>
</tr>
<tr>
<td>Non-motorized facilities</td>
<td>Sidewalks, bike lanes/paths, pavement markings</td>
</tr>
<tr>
<td>Demographics</td>
<td>Age, student status</td>
</tr>
<tr>
<td>Accessibility</td>
<td>Proximity of persons to activities</td>
</tr>
<tr>
<td>Impedance</td>
<td>Time or distance from origin to destination</td>
</tr>
</tbody>
</table>
General Modeling Challenges

- The need for *objective* measures for variables affecting non-motorized travel behavior
- Identifying the effects on other modes
  - Transit trips
  - Auto trips
- Zonal attributes
Presentation Outline

- General
- *DCHC-MPO*
- End Notes
DCHC MPO Project Objectives

Develop and implement enhancements to Triangle Regional Model (TRM) to:

- better capture travel demand impacts of non-motorized travel (walking and bicycling) due to land use and facility/infrastructure changes
- generate trip tables indicating zone-to-zone and intrazonal non-motorized travel

Enhancements intended to help DCHC MPO:

- forecast future bicycle and pedestrian demand
- assess future bicycle and pedestrian travel needs
- plan for adequate non-motorized facilities/infrastructure
- prioritize bicycle and pedestrian improvement projects
- gauge the effects of non-motorized trip-making on other travel modes
## Triangle Region Household Survey
### Non-Motorized Travel by Trip Purpose

<table>
<thead>
<tr>
<th>Trip Purpose</th>
<th>1995 Survey</th>
<th>2006 Survey (Weighted)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Home-Based Work</td>
<td>2.79 %</td>
<td>3.82 %</td>
</tr>
<tr>
<td>Home-Based Shopping</td>
<td>4.68 %</td>
<td>3.99 %</td>
</tr>
<tr>
<td>Home-Based School</td>
<td>7.74 %</td>
<td>3.64 %</td>
</tr>
<tr>
<td>Non-Home Based</td>
<td>13.12 %</td>
<td>8.50 %</td>
</tr>
<tr>
<td>Home-Based Other</td>
<td>9.09 %</td>
<td>5.57 %</td>
</tr>
</tbody>
</table>
DCHC MPO Project
Phase 1

Objective: *Improve the existing model to be more sensitive to factors affecting non-motorized travel in a short timeframe*

- Coordination with DCHC-MPO
- Determine candidate variables
- Reestimate models with new variables
- Develop program to implement new models
- Revalidate models
- Documentation
- Phase 2 work plan
Objective: Developed revised model to accurately integrated non-motorized travel into the region’s model

- Make any necessary revisions to trip generation
- Revise/revalidate trip distribution
- Develop new mode choice model including non-motorized modes
- Develop program to implement new models
- Documentation
Three potential areas for new variables to be incorporated into the model:

- land use mix and density
- zonal network characteristics
- person and household characteristics
<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Str1dum</td>
<td>No Car Indicator, 1 if Car = 0</td>
</tr>
<tr>
<td>Str2dum</td>
<td>Low Income Indicator, 1 if Inc&lt;=19,999</td>
</tr>
<tr>
<td>Str3dum</td>
<td>Med. Inc and Less Cars Indicator, 1 if 20,000&lt;=Inc&lt;=99,999 and Cars&lt;Workers</td>
</tr>
<tr>
<td>Str4dum</td>
<td>Med. Inc and More Cars Indicator, 1 if 50,000&lt;=Inc&lt;=99,999 and Cars &gt;=Workers</td>
</tr>
<tr>
<td>Str5dum</td>
<td>High Income Indicator, 1 if Inc&gt;=100,000</td>
</tr>
<tr>
<td>EmpDis</td>
<td>Employment Distance Accessibility Measure</td>
</tr>
<tr>
<td>PopDis</td>
<td>Population Distance Accessibility Measure</td>
</tr>
<tr>
<td>EPDis</td>
<td>Emp + Pop Distance Accessibility Measure</td>
</tr>
<tr>
<td>Urban</td>
<td>High Density Indicator, 1 if Area Type = 1</td>
</tr>
<tr>
<td>Suburban</td>
<td>Medium Density Indicator, 1 if Area Type = 2</td>
</tr>
<tr>
<td>Rural</td>
<td>Low Density Indicator, 1 if Area Type = 3</td>
</tr>
</tbody>
</table>
Table 2. Additional Variables Used in the Phase 1 Nonmotorized Model

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inc2</td>
<td>Low-Medium Income Indicator, 25,000&lt;=Inc&lt;=49,999</td>
</tr>
<tr>
<td>Inc3</td>
<td>Medium-High Income Indicator, 50,000&lt;=Inc&lt;=99,999</td>
</tr>
<tr>
<td>Inc4</td>
<td>High Income Indicator, Inc=&gt;100,000</td>
</tr>
<tr>
<td>Inc234</td>
<td>Not Low Income Indicator, Inc=&gt;25,000</td>
</tr>
<tr>
<td>LessVeh</td>
<td>Less vehicles than workers in the household, with at least one vehicle, Cars&lt;Workers</td>
</tr>
<tr>
<td>MoreVeh</td>
<td>At least or more vehicles than workers in the household, Cars &gt;=Workers</td>
</tr>
<tr>
<td>PChild</td>
<td>Presence of children in the household</td>
</tr>
<tr>
<td>Suburb</td>
<td>Medium Density Indicator</td>
</tr>
<tr>
<td>LUMix</td>
<td>Land Use Mix = ((2*(People+Jobs)-abs(People-Jobs))/acre</td>
</tr>
<tr>
<td>AveBlock</td>
<td>Average Street Block Perimeter in Zone</td>
</tr>
</tbody>
</table>
## DCHC MPO Project
### Preliminary Models – Significant Variables

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Intercept</td>
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<td>Intercept</td>
<td>Intercept</td>
<td>Intercept</td>
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<tr>
<td>Inc4</td>
<td>Inc2</td>
<td>Inc3</td>
<td>Inc2</td>
<td>Inc2</td>
</tr>
<tr>
<td>LessVeh</td>
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<td>MoreVeh</td>
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End Notes
Potential Resources

- Traveler Response Handbook (TCRP Report 95)
  - Chapter 16 – Pedestrian and Bicycle Facilities (Forthcoming)

- Guidebook on the Methods to Estimate Non-Motorized Travel (1999) Federal Highway Administration (available on the web)

End Notes
DCHC-MPO Project

Team Members
- Cambridge Systematics, Inc.
- Kimley-Horn and Associates, Inc.

Key Staff
- Felix Nwoko, Client Project Manager
- Tom Rossi, Project Manager
- Jay Evans, Deputy Project Manager
- Laura McWethy
- Tim Padgett
- Chris Porter
- Tara Rima
- Kevin Tierney
End Notes

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