An evaluation of topography on bike-share demand projections

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Agenda

• What is bike-share?
• Existing bike-share demand projection methods
• Adding topography
• Results
• Recommendations
What is Bike-sharing?
Key Characteristics

• Short-term use
• Unattended stations
• User fees
• Non-recreational
• “Last mile” transit

• On-demand option
• Urban locations
Benefits of Bike-share

• Relatively inexpensive
• Additional transportation alternative
• Increased bicycle ridership
• Health & safety
• Enhanced livability
• Sustainable
Bike-share Programs

- 238 bike-share programs in the world
- North America:
  - Washington, DC
  - Denver
  - Minneapolis
  - Montreal, Canada
Demand in Seattle?

- Desire to implement bike-share
- Seattle DOT wanted to:
  - understand demand
  - project costs
  - identify appropriate implementation area(s)
Existing Demand Projection Methods
Existing Demand Projection Methods

- Poorly documented
  - Relative newness of systems
  - Lack of observed data
- Early efforts were judgment-based
- Gradually becoming more quantitative
- Vendors have proprietary methods
Existing Demand Projection Methods

- Gradually becoming more quantitative
  - Lyon, France: used population & employment density in a 300m² grid
  - Paris, France: added retail- and facility-based trips
- Philadelphia has most quantitative public method to date (Krykewycz et al 2010)
Philadelphia’s Indicators

- Population Density
- University Housing
- Job Density
- Retail Job Density
- Tourist Attractors
- Parks and Recreation
- Regional Transit Stations
- Bicycle Friendly Streets
- Bicycle Lanes
- Local Transit Stops
Applying Philadelphia’s method

- Rasterized quantiles for each indicator
- Sum the results for all the indicators
- Assigned the summations to bins
- Select service areas
Local Transit Stop Density
Weighted Sum Raster Analysis
Analysis Output
Proposed Phases
Adding Topography
Need for inclusion of topography

• Topography affects biking rates
  ▫ Hood et al 2010: bike 1 extra mile to avoid 100’ elevation gain
  ▫ Parkin et al 2007: 10-15% reduced willingness to bike commute with 10% increase in grade

• Hills a significant factor in Seattle and many other cities
Need for inclusion of topography

Maps from USGS TNM 2.0 Viewer http://viewer.nationalmap.gov/viewer/
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Proposed Indicators

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- Topography
Evaluation Methodology

- Consider scoring methods
  - Manual scoring vs. linear scoring
- Consider weighting methods
  - Do nothing
  - Single vs. double-weighting
- Evaluate with available data
  - None use professional judgment on cases
Topographic Data

- 10-meter grid digital elevation models (DEM)
- From USGS
- Widely available
- Allows quantification of the slope angle of every 10m² cell
Results
Scoring Methods
Weighting Options
Case Study 1: Queen Anne Hill

Map from USGS TNM 2.0 Viewer http://viewer.nationalmap.gov/viewer/
Queen Anne Case Study

- No Slope
- Single Slope Weight
- Double Slope Weight

Bike-Share Composite Score

Scale: 1:150,000
Case Study 2: Madison Valley

Map from USGS TNM 2.0 Viewer http://viewer.nationalmap.gov/viewer/
Madison Valley Case Study
Summary
Conclusions

- Inclusion of slope:
  - Significantly affects the identified market area
  - Reduces the size of the suggested implementation area
  - Results in more difficulty in determining borders
  - Appears more accurate

- Weight of slope has the same effects
Recommendations

• Quantitative methods should be further developed

• Planners should account for topography
  ▫ Linear scoring method
  ▫ Double-weighting

• Evaluate with data when possible
  ▫ Develop standardized scoring
  ▫ Refine weighting
Questions?

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http://seattlebikeshare.org/