Methods to Better Account for Land Use in Planning Multimodal Transportation Systems and Sustainable Communities

Moderator: John L. Renne, Chair, TRB Transportation and Land Development Committee
December 10, 2015 – 3:00pm Eastern

Rich Kuzmyak & Alex Bell
Renaissance Planning Group

John Thomas & Lori Zeller
US Environmental Protection Agency
Office of Sustainable Communities
TRB Transportation and Land Development Committee (ADD30)

**Mission:**
To look at the interrelationships between transportation and land use and development, including but not limited to the following:
  - the effect that transportation has on urban form and development,
  - the effects of urban form, development and design on travel behavior, and
tools and techniques for understanding and influencing the above.

32 Committee Members + 167 Friends on Google Groups

To join Google Group as Friend, please email John Renne at jrenne@fau.edu

Early 2016 – Committee Rotation – One-third of the committee spots must be rotated per TRB rules

**All Are Welcome** - Annual Meeting, Tuesday, January 12, from 8 am - Noon in the Marriott Marquis
Next speaker

John Thomas:

Director of the Community Assistance and Research Division in the Office of Sustainable Communities at the US Environmental Protection Agency.

Works on sustainable transportation and land use planning issues at the Federal level and provides technical assistance to state and local governments.

Adjunct Professor at George Washington University.
Key themes webinar will address

• Multimodal accessibility
• Land use interaction and influence on accessibility
• Tools for exploring these interactions
• How communities, researchers, planners and leaders can take advantage of these tools to create more connected, sustainable communities
Background: EPA’s Smart Growth Program

Helps communities pursue smart growth strategies through:

- Grants and technical assistance
- Partnerships
- Research and tool development
Urban Form and Travel “D” Variables

Density
Diversity
Design of Street Network
Destination Accessibility
Distance to Transit

Image sources: Lincoln Land Institute’s “Visualizing Density” and Victor Dover
Rich Kuzmyak, Principal
- Transportation planner and research analyst with more than 30 years experience
- Specialize in quantifying relationships between transportation and land use
- Created Ds models for estimating travel behavior in relation to land use in Los Angeles, Phoenix, Baltimore, other places
- Recent manager of NCHRP Project 08-78 (Report 770) – used accessibility methods to estimate demand for bicycle and pedestrian travel
Background: Renaissance Planning

Key mission: To help build *cities that work*

[www.citiesthatwork.com](http://www.citiesthatwork.com)

Urban design + transportation/land use integration

Works with communities in the application of smart growth approaches
Webinar outline

EPA’s Smart Location Database:
  Purpose, use and demo
  Examples of use: AARP Livability Index, GSA Smart Location Calculator, EPA Walkability Index

Renaissance Activities and Tools:
  Research on Multimodal Accessibility Methods
  Applications for State/MPO/local planning & project prioritization
Next speaker

Lori Zeller
ORISE Fellow in the Office of Sustainable Communities at the US Environmental Protection Agency

Research focuses on reducing vehicle miles traveled and greenhouse gas emissions through tools and resources promoting location efficiency and active transportation.

Master in City and Regional Planning from the Bloustein School of Planning and Public Policy at Rutgers, the State University of New Jersey.
EPA’s Smart Location Database

Lori Zeller
US Environmental Protection Agency
Office of Sustainable Communities
The Smart Location Database (SLD) and community solutions for multimodal accessibility

Jobs within a 45 minute transit ride
The Smart Location Database (SLD) and community solutions for multimodal accessibility

Low income workers (home location)
The Smart Location Database (SLD) and community solutions for multimodal accessibility

Low income workers (work location)
Lightning SLD Demo!

- Play along here: http://www.epa.gov/smartgrowth/smart-location-mapping

- Scroll to Smart Location Database and click “Interactive map viewer”

Note: some of these processes take more than a split-second to complete, so for the purpose of conducting a speedy webinar demo, I will be using screenshots
Smart Location Database

The Smart Location Database is a nationwide geographic data resource for measuring location efficiency. It includes more than 90 attributes summarizing characteristics such as housing density, diversity of land use, neighborhood design, destination accessibility, transit service, employment, and demographics. Most attributes are available for every census block group in the United States.

EPA first released the Smart Location Database in 2011 and released version 2.0 in July 2013. Please review the Smart Location Database Technical Documentation and User Guide for a full description of all available variables, data sources, data currency, and known limitations.

Figure 1 illustrates one of the variables in the Smart Location Database. The map shows patterns of spatial variation in transit service availability and density in Los Angeles and its surrounding cities and suburbs.

Figure 1: Transit Service Density in the Los Angeles Metropolitan Region (Aggregate frequency of transit service per hour per square mile during evening peak period)

http://www2.epa.gov/smartgrowth/smart-location-mapping#SLD
Lightning SLD Demo: Slide 1/9

What you see when you navigate to SLD interactive map
Lightning SLD Demo:
Slide 2/9

Scroll down to see variety of SLD attributes with pre-made layers

Also note the search bar (red arrow pointing) – enter any address or city, state, and SLD will jump to that location
Lightning SLD Demo: Slide 3/9

Click left-most icon (looks like a list) to see the legend for attribute.
Click on a block group and a pop-up appears with block group data.
Lightning SLD Demo: Slide 5/9

Want to change color scheme? Classification system? Change the attribute?

To do this, click on the icon with small shapes (circled in red)
Lightning SLD Demo: Slide 6/9

Use the drop-down menu to choose a new attribute from the SLD to display. Refer to the user guide for attribute definitions.


% households in block group with 0 automobiles
Option to normalize (divide) attribute by another attribute
Lightning SLD Demo: Slide 8/9

Opportunity to change color scheme
Opportunity to change classification method and number of classes.
Highlights of SLD attributes for use in multimodal accessibility research

- Activity density
- % households with zero automobiles
Activity density (housing and jobs per acre)

Significance: dense activity centers in a region demand access via regular transit service
Use: compare activity density to transit service frequency to determine gaps
% households with zero automobiles

Significance: demand for multimodal transportation options is high in areas with high proportion of zero-car households

Use: examine multimodal transportation network performance for these areas (bike & ped network, transit)
The SLD as a resource

- Other organizations and agencies using SLD data for mapping applications and as a decision-making tool
  - AARP’s Livability Index
  - GSA’s Smart Location Calculator
  - EPA’s Walkability Index

- Can be navigated by anyone
  - interactive online map for novice mappers
  - download geodatabase/shapefile for experienced mappers
AARP’s Livability Index

<table>
<thead>
<tr>
<th>Category</th>
<th>Score</th>
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<tbody>
<tr>
<td>TRANSPORTATION</td>
<td>80</td>
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<tr>
<td>HOUSING</td>
<td>73</td>
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<tr>
<td>ENGAGEMENT</td>
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<tr>
<td>NEIGHBORHOOD</td>
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<td>HEALTH</td>
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<tr>
<td>ENVIRONMENT</td>
<td>53</td>
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<tr>
<td>OPPORTUNITY</td>
<td>47</td>
</tr>
</tbody>
</table>

What is Livability?

Livable communities have diverse features that satisfy the needs of people of all ages, incomes and abilities. Learn more about AARP’s Livability Index at www.aarp.org/livabilityindex.

SLD data used in 2 of the 7 factors for Transportation:
- Frequency of local transit service
- Walk trips
GSA’s Smart Location Calculator

Measuring the environmental benefits of workplace location efficiency

1311 East-West Hwy, Silver Spring, Maryland, US

Employees: 100
Male: 57%

Distance to nearest transit stop: 0.1 miles
Distance to rail transit: 0.2 miles

Legend:
- 0 - 39 (Very Low)
- 40 - 59 (Low)
- 60 - 69 (Fair)
- 70 - 79 (Good)
- 80 - 89 (Very good)
- 90 - 100 (Excellent)

Smart Location Index: 77
Block Group SLC: 75

Export
Show statistics
Show Blockgroup Scores

Layers & Legend

Use average block group distance to transit values
Existed in 2010
Occupied in 2010
Re-calculate Score
GSA’s Smart Location Calculator

Modeling VMT generation per worker by block group (variables from SLD highlighted in green)

- Household income
- Gender
- Vehicles per household
- Gas price
- Regional compactness score
- Regional land area
- Regional transit unlinked trips per capita
- Residential density
- Employment density
- Employment mix
- Trip production and attraction index
- Auto- and pedestrian-oriented intersection density
- Distance to transit
- Proportion of employment near rail station
- Transit service frequency
- Accessibility by workers via auto and transit
EPA’s Walkability Index

Why
• Walkable communities growing in popularity around country
• Many factors determine walkability, no central definition or index
• Desire for transparent walkability data for communities and researchers to utilize

How
A weighted index calculated using 4 variables from SLD:
• High intersection density
• Close proximity to transit stops
• High diversity of business uses
• High diversity of business and residential uses
EPA’s Walkability Index

Least walkable
Below average
Above average
Most walkable
Concluding thoughts

- Beneficial for regional land use planning, transportation planning and facility siting
- Tools for wide audiences
- Need for regular updates as transportation networks and development change over time
The Growing Role of Accessibility In Transportation and Land Use Planning
WHAT IS ACCESSIBILITY & HOW IS IT MEASURED?

- Accessibility measures “opportunity” – how much stuff can I get to in X miles or Y minutes?
- Kinds of stuff:
  - Employment/Jobs
  - Shopping, Schools, Health Care, Essential Services, Recreation
- Mode “Neutral” – not just about speed
- Measurement techniques:
  - Simple count
  - More complex: put weights on travel time or activity type

“Score”
RELATION TO THE Ds IN SLD DATABASE

One of the Original Ds: “Access to Destinations”

<table>
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<th>Accessibility Variables in SLD</th>
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<tbody>
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<tr>
<td>D5ae</td>
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<tr>
<td>D5br</td>
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<tr>
<td>D5be</td>
</tr>
</tbody>
</table>
CONTRASTING ACCESSIBILITY WITH THE OTHER Ds

Local Design (neighborhood) “3Ds”

Regional Accessibility “4th D”

Travel Behavior = f (demographics, local design, regional accessibility)
Purpose: Develop responsive tools for estimating bike/walk demand

Goal: Account for Effects of:
- Land Use
- Facilities
- Impact on motorized travel

Response:
- Original research & tool development (Washington DC & Seattle)
- Major role for GIS data/tools
3 New Tools from NCHRP 08-78

Seattle/PSRC
- Tour Generation & Mode Choice
- Enhanced 4-Step Process

Arlington/MWCOG
- GIS-Based Accessibility Approach

All Rely on Accessibility Relationships
ARLINGTON GIS ACCESSIBILITY MODEL

Multiple Contributing Factors

- Needed fine geospatial resolution for walk/bike – strength of GIS
- Liked Walk Score (Transit Score, Bike Score) – intuitive, visual
- Unusually good data & MPO support
- Arlington County = Smart Growth laboratory!
- Creative project team – GIS skills
GIS Enables Data Sources to Talk to Each Other

- Land Use
  - InfoUSA Employment Data

- Transportation Network
  - NAVTEQ Digitized Networks
CALCULATING ACCESSIBILITY SCORES THROUGH GIS OVERLAY METHODS

Accessibility = \[\sum \frac{Opportunities}{Travel\ Time \cdot Decay}\]

Where:

**OPPORTUNITIES** = Number of Jobs (HBW) or Number of Retail/Service Establishments (HBNW)

**TRAVEL TIME** = Time to reach opportunity over *actual network* (Network Analyst)

**DECAY** = Factor reflecting decrease in value of opportunities that are farther away
TRAVEL TIME “DECAY” A CRITICAL ELEMENT

Travel Time Decay – Walking for Work Trips

\[ y = 100e^{-0.07x} \]
\[ R^2 = 0.9545 \]

Trips requiring 15 minutes have only **37%** of the value of trips ≤ 1 minute

Travel Time Decay -- Walking for Non-Work

\[ y = 100e^{-0.097x} \]
\[ R^2 = 0.981 \]

Trips requiring 15 minutes have only **23%** of the value of trips ≤ 1 minute
DECAY RATES CALCULATED FOR:

- Each Mode
  - Auto
  - Transit
  - Walk
- Trip Purpose
  - Work
  - Non-Work
ACCESSIBILITY CALCULATION

Modal Activity Ranges

Starting Point

Travel Time Decay Curve

Accessibility Score = \sum \text{time-decayed opportunities}
WHAT THE SCORES LOOK LIKE (AND BEGIN TO TELL US)
ACCESSIBILITY’S INFLUENCE ON MODE CHOICE

It’s the RATIOS that really matter!

Comparative Accessibilities

<table>
<thead>
<tr>
<th></th>
<th>Logan Circle</th>
<th>Clarendon</th>
<th>McLean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Auto</td>
<td>4.26</td>
<td>2.25</td>
<td>1.0</td>
</tr>
<tr>
<td>Transit</td>
<td>13.6</td>
<td>4.82</td>
<td>1.0</td>
</tr>
<tr>
<td>Bike</td>
<td>15.17</td>
<td>3.71</td>
<td>1.0</td>
</tr>
<tr>
<td>Walk</td>
<td>38.9</td>
<td>6.9</td>
<td>1.0</td>
</tr>
</tbody>
</table>

Non-Motorized Mode Share (HH survey)

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Logan Circle</td>
<td>41%</td>
</tr>
<tr>
<td>Clarendon</td>
<td>21%</td>
</tr>
<tr>
<td>McLean</td>
<td>8%</td>
</tr>
</tbody>
</table>
USING THE RATIO RELATIONSHIPS:
Transit-to-Auto Ratio in SLD Explains Mode Shares

Auto vs Transit Mode Split for Work Trips in Virginia Using Auto & Transit Accessibility Scores in SLD
USING ACCESSIBILITY SCORES TO CALIBRATE MODE SHARE MODEL *

Mode Share for Work Trips:
- Auto
- Transit (drive access)
- Transit (walk access)
- Walk

Mode Share for Non-Work Trips:
- Auto Driver
- Auto Passenger
- Transit
- Walk

* Discussed later in Maryland DOT Multimodal Corridor Study
Using scores to estimate VMT*

Household Auto Ownership = 0.81 + 0.27 HH Size + 0.106 HH Income
- 0.586 Transit/Auto Ratio – 0.00128 Walk Score
  \((-24.3)\) \((-29.1)\)

Daily Household VMT = 12.2 + 3.59 HH Size + 0.95 HH Income + 0.317 HH Vehicles
- 0.151 Transit/Auto Ratio – 0.0179 Walk Score
  \((-19.4)\) \((-10.6)\)

\(R^2 = 0.371\) \(n = 13,700\)
\(R^2 = 0.280\) \(n = 13,700\)

* Discussed later in MWCOG GHG Study
RESULT: A COMPREHENSIVE AND VERSATILE PLANNING FRAMEWORK

ACCESSIBILITY =

Land Use

Opportunities
- Number
- Density
- Diversity
- Design

Transportation Network

Travel Time
- Connectivity
- Directness
- Safety
Application Examples

Alex Bell, AICP

- Senior Planner at Renaissance (Durham office)
- M.A. in Urban Planning
- Lead architect in Renaissance’s accessibility work
  - Arlington Accessibility Model (NCHRP 770)
  - Project manager on the Smart Location Database
ACCESSIBILITY APPLICATIONS

- Assessing Walkability in Shirlington, VA
- Transportation Network Plan for Asheville, NC
- Design Guidelines for Affordable Housing in Washington, DC
- Impact of Alternative Land Use Scenarios for GHG Reduction for Metropolitan Washington Council of Governments
- Multimodal Corridor Study for Maryland Department of Transportation
- Project Prioritization for Virginia Department of Transportation
DIAGNOSTICS
PLANNING
PROGRAMMING
ESTIMATING WALKING POTENTIALS IN SHIRLINGTON VA (NCHRP REPORT 770)
SERVING UNMET WALK OPPORTUNITIES THROUGH NETWORK IMPROVEMENTS

Major productions

“No-man’s” land

Major attractions

New link results in 500 new walk trips
ASHEVILLE EAST OF THE RIVERWAY TRANSPORTATION PLAN

- Improve connectivity to, from and within the area
- Strengthen existing neighborhoods
- Improve multimodal access to jobs, housing, services
- Reduce vehicle dependency and VMT
CREATING NEW WALK OPPORTUNITIES THROUGH LAND USE CHANGES

Problem: limited access to food stores for southern portion of study area

Best solution: provide new food market! Existing markets too far for walking
DIAGNOSTICS
PLANNING
PROGRAMMING
Develop guidelines for optimal locations for affordable housing based on:

- Multimodal transportation (walk, bike, transit) access to key opportunities
  - Jobs
  - Schools
  - Fresh food retailers
  - Health care & services
  - Parks & open space

- Limit exposure to:
  - Environmental hazards
  - Liquor stores
ASSESSING SUITABILITY FOR AFFORDABLE HOUSING BASED ON ACCESSIBILITY
USING ACCESSIBILITY FOR SCENARIO PLANNING AND GHG MITIGATION

- Metropolitan Washington COG evaluating strategies to meet regional GHG reduction goals
- Alternative Land Use a key strategy
  - Shift more future jobs and HHs into Activity Centers – especially with premium transit (TODs)
  - Improve regional jobs/housing balance
- Insufficient time/resources to use regional model
APPROACH & FINDINGS

- Carve region into rings and corridors
- Delineate TODs & Activity Centers by TAZ
- Reallocate new jobs & HHs to TODs and ACs

- Develop VMT Model from Accessibility Scores
- Use VMT rates to reallocate growth

Recalculate accessibility scores and VMT rates
Estimate impact – 14% reduction in 2040 VMT
STATE DOT TOOLS FOR MULTIMODAL PLANNING

Maryland DOT looking to accessibility for improved planning and policy support

- Gaps in existing tools
- Important to know about land use, transit, non-motorized modes
- Exploring accessibility to better understand mode choice, transportation-land use interactions
GETTING BELOW THE TAZ SCALE

Gain sensitivity to land uses, non-motorized accessibility, access to transit
ESTIMATING MODE SHARE USING ACCESSIBILITY SCORES

- Auto driver: 77.7%
- Auto passenger: 6.9%
- Transit: 11.1%
- Walk: 4.2%

Auto driver: 73.8%
Auto passenger: 67.8%
Transit: 12.1%
Walk: 11.1%

North Bethesda
White Flint
Medical Center
Bethesda/ Chevy Chase
Friendship Heights
Rock Creek Park

45.9% 35.6% 10.7%
DIAGNOSTICS
PLANNING
PROGRAMMING
USING ACCESSIBILITY TO PRIORITIZE PROJECTS UNDER HB 2 IN VIRGINIA

- Focus transportation planning and programming on the true purpose of transportation: connecting people and goods
- Provide a consistent means of evaluating projects across modes and jurisdictions
<table>
<thead>
<tr>
<th>Project ID</th>
<th>Generic Description</th>
<th>Total Cost</th>
<th>HB2 Cost</th>
<th>New Typology</th>
<th>Score Access to Jobs</th>
<th>Score Disadvantaged Access to Jobs</th>
<th>Score Multimodal Access</th>
<th>Raw Accessibility Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>38</td>
<td>15 expansion buses</td>
<td>$9,700,000</td>
<td>$5,300,000</td>
<td>A</td>
<td>100.00</td>
<td>100.00</td>
<td>61.87</td>
<td>92.37</td>
</tr>
<tr>
<td>30</td>
<td>Improve capacity deficiency by adding an auxiliary lane. (0.625 mi.)</td>
<td>$15,800,000</td>
<td>$15,700,000</td>
<td>A</td>
<td>31.64</td>
<td>47.98</td>
<td>0.00</td>
<td>28.58</td>
</tr>
<tr>
<td>32</td>
<td>To use shoulders on the NB as travel lanes to alleviate the impacts of the extended queues on the interstate. (1.8 mi.)</td>
<td>$20,000,000</td>
<td>$20,000,000</td>
<td>A</td>
<td>33.06</td>
<td>26.15</td>
<td>0.00</td>
<td>25.07</td>
</tr>
<tr>
<td>32</td>
<td>Construct one HOV + one SOV lane for 4.7 mi.</td>
<td>$73,000,000</td>
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<td>A</td>
<td>1.03</td>
<td>1.38</td>
<td>100.00</td>
<td>20.90</td>
</tr>
<tr>
<td>34</td>
<td>Expansion of Existing Commuter Lot to increase capacity for commuters in support of adjacent Interstate improvements</td>
<td>$12,800,000</td>
<td>$1,500,000</td>
<td>A</td>
<td>0.02</td>
<td>0.03</td>
<td>87.65</td>
<td>17.59</td>
</tr>
<tr>
<td>37</td>
<td>Train station in planned community</td>
<td>$15,000,000</td>
<td>$10,700,000</td>
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<td>30.15</td>
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<td>Reconstruct the Interchange. Reconstruction may include the addition of exclusive HOV access ramps within the interchange or in close proximity to the interchange. (1.153 mi.)</td>
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<td>$170,000,000</td>
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<td>3.02</td>
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## RANKING PROJECTS BY ACCESSIBILITY IMPROVEMENT

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<tr>
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<th>Generic Description</th>
<th>Total Cost</th>
<th>H83 Cost</th>
<th>Type</th>
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Accessibility Methods Summary

- Accessibility methods are greatly increasing our ability to analyze and intervene on key planning and policy questions.
- Get to the heart of MAP-21 goals for multimodal planning, performance measures, and connectivity.
- Expect to see current limitations in access to these tools remedied through software enhancements and continued testing and application.
Summary & Concluding Thoughts

- Demands on planning and analysis tools are growing
- Strong awareness of relationship between land use and transportation
- Tools are evolving in response
  - EPA's Smart Location Database & related tools
  - Proliferation and use of GIS and Accessibility-based methods
- Recognize diverse audience for tools
  - State DOTs and MPOs – scenario planning, multimodal needs assessment, project prioritization
  - Transit agencies – land use and access at both trip ends is critical
  - Local Jurisdictions – comprehensive and master planning, project design
  - National – MAP -21 call for multimodal performance measures
Questions Welcome