Analysis Tools for Livability: Current and Emerging Methods

FHWA Resource Center
Planning Technical Service Team
July 19th, 2011
Analysis Methods for Livability: Agenda

• Importance and Need for Analysis Methods to Support Livability
  Shana Baker, HQ Office of Planning

• Background and Key Concepts
  Jeff Frkonja, Resource Center

• Evaluating Land Development Affects tied to Livability
  Eric Pihl, Resource Center

• Evaluating Complete Streets and Multimodal Network Affects tied to Livability
  Jeff Frkonja, Eric Pihl

• Tool Metrics and Outputs
  Jeff Frkonja

• Vignette: The Claiborne Corridor – New Orleans, Louisiana
  Jamie Setze, Louisiana Division

• Resources: Finding More Information
Why does this matter? Seattle’s experience with Stone Way Rechannelization...

- Before (2005-7): 4-lane urban arterial, marked crosswalks at unsignalized intersections
- After (2007-9): 2 through lanes, 1 CLTL, 2 bike lanes, crosswalks removed from unsignalized intersections
Stone Way rechannelization results…

- Auto volumes decreased 6% (in line with general ADT decreases citywide)
- No measurable auto diversion
- 85th Percentile Speeds dropped 1 to 3 mph, becoming closer to posted limit
- Total Collisions down 14%, injury collisions down 33%
- Bicycle Volumes up 35%

Collision Summary

Source: Seattle DOT. Stone Way N Rechannelization: Before and After Study
Seattle’s History with 4-to-3 lane rechannelizations

- Auto capacity sustained
- Accidents decreased

<table>
<thead>
<tr>
<th>ROADWAY SECTION</th>
<th>DATE CHANGE</th>
<th>ADT (BEFORE)</th>
<th>ADT (AFTER)</th>
<th>CHANGE</th>
<th>COLLISION REDUCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Greenwood Ave. N, from N 80th St. to N 30th St.</td>
<td>April 1995</td>
<td>11872</td>
<td>12427</td>
<td>4 lanes to 2 lanes plus TWLTL plus bike lanes</td>
<td>24 to 10 58%</td>
</tr>
<tr>
<td>N 45th Street in Wallingford Area</td>
<td>December 1972</td>
<td>19421</td>
<td>20274</td>
<td>4 lanes to 2 lanes plus TWLTL</td>
<td>45 to 23 49%</td>
</tr>
<tr>
<td>8th Ave. NW in Ballard Area</td>
<td>January 1994</td>
<td>10549</td>
<td>11858</td>
<td>4 lanes to 2 lanes plus planted median with turn pockets as needed</td>
<td>18 to 7 61%</td>
</tr>
<tr>
<td>Martin Luther King Jr. Way, north of I-90</td>
<td>January 1994</td>
<td>12336</td>
<td>13161</td>
<td>4 lanes to 2 lanes plus TWLTL plus bike lanes</td>
<td>15 to 6 60%</td>
</tr>
<tr>
<td>Dexter Ave. N, East side of Queen Anne Area</td>
<td>June 1991</td>
<td>13606</td>
<td>14949</td>
<td>4 lanes to 2 lanes plus TWLTL plus bike lanes</td>
<td>19 to 16 59%</td>
</tr>
<tr>
<td>24th Ave. NW, from NW 85th St. to NW 65th St.</td>
<td>October 1995</td>
<td>9727</td>
<td>9754</td>
<td>4 lanes to 2 lanes plus TWLTL</td>
<td>14 to 10 28%</td>
</tr>
<tr>
<td>Madison St., from 7th Ave. to Broadway</td>
<td>July 1994</td>
<td>16969</td>
<td>18075</td>
<td>4 lanes to 2 lanes plus TWLTL</td>
<td>28 to 28 0%</td>
</tr>
<tr>
<td>W Government Way/Gilman Ave W, from W Ruffner St. to 31st Ave. W</td>
<td>June 1991</td>
<td>12916</td>
<td>14286</td>
<td>4 lanes to 2 lanes plus TWLTL plus bike lanes</td>
<td>6 to 6 0%</td>
</tr>
<tr>
<td>15th Ave., from Yesler Way to John St.</td>
<td>March 1995</td>
<td>11751</td>
<td>12557</td>
<td>4 lanes to 2 lanes plus TWLTL plus bike lanes</td>
<td>16 to 16 0%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>185 to 122 34%</strong></td>
</tr>
</tbody>
</table>

Lessons from the introductions: Livability analysis...

• …can assess investment alternatives, prioritize, identify needs…
• …needs to treat many factors (Environmental, Economic, Land Use, Transportation...)
• …explicitly treats the transport-land use relationship
• Suppose a city like Seattle could predict what would happen if a proposed rechannelization was implemented?

From the TMA Handbook:

• “…consider…programs or policies supporting context-sensitive solutions, ‘complete streets’…, or similar approaches to transportation corridor planning and design”
• “To what extent are non-motorized modes of travel (e.g., bicycle, pedestrian movements) analyzed and addressed in the MTP and throughout the transportation planning process?”
General Approaches and Policy Tools

- Complete Streets
- Context-Sensitive Solutions (CSS)/Context-Sensitive Design
- Land Use Policies
- Economic Development Strategies

An Analysis Framework: the “D’s”

- Density
- Diversity
- Design
- Destinations
- Distance to transit
- D...
The 4Ds: Their Origin and Relevance to Livability

- Research into the relationship between land-use and travel behavior
  - Emerged in the 1990s with work in Portland (LUTRAQ) and the University of California’s Transportation Center (Robert Cerverro)
  - Portland’s “Land Use and Transportation Connections” Effort prompted by controversial Western Bypass Project
  - Additional studies in Atlanta and Seattle have attempted to track household behavior over time (longitudinally)
- Standard practice models updated with “4D” sensitivity
  - Land development characteristics typically not well represented in most standard-practice travel models
  - Motivations to evaluate TOD or alternative that modifies land development characteristics will require this or comparable approach
The 4Ds and Travel Behavior

- **Net Residential and Employment Density**
  - **Hypothesis**: Denser developments generate fewer vehicle trips than dense developments

  \[ \text{Change in Density} = \text{Percent Change in } \left( \frac{\text{Population} + \text{Employment}}{\text{Square Mile}} \right) \]

- **Jobs/Housing Diversity**
  - **Hypothesis**: Residences and jobs in close proximity will reduce vehicle trips, enabling some trips to be made using non-motorized transportation

  \[ \text{Change in Diversity} = \text{Percent Change in } \left( 1 - \frac{\text{ABS}(b \times \text{population} - \text{employment})}{(b \times \text{population} + \text{employment})} \right) \]

- **Walkable Design**
  - **Hypothesis**: Improving the walking and bicycling environment will result in more non-auto trips and a reduction in auto travel

  \[ \text{Design Index} = 0.0195 \times \text{street network density} + 1.18 \times \text{sidewalk completeness} + 3.63 \times \text{route directness} \]
The 4Ds and Travel Behavior

- **Destination Accessibility**
  - **Hypothesis**: Centrally located generate fewer auto trips and VMT than dispersed households
  - Effect captured by most calibrated travel models

Travel Time Contour Diagram: Triad Region, North Carolina
An elasticity is a measure of the change in travel (%) [the output, in this case] that results from a change in an influential variable (%) [an input, such as density] with respect to density.

Example: If vehicle trips increase by 0.1% for each 1% increase in development density, then vehicle trips are said to have an elasticity of 0.1 with respect to density.
### 4D Elasticities: National Synthesis

<table>
<thead>
<tr>
<th></th>
<th>Vehicle Trips</th>
<th>Vehicle Miles Traveled</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Density</strong></td>
<td>-0.043</td>
<td>-0.035</td>
</tr>
<tr>
<td><strong>Diversity</strong></td>
<td>-0.051</td>
<td>-0.032</td>
</tr>
<tr>
<td><strong>Design</strong></td>
<td>-0.031</td>
<td>-0.039</td>
</tr>
<tr>
<td><strong>Destinations</strong></td>
<td>-0.036</td>
<td>-0.204</td>
</tr>
</tbody>
</table>

### EPA Synthesis of 27 Studies

- **Density**
  \[
  \text{Density} = \frac{\text{Percent Change in}\ [(\text{Population} + \text{Employment}) \text{ per Square Mile}]}{\text{where:} \ b = \frac{\text{regional employment}}{\text{regional population}}}
  \]

- **Diversity**
  \[
  \text{Diversity} = \frac{\text{Percent Change in}\ \{1 - \left(\frac{\text{ABS}(b \times \text{population} - \text{employment})}{b \times \text{population} + \text{employment})}\}}{\text{Design}}
  \]

- **Design**
  \[
  \text{Design} = \text{Percent Change in Design Index}
  \]

- **Design Index**
  \[
  \text{Design Index} = 0.0195 \times \text{street network density} + 1.18 \times \text{sidewalk completeness} + 3.63 \times \text{route directness}
  \]
How the 4D Post-Processor Works

4D Modeling Adjustments in a 4-Step Travel Model

1. After defining regional averages, the Ds are calculated for each TAZ based on lane use and zonal information
   - TAZs with a change in the Ds – where Ds are also above the regional average – will receive a reduction in vehicle trips
   - Upward limit on extent of change allowable are applied

2. The trip tables from the mode choice model step and the D adjustment factors are read
   - Result is an adjusted vehicle trip table

Figure 1 – Model Steps
The 4Ds: Trip Generation and Distribution

Trip Generation defines the size of the flows into or out of a zone

Trip Distribution defines the size of the flows between zones, constrained by the totals from Trip Generation
Application of 4D Model: Comparison of Downtown vs Exurban Development

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Land Use Inputs</td>
<td>1,000</td>
<td>3,030</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TRAVEL OUTPUTS</th>
<th>Outskirts</th>
<th>Downtown</th>
<th>Change (Downtown minus Outskirts)</th>
</tr>
</thead>
<tbody>
<tr>
<td>VT</td>
<td>7,178</td>
<td>6,888</td>
<td>-290 (-4.0%)</td>
</tr>
<tr>
<td>VMT</td>
<td>76,217</td>
<td>44,964</td>
<td>-31,252 (-41%)</td>
</tr>
<tr>
<td>VHT</td>
<td>2083.9</td>
<td>1,387.9</td>
<td>-696 (-33%)</td>
</tr>
<tr>
<td>VMT / VT (Average Trip Length)</td>
<td>10.62</td>
<td>6.53</td>
<td>-4.09 (-38.5%)</td>
</tr>
<tr>
<td>VHT / VT (Average Travel Time in Hours)</td>
<td>0.29</td>
<td>0.20</td>
<td>-0.09 (-31.0%)</td>
</tr>
</tbody>
</table>

Source: Fehr & Peers, 2009
Example: 4D Station Area Impacts in Los Angeles

**Chart 1: AM and PM Peak Hour Vehicle Trip Reduction from the 4Ds**

**Chart 2: Study Area Vehicle Trips with 4Ds Reduction**

- **AM Peak Hour Vehicle Trip Reduction**
- **PM**
### Direct Inclusion of the D’s: Auto Ownership Models

<table>
<thead>
<tr>
<th>Measure</th>
<th>Description and Formulas</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Density Measures</strong></td>
<td>Density measures are calculated over a 1/2 mile radius of the TAZ centroid. These densities are based on total area, instead of developed area.</td>
</tr>
<tr>
<td>Household Density</td>
<td>Total Households / Area</td>
</tr>
<tr>
<td>Retail Employment Density</td>
<td>Retail Employment / Area</td>
</tr>
<tr>
<td>Total Employment Density</td>
<td>Total Employment / Area</td>
</tr>
<tr>
<td><strong>Diversity Measures</strong></td>
<td>The indicators of diversity may be proportional to geometric averages of various land uses. These variables take the highest values when all the uses are high and equally allocated. Diversity can also be expressed as the relative difference between various land uses. The highest diversity occurs when the two land uses are equal, lowest when one or the other dominates. These measures are calculated over a one-half mile radius of the TAZ centroid.</td>
</tr>
<tr>
<td>Retail Employment (RE) and Household (HH) Diversity</td>
<td>0.001 x RE x HH / (RE + HH)</td>
</tr>
<tr>
<td>Retail/Service Employment (RSE) and Household (HH) Diversity</td>
<td>0.001 x RSE x HH / (RSE + HH)</td>
</tr>
<tr>
<td>Jobs/Housing diversity (SACOG)</td>
<td>1 - [ABS(b x HH - EMP) / (b x HH + EMP)], where b = regional employment / regional households</td>
</tr>
<tr>
<td>Job Mix Diversity</td>
<td>1 - [ABS(b’ x RE - NRE) / (b’ x RE + NRE)], Where NRE is non-retail employment and b = regional non retail employment / regional retail employment</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Measure</th>
<th>Description and Formulas</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Design Measures</strong></td>
<td>The only available urban design indicator is the number of intersections, calculated using the Tele Atlas street network</td>
</tr>
<tr>
<td>Mix Employment, Household and Intersection Density</td>
<td>[ \ln \left( \frac{\text{Int}^a \cdot (\text{Emp}^a \cdot (\text{HH}^b \cdot \text{Emp}^b))}{\text{Int}^a \cdot (\text{Emp}^a) + \text{HH}^b} \right) ] , where:</td>
</tr>
<tr>
<td>Intersection Density</td>
<td>3-way + 4-way intersections / Area</td>
</tr>
<tr>
<td>Street Density</td>
<td>Total street length in 1/2 mile radius</td>
</tr>
<tr>
<td>Connectivity Index</td>
<td>Proportion of 4-way intersections</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Measure</th>
<th>Description and Formulas</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Accessibility Measures</strong></td>
<td>Accessibility variables are proportional to the number of opportunities (such as jobs or retail opportunities) that can be reached by auto, transit or walk means.</td>
</tr>
<tr>
<td>Transit Accessibility Logsum</td>
<td>[ \text{TrLogsum}<em>p = \ln \left( \sum</em>{p \in E} \exp(-0.025 \times \text{Time}_{pq} + \ln(\text{Emp}_q)) \right) ]</td>
</tr>
<tr>
<td>Where Time_{pq}</td>
<td>Total transit time including a weight of 2 on all out-of-vehicle time components.</td>
</tr>
<tr>
<td>Transit Accessibility to Jobs</td>
<td>Employment within x minutes of transit (walk access), where x is a category 0-30mins, 30-60mins etc.</td>
</tr>
</tbody>
</table>
Figure 3-1: Mixed Employment, Residential and Intersection Density
Tools for Project Analysis: The MxD Model

Use

• Estimates mixed-use trip generation to support project level studies
• Utilizes ITE trip rates as a primary input source

Application Experience

• Used by several California MPOs to evaluate ‘Sustainable Community Strategies’ and Emissions Budgets
• Approved by the Virginia Department of Transportation as alternative to ITE-based methods for traffic impact studies
## MxD Model: Key Properties

<table>
<thead>
<tr>
<th></th>
<th>MXD Model</th>
<th>4D Model</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>General Size Restrictions</strong></td>
<td>• 5 to 2,000 acres&lt;br&gt;• Less than 7,000 dwelling units&lt;br&gt;• Less than 3 million square feet commercial building area</td>
<td>• Greater than 200 acres&lt;br&gt;• TDF Model TAZs OK</td>
</tr>
<tr>
<td><strong>Research Data</strong></td>
<td>200+ mixed use sites, 6 cities</td>
<td>All kinds of Households, National</td>
</tr>
<tr>
<td><strong>“D”s accounted for</strong></td>
<td>All 7 (not demand mgmt)</td>
<td>Only density, diversity, design</td>
</tr>
<tr>
<td><strong>Use in a TDF Model?</strong></td>
<td>Not usually – maybe for small list of project sites</td>
<td>Yes – can be used for widespread changes to many or all TAZs</td>
</tr>
<tr>
<td>Village</td>
<td>Time Period</td>
<td>Gross Trips (no MXD Adjustment)</td>
</tr>
<tr>
<td>------------------</td>
<td>-------------</td>
<td>---------------------------------</td>
</tr>
<tr>
<td>Mission Village</td>
<td>Daily</td>
<td>57,878</td>
</tr>
<tr>
<td></td>
<td>AM Peak Hour</td>
<td>5,101</td>
</tr>
<tr>
<td></td>
<td>PM Peak Hour</td>
<td>5,889</td>
</tr>
<tr>
<td></td>
<td>AM Peak Hour</td>
<td>2,362</td>
</tr>
<tr>
<td></td>
<td>PM Peak Hour</td>
<td>3,531</td>
</tr>
<tr>
<td>Entrada South Village</td>
<td>Daily</td>
<td>35,969</td>
</tr>
<tr>
<td></td>
<td>AM Peak Hour</td>
<td>2,362</td>
</tr>
<tr>
<td></td>
<td>PM Peak Hour</td>
<td>3,531</td>
</tr>
<tr>
<td></td>
<td>AM Peak Hour</td>
<td>2,362</td>
</tr>
<tr>
<td></td>
<td>PM Peak Hour</td>
<td>3,531</td>
</tr>
<tr>
<td>Entrada North Village</td>
<td>Daily</td>
<td>94,879</td>
</tr>
<tr>
<td></td>
<td>AM Peak Hour</td>
<td>3,329</td>
</tr>
<tr>
<td></td>
<td>PM Peak Hour</td>
<td>8,347</td>
</tr>
<tr>
<td>Landmark Village</td>
<td>Daily</td>
<td>41,258</td>
</tr>
<tr>
<td></td>
<td>AM Peak Hour</td>
<td>2,835</td>
</tr>
<tr>
<td></td>
<td>PM Peak Hour</td>
<td>4,074</td>
</tr>
<tr>
<td>Legacy Village</td>
<td>Daily</td>
<td>37,591</td>
</tr>
<tr>
<td></td>
<td>AM Peak Hour</td>
<td>2,421</td>
</tr>
<tr>
<td></td>
<td>PM Peak Hour</td>
<td>3,532</td>
</tr>
<tr>
<td>Potrero Village</td>
<td>Daily</td>
<td>104,684</td>
</tr>
<tr>
<td></td>
<td>AM Peak Hour</td>
<td>7,014</td>
</tr>
<tr>
<td></td>
<td>PM Peak Hour</td>
<td>9,876</td>
</tr>
</tbody>
</table>
What are “Complete Streets”?

Streets that are

…designed and operated to enable safe access for all users. **Pedestrians, bicyclists, motorists and transit riders** of all ages and abilities must be able to safely move along and across a complete street. Complete Streets make it **easy to cross the street, walk to shops, and bicycle to work**. They allow buses to run on time and make it safe for people to walk to and from train stations.

Source: National Complete Streets Coalition
(https://www.completestreets.org/)
Important Street Attributes:
• Geometrics
• Cross-sections
• Vehicle speeds
• Design elements of complete streets

Important Questions:
• How do complete streets affect people’s ability to get around?
• How to analyze and quantify complete streets concepts in a long range planning process?
Sacramento’s Need for Analysis Methods

• Neighborhood groups voiced concerns that old street standards negatively affected the quality of life for residents

• City responded with an aggressive traffic calming program to address existing problems

• In 1998, revised standards for new roads:
  • Minimum width for local roads reduced from 36’ to 30’
  • Planter strips required on all streets
  • Bicycle lanes required on arterials
  • Landscaped medians required if high traffic volume
The SACOG Approach

Complete Streets: How SACOG Does It

- Incentives
  - Flexible funding
  - Multimodal focus
- Education
  - Technical tools
  - Data and analysis

SACOG Complete Streets Technical Assistance Program

1. Reference Materials (available, in use)
2. GIS, Modeling and Forecasting (in use)
3. Bicycle Trip Planner (in development)
4. Walkability Auditing & Accessibility Index (in development)
GIS & Modeling: Details are Important—All Data at Parcel Level

GIS & Modeling: Intersection Density

- Green="Good" Intersections (3 or 4 legs)
- Red="Bad" Intersections (cul de sacs)
- Density of "good" and "bad" intersections used in forecasting
Enhancements to the Sacramento Regional Travel Model

- Intersection density variable to estimate:
  - The probability of walking
  - The probability of walking to transit

- Special station access coding for walk access to improve transit facility design

- Strategies to improve intersection design or transit access to stations are explicitly accounted for in project evaluations

Connectivity

Poor connectivity forces traffic onto arterials and lengthens trips

Stubs provided to connect to adjacent area but ignored by later development

- No access to north, south, or west
- No access to north, south, or east
- No access to north, east, or west

No access to east, west, or south
MMLOS Applications

- Segments
  - All four modes
- Signalized Intersections
  - Auto, pedestrian, and bicycle modes
- Facility
  - All four modes

MMLOS Defined

- MMLOS measures the degree to which the urban street design and operations meets the needs of each major mode’s users
- Four level of service results for the street:
  - Auto, Transit, Bicycle, Pedestrian
- A combined LOS is not calculated

<table>
<thead>
<tr>
<th>Main Street Level of Service</th>
<th>User Type</th>
<th>AM Pk Hr</th>
<th>PM Pk Hr</th>
</tr>
</thead>
<tbody>
<tr>
<td>Auto</td>
<td>C</td>
<td>E</td>
<td></td>
</tr>
<tr>
<td>Transit</td>
<td>B</td>
<td>C</td>
<td></td>
</tr>
<tr>
<td>Bicycle</td>
<td>D</td>
<td>C</td>
<td></td>
</tr>
<tr>
<td>Pedestrian</td>
<td>C</td>
<td>D</td>
<td></td>
</tr>
</tbody>
</table>
Analysis Methods for Livability—Examining Transportation LOS

Highway Capacity Manual
  Pedestrian LOS
  Bicycle LOS

Emphasis: QUALITY of service (QOS)
  From USER perspective

Example of BLOS A in the left picture and BLOS F in the right picture

Example of PLOS A in the left picture and PLOS F in the right picture

Source: Chattanooga-Hamilton County Regional Planning Agency. Regional Bicycle and Pedestrian Plan (2010).
Pedestrian LOS: Segments

- Factors include:
  - Outside travel lane width (+)
  - Bicycle lane/shoulder width (+)
  - Buffer presence (e.g., on-street parking, street trees) (+)
  - Sidewalk presence and width (+)
  - Volume and speed of motor vehicle traffic in outside lane (-)

Bicycle LOS: Segments

- Factors include:
  - Volume and speed of traffic in outside travel lane (-)
  - Heavy vehicle percentage (-)
  - Pavement condition (+)
  - Bicycle lane presence (+)
  - Bicycle lane, shoulder, and outside lane widths (+)
  - On-street parking presence and utilization (+/-)

Sources: Highway Capacity Manual 2010 and Kittelson & Associates
HCM Regionwide Example: Chattanooga MPO Regional Bike/Ped Plan

~ 918 Non-freeway roadway miles
~ 170 miles of which have sidewalk(s)

Pedestrian Level of Service

Bicycle Level of Service

Note: < 1.5 miles have BLOS F

Source: Chattanooga-Hamilton County Regional Planning Agency. Regional Bicycle and Pedestrian Plan (2010).
Analysis Methods for Livability—HCM vs. Regional Models

HCM

“Deterministic”
Takes fixed demand inputs
Non-varying demand (regardless of mode)

Regional Travel Demand Models

“Probabalistic”
Demand is an output, not an input
Demand can vary depending upon other inputs (regardless of mode)
Advances in Regional Modeling

- Trip based models represent the state of the practice in travel modeling
- Activity models developed or under development in many large US cities
- Key advantages of activity-based models:
  - Representation of household interactions
  - Tours in lieu of trips
  - Improved behavioral realism
  - Greater policy sensitivity
  - Finer time and spatial detail

```
<table>
<thead>
<tr>
<th>Trip-based</th>
<th>Tour-based</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trip generation</td>
<td>Daily activity pattern</td>
</tr>
<tr>
<td>Trip distribution</td>
<td>(tour generation)</td>
</tr>
<tr>
<td>Trip time of day</td>
<td>Tour primary destination</td>
</tr>
<tr>
<td>Trip mode choice</td>
<td>Tour time of day</td>
</tr>
<tr>
<td></td>
<td>Tour mode choice</td>
</tr>
<tr>
<td>Assignment (route choice)</td>
<td>Stop frequency</td>
</tr>
<tr>
<td></td>
<td>Stop location</td>
</tr>
<tr>
<td></td>
<td>Trip mode choice</td>
</tr>
<tr>
<td></td>
<td>Assignment (route choice)</td>
</tr>
</tbody>
</table>
```

Advancing trip-based and tour-based modeling approaches
Regional models with coarse time and space representation limited in their ability to:

- Accurately represent congested conditions
- Understand the time-dependent characteristics of congestion
- Represent impacts of bottlenecks on downstream links
- Understand how reliability impacts route choice (and other) decisions
- Accommodate perceptions of multimodal Level of Service (L) based assignment methods (e.g., dynamic traffic assignment) offered an improved range of capabilities
Improving Consistency with Congestion Dynamics

DTA is a technique that allows the analyst to:

- model long-term adaptation to experienced (learned) congestion dynamics
- accurately model within-day congestion dynamics

For livability: DTA has potential to evaluate operational strategies and treat finer levels of spatial and temporal detail
Example: Puget Sound Regional Regional Plan

Analysis: regional land use modeling integrated with regional travel demand modeling, reported in BCA framework.

Premise: net benefits will become capitalized in the regional economy

<table>
<thead>
<tr>
<th>Measure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>EP1. Benefits to Low-wage and High-wage Employment</strong></td>
<td>Changes in user benefits that accrue to parts of the region with high concentrations of existing low-wage and high-wage employment <em>(based on Benefit-Cost Analysis)</em>.</td>
</tr>
<tr>
<td><strong>EP2. Benefits to Cluster Employment</strong></td>
<td>Changes in user benefits that accrue to parts of the region with high concentrations of employment in existing cluster industries <em>(based on Benefit-Cost Analysis)</em>.</td>
</tr>
<tr>
<td><strong>EP3. Benefits to Freight-Related Employment</strong></td>
<td>Changes in user benefits that accrue to parts of the region with high concentrations of existing freight-related employment <em>(based on Benefit-Cost Analysis)</em>.</td>
</tr>
</tbody>
</table>

Source: Transportation 2040 Final Environmental Impact Statement (Appendix D)
Example: Puget Sound Regional Plan

Inputs: investment and policy scenarios, regionwide

Metrics: total and per-trip (shown below) benefits, relative to the baseline, accruing to zones with selected employment concentrations

Outputs: User benefits include travel time savings, operating cost savings, and reliability savings

Source: Transportation 2040 Final Environmental Impact Statement (Appendix D)
<table>
<thead>
<tr>
<th>Tool</th>
<th>Outputs</th>
</tr>
</thead>
<tbody>
<tr>
<td>4D Tool</td>
<td>Trips, VMT</td>
</tr>
<tr>
<td>MXD Model</td>
<td>Trips</td>
</tr>
<tr>
<td>Highway Capacity Manual</td>
<td>Multi-modal LOS</td>
</tr>
<tr>
<td>*Regional Model (with or w/o DTA)</td>
<td>Accessibility (Destinations)</td>
</tr>
<tr>
<td></td>
<td>Emissions</td>
</tr>
<tr>
<td>*Regional Model (with BCA)</td>
<td>User Benefits</td>
</tr>
<tr>
<td>Land Use Model (emerging)</td>
<td>Pop+Emp location, Pop+Firm demographics</td>
</tr>
</tbody>
</table>

* Emerging regional models may become better at LOS and trip/VMT response to livability strategies
Analysis Methods for Livability: An Example
Study Purpose: To Allow for the Analysis of Potential Infrastructure Investments along the New Orleans inter-Parish Claiborne Corridor, to:

- Provide Multimodal transportation options that connect new and existing developments to jobs, healthcare, and education opportunities
- Lessen the burden of transportation costs on low income family
- Build on strong local commitments and partnerships to address problems of equity and access

Proposal: Develop feasible alternatives to reconnect a neighborhood divided by an elevated expressway
Key Elements of Project Workplan

• The Consultant Team shall develop conceptual visions, based on public, PAC, and agency input that would include:
  • Street Connectivity Improvements
  • Land Use Development Strategies (such as TOD)
  • Freeway system improvements

• The Consultant Team shall establish a methodology for alternatives evaluation, including:
  • Measures of Effectiveness
  • Safety Analysis
  • Street Reconnection Analysis
  • Pedestrian and Bicycle Accommodation
  • Transit Impact Analysis
  • Freight Movement – Goods and Services to Regional Area
  • Traffic Impact Analysis
  • Economic Impact Analysis
You are in charge of developing a technical work plan for the Claiborne Corridor

**Task #1**: Identify two or three performance measure that would target any one of the six livability categories. As you enter your measure, be sure to identify the corresponding livability measure.

Example: Percent of Claiborne Corridor residents with transit access → Promote more transportation choices

**Task #2**: Identify a technical tool or other method that you would need to evaluate the performance measure you entered in task #1. For the example above, an answer could be “regional travel model”.

We’ll discuss your responses, and then briefly touch on actual elements of the analysis plan
Analysis Approach: Bike/Ped

- **assess** pedestrian and bicycle facilities and corridors within the study area
- **identify** gaps in the bicycle and pedestrian system, including street crossing and connectivity barriers, incomplete sidewalks and bikeways, and insufficient connections with adjacent neighborhoods to help identify potential strategies for the continuity of sidewalks and pedestrian accommodations and bicycle accommodations.
- **review** existing and planned trails within or near the study area
Transit Analysis

- **utilize** data to identify any gaps in the existing provision of transit service and the pedestrian network providing access to transit facilities
- **identify** opportunities to improve the system through evaluation of the current service and interviews with transit users, transit providers, and PAC.
Transportation Impact Analysis

Measures of Effectiveness (MOE):

- Travel time and average travel speed
- Approach and control delay
- Arterial, intersection, pedestrian, and bicycle level of service (LOS),
- Volume to capacity ratio (v/c)
- Vehicle-hours traveled
- Fuel consumption
- Evacuation route impact
- Multimodal freight route impacts
- Emissions (e.g. nitrogen oxides, carbon monoxide, and hydrocarbon),
- Queue length (50th and 95th percentile)

Analytical Approach: “The Consultant Team shall conduct an analysis of AM and PM peak hour multi-modal traffic operations, develop a calibrated mesoscopic planning based traffic simulation model… to evaluate small geographic areas, perform reasonable level of validation to enable meaningful comparison of existing and future conditions.”
Socioeconomic Impact Analysis

- Potential implications of the alternatives on area business sales and employment, land use and local population groups
- Consider environmental justice and economic impacts on low-income, elderly, minority, or other disadvantaged groups
- Effects on neighborhood and community cohesion, social resources, community facilities, potentially displaced households and businesses, right-of-way costs, and conformance to local plans
- Evaluation measures
  - Quantitative user benefits and costs, such as differences in VHT, VMT, mode share and transportation choices within corridor, multimodal accessibility
  - Impacts on business output, employment income, taxes to the regional economy based on predicted changes in business productive due to travel time.
Analysis Methods for Livability: Resources

FHWA Livability Resources (see especially “Highlights” sidebar)
http://www.fhwa.dot.gov/livability/

Federal “New Partnership”
www.sustainablecommunities.gov

EPA Resources
http://www.epa.gov/smartgrowth/about_sg.htm

HCM 2010 (for purchase)

National Complete Streets Coalition
http://www.completestreets.org/

Planning and Environment Disciplines Livability Sharepoint Sites
https://one.dot.gov/fhwa/PlanningDSS/Page%20Library/Livability%20(2).aspx
https://one.dot.gov/fhwa/EnvironmentDSS/Context%20Sensitive%20Solutions%20CSS/Forms/AllItems.aspx

Rechannelization
City of Seattle Department of Transportation. Stone Way N Rechannelization: Before and After Study (May, 2010)
Questions?

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