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**

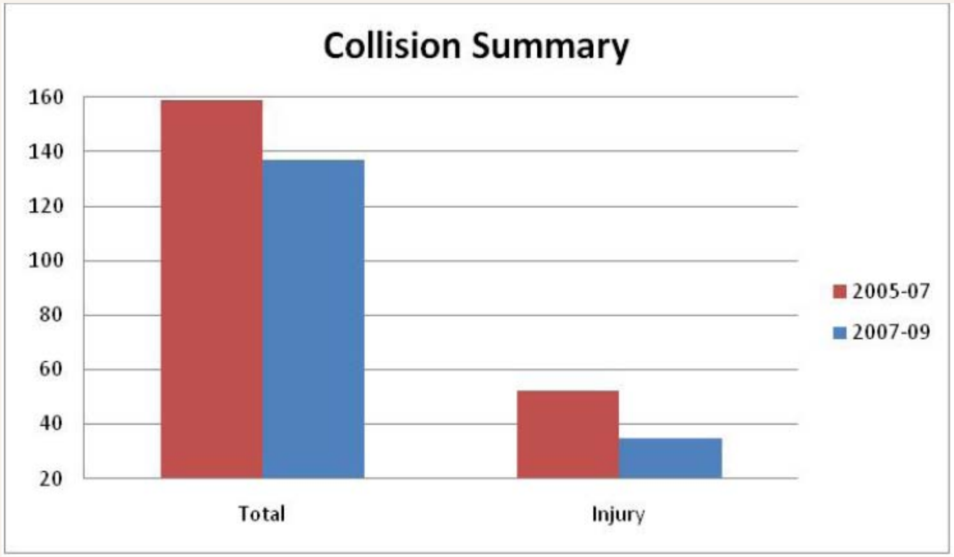
Why does this matter? Seattle's experience with Stone Way Rechannelization…

- 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

	
Before Rechannelization, looking south from 35th St	After Rechannelization, looking south from 35th St

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%



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

Data on Street Conversions - Seattle, Washington

ROADWAY SECTION	DATE CHANGE	ADT (BEFORE)	ADT (AFTER)	CHANGE	COLLISION REDUCTION
Greenwood Ave. N, from N 80th St. to N 50th St.	April 1995	11872	12427	4 lanes to 2 lanes plus TWLTL plus bike lanes	24 to 10 58%
N 45th Street in Wallingford Area	December 1972	19421	20274	4 lanes to 2 lanes plus TWLTL	45 to 23 49%
8th Ave. NW in Ballard Area	January 1994	10549	11858	4 lanes to 2 lanes plus planted median with turn pockets as needed	18 to 7 61%
Martin Luther King Jr. Way, north of I-90	January 1994	12336	13161	4 lanes to 2 lanes plus TWLTL plus bike lanes	15 to 6 60%
Dexter Ave. N, East side of Queen Anne Area	June 1991	13606	14949	4 lanes to 2 lanes plus TWLTL plus bike lanes	19 to 16 59%
24th Ave. NW, from NW 85th St. to NW 65th St.	October 1995	9727	9754	4 lanes to 2 lanes plus TWLTL	14 to 10 28%
Madison St., from 7th Ave. to Broadway	July 1994	16969	18075	4 lanes to 2 lanes plus TWLTL	28 to 28 0%
W Government Way/Gilman Ave. W, from W Ruffner St. to 31st. Ave. W	June 1991	12916	14286	4 lanes to 2 lanes plus TWLTL plus bike lanes	6 to 6 0%
12th Ave., from Yesler Way to John St.	March 1995	11751	12557	4 lanes to 2 lanes plus TWLTL plus bike lanes	16 to 16 0%
				Total	185 to 122 34%

Source: Welch, Thomas M. The Conversion of Four Lane Undivided Urban Roadways to Three Lane Facilities. (1999)

Analysis Methods for Livability: Why?

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?"


Nomino

Analysis Methods for Livability: Toolkit Concepts

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

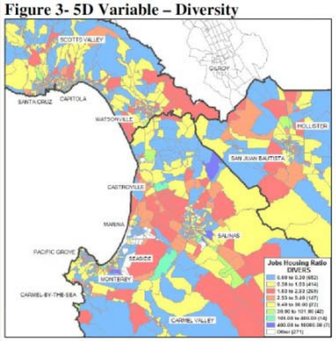
The 4Ds and Travel Behavior

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

Change in Density = *Percent Change in [(Population + Employment) per Square Mile]*

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

Figure 3- 5D Variable – Diversity



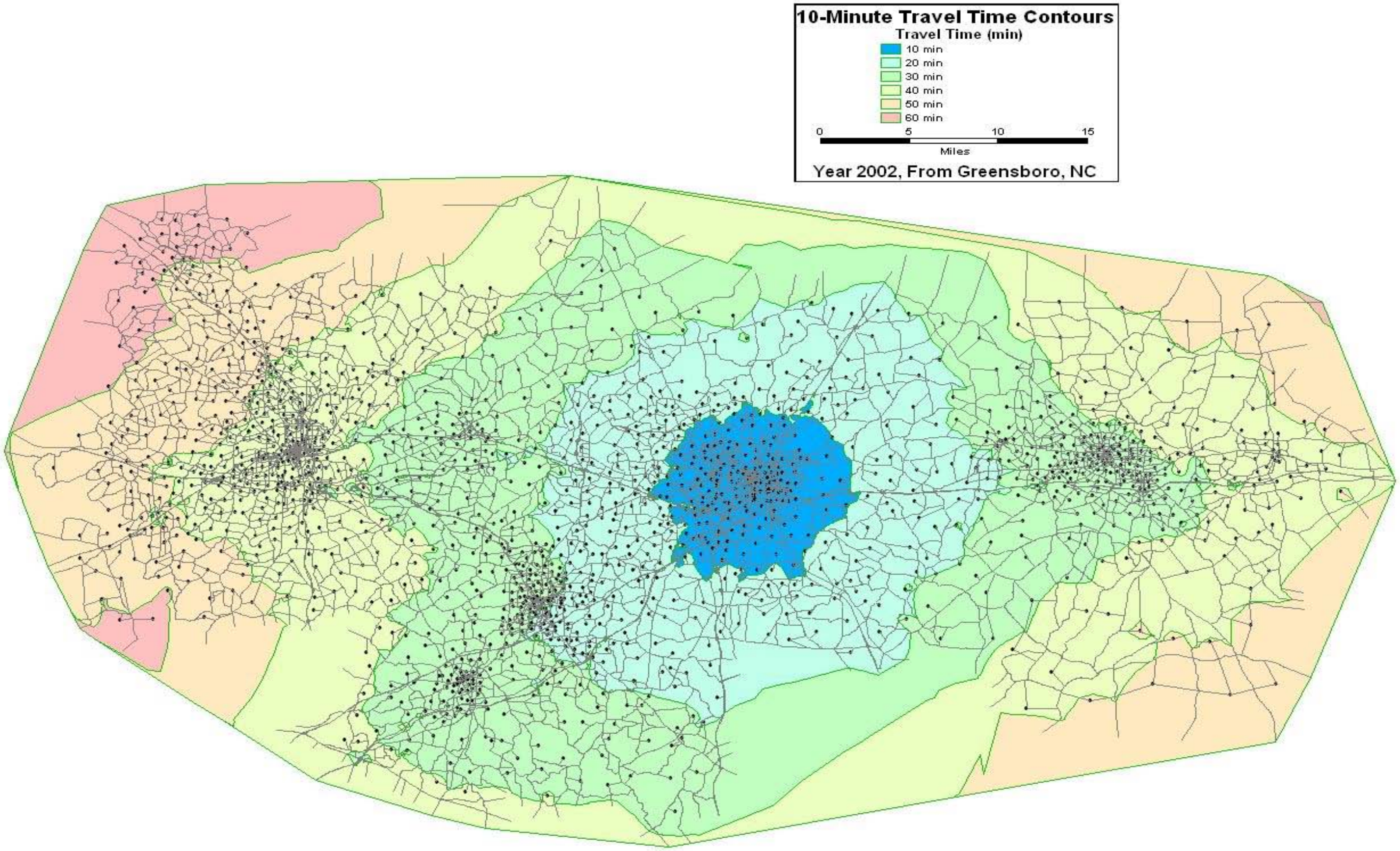
Change in Diversity = *Percent Change in {1-[ABS(b*population – employment)/(b*population+employment)]}*

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

Design Index = *0.0195 * street network density + 1.18 * sidewalk completeness + 3.63 * 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

4D Elasticities

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]

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**.

TABLE 4

ELASTICITIES FROM SJCOG 4D MODEL ENHANCEMENTS

D variable	VT Elasticity
Density	-0.04
Diversity	-0.06
Design	-0.02

Source: Fehr & Peers, 2009

4D Elasticities: National Synthesis

Federal Highway Administration RESOURCE CENTER

EPA Synthesis of 27 Studies

	Vehicle Trips	Vehicle Miles Traveled
Density	–0.043	–0.035
Diversity	–0.051	–0.032
Design	–0.031	–0.039
Destinations	–0.036	–0.204

Density	=	Percent Change in [(Population + Employment) per Square Mile]
Diversity	=	Percent Change in {1 - [ABS(b * population - employment) / (b * population + employment)]}
where:		*b* = regional employment / regional population
Design	=	Percent Change in Design Index
Design Index	=	0.0195 * street network density + 1.18 * sidewalk completeness + 3.63 * route directness

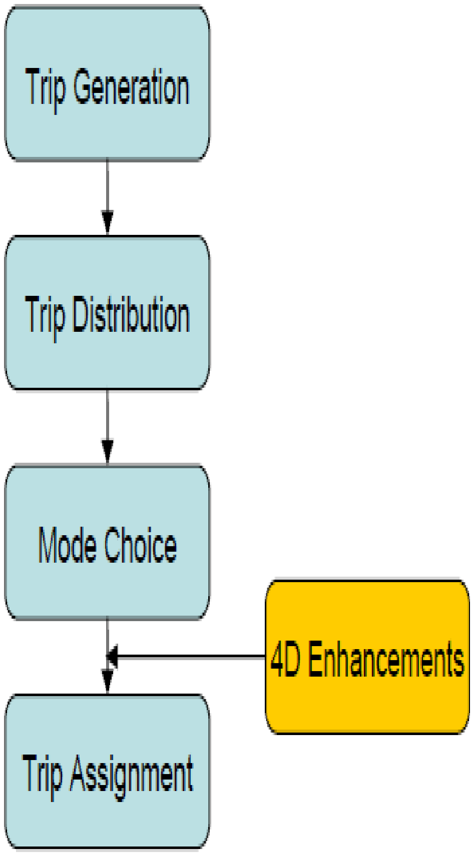
Source: U.S. Environmental Protection Agency. SMART GROWTH INDEX ® A Sketch Tool for Community Planning. Version 2.0 -- Indicator Dictionary. (2002)

How the 4D Post-Processor Works

4 D 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

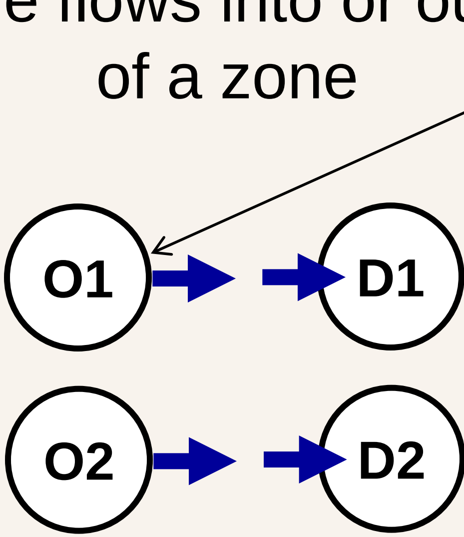


The 4Ds: Trip Generation and Distribution

Trip Generation

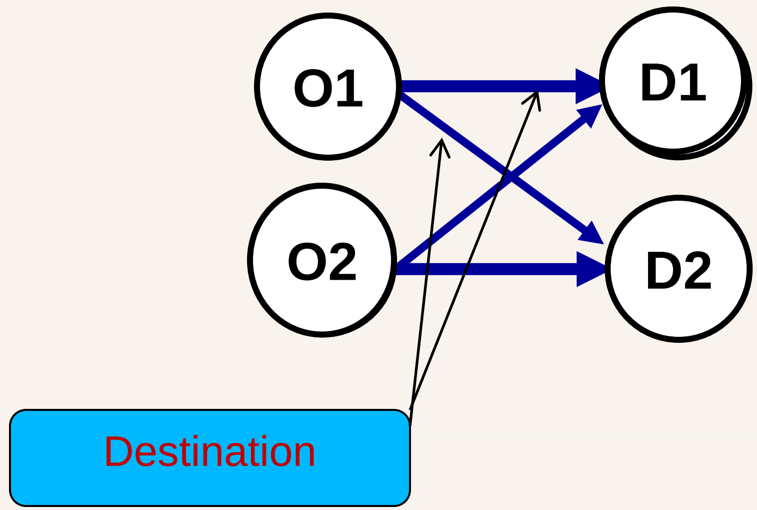
defines the size of the flows into or out of a zone

Density, Diversity, and Design



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

Federal Highway Administration RESOURCE CENTER

TABLE 14
TEST #4: REGIONAL DESTINATION

LAND USE INPUTS							
	Households (3)	Household Population (5)	Group Quarters (6)	Basic Employment (7, 11)	Retail Employment (8-10)	Other Employment (12)	School Enrollment (13-15)
Land Use Inputs	1,000	3,030	0	0	0	0	0

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

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

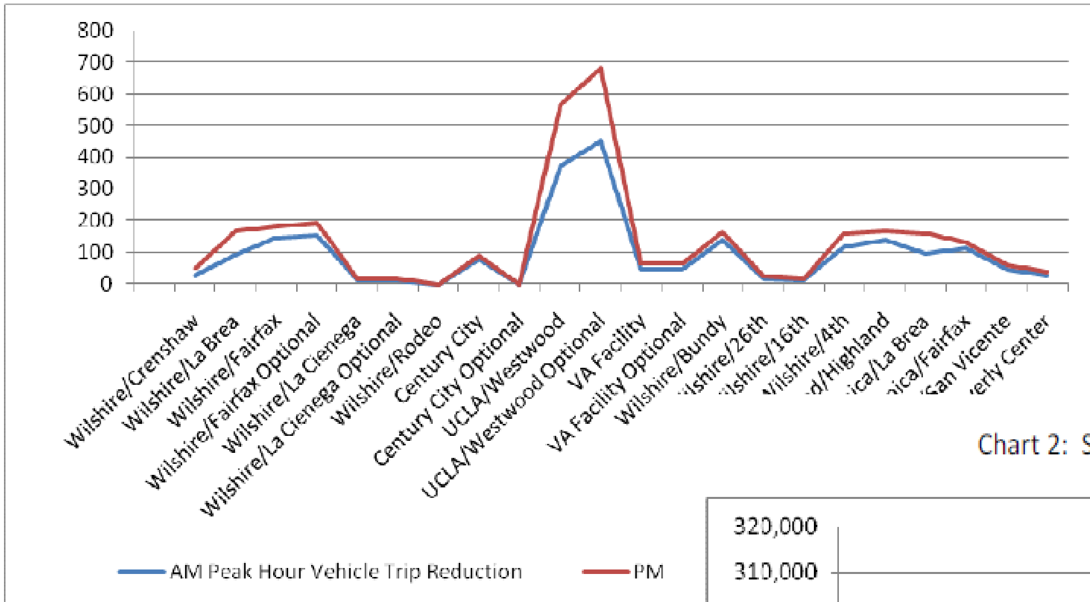
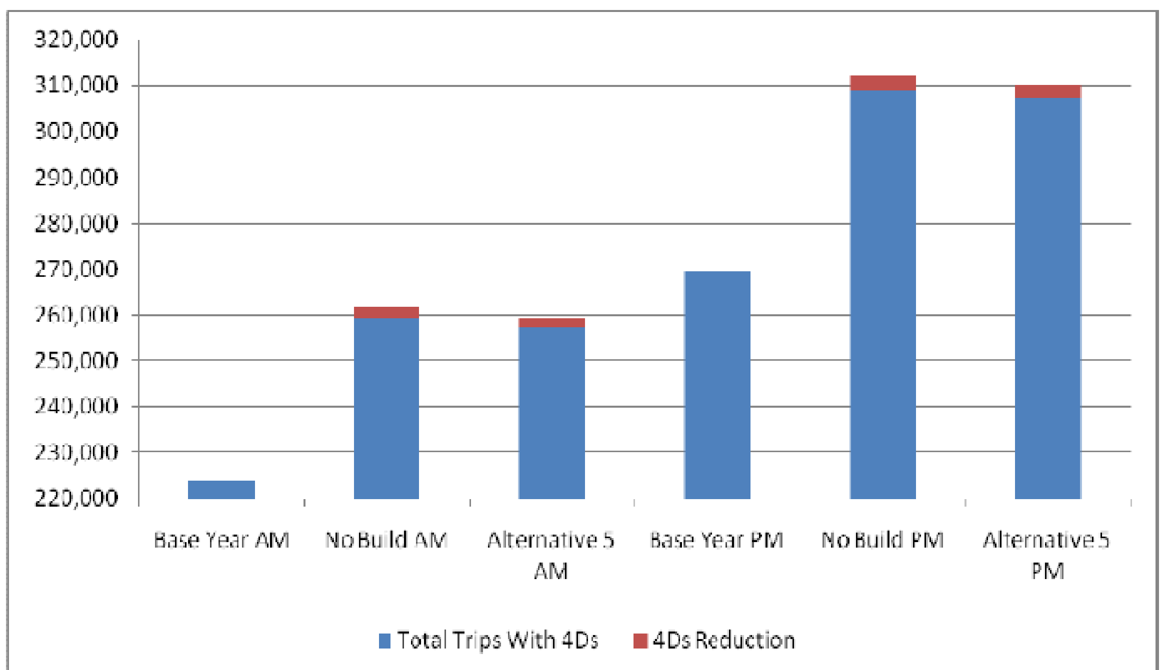


Chart 2: Study Area Vehicle Trips with 4Ds Reduction



Direct Inclusion of the D's: Auto Ownership Models

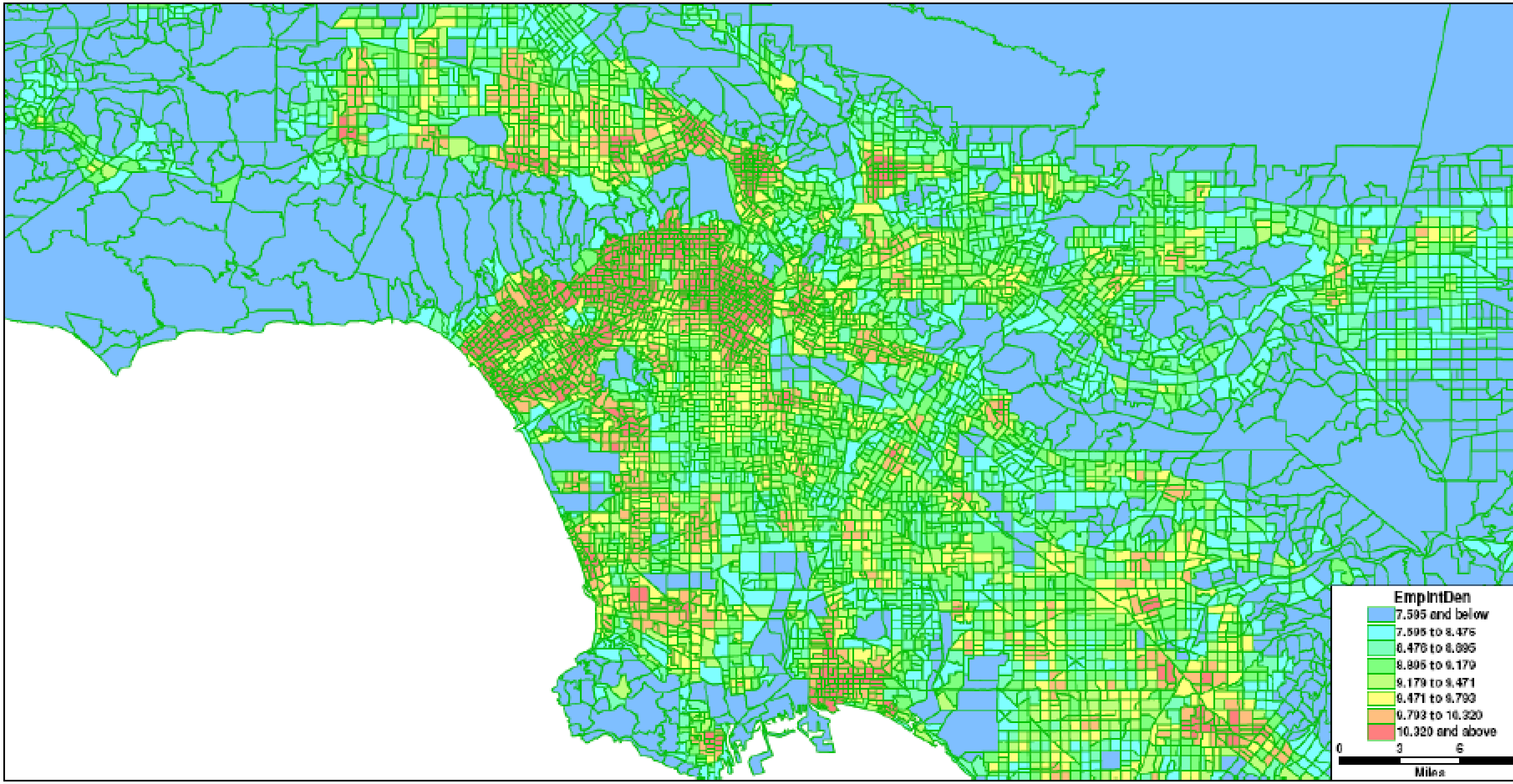
Federal Highway Administration RESOURCE CENTER

Measure	Description and Formulas
Density Measures	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.
Household Density	Total Households / Area
Retail Employment Density	Retail Employment / Area
Total Employment Density	Total Employment / Area
Diversity Measures	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.
Retail Employment (RE) and Household (HH) Diversity	0.001 x RE x HH / (RE + HH)
Retail/Service Employment (RSE) and Household (HH) Diversity	0.001 x RSE x HH / (RSE + HH)
Jobs/Housing diversity (SACOG)	1- [ABS(b*HH - EMP)/(b*HH + EMP)], where b = regional employment / regional households
Job Mix Diversity	1-[ABS(b*RE - NRE) /(B*RE + NRE)], Where NRE is non-retail employment and b = regional non retail employment / regional retail employment

Design Measures	The only available urban design indicator is the number of intersections, calculated using the Tele Atlas street network
Mix Employment, Household and Intersection Density	Ln {[Int*(Emp*a)* (HH*b)] /[Int + (Emp*a) + (HH*b)]}, where: Int= Number of local intersections in 1/2 mile of centroid Emp= Employment within 1/2 mile of centroid HH= Households within 1/2 mile of centroid a= average Int / average Emp b= average Int / average HH
Intersection Density	3-way + 4-way intersections / Area
Street Density	Total street length in 1/2 mile radius
Connectivity Index	Proportion of 4-way intersections
Accessibility Measures	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.
Transit Accessibility Logsum	$TrLogsum_p = \ln\left(\sum_q \exp(-0.025 * Time_{pq} + \ln(Emp_q))\right)$ Where Timepq is total transit time including a weight of 2 on all out-of-vehicle time components.
Transit Accessibility to Jobs	Employment within x minutes of transit (walk access), where x is a category 0-30mins, 30-60mins etc.

Density Maps: Los Angeles

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

	MXD Model	4D Model
General Size Restrictions	•5 to 2,000 acres •Less than 7,000 dwelling units •Less than 3 million square feet commercial building area	•Greater than 200 acres •TDF Model TAZs OK
Research Data	200+ mixed use sites, 6 cities	All kinds of Households, National
"D"s accounted for	All 7 (not demand mgmt)	Only density, diversity, design
Use in a TDF Model?	Not usually – maybe for small list of project sites	Yes – can be used for widespread changes to many or all TAZs

Example Outputs from MxD Model

NEWHALL RANCH VILLAGES MXD TRIP GENERATION AND INTERNALIZATION ESTIMATE					
Village	**Time Period**	**Gross Trips (no MXD Adjustment)**	**Net External Trips (after MXD adjustment)**	**Difference**	**Vehicle Trip Internalization**
Mission Village	Daily	57,878	38,922	18,956	33%
	AM Peak Hour	5,101	3,615	1,486	29%
	PM Peak Hour	5,889	4,123	1,766	30%
Entrada South Village	Daily	35,969	26,672	9,297	25%
	AM Peak Hour	2,362	1,716	646	27%
	PM Peak Hour	3,531	2,738	793	22%
Entrada North Village	Daily	94,879	75,190	19,689	21%
	AM Peak Hour	3,329	2,959	370	11%
	PM Peak Hour	8,347	7,049	1,298	16%
Landmark Village	Daily	41,258	29,637	11,621	28%
	AM Peak Hour	2,835	1,962	873	31%
	PM Peak Hour	4,074	3,063	1,011	25%
Legacy Village	Daily	37,591	28,611	8,980	24%
	AM Peak Hour	2,421	1,988	433	18%
	PM Peak Hour	3,532	2,751	781	22%
Potrero Village	Daily	104,684	69,790	34,894	33%
	AM Peak Hour	7,014	4,527	2,487	35%
	PM Peak Hour	9,876	6,692	3,184	32%

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 (http://www.completestreets.org/)

Analysis Questions

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

Federal Highway Administration RESOURCE CENTER

Complete Streets: How SACOG Does It

SACOG

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

Sacramento Area Council of Governments

SACOG Complete Streets Technical Assistance Program

SACOG

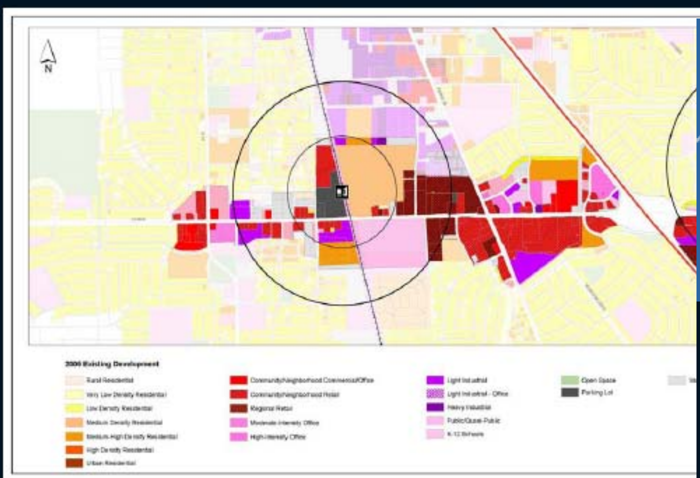
1. Reference Materials (available, in use)
2. GIS, Modeling and Forecasting (in use)
3. Bicycle Trip Planner (in development)
4. Walkability Auditing & Accessibility Index (in development)

Sacramento Area Council of Governments

Data Resources for Livability

GIS & Modeling: Details are Important—All Data at Parcel Level

SACOG



Sacramento Area Council of Governments

GIS & Modeling: Intersection Density

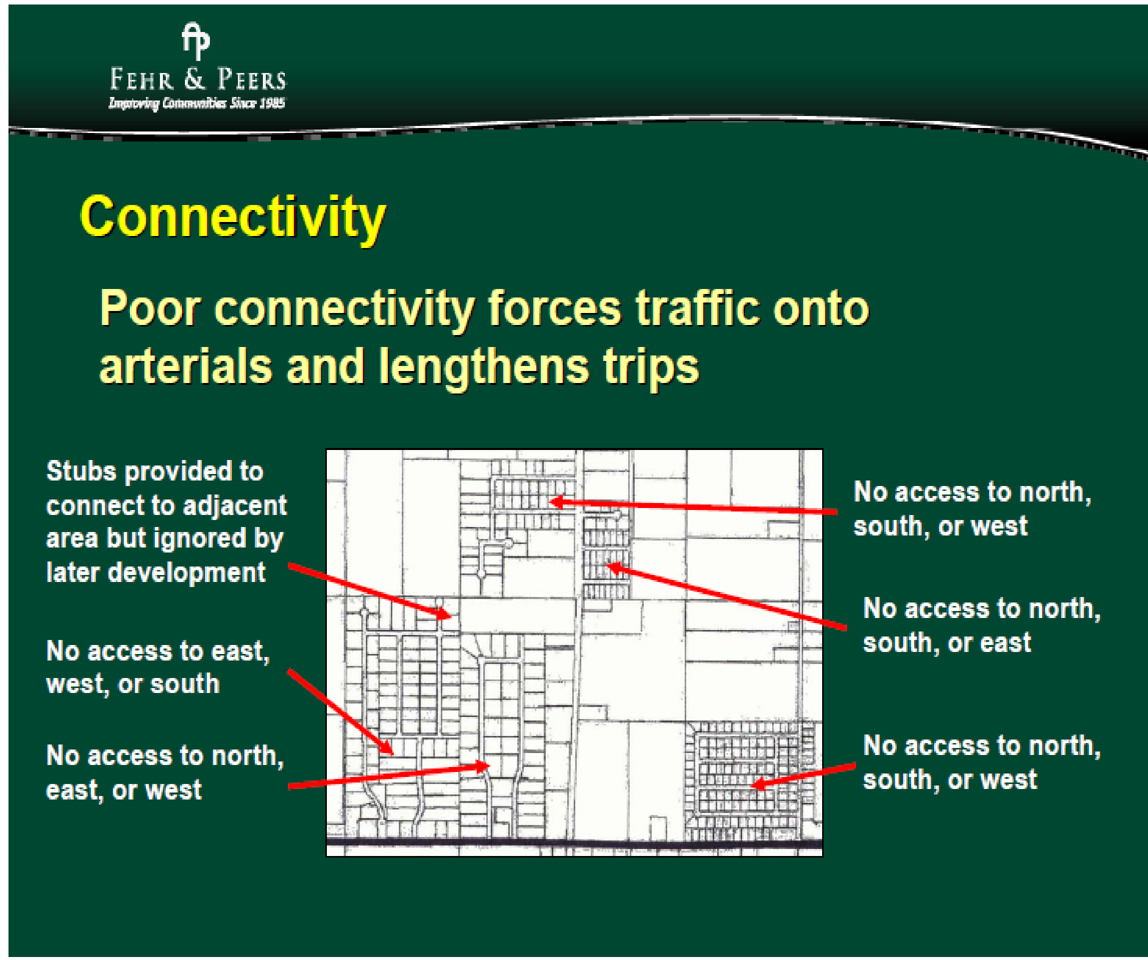
SACOG

- Green="Good" Intersections (3 or 4 legs)
- Red="Bad" Intersections (cul de sacs)
- Density of "good" and "bad" intersections used in forecasting

Sacramento Area Council of Governments

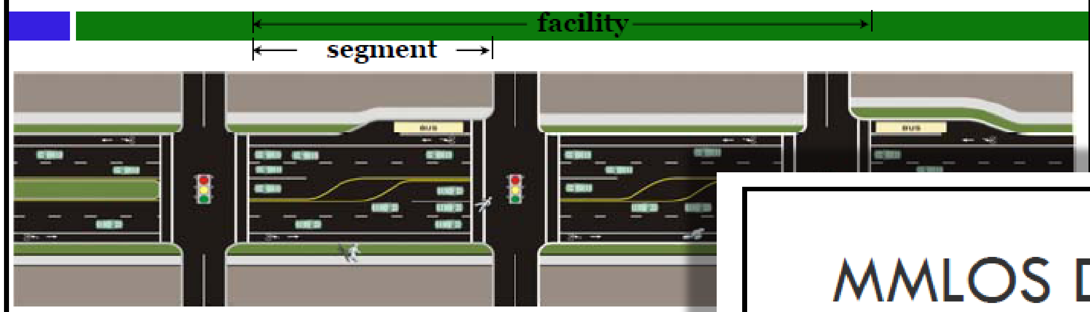
Enhancements to the Sacramento Regional Travel Model

- 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



The 2010 Highway Capacity Manual

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

Main Street Level of Service

User Type	AM Pk Hr	PM Pk Hr
Auto	C	E
Transit	B	C
Bicycle	D	C
Pedestrian	C	D

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

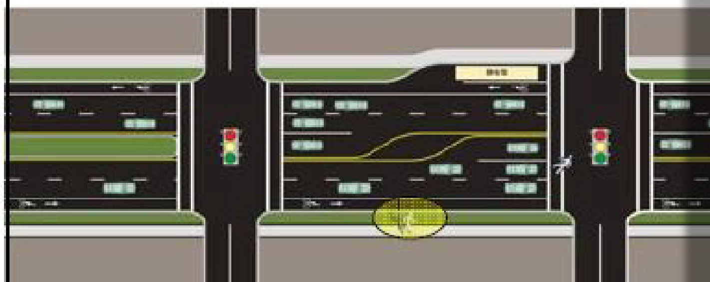
Example of PLOS A in the left picture and PLOS F in the right picture

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

Analysis Methods for Livability—Transportation LOS Inputs

Highway Capacity Manual

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

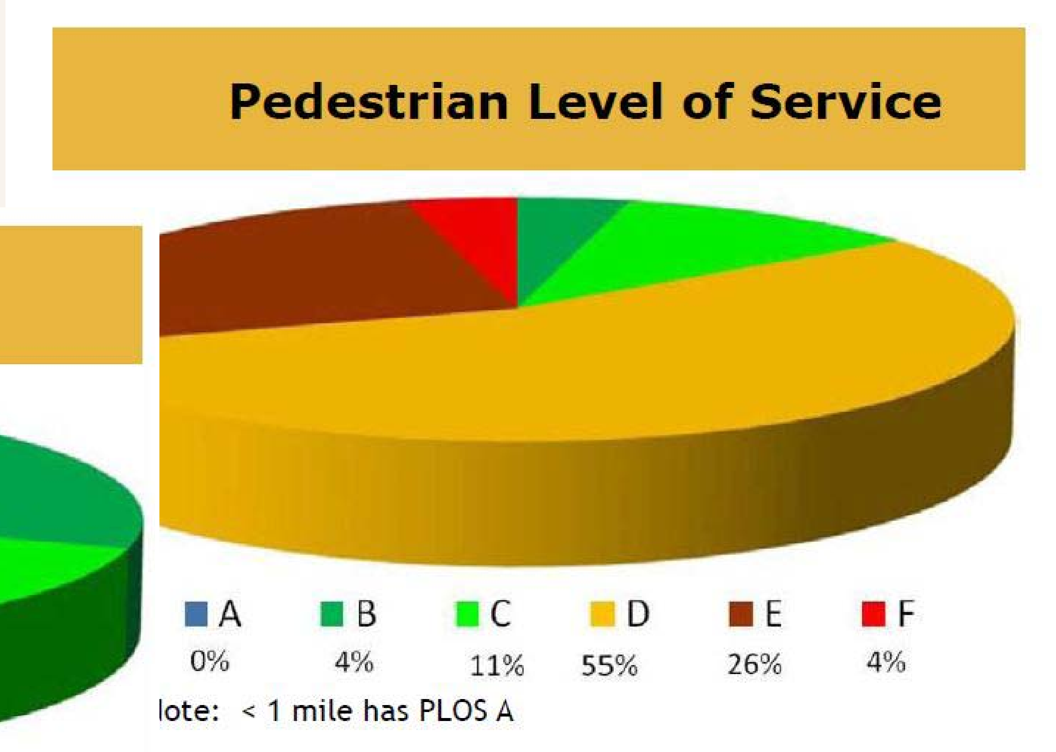
Analysis Methods for Livability—Transportation LOS Outputs

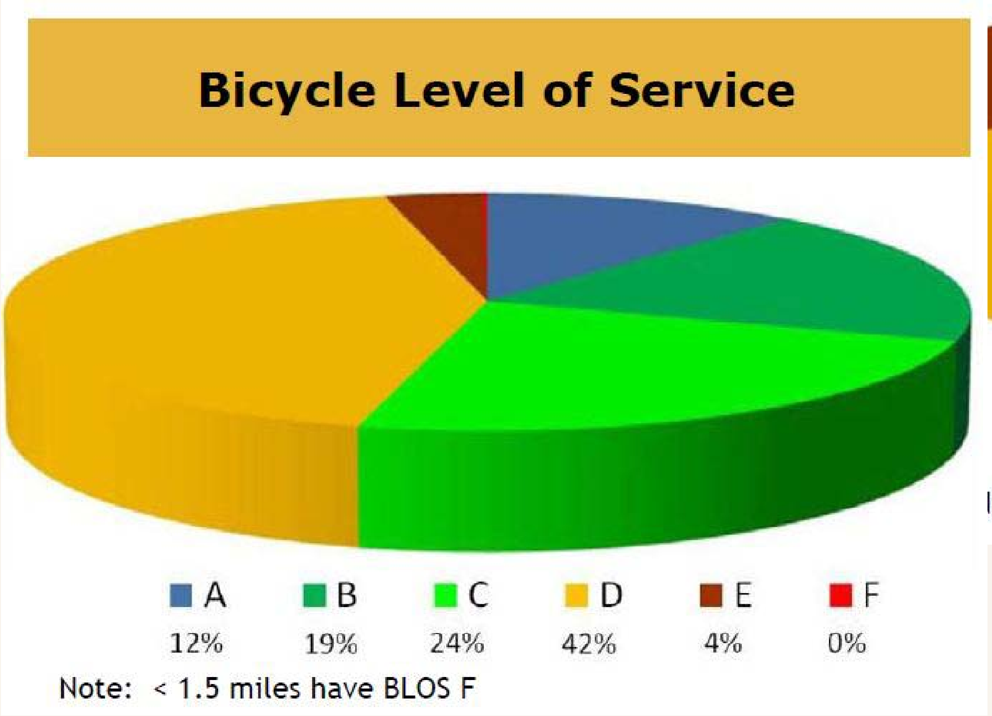
Federal Highway Administration RESOURCE CENTER

HCM Regionwide Example: Chattanooga MPO Regional Bike/Ped Plan

~ 918 Non-freeway roadway miles

~ 170 miles of which have sidewalk(s)





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

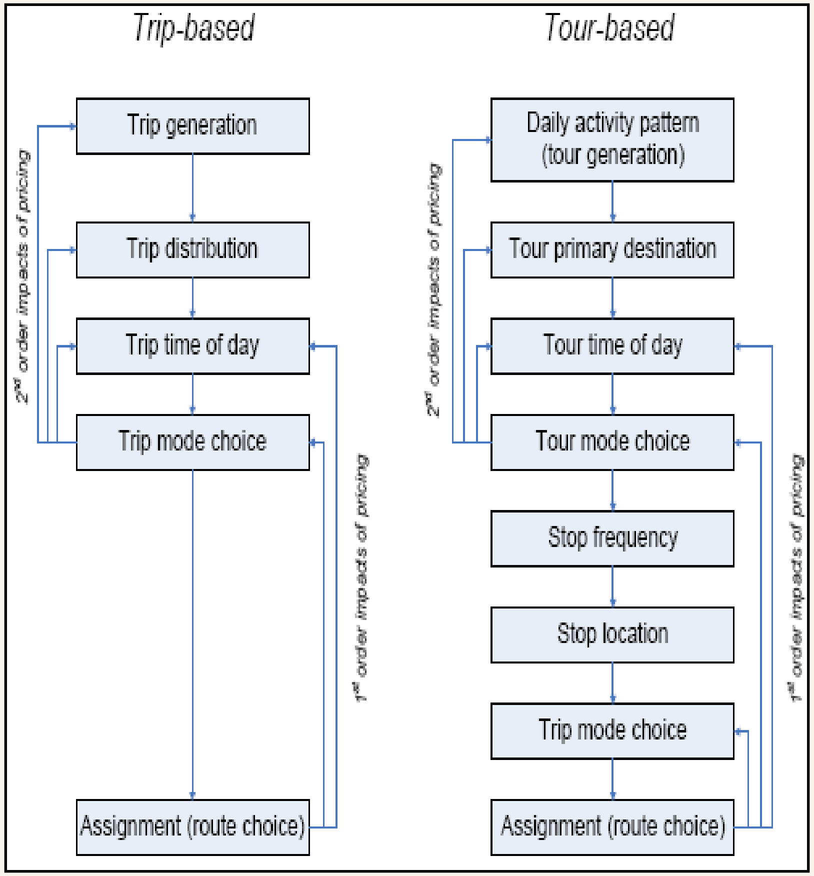
Demand can vary depending upon other inputs (regardless of mode)

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



Limitations of Network Models

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

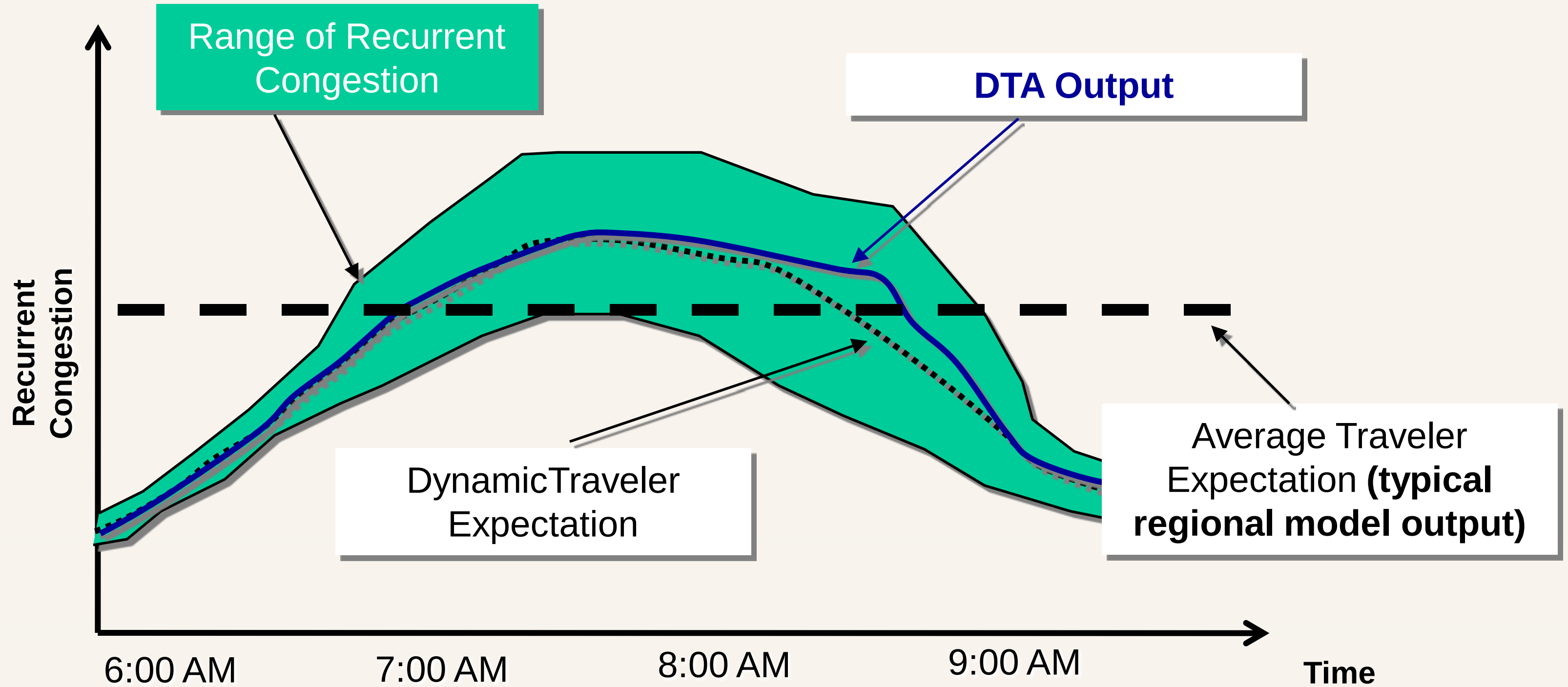
n-based assignment methods (e.g. dynamic traffic assignment) offered an improved range of capabilities

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



Analysis Methods for Livability—Examining Economic Benefits

RESOURCE CENTER
Federal Highway Administration

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

Measure:	*EP1. Benefits to Low-wage and High-wage Employment*
Unit:	Changes in user benefits that accrue to parts of the region with high concentrations of existing low-wage and high-wage employment *(based on Benefit-Cost Analysis).*
Measure:	*EP2. Benefits to Cluster Employment*
Unit:	Changes in user benefits that accrue to parts of the region with high concentrations of employment in existing cluster industries *(based on Benefit-Cost Analysis).*
Measure:	*EP3. Benefits to Freight-Related Employment*
Unit:	Changes in user benefits that accrue to parts of the region with high concentrations of existing freight-related employment *(based on Benefit-Cost Analysis).*

Source: Transportation 2040 Final Environmental Impact Statement (Appendix D)

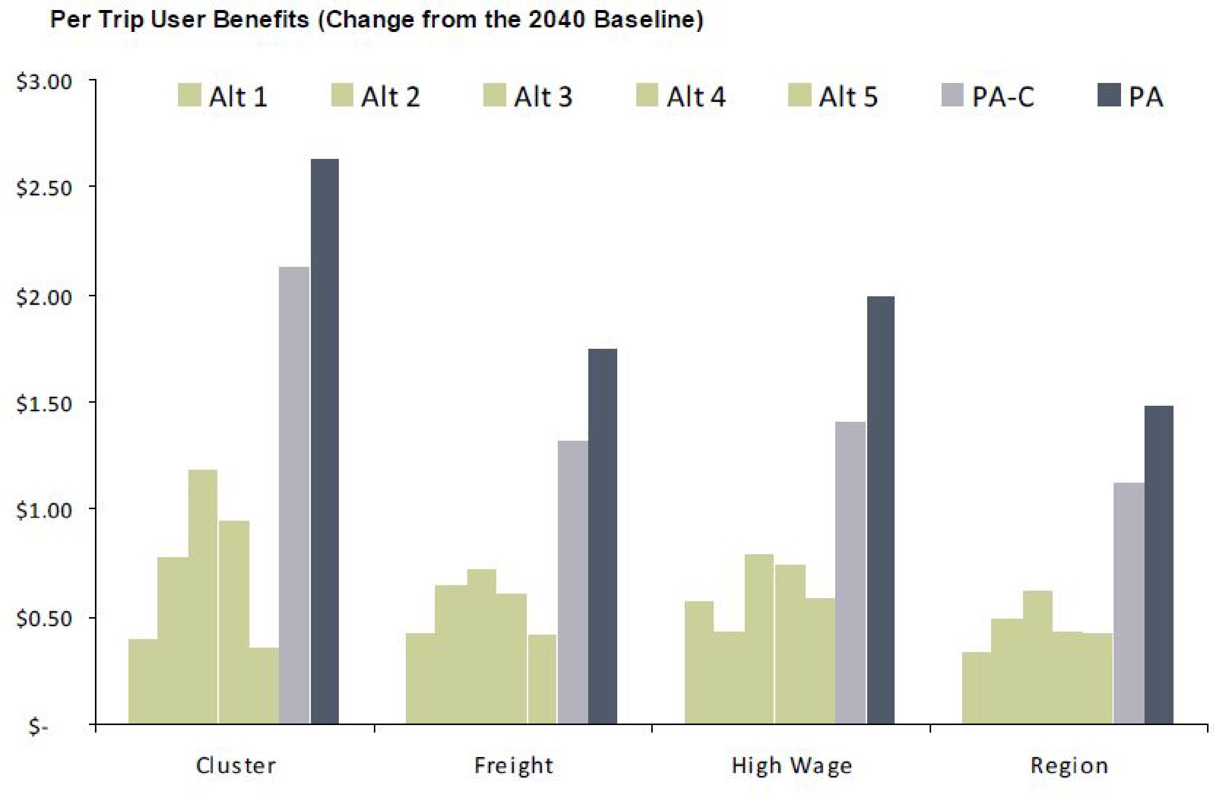
Analysis Methods for Livability—Economic-Related Outputs

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)

Analysis Methods for Livability—Analysis Toolkit Summary

Federal Highway Administration RESOURCE CENTER

Tool	Outputs
4D Tool	**Trips, VMT**
MXD Model	**Trips**
Highway Capacity Manual	**Multi-modal LOS**
***Regional Model (with or w/o DTA)**	**Accessibility (Destinations)** **Emissions**
***Regional Model (with BCA)**	**User Benefits**
Land Use Model (emerging)	**Pop+Emp location,** **Pop+Firm demographics**

* Emerging regional models may become better at LOS and trip/VMT response to livability strategies

Analysis Methods for Livability: An Example

Claiborne Corridor

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

Claiborne Avenue Corridor: The Analytical Plan

- 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)

www.trb.org/Main/Blurbs/Highway_Capacity_Manual_2010_HCM2010_164718.aspx

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?

Contacts

Eric Pihl

FHWA Resource Center Planning TST

eric.pihl@dot.gov

720.964.3219

Jeff Frkonja

FHWA Resource Center Planning TST

jeffrey.frkonja@dot.gov

708.283.3548