Effective Approaches to Multimodal Modeling

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Introduction

This document supplements the material presented during the September 25, 2007 webinar – *Understanding the Transportation Models and Asking the Right Questions* – sponsored by the Surface Transportation Policy Project and the Center of Neighborhood Technologies with support from the Federal Transit Administration, the Oak Foundation and AARP. It is targeted at the same broad audience as the webinar, including interested citizens, public officials without modeling expertise, and professional modelers.

Transportation modeling is a central part of transportation planning. At the regional and state level, modeling is used in developing regional and statewide transportation plans and air quality conformity analyses. At the corridor level, modeling is used in developing Environmental Impact Statements for major road and transit projects. In small areas, transportation modeling is used in project reviews, traffic impact studies, and small area transportation improvements.

Modeling at all three levels – regional, corridor and small area – generally has focused on auto travel. Effective modeling places equal weight on non-auto modes including public transportation, walking and biking.

Transportation modeling also generally has been done as if the type of land use did not matter. Effective modeling integrates transportation and land use.

General introductory material is presented in the front of this document. This is followed by checklists that contrast good modeling practice from typical practice for a number of important questions. For each question, technical resources are provided that provide more information. This information can be used to facilitate discussions between non-modelers and modelers about how to make models more effective in advancing community goals. For example, non modelers can ask modelers to consider the methods described in the technical resources.

Models in Transportation Planning

Different transportation models support transportation planning at the three geographic scales:

- region or state
- corridor, and
- local area.

While there are unique modeling tools at each of the separate levels, some planning efforts involve modeling at two or even all three of the levels.

Region or State

There is tremendous uncertainty about the future. The common practice of evaluating a single future in a distant year like 2030 is poor practice. Instead, a range of scenarios should be evaluated that vary both future land use and future transportation networks. Using multiple scenarios also helps work towards a community vision. Rather than viewing the trend as destiny, the future is reframed as a conscious choice. This is both more empowering and more accurate.

A potential pitfall in scenario analyses involving different land use futures is that many regional transportation models are insensitive to land use. In good practice, special attention is paid to ensure that the transportation models used to evaluate future scenarios are sensitive to land use. This can be accomplished either by modifying the regional models or adding a "postprocessing stage" on the back end of the model to correct for model errors.

Transit ridership is especially sensitive to land use form. Most transit trips begin and end with walk trips. The pedestrian environment is critical in determining the relative attractiveness of transit. Commuting by transit is also much more attractive when the work location is in a walkable area with services for lunch and other mid-day trips. As discussed above, it is critical that transportation models are properly sensitive to land use. It is important that this be confirmed by checking that models estimate ridership correctly for subareas, and not just for entire regions, as is commonly done.

Roadway and transit capacity typically are planned to meet travel demand during the weekday peak morning and afternoon commuting periods. It is important that transportation models explicitly evaluate these peak travel periods.

Congestion acts to deter travel, shift it to other modes including transit and HOV if available, and to shift it out of the most congested time periods. In these ways, congestion acts to *reduce* travel. When highway capacity is increased, and congestion is relieved, the same systemic forces cause *induced* travel. Travel will be encouraged and will shift to cars and to the peak travel periods. It is important that transportation models represent these effects. This is accomplished through including feedback in the models.

Corridor

A common problem in corridor studies is a myopic focus on single roadways. In part, this is a result of funding mechanisms that focus Federal and state funding on a few primary arterials. It is important that both existing and potential parallel roadways be included in the analyses. Investing in these parallel roadways is often more cost effective and will result in less future traffic congestion than in building a single roadway larger and larger. In some jurisdictions, this has been recognized and the funding mechanisms have shifted.

There are long established quantitative methods for evaluating levels of service for cars. Level of service metrics are just being developed for walk, bike and transit trips. It is important that all modes be considered in corridor studies.

The modeling tools used in many corridor studies cannot adequately estimate the potential for transit ridership. Good practice requires that transit options be considered and that they be evaluated fully. This requires models that are sensitive to the interrelationships between land use and transit.

Building new roadway capacity will result in land use shifts and additional travel. It is important that corridor studies disclose these indirect land use effects and induced travel effects. (Environmental Impact Statements are legally required to make these disclosures.)

Local Area

Increased density in redevelopment and urban infill sites is often opposed due to localized impacts, including traffic impacts. However, denser core development typically will have significant regional traffic benefits relative to development on vacant land at the region's edge. It supports more walk, bike and transit trips as well as shorter trips for those using cars. It is important that analyses of redevelopment and infill consider the benefits relative to suburban development.

Vehicle trip generation is lower for denser, mixed use developments than for decentralized single use developments such as housing subdivisions, office parks or shopping centers. In evaluating the impacts of dense, mixed use projects, it is important to give credit for vehicle trip reductions.

High minimum parking requirements are present in most municipal ordinances. These requirements cause too much of urban space to be devoted to parking that returns little value, is ugly, and breaks up the urban form. An oversupply of parking spaces results in free or under-priced parking which encourages driving instead of walking, biking or using transit. Instead, parking minimum requirements should be eliminated and the market will supply the necessary parking spaces at an appropriate price. Even if the requirements remain in place, waivers should be granted for dense multi-use redevelopment and infill projects.

Local studies often focus on roadway levels of service. All modes, including walking, biking and transit, should be considered.
U.S. street design since World War II has focused on serving auto mobility. There is now a renewed focus on multimodal streets. When streets are reconstructed or new streets are built, they should serve all travel modes.

Good Modeling Practice: Regional Level

Question	Typical Practice	Good Practice
1) Long-range	A single forecast is	Multiple population and employment

transportation plans require population and employment model inputs for 20 years or more in the future. How are these numbers developed?	developed through a committee process that often involves a combination of analysis and politics.	scenarios are tested to account for uncertainty and also to support work towards a desired future vision.
2) Walking and transit use are greater in walkable, higher-density areas than in auto-oriented single use areas. How are these effects captured in the model?	These land use effects are not included in the model.	The “3 D” land use effects (density, diversity and design) are included in the model process – either within the model or in a postprocessing step.
3) Models typically include only major streets. How is the capacity of parallel streets in urban grids accounted for?	This capacity of urban grids is underestimated in the model.	All of the streets are included in the model or the capacity of the streets in the model is adjusted upwards to account for the capacity of missing streets.
4) Congestion is primarily a problem only in weekday morning and afternoon peak hours, and often only in the peak direction. How are these time periods modeled?	Many models still represented only a 24-hour weekday in its entirety.	The morning and afternoon time periods are modeled explicitly. Larger and more congested urban areas use multi-hour peak periods to represent peak spreading.
5) Induced travel is a well-documented process where increased roadway capacity leads to increased travel. How is induced travel captured in the model?	Induced travel can include changes in housing and job locations, destination, mode, and route. Some models capture none of these effects, and many capture only route changes.	Modeling land use changes from added roadway capacity requires either an integrated land use allocation model or scenarios that represent induced land use. The other induced travel effects are modeled through model feedback. Feedback assures that destination choice and mode choice are affected by travel times which are determined, in part, by roadway capacity.
6) How accurate is transit modeling?	Transit ridership is matched to base year data at the regional level. In general, this underestimates ridership in areas with transit-supportive land use.	The “3 D” land use effects are included in transit mode choice modeling, and transit ridership is validated at a subregion and/or route level.

Technical Resources: Regional Level

Topic	More Information
1) Future households & employment	Federal Highway Administration (FHWA) Scenario Planning website Bartholomew, Keith. Integrating Land Use Issues into Transportation Planning: Scenario Planning – Summary Report (PDF) and Annotated Bibliography (PDF) Seskin, Samuel N., Katherine Gray Still, John Boroski. *The Use of Expert Panels in Analyzing Transportation and Land Use Alternatives (PDF)*, completed as part of National Cooperative Highway Research Program (NCHRP) Project 8-36 Task 4, April 2002. Fourth Symposium on Integrated Land Use-Transport Models, Portland Oregon (November 15-17, 2005). Presentations at the Oregon State website
2) Land use impacts	Cevero, Robert. Alternative Approaches to Modeling the Travel-Demand Impacts of Smart Growth. *Journal of the American Planning Association*, Summer 2006. DKS Associates, University of California, Irvine, University of California, Santa Barbara and Utah State University Assessment of Local Models and Tools for Analyzing Smart Growth Strategies (PDF). Prepared for California Department of Transportation, 2007. Marshall, Norm and Brian Grady. Travel Demand Modeling for Regional Visioning and Scenario Analysis, *Transportation Research Record Journal of the Transportation Research Board*, No. 1921, Travel Demand 2005.
3) Network	Metro (Portland). *Street Connectivity: An Evaluation of Case Studies in the Portland Region* (PDF), June 22, 2004.
4) Time periods	Harvey, Greig and Elizabeth Deakin. *A Manual of Regional Transportation Modeling Practice for Air Quality Analysis. National Association of Regional Councils*, July 1993.
5) Induced travel	Comsis Corp. *Incorporating Feedback in Travel Forecasting: Methods, Pitfalls and Common Concerns. Published by the Travel Model Improvement Program* (U.S. DOT and U.S. EPA), March 1996.
6) Transit modeling	Marshall, Norm and Brian Grady. Sketch Transit Modeling Based on 2000 Census Data. *Transportation Research Record: Journal of the Transportation Research Board*, No. 1986, Transit Management, Maintenance, Technology and Planning 2006.

Good Modeling Practice: Corridor Level

Question	Typical Practice	Good Practice
7) Is the planning focus on a single roadway or are nearby parallel roadways included in the analysis?	The focus is on a single roadway.	Nearby parallel roadways and potential new parallel roadways are included in the analysis. Addressing capacity needs through multiple roadways is often more cost effective and meets community needs better than creating one undesirably wide roadway.
8) Do the analyses	Only roadway	Performance measures are presented not only for

present only roadway levels of service and other metrics, or are alternative modes analyzed?	measures of performance are presented.	autos, but also for transit, walking, and biking.
9) Are indirect land use and induced travel effects from increased roadway capacity analyzed?	Indirect land use and induced travel effects are not analyzed.	Indirect land use and induced travel effects are included in the analyses. This work can include use of regional models that address these impacts and/or the use of expert panels.
10) Are transit ridership estimates sensitive to the land use form, including Transit Oriented Development (TOD)?	Corridor-level transit ridership is estimated using a model that is insensitive to these land use effects.	The "3 D" land use effects are included in transit mode choice modeling, and transit ridership is validated at a subregion and/or route level. It is also important to consider how ridership will be affected if a more complete transit system is built. Ridership on a complete transit system will be higher than would be indicated by modeling a set of transit corridors separately, because many potential trips will use more than one transit corridor.

Technical Resources: Corridor Level

Topic	More Information
7) Scope of Study	Thomas Jefferson Planning District Commission (Charlottesville) US 20 North Corridor Transportation Study, 29H250 Phase 2 Report (PDF).
8) Multimodal analysis	Dowling and Associates et. al., Multimodal Level of Service Analysis for Urban Streets, National Cooperative Highway Research Project (NCHRP) 3-70 Report forthcoming, PowerPoint summary Florida Department of Transportation Multimodal Level of Service
9) Indirect land use effects and induced travel	The Louis Berger Group, Inc. *Desk Reference for Estimating the Indirect Effects of Proposed Transportation Project (PDF).* National Cooperative Highway Research Program (NCHRP) 466 Report (2002)
10) Transit modeling	Marshall, Norm and Brian Grady. Sketch Transit Modeling Based on 2000 Census Data. *Transportation Research Record: Journal of the Transportation Research Board*, No. 1986, Transit Management, Maintenance, Technology and Planning 2006.

Good Modeling Practice: Local Level

Question	Typical Practice	Good Practice

11) Is the geographic scope of a local study narrowly defined?	The focus is on small area.	The regional impacts of the project are also considered. In general, a higher-density infill project may have greater local impacts but these can be more than offset by regional benefits. These tradeoffs are highlighted in the analyses.
12) Are vehicle trip generation and parking generation affected by the character of the land use?	The numbers in *Trip Generation* and *Parking Generation* are applied without consideration to the land use form.	Vehicle trip generation and parking generation estimates are reduced for the "4 Ds" – density, diversity (mixed use), design (walkability), and distance (to transit).
13) Are parking minimum requirements applied in all cases?	Parking minimum requirements are strictly applied.	Parking minimums generally result in an over-supply of parking in urban areas, causing unnecessary expense, wasted land, reduced tax revenues and a poor urban form. The parking over-supply also causes parking to be free or under-priced, causing more traffic congestion. Allowing the free market to balance supply and demand through price provides necessary parking while also better meeting other community objectives.
14) Is only traffic level of service presented or are other travel modes analyzed?	Only auto level of service is analyzed and presented.	The analysis also includes pedestrian, bicycle, and transit levels of service. This highlights tradeoffs including the common case where adding turn lanes improves auto levels of service but reduces pedestrian levels of service.
15) Is auto level of service the only determinant of street design?	Street design is dominated by vehicle capacity and vehicle speed.	The design is for all modes, i.e. "Complete Streets", and considers all community needs and objectives – not just vehicle capacity and vehicle speed.

Technical Resources: Local Level

Topic	More Information
11) Geographic scale	Walters, Gerald, Reid Ewing and William Schroeer. Adjusting Computer Modeling Tools to Capture the Effects or Smart Growth: Or "Poking at the Project Like a Lab Rat." *Transportation Research Record: Journal of the Transportation Research Board*, No. 1722, Transit Management, Maintenance, Technology and Planning 2000.
12) Vehicle trip generation and parking generation	Cevero, Robert. Making Tysons Corner Work. (PowerPoint presentation) http://www.fairfaxcounty.gov/dpz/tysonscorner/cerveroapr2007.pdf Bochner, Brian et. al. Enhancing Internal Trip Capture Estimation for Mixed-Use Developments, National Cooperative Highway Research Project 08-51, forthcoming.

13) Parking requirements	Shoup, Donald. *The High Cost of Free Parking.* American Planning Association, 2005
14) Modes considered	References on multi-modal level of service in *Corridor* section above. Complete Streets www.completestreets.org
15) Street design	Institute of Transportation Engineers (ITE), *Traditional Neighborhood Development Street Design Guidelines: An ITE Recommended Practice;* and *Context Sensitive Solutionsin Designing Major Urban Thoroughfares for Walkable Communities: An ITE Proposed Recommended Practice*, 2006. http://www.ite.org/bookstore/RP036.pdf

Technical Resources: General

Topic	More Information
Transportation planning process	Federal Highway Administration, *The Transportation Planning Process: Key Issues, A Briefing Book for Transportation Decisionmakers, Officials and Staff*, Updated September 2007, http://www.planning.dot.gov/documents/briefingbook/bbook.htm
Introduction to technical aspects of modeling for non-modelers	Beimborn, Edward, Rob Kennedy and William Schaefer, *Inside the Blackbox: Making Transportation Models Work for Livable Communities*, http://www.environmentaldefense.org/documents/1859_InsideBlackBox.pdf
State of the practice	Transportation Research Board, *Metropolitan Travel Forecasting: Current Practice and Future Direction, Special Report 288*, 2007, http://onlinepubs.trb.org/onlinepubs/sr/sr288.pdf
Travel Model Improvement Program	U.S. Department of Transportation, Travel Model Improvement Program (TMIP) – a large collection of resources at http://tmip.fhwa.dot.gov/ including peer review reports for a number of regions at http://tmip.fhwa.dot.gov/services/peer_review_program/status.stm
Air quality conformity	Association of Metropolitan Planning Organizations (AMPO) *Transportation Conformity: A Basic Guide for State & Local Officials*, Revised 2005, http://www.ampo.org/assets/25_bguide05.pdf
FHWA Certification Checklist	Federal Highway Administration *Certification Checklist for Travel Forecasting Methods* http://www.fhwa.dot.gov/planning/certcheck.htm
Roadway Environmental Impact Statements (EIS)	Federal Highway Administration website on Project Development focused on National Environmental Policy Act (NEPA) issues, http://www.environment.fhwa.dot.gov/projdev/index.asp