TFS 9/23/2011
Item #5

# Recent Research on Activity-Based Models

Presentation to TPB Travel Forecasting Subcommittee
September 23, 2011

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# Overview

- What are activity-based models (ABMs)?
- Basis of research: TRB Special Report 288
- NCHRP Synthesis 406
- AMPO Pooled Funding Initiative, Phase 1
- Ohio DOT comparison of Columbus ABM and trip-based model (TBM)
- AMPO Pooled Funding Initiative, Phase 2
- Implications for TPB model development

# What are Activity-Based Models?

- A simulation of individual persons rather than aggregate trip flows
- Unit of travel analysis is tour rather than trip
- Typically more disaggregate inputs than with trip-based model
- Typically disaggregate application for first three steps of “four step” model
- Concept of daily activity pattern

# Reported Benefits of ABMs

- Theoretical foundation closer to observed travel behavior than trip-based foundation
- Improved modeling of intra-household interactions and impact on travel behavior
- Ability to validate against a broader range of criteria
- More detailed analysis of outputs
- More detailed representation of time
- Improved ability to model pricing
- Eliminating category of non-home-based trips

*Source: NCHRP Synthesis 406*

# Concerns About ABMs

- Cost of implementation
  - Consultant support for development and maintenance
  - Staff skills / training
- Lack of standards
  - Model form
  - Software
- More complex models
  - More pieces to calibrate / validate
- Do ABMs produce better forecasts of travel demand?
  - Evidence is lacking

# Basis for Current Research

TRB Special Report 288

# TRB Special Report 288: Metropolitan Travel Forecasting – Current Practice and Future Direction

- Committee for Determination of the State of the Practice in Metropolitan Area Travel Forecasting
- Released June 2007
- Narrative Report
- Complemented by results of survey of 220 MPOs nationwide (roughly 60% of all MPOs)

# TRB SR 288: Findings and Recommendations (1)

- *"The basic modeling approach at most MPOs remains a sequential fourstep process by which the number of daily trips is estimated, distributed among origin and destination zones, divided according to mode of travel, and finally assigned to highway and transit networks."*

# TRB SR 288: Findings and Recommendations (2)

- *"The committee finds that there is no single approach to travel forecasting or set of procedures that is "correct" for all applications or all MPOs. Travel forecasting tools developed and used by an MPO should be appropriate for the nature of the questions being posed by its constituent jurisdictions and the types of analysis being conducted."*

# TRB SR 288: Findings and Recommendations (3)

- *"The demands on forecasting models have grown significantly in recent years as a result of new policy concerns. Existing models are inadequate to address many of these new concerns."*
- *"Current models have inherent weaknesses."*
- *"Studies should be performed to compare the performance of conventional and advanced models."*

# TRB SR 288: Findings and Recommendations (4)

- ***"Insufficient evidence exists that advanced models can be implemented for a reasonable cost and will provide significant improvements over current practice. Although a number of agencies have begun to use tour- and*** activity-based models, many believe that these models are not fully ready for implementation. There are valid concerns about the costs associated with the new models and the amount of data needed to specify, calibrate, and validate them."
- "Yet agencies that are using these advanced models are providing a growing body of evidence that they can successfully replace the current models used to perform basic MPO forecasting activities and address more complex policy and operational issues as well."

# TRB SR 288: Findings and Recommendations: (5)

- *"MPOs experimenting with or fully implementing advanced modeling practices should document their experiences, including costs, advantages, drawbacks, and any transferable data or model components."*

# Seeking ABM Documentation and Evidence of Benefits

NCHRP Synthesis 406

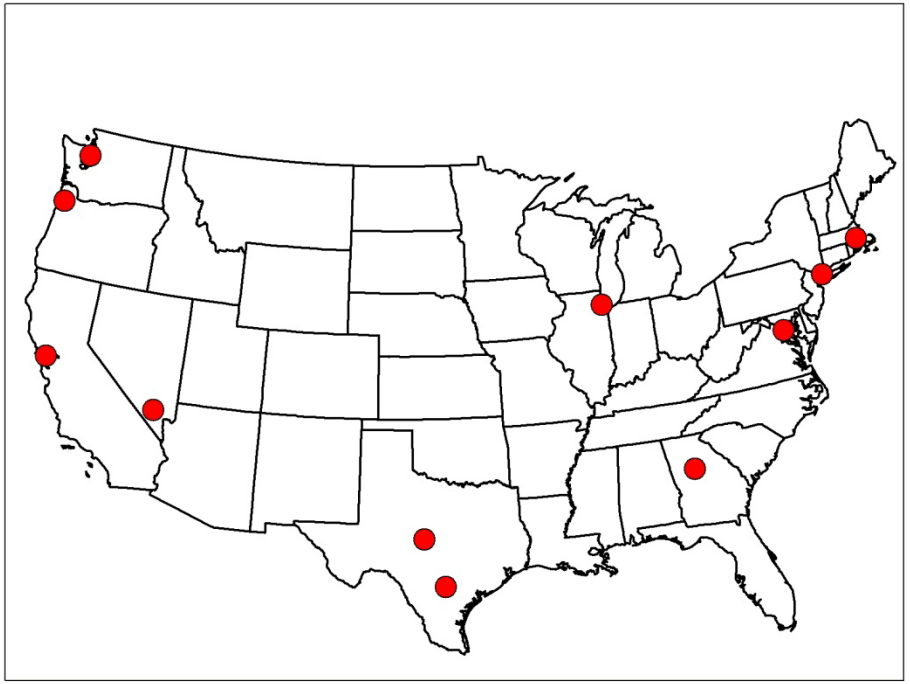
AMPO Pooled Funding Initiative, Phase 1

# NCHRP Synthesis 406: Advanced Practices in Travel Forecasting

- Released mid-2010
- Documents interviews with users of advanced models
  - ABMs, dynamic network models, land use, freight and commercial vehicle, and air quality models
- Used a case study / interview approach
- Generally positive outlook on ABMs and other advanced models
- Noted methodological, data, cost, scheduling, and institutional issues, and lessons learned

# AMPO Pooled Funding Initiative, Phase 1

- Responded to TRB SR 288 recommendation to document advanced modeling practices
- $100K consultant contract funded by contributions from 11 large MPOs
- Final report released July 2011



Contributing MPOs

# AMPO Phase 1 Work Scope

- Identify MPO experiences with ABMs that would interest other practioners
- Describe status of documentation and information available from selected MPO experiences with ABMs
- Develop performance and cost criteria for assessing ABMs
- Design a study to compare ABMs and TBMs in the same geographic area

# AMPO: Identify MPO experiences with ABMs that would interest other practioners

- Criteria for “interest”
  - Is the ABM the MPO production model?
  - Has the ABM been applied to specific projects?
  - Is there sufficient documentation to determine the relative cost?
- 21 MPOs and one county transportation agency reviewed
- 4 agencies fully met criteria; 5 partially

# AMPO: Describe status of documentation and information available from selected MPO experiences with ABMs

- Reviewed model development and model application documentation from 9 agencies
- Interviewed agency modelers
  - NYMTC (New York City)
  - MORPC (Columbus)
  - SACOG (Sacramento)
  - SFCTA (San Francisco County)
  - ARC (Atlanta)
  - DRCOG (Denver)
  - KRTPO (Knoxville)
  - Tahoe MPO
  - PSRC (Seattle)

# AMPO: Describe status of documentation and information available from selected MPO experiences with ABMs

- Finding: “The overall status of ABM development and ABM application documentation available from the surveyed agencies is mixed, **but generally not sufficient to permit an assessment of the benefits to the agency of implementing an activity-based model relative to the incremental cost of new model development rather than maintenance or upgrading of the trip-based model**. Better documentation and measurement of specific cost and performance metrics for both sets of models is needed in order to evaluate the relative merits of TBMs and ABMs.”

# AMPO Pooled Funding Initiative, Phase 1: Additional Findings

- "A side-by-side comparison is the best way to test both sets of models and their costs and performance relative to each other."
- Three approaches considered for side-by-side comparison study
  - Aligned Model Comparison ($$$)
  - Case Study Comparison ($$)
  - Conceptual Comparison ($)
- Case study selected for Phase 2 work

# AMPO Pooled Funding Initiative, Phase 1: Additional Findings

- "…while many agencies have made significant progress developing and applying activity-based models, not enough information exists to determine if, in actual practice, ABMs provide benefits to other MPOs that would justify the cost of replacing the existing TBM."
- "Further research as envisioned in Phase 2 of this study, that is, a side-by-side comparison and documentation of a trip-based and activity-based model in the same metropolitan area, is needed to obtain more evidence to assist MPOs in choosing the right modeling approach for their forecasting needs."

# Side-by-Side Comparison

Ohio DOT Study of Columbus Models

# Ohio DOT Study of Columbus Models

- Performed by consultants for ODOT and FHWA, completed February 2011
- Side-by-side comparison of ABM and TBM for Columbus area
  - Columbus has ABM production model
  - A new TBM was developed for this study that shares many features with the ABM
- Results compared regionally and for three study areas with major changes to land use and/or transportation network and one control area with little change
- Analysis years: 1990, 2000, 2005 (i.e., backcasting)

# Ohio DOT Study of Columbus Models: Conclusions (1)

- ABM performed slightly better than TBM overall at the regional level
  - Estimating vehicle ownership
  - Work flow distribution
  - Work start time distribution
  - Average travel time for work trips
- Challenge to compare models with different units of travel

# Ohio DOT Study of Columbus Models: Conclusions (2)

- "Given this challenge, definitive statements about the superiority of one model over the other are not easily made."
- "Generally, the performance of the [ABM] in these specific tests provides evidence of the ability of these types of models to provide decision makers with better information on travel behavior."

# Ohio DOT Study of Columbus Models: Conclusions (3)

- “In the overall, the results from the trip-based and tour-based models indicate about equal predictive abilities for both the before-project and after-project situations at the level of link predictions. It is difficult to make a strong case for one of the MORPC models being superior to the other from this standpoint.”
- “It should be noted that the use of a traditional static traffic assignment process does, to an extent, ‘undo’ the benefits of the fine resolution of time represented in the tour model.”

# Ohio DOT Study of Columbus Models: Conclusions (4)

- "The performance of the [ABM] in the project situations was somewhat disappointing, even if it performed about as well as the trip-based model."
- "The results suggest this [ABM] will not forecast better than traditional methods without additional behavioral resolution, network resolution, validation procedures, or some combination thereof."
- Only supply changes tested, future tests needed on demand management

# A More Focused View

AMPO Pooled Funding Initiative, Phase 2

# AMPO Pooled Funding Initiative, Phase 2

- ODOT-style side-by-side comparison not possible given budget and schedule
  - $85K FHWA funds, completion by 12/31/2011
- Case study approach / detailed comparison to be performed (in person site visits) in Atlanta and Sacramento
- Two different approaches to ABM development
  - Atlanta: incremental over 10 years, TBM still production model
  - Sacramento: full ABM development over 3 years at cost of approximately $1 Million, both models used

# AMPO Pooled Funding Initiative, Phase 2

- Describe the nature and rationale for development and application of ABMs in each metropolitan area, the timeline of model development activities, and the relationship of the ABM to the TBM, such as common data, surveys, and model components, the approximate financial and staff resources and their sources of funding devoted to ABM and TBM development and application will be documented, to the extent that data are readily available from the MPO.

# AMPO Pooled Funding Initiative, Phase 2

- Describe how ABMs and TBMs have been used in the respective MPO planning process and other studies throughout the region (NEPA, New Starts, etc.). To the extent useful, explain the rationale behind the choice to use each modeling system.
- Review the process and results of applications of the ABM in each metropolitan area to date and compare the process and results to those from the area's TBM with regard to [multiple dimensions]

# AMPO Pooled Funding Initiative, Phase 2

- Prepare a thorough summary of ABM development and application experience in the Atlanta and Sacramento metropolitan areas, including key factors and lessons learned that can assist other MPOs in their decision-making process regarding ABM development

# Conclusions and Implications for TPB Models Development

# Conclusions and Implications for TPB Models Development (1)

- "This memo suggests that now is not the right time for TPB to begin full-scale adoption of an activity-based model – the technique is not yet widely accepted, and there are still numerous issues to be resolved before activity-based modeling is "ready for prime time" in the Washington region."
  - Vanasse Hangen Brustlin, Inc., report to Travel Forecasting Subcommittee, 9/22/2006

# Conclusions and Implications for TPB Models Development (2)

- More data points in the analysis and comparison of ABMs with TBMs coming
  - AMPO Phase 2 Study
- More documentation of evidence of benefits of ABM still needed
- More ODOT-style studies needed
- All studies agree: choose the right model for your forecasting needs

# Conclusions and Implications for TPB Models Development (3)

- Need must be determined by TPB
- ABM development requires significant funds not available during this time of scarcity
- Modeling tools constantly evolving, and incremental approach to ABM development still best at this time