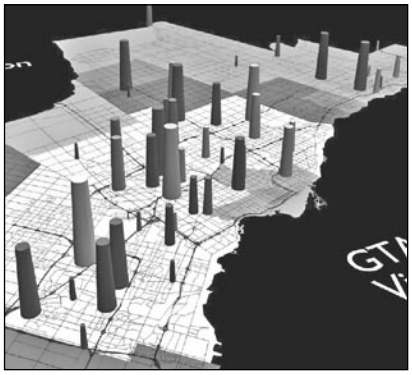
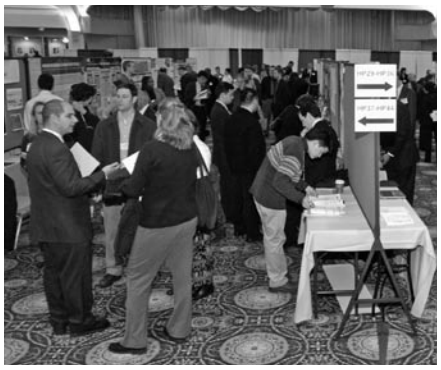
SPRING 2005

TMIP Connection

The Travel Model Improvement Program Newsletter





Modeling Takes TRB by Storm!

Transportation modeling showcased its latest innovations to the transportation community with three well-attended workshops at the Transportation Research Board (TRB) Annual Meeting in Washington D.C. in January. The workshops were hosted by the TRB Committees on Traveler Behavior and Values (ADB10), Transportation Demand Forecasting (ADB40) and the Task Force on Moving Activity-Based Approaches to Practice (ADB60T), and covered the topics of innovative travel models, activity-based approaches and integrated land use.

"The attendance at all three workshops proves that there is a lot of interest and enthusiasm in this new era of traffic model improvements," said Kostas Goulias, Professor of Geography at the University of California, Santa Barbara, and moderator of the activity-based approaches workshop.

The following are summaries of each workshop:

Innovative Travel Models: Proof of Concept

This workshop focused on the innovations that have been made in travel demand modeling over previous decades. While there have been numerous and wide-ranging developments, five-specific areas were highlighted: discrete choice methods, microsimulation, activity-based modeling, dynamic traffic assignment and land use modeling. The emphasis was on providing overviews of these methods; presenting the evidence available that these methods have proven to be useful; and looking toward the future in terms of the overall potential of the methods, means of evaluation and issues of wide-scale implementation. The workshop provided an opportunity to assess what has been accomplished thus far, and to develop key action items for the future in terms of development, application and evaluation.

"We reviewed a range of interesting material in five main areas of model development and the audience was very responsive," said Frank Koppelman, professor of Civil Engineering and Transportation at Northwestern University. "We prepared a backup plan to create some discussion if the audience was not responsive, but they were very interested and had many questions, comments, suggestions and experiences to contribute. Since the workshops, there have been discussions about ways that MPOs can work together to undertake some of the model validation that we talked about in the meeting."

Activity-Based Approaches: Theory, Methods, Data and Applications

The main objective of this workshop was to showcase and demonstrate activity-based approaches in practice. The workshop featured industry practitioners and academic researchers. The wide spectrum of viewpoints allowed for a broad representation of examples demonstrating considerable progress.

The practitioners explained how activity-based approaches are currently applied by major metropolitan areas like Portland, New York City, Atlanta, Columbus and San Francisco. The academic viewpoint, represented by Chandra Bhat from the University of Texas and Ram Pendyala from the University of South Florida, explained how new technologies are now ready for practical applications.

Another workshop topic focused on the integration of activity-based approaches with other innovations, such as microsimulation, demographic microsimulation, land use integrated models and the dynamic traffic assignment procedures that were developed for transportation operations. The workshop also addressed some of the skepticism surrounding traffic modeling with verification, validation and explanation of the value of the new models.

TRB CONTINUED ➤

U.S. Department of Transportation
Federal Highway Administration

The Road Less Traveled: The "MPO Coalition" Quest For The Robust Yet Practical Activity-Based Model

By Ken Cervenka, P.E., AICP
Senior Program Manager, Information Systems and Model Development
North Central Texas Council of Governments

So which is better: to follow the well-trodden path, regardless of the underlying "goodness" of such a journey; or to blaze a new trail—darn those torpedoes, full speed ahead? Pardon those cliches, but how the "movers and shakers" of MPOs answer this question may explain the state of their travel model practice. Maybe a third way exists: the "information sharing" or "march together" approach. On February 8, 2005, a temporary "MPO Coalition" email list group was formed with the stated goal being "The Examination and Advancement of Activity-Based Models for Use in Transportation Planning Applications."

This loosely held band of MPOs has no direct affiliation with any organization, as well as (currently) no actual funding source. But as of this writing, 30 organizations (24 MPOs and six non-MPOs) have joined in an effort to at least pool our minds. In answer to the question, "What do you see as the role for this MPO Coalition," here are excerpts of responses:

- The role of this MPO coalition could be to become an objective body (some sort of a "watch dog") that would ensure an eventual smooth transition from a trip-based modeling platform to a tour-based one.
- I see the "MPO Coalition" role changing over time as one that begins as a "sounding board" that I hope moves us towards a framework where we will pool our resources together to develop an "agreed" upon tour-based model that may be implemented within each MPO's region of responsibility.
- Peer exchange = giving and receiving advice from others; be questioning and curious about who is doing what, and why? What works and what doesn't work? How and where to get funding. How to build partnerships with local universities.
- Information exchange = sharing relevant RFPs, relevant consultant work products, relevant agency work products. "Invent the Wheel; Share the Wheel; Don't Reinvent the Wheel"
- Professional Capacity Building = training opportunities, including relevant conferences; essential training for staff (NHI, NTI, TMIP, etc.)
- Tool Sharing = exchange of software-specific scripts, macros, applications related to data preparation and model building (e.g., scripts for ALOGIT, SAS, SPSS, R, ArcGIS, TransCAD, Voyager, etc.)
- I am hoping we will find a mechanism for getting all of the "leading brands" of existing activity-based models rigorously tested, so we can get a very clear picture of "where things really stand" in terms of how well they are currently functioning.
- Using the same survey in several regions would allow comparison of regional behaviors and would enhance the development of transferable models. Of course, we should also be examining the features of existing models to see what has worked and is most elegant.
- I would like to see this Coalition sponsor a test in one or more urban areas where an activity-based model, an advanced four-step model, and a simple four-step model are developed off the same survey data sets and then applied for a base year, a forecast year, and better yet, an historical year. It would then be possible to quantify improvements in base year model accuracy, differences in travel forecasts, ease of application, model execution times, etc., to determine the strengths and weaknesses of the different approaches.
- I will do everything possible to move this region into the promised land (little p and l)! I just hope this group will facilitate this effort.

Whether anything truly productive comes out of this MPO group remains to be seen. Be sure and stay tuned to: http://groups.yahoo.com/group/Activity_Model/messages for further details! ■

Ken Cervenka is a Senior Program Manager for the North Central Texas Council of Governments, which serves as the Dallas-Fort Worth MPO. His management responsibilities include three program areas: Travel Model Development/Simulation, Transportation Data Management, and Computer Systems. Prior to joining NCTCOG in 1993, he has worked as both a consultant and a university research associate. He holds a bachelor's and a master's degree in civil engineering from the University of Texas at Austin, and is a member of the American Institute of Certified Planners (AICP) and the Texas Society of Professional Engineers.

MAILROOM MIX-UP.

Due to a mailing mix-up earlier this year, many of our subscribers received two copies of the same newsletter. You may have received either two copies of the TRB year-end special edition or two copies of the Fall edition. To see the other newsletter – the one you may not have received – go to http://tmip.fhwa.dot.gov/clearinghouse/tmip_newsletter/ and select the one you didn't get. If you feel you must have a print copy, in order to maintain the integrity of your collection of the complete TMIPConnection, send your request with mailing address to me at Penelope.Weinberger@fhwa.dot.gov.

Oh, and don't forget to tell me which one you are missing, or you will likely end up with three the same!

Travel Demand Model Forecast Accuracy

By Jiji V. Kottommannil,
Transportation Engineer/Modeler, Crawford Bunte Brammeier, St. Louis, MO

Considerable time and resources are involved in the development of travel demand models (TDM). These tools are commonly used to develop long-term traffic forecasts that aid in policy decision-making. Studies comparing current actual values to forecasts done in the past have revealed inaccuracies in the forecasts. Unfortunately, developers of travel demand models do not quantify or document the level of uncertainty involved in the forecasts. A question was posed to the TMIP email list regarding the accuracy of travel demand models. Interestingly, a similar question was posed to the list about five years ago. The following is a summary of the current and past email list discussion and some relevant findings from the associated literature.

TDM Forecast Error Measurement

Several studies have been done in the past that compare old travel demand model forecasts with current actual values, which include traffic volumes, average speeds, delays, vehicles miles traveled (VMT) and vehicle hours traveled (VHT). Significant differences have been observed, which were attributed to large unanticipated societal and economic changes. Standard and Poor's have also been publishing retrospective analysis on traffic forecasting performance annually for the past three years.

Forecasts made for a particular year using two different 'base' years have also been shown to produce different results. In a paper by John S. Niles and Dick Nelson, an example from the Puget Sound Region was used to demonstrate that 2020 forecasts of VMT, VHT, average speed and delay were considerably different when estimated in 1995 and 1998. This was attributed to new data for the model variables and to improved modeling methodologies.

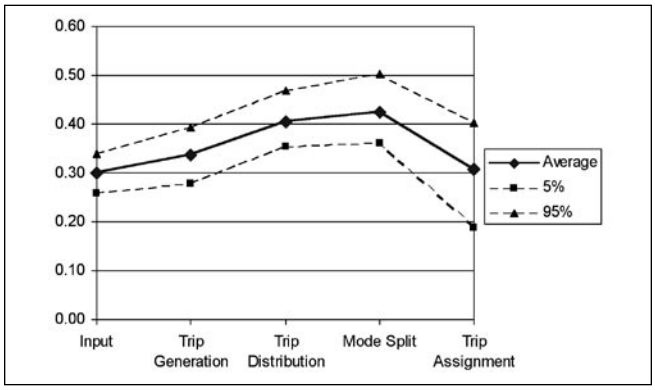
Caroline Rodier's study on verifying the accuracy of regional models showed that errors in land use forecasts can double the model's errors in estimating VMT and VHT. Therefore, if the 'correct' land use forecasts are used, the errors tend to be much smaller. Even with perfect planning data, it has been found that a badly specified model can produce significant errors in travel forecasts for urban areas under congested conditions.

TDM Forecast Uncertainty Measurement

Every serious travel demand modeler should acknowledge that models have uncertainty. According to Hani Mahmassani, "I do not think we undermine our credibility by recognizing the inherent uncertainty of the complex process we are modeling".

The factors that contribute to uncertainty in travel demand forecasts have been documented in detail in several studies. Among these factors are uncertainty in model design/structure, transportation network uncertainty, demographic forecast uncertainty and uncertainty resulting from social/political bias.

Yong Zhao and Kara Maria Kockelman demonstrated the propagation of uncertainty in travel demand models using multiple runs (Monte Carlo simulations) and sensitivity analysis of model parameters and inputs for a part of the Dallas-Fort Worth regional travel demand model. It was shown that although uncertainty compounds in sequential four-step models, the final uncertainty is attenuated after the equilibrium assignment stage to a level comparable to that at the input stage. The propagation of uncertainty in a 4-step model as demonstrated in that study is worth depicting here. It was also found that the greatest contributors to output uncertainty were the demographic inputs and trip generation parameters.



Uncertainty propagation through four-step models

Confidence Intervals/Ranges

Having acknowledged that travel demand models are prone to uncertainties, the next step would be to make efforts to provide confidence intervals, probability distributions or ranges of the forecast instead of producing a unique set of numbers ('point estimates') as forecasts. There was a discussion in the list that overlapping of confidence intervals can sometimes result. This could lead to several alternatives that would have indistinguishable performance. Confidence intervals for 20-year forecasts have been encountered that are so large as to render the forecasts meaningless. On the other hand, probability distribution functions of the outcome of the forecasting process may be hard for the public and the media to comprehend. Therefore, providing ranges for forecasts might be helpful, which is easier said than done. Several attempts have been made to devise methods to produce confidence intervals and ranges, but these did not become popular as they turned out to be too complex and expensive to implement. One feasible method to develop forecast ranges, which has been acknowledged and implemented by several modelers, is through the use of several future land use scenarios (low, medium, high). According to Juan de Dios Ortuzar, scenario planning approach for evaluation has been successfully used in Chile, wherein the objective is to achieve project/policies which are robust in the sense of not performing badly in any of the scenarios.

Conclusions

If time and budget permits, efforts should be made to determine the level of uncertainty of travel demand model forecasts and document/publish an estimate of the error. It is equally important that the uncertainty be communicated effectively to decision makers and people who do not know the limitations of forecasting models. This needs to be done in a manner such that models and modelers do not lose credibility. It needs to be emphasized that although models have inherent uncertainty, they still remain effective tools to develop "best guess" forecasts for policy decision making as long as their limitations are well understood and an estimate of the forecast error is well documented and communicated. ■

To see the full discussion or explore other Hot Topics in travel demand forecasting, visit or join the TMIP email list at: http://tmip.fhwa.dot.gov/email_list/

Mid-Ohio Region Travel Forecasting Model

By Rebekah S. Anderson, P.E., MORPC
Bob Donnelly, PB Consult

In October 2001, the Mid-Ohio Regional Planning Commission (MORPC) contracted with PB Consult to develop a new set of regional travel forecasting models. The new model is an activity/tour-based model applied with micro-simulation. The development is based on the 1999 Household Interview Survey, which is supplemented by the 1993 Central Ohio Transit Authority On-Board Survey and an External Cordon Survey that had been conducted in 1995. The new modeling system was completed in late 2004, and testing continues into early 2005. The new model is being used by MORPC for Conformity Analysis, transit alternative analysis, and for highway-related MIS projects in the Columbus region.

The model area is divided into 1805 internal and 72 external zones and includes Franklin, Delaware, and Licking counties, and parts of Fairfield, Pickaway, Madison and Union counties. As in the prior four-step model, the primary inputs to the model are transportation networks and zonal data, where each zone has the standard socioeconomic characteristics that one would normally find in a four-step model. The main differences from the prior four-step model are that the new model accounts for travel at the tour-level, as opposed to the trip-level, and for each individual household and person, as opposed to zonal and market segment aggregates.

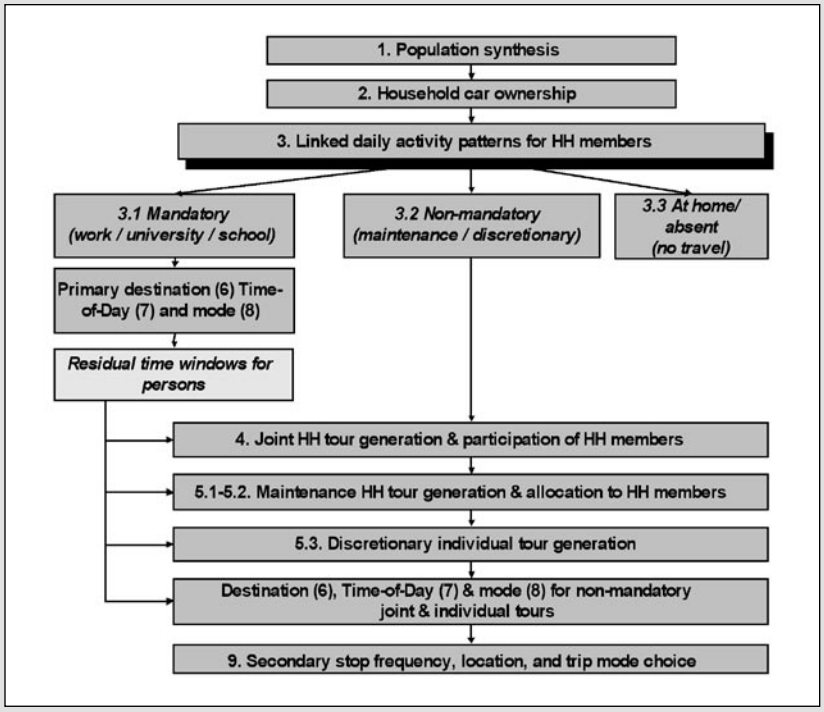
The forecasting model consists of **9 separate linked models** as shown in **Figure 1**. **The first model generates a synthesized list of all households and population for the entire area**, consistent with the household and workforce variables in the zonal data. The output from this Population Synthesis model is a file with a record for every person in the area (currently about 1.5 million), containing various attributes for each synthesized person. Attributes include what household the person belongs to, whether it's a high-, medium- or low-income household, and the type of worker/person (e.g. part-time worker, school child, university student). To gain more information about a household and household composition, a record is sampled from Public Use Micro Sample (PUMS).

The second model is the Auto Ownership model, which determines the exact number of vehicles available for each household based on household attributes and the transit accessibility level of the residence. **The third model determines what the "Daily Activity Pattern" (DAP) is for each person**. A person can either have a mandatory activity pattern, such as work or school, only non-mandatory activities such as shopping, or no travel activity for the day. This model determines how many mandatory tours each person with a mandatory activity pattern makes during the day. After a mandatory tour is scheduled, the available time left for other travel opportunities is updated.

The fourth model is unique to the MORPC set of models and **determines joint travel among household members**. This model allows two or more members of a household to travel jointly for a shared activity, for example eating out. Given the high propensity of household members to travel together, this model is important in that it more accurately accounts for the characteristics of this travel, particularly in terms of mode choice. In virtually all other models in the U.S., this phenomenon is not accounted for directly. Again, after joint tours are determined, the available time left for additional travel is updated for each synthesized person. **The fifth model generates all individual non-mandatory tours**, such as shopping, eating out, and recreational. Each tour can be scheduled only within the residual time window left after the scheduling of all previous tours. If no time exists for additional tours, then additional tours cannot be scheduled.

The sixth, seventh and eighth models are applied together and include Tour Destination Choice, Time of Day Choice

Figure 1: Structure and Flow of the MOPRC Tour-Based Models



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(TOD) and Tour Mode Choice models. The Destination and Mode Choice models are both logit-based, and the Destination Choice step uses the "LogSum" composite impedance measure from the Mode Choice model. The Time of Day model is based on the "time windows" concept, accounting for the use of a person's time budget over the day. It includes the mode choice LogSum for various TOD periods, making it sensitive to congestion. These models are applied at the tour level, yielding the primary destination, time of day, and mode choice for the entire tour, and consider both out-bound and in-bound portions of the tour.

The ninth model is the Stops and Trip Mode Choice model. This model determines if any stops are made on either the outbound (from home), or inbound leg of the tour and the location of those stops. Additionally, given the overall tour mode previously determined, the exact mode the traveler uses for each segment or "trip" on the tour is set based on a set of rules. Each of these trips is connected and all stops are based upon the previous choices. Therefore, if the main tour mode is transit, then a person will not be able to choose drive alone for a lunch trip made at work. Furthermore, if the primary mode of a tour was auto, then a person would be allowed to drop off a child at school, and then drive to work. The final trips are then aggregated by zones and assigned as conventional trip tables to the highway and transit networks.

The core choice models (1 through 9 as described above) are applied in a disaggregate manner. Instead of using aggregate fractional probabilities to estimate the number of trips, the new model is applied with micro-simulation of each individual household, person, or tour, mostly using Monte Carlo realization of each possibility estimated by the models, with use of a random number series to determine which possibility is chosen for that record. Both the Population Synthesizer and the Auto Ownership models, however, perform the micro-simulation using deterministic "discretizer" procedures that avoid Monte Carlo variability. The new model is applied with an implementation of three global feedback loops for consistency between highway travel times that are both used as inputs to, and forecast outputs of, the model.

A simplified comparison of an activity/tour-based model such as the MORPC model, with that of a conventional "four-step" travel forecasting model is shown in **Figure 2**, highlighting the general correspondence of the basic components in the two types of models.

Figure 2: Correspondence of Activity/Tour-based and Conventional Models

Level	*MORPC model*	*Conventional 4-step*
Long term	1. Pop. Synthesis	SE zonal data / HH segments
	2. Car ownership	Car ownership
Day (tour generation)	3. DAP	Work/school production
	4. Joint tours	Non-work production
	5. Individual tours	
Tour	6. Destination	Distribution
	7. Time of day	Peak factors
	8. Tour mode	Mode
Trip	9. Stops	Distribution, Mode

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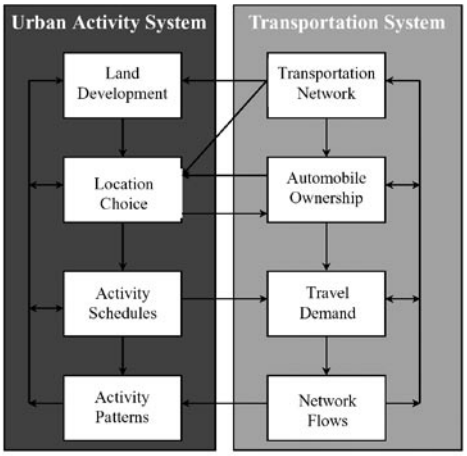
Workshop on Integrated Land Use-Transport Models

This workshop presented an introductory, nontechnical primer on types of land use models and current capabilities of the state of the best practice. It included presentations on a number of case studies of operational models. Issues addressed within the workshop included typical development and operating costs, data requirements and model capabilities for policy analysis. Specific examples of model applications and their impacts on decision making were presented. The primary audience was metropolitan planning organizations, state departments of transportation and federal planners and modelers interested in learning about current capabilities of integrated models. The workshop was also of interest to consultants and academics interested in learning more about land use models. The workshop focused on the dissemination of information concerning operational models, current best practices in integrated modeling, why integrated models are useful in practical planning applications and how to go about developing an integrated modeling capability at the local or state level.



"This workshop presented a wide range of recent innovations across a number of different fields related to travel demand modeling," said Dr. Eric Miller, professor of Civil Engineering at the University of Toronto. "It was well received and gave a coherent and interesting introduction to a variety of methods, including land use models, to the audience, which I believe was the objective of the workshop." ■

For more information about the workshops, or for copies of the presentations given, please visit the TRB Committee on Transportation Demand Forecasting website at http://www.trb-forecasting.org/index.html.

UPCOMING EVENTS

Courses and Seminars

Estimating Regional Mobile Source Emissions
March 29-April 1, 2005 – Little Rock AR
Contact: http://nhi.fhwa.dot.gov/coursedesc.asp?coursenum=1068

Activity and Tour Based Forecasting Seminar
April 12, 2005 – Denver, CO
Contact: http://tti.tamu.edu/conferences/tmip_seminars/drcog.stm

Travel Model Calibration, Validation and Reasonableness Checking Seminar
April 13, 2005 – Denver, CO
Contact: http://tti.tamu.edu/conferences/tmip_seminars/drcog.stm

Forecasting Land Use Activities Seminar
April 14, 2005 – Denver, CO
Contact: http://tti.tamu.edu/conferences/tmip_seminars/drcog.stm

Activity and Tour Based Forecasting Seminar
May 10, 2005 – Chapel Hill, NC
Contact: http://tti.tamu.edu/conferences/tmip_seminars/uncch.stm

Travel Model Calibration, Validation and Reasonableness Checking Seminar
May 11, 2005 – Chapel Hill, NC
Contact: http://tti.tamu.edu/conferences/tmip_seminars/uncch.stm

Forecasting Land Use Activities Seminar
May 12, 2005 – Chapel Hill, NC
Contact: http://tti.tamu.edu/conferences/tmip_seminars/uncch.stm

Introduction to Urban Travel Demand Forecasting
May 23-27, 2005 – Costa Mesa, CA
Contact: http://nhi.fhwa.dot.gov/coursedesc.asp?coursenum=133

Tentative
Introduction to Urban Travel Demand Forecasting
July 25-29, 2005 – Asheville, NC

Conferences

10th TRB Transportation Planning Applications Conference
April 24-28, 2005 – Portland, OR
Contact: http://www.trb-portland-05.com/conference_resources.html

Additional offerings may become available; consult the TMIP website http://tmip.fhwa.dot.gov/ for the latest training information.

To subscribe to this free newsletter, unsubscribe, or change your mailing address, please send a detailed email to:

tmip@tamu.edu

Put "TMIP Connection" in the subject

TMIPConnection is seeking subjects for the Model Citizen column. If you are a modeler employed in the public sector working on an interesting problem and you would like to talk about it in the TMIPConnection, please send an email describing the work to penelope.weinberger@fhwa.dot.gov"

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