Fall 2004

TMIP Connection

The Travel Model Improvement Program Newsletter

FHWA's "Model Vision"

By Cynthia J. Burbank *Associate Administrator for Planning, Environment and Realty, Federal Highway Administration*

Cynthia Burbank, *FHWA*

Does the Federal Highway Administration (FHWA) see a compelling need to advance the state of the art and the state of the practice of Travel Demand Modeling?

The answer is a resounding YES! We need better modeling to support effective transportation decision-making, better transportation investments, better operating decisions, improved air quality analysis, and much more. Improved modeling will help all levels of government meet large transportation challenges with limited budgets.

Modeling plays an important role in emerging priorities such as road pricing, operations, freight, land use-transportation integration, homeland security, safety, and suppressed travel. Modeling can increase the power of scenario planning, visualization, and communication of results to the public and elected officials.

Here's how modeling can help respond to policy issues:

Pricing—With resources for transportation stretched and congestion on the rise, transportation agencies are looking at innovative funding and management strategies, such as pricing. Models need to predict travel behavior under various pricing options.

Freight—An ongoing focus of the transportation planning process, freight requires good models, sensitive to carrier and shipper decisions.

Land Use-Transportation Integration—There is an increased need for MPOs and DOTs to coordinate transportation and land use planning decision making processes at the system, corridor and project levels.

Homeland Security—MPOs, cities and states must develop homeland security plans based in part on travel models.

Safety—Models can help safety planners analyze system-wide safety impacts in their long-range transportation plans and hone in on the most effective strategies to increase safety.

Suppressed Travel—Perhaps one of the most polarizing issues today, suppressed (or "induced") demand must be reflected in travel models to predict impacts on congestion, air quality, and the environment.

And accurate modeling is needed to increase the power of other planning tools:

Scenario Planning—Travel demand and land use forecasts can help create regional visions of urban growth and form. They can be used to screen alternatives and formulate policy initiatives to achieve the desired vision. However, more work is needed to further develop and apply integrated transportation/land use models. Also, for the purposes of public and decision maker involvement in scenario planning, simplified models may be needed for quicker turnaround of policy impact evaluation.

Visualization and Communication of Results—Planners need better technical tools and techniques to communicate travel data and results to decision makers and the public. Visualization technologies may be one innovative tool, but perhaps more simply, planners should strive to present data and information in a clearer, more thoughtful manner.

Microsimulation—As management and operations initiatives are planned, there is a need to evaluate these strategies along with other types of alternatives. Increasing the sensitivity of models to better show the impacts of operational improvements, and to better estimate emissions, will likely mean more reliance on micro-simulation.

Activity and Tour Based Modeling—The nascent development of these models is a result of recent research into travel demand forecasting procedures and advances in computing technology, which enable more detailed and disaggregate travel demand analysis.

Models also need to be more responsive to non-motorized transportation. Current health concerns, developing pedestrian friendly environments and reducing congestion and pollution through reductions in auto travel all impact policy issues. Data collection methods and models need to be more sensitive to non-motorized alternatives to better estimate the impacts of these facilities on travel behavior and air quality.

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INSIDE

U.S. Department of Transportation
Federal Highway Administration

Model Citizen

H. Sarah Sun, *Memphis MPO*

The Environmental Protection Agency (EPA) on April 15, 2004, designated new ozone nonattainment areas based on the new eight-hour ozone national ambient air quality standard (NAAQS). The nonattainment designations were effective on June 15, 2004. These areas will need to perform transportation conformity determinations one year after the effective date of the nonattainment designations. A vital part of the conformity process is to estimate mobile source emissions. The estimation results will demonstrate if your Long Range Transportation Plan, Transportation Improvement Program and your transportation projects conform to a State Implementation Plan (SIP). What determines the mobile source estimation outcome is your data, the assumptions and methodologies utilized. Thus, it is critical that agencies performing conformity demonstration employ the most current analysis techniques available.

In July 2004, the National Highway Institute (NHI) offered the "Estimating Regional Mobile Source Emissions" course in Knoxville, TN. This course covered the best practice analysis techniques on estimating mobile source emissions. It conveyed a wide range of topics such as:

- travel demand forecasting (TDF),
- Mobile source emissions rate model (MOBILE6),
- Highway Performance Monitoring System (HPMS) data,
- SIP inventories,
- estimation of Vehicle Miles Traveled (VMT) and VMT Mix Inputs,
- vehicle activities measures, and
- fleet characteristics and emissions estimation without a model.

Some of the issues discussed in this course are especially important to the agencies that are about to do conformity analyses for the first time.

Being active and involved in your SIP process—It is extremely important for conformity determination agencies to take an active role in the SIP development process. The attainment demonstration SIP sets your motor vehicle emissions budget (MVEB), which is the foundation of conformity determination. It is your responsibility to make sure that the latest transportation planning assumptions are used in the mobile source emissions inventories so that you will not end up with an unachievable budget.

Obtaining pre-analysis consensus—The Conformity rule requires that the underlying

TMA Certification to include Checklist for Travel Forecasting Methods

By Bruce Spear, *FHWA*

23 CFR 450.334 specifies that the Federal Highway Administration (FHWA) and the Federal Transit Administration (FTA) jointly will review and evaluate the transportation planning process for each Transportation Management Area (TMA) to determine if the process meets federal transportation planning requirements.

Recently, it was determined that including a review of the TMA's travel forecasting methods would ensure that they adequately support the applications for which they are being used. These applications can vary considerably from one Metropolitan Planning Organization (MPO) to another, depending on such factors as non-attainment status, regional population and economic growth, and the types of strategies/investments being considered in the transportation plan.

To assist both FHWA/FTA field planners and MPOs in this review, FHWA has prepared a "checklist" of key questions associated with travel forecasting methods and their applications.

The questions included in the checklist are designed to provide the certification review team with an overview of the travel forecasting methods being used by an MPO, the suitability of those methods for intended applications, and the technical capabilities of the local planning staff in applying the methods. Currently, the checklist is not being used to identify "correctible actions" in the Certification Review. In cases where responses to the checklist questions raise serious concerns on the adequacy of the forecasting methods, the certification review team should request a more in-depth review by FHWA Resource Center or FHWA/FTA Headquarters travel model experts.

The checklist questions are excerpted here. The complete text of the guidance can be found online at: http://www.fhwa.dot.gov/planning/certcheck.htm.

QUESTIONS REGARDING RISK

Is the metropolitan area a designated serious, severe or extreme ozone or serious carbon monoxide non-attainment area?

Is the metropolitan area a designated non-attainment or maintenance area, and has the MPO used travel demand models previously?

Does the metropolitan area plan to apply for an FTA transit new start grant?

Does the transportation plan include any major projects that will significantly increase highway capacity?

Regionally significant highway projects (e.g., new highways or additional lanes on existing highways) have been consistently targeted by national environmental advocacy groups as contributing to "urban sprawl" and "induced demand." These projects are particularly susceptible to legal challenges in which the plaintiffs hire their own travel model experts to dissect the forecasting methods used to derive forecasts of future traffic.

Is the metropolitan area proposing any transportation projects where there is strong and coordinated opposition by local advocacy groups?

Local groups with sufficient resources, or in coordination with national organizations, may also hire their own travel model experts to challenge controversial projects on methodological grounds.

Has the MPO been a defendant in, or threatened with, legal action in which the adequacy of their travel forecasting methods was challenged?

If so, what was outcome of this action? MPOs whose travel forecasting methods have been challenged in the past may be vulnerable to future challenges. However, if the challenge was summarily dismissed, or if the travel forecasting methods were upgraded in response to identified deficiencies, the MPO may actually be immunized against future challenges.

QUESTIONS REGARDING AGENCY TECHNICAL CAPABILITIES

Who is responsible for travel forecasting at the MPO?

Technical staff with expertise and experience in travel demand models is needed to develop, maintain and interpret the output from travel forecasting methods used in metropolitan transportation planning applications. This expertise may be provided by MPO in-house staff, by technical staff from another agency (e.g., another MPO or the state DOT), or by outside contractors.

If another governmental agency provides required modeling technical expertise:

- **Is there a formal memorandum of agreement between the agencies to delineate technical responsibilities, lines of communication and review, authorized expenditures and reimbursement procedures?** Without a formal agreement, the MPO must rely entirely on the generosity of other agencies to provide the appropriate expertise and tools.

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To meet the needs for better modeling, FHWA is ramping up our outreach and training to the modeling community, research on models and model quality assurance. We are currently conducting a research needs assessment that aims to bridge the gaps between decision makers, practitioners, and academia.

In light of the myriad issues stated above and unforeseen issues that will arise in the future, FHWA calls on state DOTs (Departments of Transportation) and MPOs (Metropolitan Planning Organizations) to place a higher priority on high quality modeling. We will help transportation agencies build their modeling capacity through the methods above. We will also use the planning certification process to identify opportunities to raise the state of the practice in modeling.

FHWA is funding a National Academies of Science synthesis of the state of current practice in modeling. The synthesis will serve as a baseline for agencies to evaluate their own modeling practice. To further the state of the practice FHWA will collect information on modeling "hot topics" such as pricing, microsimulation, peak spreading and others, and will improve technology transfer to the user community through technical roundtables and a more robust clearinghouse.

If contractors perform all travel model development:

- **Who, if anyone, on the MPO staff is responsible for evaluating the technical work of the contractor?** Even if contractors develop the travel demand forecasts, some in-house expertise is still needed in order to independently evaluate the reasonableness of the travel forecasts produced, to defend the methodology in public forums, and to provide institutional memory of what changes were made to the methodology or why they were made.

If in-house staff actively participate in model development and application:

- **What formal training has the MPO technical staff received in travel demand forecasting?** Formal training may include coursework taken as part of an academic degree program, or completion of one or more professional training courses offered by FHWA or FTA.
- **Does the MPO technical staff require training in specific technical areas?**

Does the MPO organizational structure include a technical committee to review planning assumptions and forecasting methods?

Does the MPO have a strategic plan and a guaranteed minimum level of funding in its Unified Planning Work Program (UPWP) for maintenance and improvements to its travel forecasting methods?

Has the MPO convened a peer review or other independent assessment of their travel forecasting methods?

DOCUMENTATION

The Certification Review Team should request and obtain readily available written, technical documentation from the MPO covering the following subject areas:

1. **Inventory of Current Conditions**—should include information on (1) the local transportation system, (2) current population and employment, (3) measures of transportation system performance (e.g., VMT, transit mode share and congestion), local land use patterns, and special considerations (e.g., major port facilities, tourist areas).
2. **Planning Assumptions**—should, at a minimum, address expected changes in (1) study area population and employment, (2) the geographic distribution of population, employment and land use within the study area, (3) and anticipated demographic or travel behavior trends that may influence future transportation needs.
3. **Forecasting Methods**—should provide basic technical information on the forecasting methods, including calibration data sources, model specifications and calibration parameters, model validation results, and future plans for model updates and enhancements. ■

Finally, I want to highlight that under our SAFETEA (Safe, Accountable, Flexible and Efficient Transportation Equity Act) proposal, Metropolitan Planning (PL) funds would increase approximately 52% and State planning and research (SPR) funds would increase approximately 37%, with the bulk of the increase in SPR funds dedicated to improved data collection activities. We remain hopeful that congress will enact legislation at these levels, because the increased funding can be used by states and MPOs to improve their modeling and data collection activities and thereby better inform transportation decisions. ■

"MODEL CITIZEN" continued from page 2.

assumptions and methodologies used in conformity determination be reviewed through interagency consultation. It is in your best interest to review with your partners all assumptions and proposed methodologies and be persistent about having a pre-analysis consensus.

Knowing your data-providing agencies—It is not only important to know which agencies provide what data, but it is also critical to know the right staff person.

- Who knows the methodology for calculating the seasonal and Day-of-Week adjustment factors from Automatic Traffic Recorder (ATR) data?
- Who is in charge of HPMS data?
- Who is familiar with classification counts and vehicle registration data, which are needed for VTM mix estimation?
- Who is responsible for travel modeling?
- From whom should you get the temperature, Reid Vapor Pressure (RVP), absolute humidity and Inspection and Maintenance (I/M) data?

Being aware of your data limitations—This is easier said than done, but always insist on getting the documentation with the data and ask lots of questions.

- How many ATRs are in your area?
- How representative is your ATR data for the entire conformity analysis area?
- Do you have ATR data from several stations and different roadway functional classifications?
- If you do not have enough ATRs in your area, do you need to enlarge your ATRs to include all urban or rural areas' ATRs in your state?
- What is the limitation of automatic vehicle classifiers?
- Do you know your state's classification procedure?
- How are the data collected and summarized?
- Are the vehicle classification count data by location, by functional classification, by day and by hour?
- Are the collector and local classes counted?
- Are Fridays, Saturdays, and Sundays counted?

Reconciling your data at the beginning of the analysis process—It is imperative to know the compatibility of the data utilized in your analysis.

- Are the data used in calculating the HPMS adjustment factor compatible?
- Are your HPMS boundaries consistent with the model boundaries?
- Does your model estimate average non-summer weekday travel (ANSWT)?
- Does the weekday in your model include Friday?
- How do you ensure the consistency between the model VMT with HPMS VMT, which is Average Annual Daily Traffic (AADT)?
- How is HPMS local VMT and ramp VMT estimated?
- What methodologies are you going to use for local VMT and ramp VMT estimations?
- How do you reconcile the EPA driving cycles with the roadway classifications in your model?
- The volume-delay equations in your model determine the reasonableness of the VMT by speed for freeways and arterials. Are the equations reasonable?
- What methodology do you use for adjusting the model speed results to obtain actual average speed?
- Is the trip length distribution from your model defined in the same way as the trip length distribution in MOBILE model?

All these issues and much more are talked about in the Estimating Regional Mobile Source Emissions course. This is a good complementary course to "Introduction to Transportation/Air Quality Conformity". It is unique because the course comprehensively covers the technical aspect of conformity demonstrations.

At the same time, the course could be further enhanced. For the lesson on TDF, the majority of the time could be spent on identifying the critical issues as far as conformity analyses are concerned and gloss over the TDF structure, since NHI offers "Introduction to Urban Travel Demand Forecasting" course. The same goes for the MOBILE6 section, the course could skim over the model structure and concentrate on pros and cons of using local data, as FHWA already has a course on "MOBILE6 Emission Factor Modeling". Last but not least, the course could employ only one or two case studies in lieu of some of the existing exercises. The case study or studies could serve as the thread that connects together the concepts, issues and analysis techniques discussed in the course. ■

H. Sarah Sun, Memphis MPO

Sarah Sun is a principal planner for Memphis Metropolitan Planning Organization (Memphis MPO). Memphis MPO serves Shelby County, TN, and portions of Fayette County, TN and DeSoto County, MS. Sun has been responsible for running the Memphis MPO Travel Demand Model since 1993 and performing conformity determination since 1997. Sun served as the project manager for the 1998 Memphis MPO household travel survey, and is the project manager for the development of the new travel demand model, which is to be completed in early 2006. Sun has earned a Master of Arts in Sociology with a Concentration on Population Studies and a Master's degree in City and Regional Planning with Concentration on Transportation Planning.

Hot Topics: Speed Flow Curves

By Madhav Pai, *Dowling Associates,* and Penelope Weinberger, *TMIP*

A general question was posed to the TMIP e-mail list in May 2004, regarding Speed Flow Curves. On behalf of the Southern California Association of Governments, a consultant sought innovative information on concepts, coefficients, and experimentation with speed flow relationships. Atlanta Regional Council (ARC) said that the result of extensive research resulted in unique volume delay functions for each time of day (see graphic). This led to response conjecturing on the various reasons why there are different curves for different times of day as it seemed counter-intuitive to the responder. ARC replied with more methodology by way of an answer and brought up the mid-day peak phenomenon occurring in large metropolitan areas. "Time of day models are the way to go it seems nowadays, especially in the context of large metro areas with complex and spread-out travel patterns, as encountered and observed in Atlanta," said Guy Rosseau, modeling manager with ARC. Next was the suggestion that an effect is the "non-local" nature of congestion; a result of measuring delay at a link different from the congested one. Of course, this led to a discussion of types of congestion and how they impact speed and volume. The discussion raised yet more questions and responses and even the comment that speed flow curves are irrelevant to what happens on urban arterial streets.

Summary of Speed Flow Curves used around the Nation

Methodologies used by different public agencies to model arterials in a travel-forecasting model were reviewed. The agencies were chosen based on geographical location (across the country) and sophistication of modeling methodology.

List of the agencies:

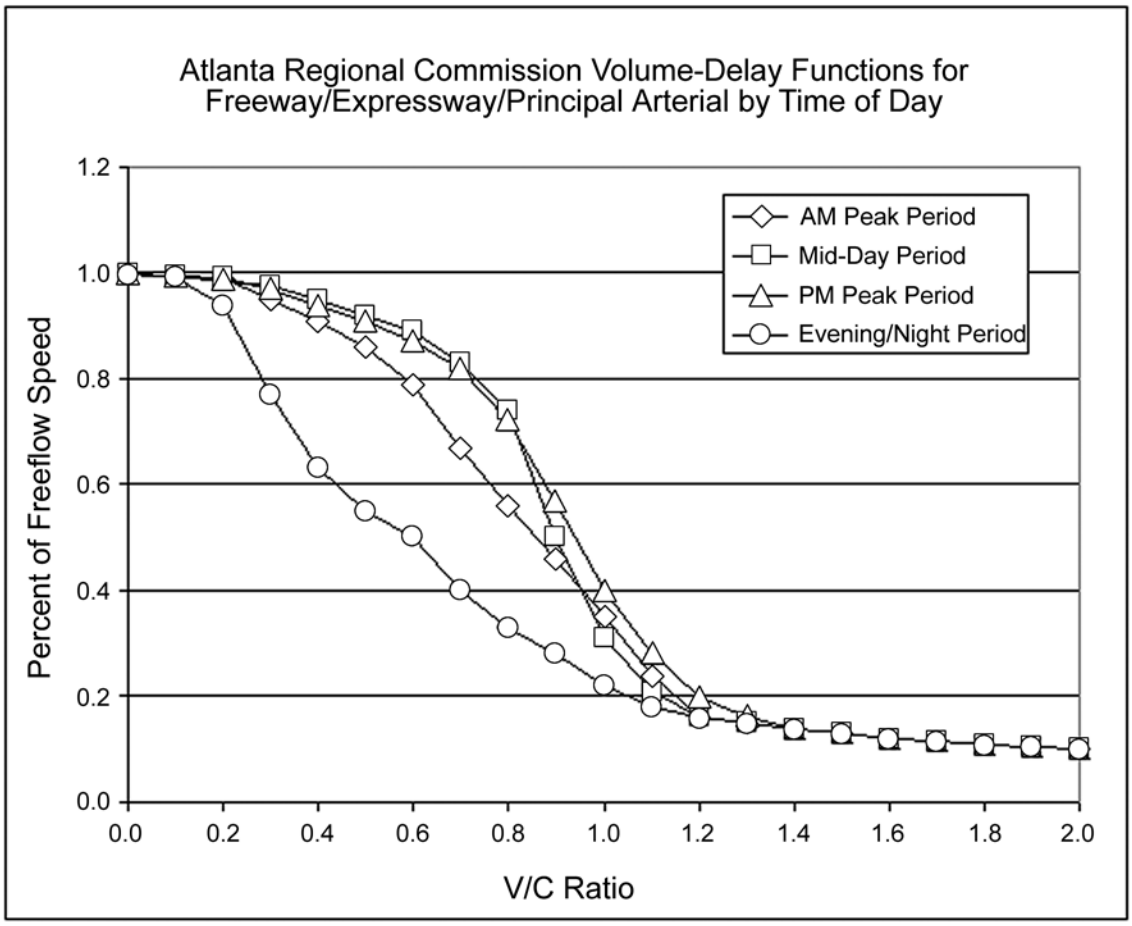
- Metropolitan Transportation Commission (MTC), San Francisco Bay Area, CA
- North Central Texas Council of Governments (NCTCOG), Dallas Fort Worth, TX
- Sacramento Council of Governments (SACOG), Sacramento, CA
- Denver Regional Council of Governments (DRCOG), Denver, CO
- Atlanta Regional Council (ARC), Atlanta, GA
- Metro, Portland, OR
- San Diego Association of Governments (SANDAG), San Diego, CA

The initial intention was to plot all the speed flow relationships in a single graph. The approach and the parameters used by different agencies vary a great deal. For example the SACOG model uses a conical delay function, which adds an additional dimension to the graphical display. Hence we decided to present the mathematical form of the speed flow relationships.

Summary of Arterial Speed Flow Curves

Agency	Location	Form Type	Mathematical Form	Where
MTC	San Francisco, CA	Akcelik	$T = T_0 + 0.25T_f\left[(x\text{-}1) + \sqrt{(x\text{-}1)^2 + \frac{8J_A x}{c_u T_f}}\right]$	T_f = flow period (typically one hour) x = degree of saturation (v/c_u), and J_A = the delay parameter
NCT	Dallas – Ft. Worth, TX	Exponential	$Delay = \min\left\{A \times exp^{\frac{B \times Hourly\ Volume}{Hourly\ Capacity}}, C\right\}$	**Daily**: Freeway: A = 0.015, B = 6.20, C = 60.00. Non-Freeway: A = 0.05, B = 4.00, C = 60.00. **Hourly**: Freeway: A = 0.015, B = 8.20, C = 60.00. Non-Freeway: A = 0.05, B = 6.00, C = 60.00.
*SACOG	Sacramento, CA	conical delay	$T_C = T_0 + \min\left\{\varepsilon - \alpha(1-\rho x) + \sqrt{\alpha(1-\rho x)^2 + \beta^2}, \max(T_C)\right\}$	T_C =congested travel time T_0 = free flow travel time x = degree of saturation (n/c_u), and a = a user-specified coefficient; and b = (2a - 1)/(2a - 2) e = 2 – b r = VC ratio factor, adjusted so that TC = +/- 1.5 when VC = 1.0 $\max(T_c) = \mu + n(VC)$
DRCOG	Denver, CO	Form depends on value of Beta	$gc = VOT \times T_{FF}\left[1 + a\left\{\frac{V}{C}\right\}^B\right] + VOD \times D + K$	gc = Generalized Cost (Dollars) VOT = Value of Time (Dollars per minute) TFF = Free-Flow Travel Time (Minutes) a = A Calibrated Parameter V = Volume (Vehicles per Hour) C = Capacity (Vehicles per Hour) B = A Calibrated Parameter VOD = Value of Distance (Cents per Mile) D = Distance (Miles) K = Fixed Penalties (Dollars)

Agency	Location	Arterials	Mathematical Form	Where
ARC	Atlanta, GA	Different Curves by Time of Day	** See Figure 1	
Metro	Portland, OR	Intersection Delay + Mid-block Delay	$f_d = \frac{ab + cx^d}{b + x^d}$	**Intersection:** a = 0.034807783 b = 0.22996809 c = 35.210296 d = 2.3015579 x = volume/capacity **Mid Block:** a = 0.9999895 b= 0.70062753 c = 1.633602 d = 7.0559061 x = volume/capacity
SANDAG	San Diego, CA	Intersection Delay + Mid-block Delay	$f(x) = time \times c_1 \times \left(\frac{1}{1 - \frac{c_2}{1 + exp^{c_3 - c_4 voc}}} \right)$ $Delay(x) = time \times p_1 \times \left[1 + \left(\frac{p_2}{1 + exp^{p_3 - p_4 voc}} \right) \right]$	f(x)=volume capacity function c_1 = 0.9526, c_2 = 1, c_3 = 3, c_4 = 3 p_1 = 0.09, p_2 = 350, p_3 = 3.5, p_4 = 2.3



For the full discussion go to http://tmip.fhwa.dot.gov/email_list/ and join the list or peruse the archives. ■

TMIP Panel Suggests Topics for Peer Exchanges

A topic of discussion at the March 2004 TMIP Panel meeting was potential subjects for future focus. The panel members discussed many possible topics and conceived of the future study of those topics in a variety of forms, from workshops to agglomerations of information at ready disposal. Since that meeting, the topics have been conceptualized as peer exchanges, preliminarily defined and the panel members have each had opportunity to assign a value of importance to the topics.

These exchanges would denote a point of departure for further study. They are briefly described here with the hope that they will be conducted as schedules and funding allow.

Pricing and Tolling Analysis

Planning agencies face the challenge of incorporating pricing and tolling strategies into their traditional technical planning analyses in order to evaluate potential impacts to the transportation system. This exchange is to identify the state of the practice in pricing analysis, identify knowledge gaps, share best practices, and prioritize research. The USDOT Office of the Secretary will conduct this peer exchange sometime in the next calendar year.

Time of day, peak spreading and over-capacity links

Many urban areas are experiencing increasingly severe congestion and more prominent peak spreading. While over-capacity links may initially meter traffic, systemic congestion will result in changes in travel behaviors that include changed departure times, linked trips, and perhaps deferral of travel. Credible travel models in urban areas must reflect peak spreading phenomena. This exchange will discuss model formulations and approaches that incorporate time-of day choice and peak spreading with traditional models and tour based models with consideration for dynamic assignment methodologies.

Transportation Impacts on Development/Land Use

Land use impacts of transportation plans or projects are an area of significant debate. Although legal challenges to transportation agencies regarding plans or projects have focused on the issue of "sprawl inducing" transportation investments, implementing agencies often do not include project or plan specific land use scenarios in their impact assessments or plan updates. This exchange will review methods being used to estimate land use impacts of transportation plans or projects.

Communication and Use of Travel Models in Decision Making

Planning agencies spend considerable resources each year to collect data, build models, forecast land use and travel demand, and deliver information to assess the likely future utilization of existing and proposed transportation facilities and services. The intent is to help communities and their decision-makers make better transportation investment choices. This exchange will address how information produced from models is used by decision-makers and will explore ways to improve not only communication of model results but also institutional relationships in communication between technical staff and decision-makers.

Issues in Data Collection and Maintenance

As the field of transportation broadens to focus on new issues, and as planning analysis methods become more complex (and thus data hungry), agencies are challenged by data acquisition and management. While the broad adoption of GIS technologies have made some data management easier, the increasing demands for more data and analysis point to the need for sharing best practices in data collection and management. This exchange will focus on sharing best practices in planning analysis data collection and management strategies.

Freight/light duty commercial vehicles

Current travel demand forecasting models focus primarily on trips made by households. However, a significant number of trips, made by commercial vehicles, including package and freight deliveries, tradesmen, taxis, rental cars, school buses, emergency services, etc., are not fully addressed by household-based travel models. This peer exchange will help identify different methods to incorporate freight and commercial vehicle travel into travel forecasting models. ■

Upcoming Events

Conferences

84th TRB Annual Meeting
January 9-13, 2005 – Washington D.C.
Contact: http://ww4.trb.org/trb/annual.nsf

NARC 2005 Washington Policy Conference
February 4-8, 2005 – Washington D.C.
Contact: http://www.narc.org

APA National Planning Conference
March 19-23, 2005 – San Francisco, CA
Contact: http://www.planning.org/2005conference/index.htm

Courses

Multimodal Travel Forecasting
March 7-9, 2005 – Tampa, FL
Contact: nti.rutgers.edu
Phone: 732-932-1700

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

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