Summary Report for the First Review Panel for the Memphis Metropolitan Area Planning Organization Travel Model Improvement Effort

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Memphis, Tennessee

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Travel Model Improvement Program (TMIP)
Summary Report for the First Review Panel for the
Memphis Metropolitan Area Planning Organization (MPO)

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Peer Review Panelists:

Panelist	Organization	Location
Ken Cervenka (Chair)	North Central Texas Council of Governments	Arlington, TX
Ed Granzow	CH2MHill	Oakland, CA
Guy Rousseau	Atlanta Regional Commission	Atlanta, GA
Howard Slavin	Caliper Corporation	Newton, MA

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I. Executive Summary

On October 27 and 28, 2004, the Memphis Metropolitan Planning Organization (MPO) hosted a peer review meeting at the Memphis Area Transit Authority (MATA) Central Station offices. The two-day peer review was held as part of the Travel Model Improvement Program (TMIP) sponsored by the Federal Highway Administration (FHWA). In addition to four review panel members, attendees included Memphis MPO representatives, members of the Memphis Model Steering Committee, FHWA representatives, stakeholders from other transportation agencies and jurisdictions, and the consultants developing the Memphis travel demand model. The primary purpose of the peer review was to help the Memphis MPO ensure the successful implementation of an updated travel demand model by discussing the issues, obstacles, and solutions for achieving the goals laid out in the *Memphis MPO Travel Demand Model Study Design*.[1]

This meeting is the first of two planned peer reviews sponsored by the TMIP program for the Memphis MPO. Following initial introductions and a summary of the MPO's previous model development activities, the first day of presentations and discussions focused on:

- Project schedule
- Network and traffic analysis zone (TAZ) development
- Demographic forecasts and TAZ allocation
- Travel model development
- Model validation
- Model automation, training and documentation

The peer review panel met in closed session on the morning of the second day. Panel members then presented a set of recommendations to the MPO and its consultants for their travel demand modeling activities. This report summarizes the activities of the two-day peer review meeting.

II. Background

The current study area covered by the Memphis Metropolitan Area Planning Organization (MPO), shown in Appendix A, is composed of one full county and two partial counties:

- Shelby County, Tennessee - including the municipalities of Memphis, Arlington, Bartlett, Collierville, Germantown, Lakeland, and Millington
- Northern DeSoto County, Mississippi - including the municipalities of Hernando, Horn Lake, Olive Branch, and Southaven
- Western Fayette County, Tennessee - including the municipalities of Gallaway and Piperton

The Memphis MPO is in the process of developing new travel demand forecasting tools to aid with various transportation planning, programming and project evaluation activities; air quality

[1] Kimley-Horn and Associates, Inc., Cambridge Systematics, Inc., and HNTB. *The Memphis MPO Travel Demand Model Study Design*. Developed for The Memphis Metropolitan Planning Organization. December 2002.

analyses; and transportation and land use policy decisions. Although the MPO currently maintains a validated travel demand model, it wants to update its travel demand modeling practices using data from Census 2000 and a household travel survey conducted in the fall of 1998 using one-day travel diaries kept by members from 2,526 area households. The MPO hopes to quantify a wider variety of transportation options and provide a greater level of detail for the types of transportation investments analyzed with travel demand forecasting models.

The first phase of the travel demand model update project was the 1998 household travel survey. The second phase includes two elements:

1. Inventory of available data and creation of the Memphis MPO Travel Demand Model Study Design document (hereafter referred to as the Study Design)
2. Implementation of a model that follows the Study Design and contains "best practice" approaches wherever supported by the available data

The MPO hired the consulting firm Kimley-Horn & Associates, Inc (with Cambridge Systematics, Inc and HNTB as sub-consultants) to help it implement phase two of the travel demand update project. The consultants completed the final Study Design in December 2002. It included:

- A review of the 1998 household travel survey and other existing transportation data
- Results from a Memphis Travel Demand Model Visioning meeting in 2001 attended by a wide variety of stakeholders in the local transportation planning and engineering community
- Recommendations made by an earlier peer review panel[2] of a previous draft of the Travel Demand Model Study Design

The MPO used the December 2002 Study Design to guide its summer 2004 negotiation of a $1.6 million consultant services contract for development of a state-of-the-practice travel model. The MPO required a model that:

- uses the TransCAD® geographic information systems (GIS)-based travel demand model software platform
- expands the current travel model area
- includes the ability to model sub-areas
- provides a direct link between the travel demand model and a consistent and repeatable land use forecasting methodology
- is capable of handling multiple time-of-day periods
- includes a truck/freight component
- the MPO can maintain given its financial and human resources
- allows for review and interpretation of interim and final model calibration results
- can be validated at each step of model development, with allowance for adjustment of parameters to replicate observed travel conditions
- provides output consistent with the needs of air quality models

[2] The Memphis MPO sponsored its own peer review during the initial phase of its model redesign process. The results of this peer review, which had different panel members, are not addressed in this report.

- contains calibration and validation procedures and a structure that are can be implemented using available data
- automates travel demand forecasting steps, performance reports, GIS data manipulation, thematic map creation, and web publishing activities
- has the ability to obtain transit ridership data by line, link, and time of day
- is comprehensive and transparent
- provides socioeconomic data and corresponding travel demand forecasts for various years between 2000 and 2040

Further, the contract required that the consultants collect necessary data and compare Memphis model parameters against those of other regions.

As an integral part of the model development work, the FHWA-sponsored Travel Model Improvement Program (TMIP) peer review panel was tasked with two general charges:

- Advise the Memphis Model Steering Committee, composed of representatives from various local transportation agencies, and Memphis MPO staff on development of a new travel demand model for the Memphis area
- Aid with the successful implementation of a state-of-the-practice four-step model that can be used in developing the Regional Transportation Plan (RTP), the Transportation Improvement Program (TIP), and air quality conformity determinations

The peer review panel's responsibilities included:

- Review and comment on model milestones, memos, presentations, and reports
- Determine if the foreseeable needs of the MPO and regional planning community are addressed
- Make recommendations for solutions to current obstacles to help keep the project within the available budget and timeframe
- Offer insights regarding a longer-term future model improvement program
- Ensure that proper standards are met throughout the model development process

III. Presentations and Discussions

A. Panel Member Presentations

After opening remarks and introductions, each panel member gave a presentation on their travel modeling experiences, the travel modeling programs of their respective agencies, or ideas on modeling best practices.[3]

[3]Presentations by most of the panelists are referenced in Appendix B of this report. These are available on the TMIP web site at http://tmip.fhwa.dot.gov/.

North Central Texas Council of Governments
Ken Cervenka

The North Central Texas Council of Governments (NCTCOG), represented on the panel by Mr. Ken Cervenka, has a four-step travel demand model based on the TransCAD software and incorporates a fully batched user interface (UI) to simplify the model's use in standard multimodal model applications work. With the exception of the mode choice estimations performed by Cambridge Systematics in 2002, the entire model system was developed in-house.

A user equilibrium generalized cost traffic assignment is performed for four vehicle classes and three time periods (morning peak, afternoon peak, and off peak). NCTCOG plans to update its model to:

- Perform destination choice estimations and sensitivity tests, for consideration as a replacement of the existing gravity model trip distribution
- Expand the existing 5,000 square mile, 4,874 zone travel model area to include the full air quality non-attainment area
- Develop a multi-year all-streets roadway/transit network coding environment
- Review NCTCOG's current land use forecasting tools (Metropilus, the update to the disaggregate residential allocation model/employment allocation model known as DRAM/EMPAL) to determine if other tools are needed
- Begin a gradual transition to activity-based modeling by supporting research and sensitivity tests

Atlanta Regional Commission
Guy Rousseau

The Atlanta Regional Commission (ARC), represented by Mr. Guy Rousseau, currently uses a four-step trip-based travel demand model. In the trip generation model, the production model uses a set of logit models and the attraction model uses a set of cross-classification models. The model treats Hartsfield-Jackson Atlanta International Airport (the busiest airport in the nation) as a special trip generator.

Trip distribution consists of singly-constrained gravity models. Until recently, impedances were based on the mode choice logsums. New friction factors have been calibrated based on composite time values representing a weighted average (harmonic mean) of highway travel times and transit travel times. Purpose-specific internal-external trips are created from trip generation and distribution procedures, while truck and passenger vehicle external-external trip forecasts are derived from a frataring process. Mode choice is a fully nested logit model written in FORTRAN.

Traffic assignment is performed for four separate time periods. The assignment speeds are fed back into trip distribution (as well as into the DRAM/EMPAL land use model). Convergence is based on the method of successive averages.

A truck model containing truck weight specific trip tables has also been developed. The ARC model has a user-friendly interface, with much of the modeling stream available for control by the user. The ARC model has a "dry run" function that takes just a few hours to run, and allows users to catch and troubleshoot errors without having to perform a full eight to ten hour model run.

In 2005, ARC will expand its modeling domain from 13 to 20 counties. Further, it is considering activity-based modeling but still focuses on the trip-based four-step model.

CH2MHill Consultants
Ed Granzow

Mr. Ed Granzow from CH2MHill recently participated in a similar peer review of the Anchorage Metropolitan Area Transportation Study (AMATS)[4], where he was on the model development team. In Memphis, he presented what he considers to be important elements of a successful model development process:

- Understand the client's needs and expectations for the model
  - Understand the technical limitations of the existing model and the shortcomings the client has experienced in the past.
  - Know the issues the community is facing; identify the critical needs, which may be different from the technical needs.
  - Be aware of how travel modeling fits into regional modeling, e.g., the relationship between land use forecasting and travel demand modeling.

- Good technical resources for modeling are needed
  - This includes the right staff, analysis tools, and data. The review and oversight committee should be put in place at the beginning of the process to allow for its participation throughout the model development process.
  - A peer review panel is a good idea since model developers tend to get very involved with the process and may benefit from an outside perspective. A peer review panel can give a good independent assessment of the technical details. Further, it allows the model development team to have on-call counseling and learn lessons from peers.

- The model development process needs to be carefully planned and flexible enough to deal with contingencies
  - One goal should be to create a process that can quickly integrate new information.
  - Record-keeping should be continually updated to reflect changes throughout the model development process.

- A process for transition and distribution of the model and its products needs to be in place
  - The implementation plan should consider the forecasting needs of local agencies.

[4] The report of this peer review is available at: http://tmip.fhwa.dot.gov/services/peer_review_program/status.stm

  - The process of transitioning the model from consultant to modeling agency should be well-planned.
  - Transitions to move from the model calibration and validation stages to the model forecasting stage should also be well-planned.

- The consultants and transportation agencies should treat the model as an information technology product rather than just a transportation model
  - The scripts and the general model process should be subjected to rigorous software testing and operational audits.
  - In the past, modeling was largely a matter of entering information (TRANPLAN), now it is more like a programming language.

- Careful attention needs to be paid to the system, software and database design

Caliper Corporation
Howard Slavin

Howard Slavin, president of Caliper Corporation, has been involved with all aspects of TransCAD model development and application. He offered some general observations and recommendations on travel demand modeling:

- All transportation models have limitations; be clear about model capabilities to manage expectations at the beginning of the process.
- Keep the focus on the local goals and concerns, rather than on new or "fashionable" modeling procedures that may not be appropriate.
- Many models borrow values from other areas without properly justifying their use in their particular area. To the extent possible, Memphis should rely on local data to determine model parameters.
- Take advantage of GIS and related tools that can add functionality to travel demand models.

Federal Transit Administration
Eric Pihl

Mr. Eric Pihl, of the Federal Transit Administration (FTA), who was a member of the first Memphis peer review panel in 2002, was not able to attend. He prepared a presentation that was distributed to meeting attendees, but not discussed in detail.

B. Comments from Stakeholders

A representative from the City of Memphis noted there has been a history of underestimating future traffic volumes by the Memphis MPO and Tennessee DOT. Further, the Memphis economy does not usually follow national trends; local birth rates and household sizes have always been higher than the national values.

The Memphis Area Transit Authority (MATA) expressed concern that parking cost data are not reflected in the current model and should get more attention in the new model. MATA also noted that the MPO Long Range Transportation Plan includes several fixed guideway transit projects so the new model must meet FTA's New Starts analysis requirements. The new model should also incorporate special generation and distribution sub-models such as trips to the airport, special event travel and visitor travel.

Representatives from the Tennessee and Mississippi Departments of Transportation (TDOT and MDOT) emphasized that the model should be compatible with their statewide modeling efforts.

C. Memphis Travel Demand Model Study Design

Consultant presentations by Kimley-Horn (Carroll Collins, James Collins, and Mark Dunzo), Cambridge Systematics (Tom Rossi and Ed Bromage) and HNTB (Jane Dembner and Tom Hammer, via speakerphone).

All peer review participants were given the December 2002 Travel Demand Model Study Design document ahead of time for review. The consultants presented their recent work toward implementation of the Study Design, as well as necessary updates to the Study Design. The review panel members, the Memphis MPO staff, and stakeholders were given an opportunity to ask questions for clarification and offer comments. The process resulted in all parties achieving a better understanding of the Memphis model under development, and provided the basis for the panel's recommendations on the second day of the peer review.

The following sections present information on the discussions and panel recommendations, as well as information that may be of use to other organizations with similar model development interests. More details about the discussions can be obtained from Ms. Sarah Sun of the Memphis MPO.

Project Schedule

The FHWA and FTA jointly approved the Memphis MPO's current conformity ruling in February 2004. The next review will be conducted by February 2007. The consultant's March 2006 completion is sensitive to coordination efforts from the Memphis MPO, the Memphis Model Steering Committee, the peer review panel, and the consultant team members.

Base Road Network

The Memphis MPO's current travel model network served as the starting point for development of a more detailed network. TransCAD tools are being used to update roadway alignments and network attributes from several sources:

- A review of ground-based photography from the Tennessee Roadway Information Management System (TRIMS)

- A windshield survey (consisting of a driver and an observer taking notes on number of lanes, median type, and speed limit) covering selected roadways
- Use of aerial photos to verify alignments and number of lanes

TransCAD's line layer connectivity tool, visual review of plots of network attributes, minimum path tests, and test loadings will be used to check the reasonableness of the coded network. The consultants are collecting only link level data: Global rules will be used to develop base year and forecast year intersection-based attributes that may be needed for determination of assignment capacities.

While the travel model network generally includes only major roads, some local streets will be included if needed for transit route coding or for proper modeling of pedestrian access to and from transit (or between zones). Consideration will also be given to local streets being used for cut-through traffic, as well as local streets that may become re-classified if their traffic volumes increase sufficiently.

For connection of zone centroids to the coded network, TransCAD tools will be used to develop auto-access and non-auto access connectors. One panelist suggested that the consultants should err on the side of more centroid connectors rather than fewer. A further suggestion was that the consultants should consider varying the centroid connector speeds based on area type.

Multi-Year Network

A TransCAD-based multi-year network will be used for representation of all travel model roadway links. Each model link will contain "born-on" and "expiration" dates that allow the baseline, long-range plan, and interim-year plans to be included in a single GIS layer.

The consultants confirmed they have used this approach successfully in other models, and that it is worth the extra upfront effort because it reduces the complexity of fixing errors. It also requires less effort for general quality control compared to an alternative process consisting of maintaining separate networks for each model year. The panelists were very supportive of the multi-year concept, but noted the method is ambitious and will require additional network field keys to address different scenarios for the same time period. The consultants emphasized that a proper UI is needed to ensure that multi-year coding procedures can be followed.

Transit Speeds

The consultants proposed an approach for transit speed calculations that is similar to what is currently done at the Southeast Michigan Council of Governments (SEMCOG). For transit in mixed-flow traffic, the SEMCOG approach calculates transit travel times that are a function of the congested roadway link travel times and the roadway classification.

The panelists discussed issues related to this transit travel time technique. One panelist noted that auto speeds must be very accurate if one attempts to calibrate a bus speed equation, and that a simpler schedule-derived bus speed may be a better choice. Several panelists noted the importance of travel times in mode choice modeling, and emphasized the need for a proper

relationship between auto and bus speeds. Another panelist described the transit travel time technique used by NCTCOG which calculates bus travel time as the congested roadway link travel time plus an extra dwell time associated with the actual coded stops.

Model Coverage and External Travel

The existing travel model includes all of Shelby county and portions of DeSoto and Fayette counties. The proposed new model will expand beyond these existing boundaries to include all of DeSoto County, the western half of Fayette County, the southern third of Tipton County, and the northwest corner of Marshall County, as shown in Appendix A. This expansion will result in the model area increasing from approximately 1,100 square miles to approximately 1,825 square miles. The proposed additions to the modeling area are much less densely populated than the existing model area.

There was discussion about whether the area west of the Mississippi River (Crittenden County, Arkansas) should be included. The conclusion was that the two existing bridges over the Mississippi River are primarily used by very long-distance traffic and are not sufficiently congested. Therefore the two bridges will be treated as external stations.

For modeling of external trips, an external station survey was originally included in the model development scope. Due to issues of cost and TDOT limitations on such surveys on major interstate routes, this was eliminated from consideration. For external-internal modeling, the consultants are considering an approach similar to what was recently done at SEMCOG. For external-external trips, the consultants are proposing an approach described in the *Travel Estimation Techniques for Urban Planning* (NCHRP 365).[5]

The panel suggested that base year and forecast year auto and truck data from the statewide models might be used to determine external trip characteristics. The representatives from MDOT and TDOT said they will provide their preliminary statewide transportation models to the consultants in January 2005 for examination.

Development of TAZ Structure

The Memphis MPO's current model has 646 TAZs, of which 512 are in Shelby County. The consultants will use this TAZ structure as the base for development of new TAZs for the expanded travel model area that is balanced with the new model's level of detail for roadway network coding. Other criteria for TAZ structuring include:

- Each Census 2000 block nests within the TAZ structure
- If possible, each TAZ nests within the census tract and census block group structure
- Each TAZ will be consistent with the current and "known" future transportation network/infrastructure serving the zone
- Each TAZ boundary will follow actual geographic features

[5] Martin, WA, McGuckin, NA. *Travel Estimation Techniques for Urban Planning*. National Cooperative Highway Research Program (NCHRP) Report 365. Washington, DC: National Academy Press, 1998. (Available from the Transportation Research Board (TRB) bookstore at http://gulliver.trb.org/bookstore/).

- Land uses and population and employment densities will be consistent across the zone
  - Evaluation of existing land uses and zoning
  - Cross reference with an evaluation of the future land use plan
- TAZs will be configured so that both vehicle trips and transit walk trips can be loaded appropriately to the coded current and future transportation networks

The consultants said the final TAZ boundaries will be rectified to fit with the final roadway network. The MATA representative pointed out that the TAZ structure must be flexible enough to test alternative land use and transit oriented development scenarios near proposed fixed guideway stations.

Demographic Forecasts and TAZ Allocations

The land use and demographic forecasts will use year 2000 as the baseline. All forecasting and allocation tools used in this project will be fully documented and made available to the Memphis MPO for their future use. Since the Memphis-specific methodology has not yet been developed, the discussions focused on the general proposed strategy and data reconciliation issues, including the following:

- Use of Census 2000 data for base year TAZ-level population and household variables.
- Documentation of sources for base year employment data.
- Base year employment estimates to be reconciled with numbers from the Federal government's Bureau of Economic Activities and Bureau of Labor Statistics.
- The need for both base year 2000 and 2004 TAZ-level demographics for model calibration and validation activities. For the year 2004 TAZ allocation, the interpolated sub-county forecast will be used as a control total. To produce a robust 2004 forecast and allocation, the sub-county control totals as well as the preliminary TAZ allocation will be checked to ensure the results are reasonable and consistent with the available data trends such as building permits. This reality check will be done for the more dynamic TAZs in consultation with the steering committee and planning staff from the participating jurisdictions.
- The pros and cons of state-derived forecast data (such as from the University of Tennessee) rather than nationally-derived data.
- Examination of forecasts contained in the Tennessee and Mississippi statewide transportation models.

The proposed methodology for demographic forecasting and TAZ allocation is a top-down approach done by preparing forecasts sequentially for the Memphis Metropolitan Statistical Area (MSA): first, for the area as a whole, then for the approximately twenty sub-county areas (SCAs) within the MSA; and finally for individual TAZs. The general forecasting approach will be customized to reflect unique characteristics of the region. An expert panel will be convened to review regional forecasts and estimate the percentage of households and jobs for each of the sub-county areas in the Memphis MSA. The SCA to TAZ allocations will be based on criteria such as the amount of developable land; environmental constraints; current and future zoning regulations; travel accessibility; and reasonableness checks. HNTB will hold up to five review

sessions with the planning staff and steering committee at five key stages of the forecast to review:

- base year household and employment data
- regional household and employment forecasts
- SCA totals
- initial draft allocations to TAZs
- final TAZ inputs

Trip Generation and Special Generators

The consultants' review of the fall 1998 household survey revealed the following trip types to be significant:

- Home-based work
- Home-based school
- Home-based shop
- Home-based university
- Home-based social/recreational
- Home-based other
- Non-home-based work
- Non-home based other
- External-internal/internal-external/external-external

Unfortunately, the preliminary results also show the survey does not appear to have enough total person trips per household. The consultants are examining the potential trip under-reporting issue and must identify a strategy for making effective use of the household survey data in the model development work.

The trip generation strategy includes a logit model for home-based work trips (to address intermediate stops from home to work and work to home), and cross classification tables for all other purposes. The consultants noted that while accessibility (as quantified by means of the mode choice logsum variable) may be a determinant in trip rates, this is not in the current Scope of Services.

The panelists felt that too many special generators might be an indication of problems with the trip generation model. As a starting point, the consultants will consider only four special generators: air passengers at Memphis International Airport; FedEx operations at Memphis International Airport; the FedEx headquarters in Collierville; and visitor activities at Graceland.

Trip Distribution

The proposed trip distribution model has three important elements:

- Each trip purpose is allocated to four time periods (morning peak, mid-day, afternoon peak, and off peak evening/night) right after trip generation, which means four separate

trip distribution runs—each with its own set of impedances—will be performed for each trip purpose.
- The zone-to-zone impedances will use the mode choice logsum variable to represent all modes of travel.
- A logit-based destination choice formulation will be used with a special intermediate stop implementation for handling home-based work trips with intermediate stops.

Mode Choice

The proposed mode choice model has five separate modes: non-motorized (walk/bicycle); auto access transit, walk access transit, drive alone; and shared ride (two or more occupants). The mode choice estimation steps include:

- Conduct (under separate contract) a transit onboard survey, currently scheduled for January 2005
- Obtain the time-of-day trip records from the 1998 household survey and the 2005 transit onboard survey
- Attach the level of service variables (roadway, walk access transit, auto access transit, and bike/walk skims) and geographic data to the trip records to create the model estimation data set
- Determine candidate variables, estimate multinomial logit models, and test nested logit structures

Some coefficients in the model estimation may need to be constrained to meet any required FTA guidelines; maintain proper relationships among coefficients; and ensure reasonableness with models implemented in other regions.

Commercial Vehicle (Truck) Modeling

Procedures from the *Quick Response Freight Manual*[6] will be used to develop commercial vehicle (truck) models. The key steps include:

- Obtain vehicle classification counts
- Establish truck trip generation rates for three classes of commercial vehicles: four-tired vehicles, single-unit trucks (6+ tires), and combination trucks
- Use TransCAD's matrix estimator to create synthesized trip tables for each of the three commercial vehicle classes
- Calibrate gravity model friction factors for each vehicle class based on the input of roadway skims and the estimated trip tables

[6] Cambridge Systematics, COMSIS Corporation, and the University of Wisconsin-Milwaukee. *Quick Response Freight Manual*. Prepared for Federal Highway Administration, September 1996.
(Available at the TMIP Clearinghouse at http://tmip.fhwa.dot.gov/clearinghouse/docs/quick/index.stm).

Trip Assignment

Traffic assignment will be run for four separate time periods: morning peak, mid-day, afternoon peak, and off peak evening/night. Each model run is proposed as two separate assignments:

- The all-or-nothing assignment is used to load the external-external trips and the large combination trucks.
- The multi-class user equilibrium (UE) assignment will be used for autos and light trucks, with the combination truck volumes input as preloads.

One panelist noted that a very tight gap (convergence criteria) needs to be used for each UE assignment. The method of successive averages will be used for feedback of assignment speeds to trip distribution. Toll roads are not currently allowed in the state of Tennessee, so the proposed model does not address road pricing. Nonetheless, several panelists mentioned that including road pricing should be relatively easy by means of a generalized cost UE assignment.

TransCAD's pathfinder transit assignment will be used to load origin-destination transit riders by mode (transit-walk access and transit-drive access) and by time period.

Model Validation

Validation standards will be developed for the following sub-components:

- Model input data
  - Use GIS to examine socioeconomic and network data
  - Compare socioeconomic data to other sources
  - Conduct network path, connectivity, and other reasonableness checks
- Trip generation
  - Compare trips by purpose and trips per demographic unit to NCHRP 365, National Household Travel Survey and other national values
  - Examine balancing factors between productions and attractions
- Trip distribution
  - Generate trip length frequency distributions by purpose
  - District level origin-destination checks
  - Calculate intrazonal trip percentages by purpose
- Mode choice
  - Check reasonableness of model coefficients and relationships
  - Check against a target matrix of trips by purpose, mode, and market segment
  - Conduct sensitivity checks (elasticities)
- Trip assignment
  - Generate vehicle miles traveled data by functional class and geographic area
  - Check percent of root mean square error
  - Compare volumes versus counts on screenlines and cutlines
  - Generate transit volumes by route group

Model Automation

The consultants realize that some users want control at each model step, whereas others are interested in running a full model. The UI will therefore be developed to step through each model or to run an entire model suite with a push of a button. A modular process will be used so that interfaces can be changed easily and previously saved macros will be accessible. All source code created for this project will be provided to the Memphis MPO so that it can make changes in the future.

To help users keep track of their inputs, scenario management tools will be provided in which all input files are kept in one folder and all output files are kept in another folder. All outputs will be in common data exchange formats and execution reports will be formatted to be self-explanatory.

Model Training and Documentation

The consultants will provide training to the Memphis MPO staff and other stakeholders such as MATA, the City of Memphis, MDOT, TDOT, Shelby County, and Desoto County. This training will be provided on-site at the MPO offices. Topics will include information on performing basic model runs, testing of alternatives, and understanding the development and limitations of the model. Documentation will consist of technical memoranda written during model development; a model development methodology report; and a comprehensive model user's guide.

Model Application

The final stress tests will consist of the consultants' use of the implemented models for the Memphis MPO's next RTP. This activity will require the development of interim and horizon year socioeconomic forecasts and roadway and transit networks. The initial networks will consist of the "existing plus committed" projects for the Memphis MPO region.

The model outputs will include traffic, transit ridership, and freight movement forecasts and performance reports. A deficiency analysis will be conducted, and recommendations for improvements made for three time frames: short-term (0-5 years); mid-term (5-15 years); and long-term (15-25 years).

IV. Panel Recommendations and Action Plan

This TMIP peer review was intended to provide feedback from a panel of experts to the Memphis MPO and the Memphis Model Steering Committee on the consultants' development of new travel demand models for the Memphis MPO area. The panel convened in closed session the morning of the second day to discuss the Memphis travel model presentations and discussions of the previous day. The panel then developed a set of consensus recommendations that addressed the panel's stated charge.

A. Strengths

The panel stated that the Memphis MPO has a strong model consultant team in place. The panel also noted that the consultants and their client seem to work well together, which puts the entire model implementation effort in a very good position for completion at budget and under a tight schedule.

Special commendation goes to the stakeholders for being proactively involved with the Study Design and this peer review. Based on what the panelists heard from the presentations and discussions on the first day, the proposed model structure for the Memphis MPO appears to represent a reasonable state-of-the-practice model development effort.

The panel highlighted three specific strengths to the consultants' proposal:

- The incorporation of time-of-day modeling early in the model stream
- The use of a logit-based destination choice formulation for trip distribution with impedances based on the mode choice logsum variable
- The implementation of multi-year roadway and transit TransCAD-based networks

B. Recommendations and Action Plan

The Memphis MPO and the consultants wanted to discuss the recommendations presented by the panel in further detail. The following includes both the panel recommendations and the subsequent discussions leading to an identification of the next steps (action plan).

1. **Revisit the planned economic/demographic forecasting and land use allocation procedures, specifically:**
   - Strengthen procedures to reflect unique regional economic trends
   - Prepare white paper describing process for panel to better understand what the consultant is delivering to the client
   - Get consensus upfront on economic/demographic and land use allocation forecasts through a Delphi panel
   - Make better use of university resources

Resulting Action Items

- HNTB will clarify and present in more detail what the Memphis MPO can expect as the end product of their work.
- A white paper will be written to:
  - Present the details of the current proposal.
  - Explain the differences and deviations that the Memphis forecast methods will have from the forecast methods used in Charlotte and Asheville.
- The Memphis MPO will document their past processes for consensus-building, especially for previous land use (population and employment) forecasts so that those involved can review the Delphi and political processes.

2. Clarify the methodology for mapping data from SCAs to TAZs

Resulting Action Item

- Prepare a brief description and spreadsheet of a mapping method from another area that is intended for use in Memphis (Charlotte was suggested as a good example). Include a description of any deviations from the example application to clarify the method to be used in Memphis.

3. Present the consultants' recommended TAZ structure. At a minimum, this needs to reflect the planned future roads

The panelists suggested that, in determining the number of TAZs, the MPO calculate the ratio of average square miles per TAZ and compare to ratios in other areas. One of the panelists has collected such ratios through an informal survey of users on the online TMIP forum.[7]

Resulting Action Items

- MPO and stakeholders will review TAZ structure.
- Consultants will provide statistical information regarding TAZ structure (population per TAZ, square miles per TAZ).
- Document the criteria with which the final decision will be made on TAZ structure

4. Consider making the travel model more sensitive to environmental justice issues

The panelists pointed out that there are some significant ethnic concentrations in housing in the Memphis area. It is possible that a lack of consideration of environmental justice variables may affect the quality of the transit model validation results.

Resulting Action Items

- The MPO will identify areas sensitive to environmental justice issues and provide this information to the project team.
- A white paper will be prepared on how the model might be used to address environmental justice concerns.
- Review the Cambridge Systematics study on environmental justice.

5. Direct special attention to transit route group validation and what it may reveal during the development of the mode choice model even though transit mode share is very low in this region

The panel agreed that the mode choice plan presented during the peer review is correct. It also recognized that some routes have much higher passenger volumes than others. The project team should determine why this is occurring and whether the model will eventually need to be adjusted to account for these differences.

[7] The TMIP forum can be found on the TMIP website, http://tmip.fhwa.dot.gov/

Resulting Action Item

- Document and clarify the new developments in the model since the Study Design was written.

6. Resolve issues related to different model calibration years and various data reconciliation concerns

- Available data that needs to be reconciled
  - 1998 household survey
  - Census 2000 data
  - 2003 economic inventory data (employment)
  - 2005 transit onboard survey
  - Yearly traffic counts where available
- Networks for different years needed for highway, transit, and land use

Early on in the project, data creation needs should be clarified. Networks from different years (previous and future) will be needed to complete the modeling. After determining what the calibration year will be, it will be necessary to specify a consistent method for adjusting to the calibration year. Alternatively, a rationale for not making the data consistent should be documented.

Resulting Action Items

- Consultants will work with the model team to reach a consensus on how to address base year issues for each part of the model.
- Consultants will document and clarify the data standardization methodology.

7. Examine information from statewide models for possible integration

The panel suggested that the Tennessee and Mississippi statewide models be examined as resources for the Memphis MPO model, including the development of economic forecasts and external vehicle volumes. The panel believes that there is a tremendous opportunity for integration, but recognizes that full integration of models will be difficult and impractical. Further, integrating with statewide models is dependent on the timing of the completion of the statewide models.

Resulting Action Items

- The MPO will report back to the group on the Tennessee model and KHA will report to the group on the Mississippi model.
- Write a short memo to address the possibility of integrating any elements from the statewide models into the Memphis travel demand model.

8. Pay careful attention to the model sensitivities to current and projected income

The panel questioned whether the projection of future income should be the same for all zones and whether there are any other methods available to the Memphis MPO for predicting future income. One panelist suggested that the zonal and socioeconomic groups be small enough to have economic homogeneity within the zone. For example, although college students may have low incomes and live with seven unrelated people in a single household, the students may not fall in the same economic category as a family of seven with low income.

Resulting Action Item

- The consultants will test the model for sensitivity to income. It is possible that income will not ultimately be used as a direct variable.

9. Review the previous work done by Parsons Brinkerhoff (PB) regarding Memphis airport planning and modeling needs for possible incorporation into the travel demand model

The panel recognized that the airport may not be a significant travel generator. However, given that MATA has undertaken a study to model the Memphis International Airport for planning purposes, the Memphis MPO travel demand model might be able to use the information produced from the PB study. One panelist suggested comparing the nesting structures of both models. Another panelist noted the possible future need for an air passenger (or airport employee) survey that is not in the current consultant Scope of Services.

Resulting Action Items

- The MPO will provide the consultants with the Airport Master Plan and the airport sub-area model prepared by PB.
- Determine appropriateness of using the airport sub-area model, including possible inclusion in the regional travel demand model or inclusion as a special generator. Trip distribution for the 4,500 airport employees generally differs from trip distribution patterns in the rest of the region.

10. Update the December 2002 Travel Demand Model Study Design document to reflect the latest plans. This update should include:

- Consultant commitments made at peer review
- Additional model design details that have been determined since July 2004
- Key methodologies noted as supplements

Items such as performance measures (e.g. corridor based vs. system wide), methodologies (e.g. model processes, how variables and coefficients line up, and intersection inputs to capacity calculations), and other model directions (destination choice versus gravity model) may require additional documentation to facilitate communications, progress the project, and prevent future misunderstandings.

Resulting Action Items

- Revise the Study Design document to reflect revisions and updates by either including an addendum to the Study Design or adding all comments/changes directly within the Study Design and add a page at the front that lists change dates of the document.
- Post documents and revisions electronically (e.g. ftp site).
- Update both the Scope of Services and Study Design documents so that they are consistent in their description of the model development process.

11. Evaluate all available speed data for possible use in calibration and validation

The panelists originally suggested that global positioning system data be collected as part of the windshield survey to perform travel time runs for use in calculating more accurate travel times in the model. Further discussions revealed that it was not possible to gather true speed data as part of the existing windshield survey because surveyors do not operate at normal speed, stop frequently to record data, and do not operate at all times of day. The Memphis MPO was willing to collect additional travel time and speed data if needed for model calibration and validation.

Resulting Action Items

- Carefully evaluate existing speed data, which might be useful for skims and volume delay functions
- Perform additional travel time runs. This is included in the consultants' current scope of work

12. Review the model development process to identify items that can be moved forward in the schedule.

Since the overall model development schedule is very tight, the panel recommended that methods for getting a head start on the trip assignment model would be extremely beneficial. The panel suggested building a prototype model that would help identify potential problems and serve as a validation check to ensure there are no fatal flaws in the model structure.

Resulting Action Items

- Investigate the possibility of accelerating parts of the current schedule in case the transit onboard survey is delayed in order to avoid overall schedule delays.
- Possibly:
    - Temporarily cut and paste another mode split model to siphon off number of transit trips to get initial highway test assignments performed quickly.
    - Perform some dry runs and sensitivity analyses as preliminary checks.

13. Examine the average trip rates by trip purpose. Also, trip purposes to be used in each step of the modeling process need to be clarified.

The panel suggested that the entire set of trip purposes be analyzed at each step to determine if it is possible to combine purposes at some steps. Where different steps need different trip purposes, this should be explained. In analyzing the trip purposes, the observed under-representation of trip purposes—the reason for which is not yet clear—should be addressed.

Resulting Action Item

- The consultants will make a decision on trip rates within the next few weeks, and will give the model development team an opportunity to review their findings.

14. Examine the household survey to determine if other trip rate variations need to be addressed (e.g. accessibility, environmental justice)

The panel recognized that accessibility (as a trip generation variable) is already off the table for the current contract, but noted that accessibility along with environmental justice issues may help reveal the reasons for some unexplained travel behavior. The panel recommended that accessibility and environmental justice issues be further explored in future model update efforts.

Resulting Action Item

- Investigate trip rate variations as part of the analysis of why Memphis area trip rates are lower than the national averages.

15. Articulate the policies and sensitivities that can and cannot be evaluated using the proposed travel demand model

The panel recommended that stakeholders clearly communicate to the consultants their expectations for the model. One panelist recommended producing a list of what will be delivered and what the model can and cannot do.

Resulting Action Items

- The consultants will revise the "wish list" of model capabilities to reflect the current scope of the work, what the model can and cannot do, what data will be available that could be extracted for analysis, and what functions the model could include in the future. The consultants will complete this activity by January 2005.
- The steering committee will present this information to the MPO Engineering Technical Committee for concurrence.

16. Prepare air quality modeling methodology

The panelists were unable to comment on the air quality determinations of the model because neither the MPO nor the consultants presented any information about air quality modeling.

Resulting Action Items

- The MPO and the consultants will clarify and confirm their mutual understanding of the travel demand model outputs required for air quality modeling.
- Clarify whether the model-calculated speeds need to be adjusted to the actual observed speeds.
- The modeling team will consult with local FHWA, FTA and EPA (Environmental Protection Agency) employees and with TDOT to determine the requirements for federal air quality modeling compliance.

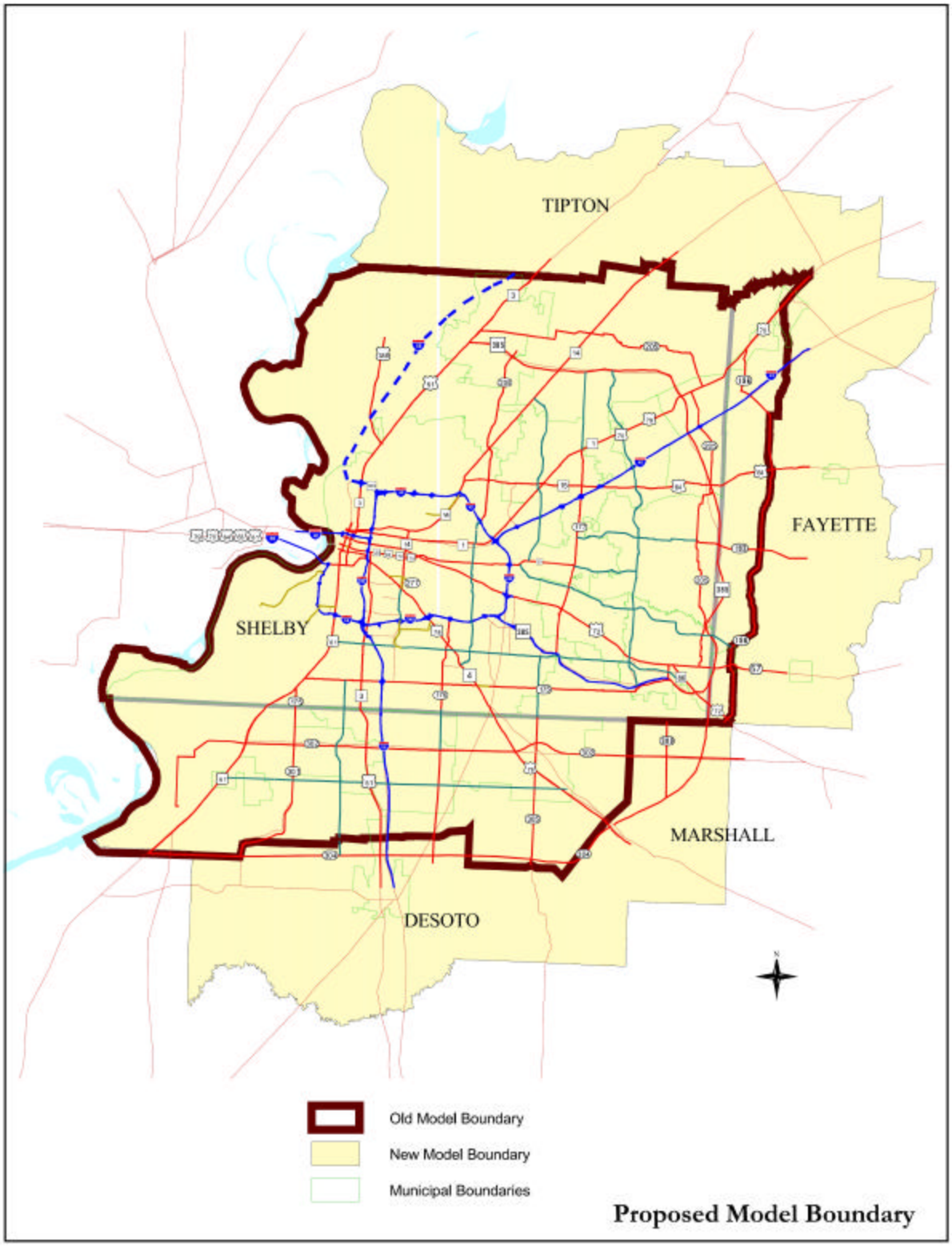
17. Make provisions to integrate the TIP and the RTP in the coding of the highway network layer

The panelists suggested including plan information in the highway network layer for future reference. One panelist warned that a future year condition analysis may become a huge part of the model development work and subsequent model applications work.

Resulting Action Items

- Ensure that the coding of the highway network layer includes provision for the TIP and RTP.
- Ensure that the model can be updated in parallel with TDOT's evaluation and update cycle of their TIP (evaluated every other year and updated every 3 years).

Appendix A. Proposed Model Boundary



Appendix B. Presentations and Handouts

Presentations and handouts are available as links on the TMIP website. They can be accessed at: http://tmip.fhwa.dot.gov/services/peer_review_program/status.stm

Reference #1: Travel Demand Modeling at NCTCOG (Ken Cervenka)
Reference #2: Atlanta Regional Commission Traffic Model (Guy Rousseau)
Reference #3: Elements of a Successful Travel Model Development Project (Ed Granzow)
Reference #4: Travel Forecasting for New Starts Projects (Eric Pihl)

Appendix C. List of Participants

Names	Affiliation	Role
Ed Bromage	Cambridge Systematics	Consultant
Eugene (Gene) Bryan	Memphis MPO	Memphis Model Steering Committee Member
Ken Cervenka	North Central Texas Council of Governments (NCTCOG)	Peer review panel chair
James Collins	Kimley-Horn & Associates, Inc. (KHA)	Consultant
Carroll Collins	Kimley-Horn & Associates, Inc. (KHA)	Consultant
Mark Dunzo	Kimley-Horn & Associates, Inc. (KHA)	Consultant
Tom Fox	Memphis Area Transit Authority (MATA)	Memphis Model Steering Committee Member
Ed Granzow	CH2M Hill	Peer review panelist
Theresa Hutchins	Federal Highway Administration (FHWA), TN Division	FHWA field office representative
Karen Jarrett	Lakeland City	Stakeholder
Shohan Koneru	Memphis MPO	Stakeholder
John Lancaster	Memphis Area Transit Authority (MATA)	Stakeholder
Ging Ging Liu	U.S. DOT Volpe Center	
Rick McClanahan	City of Bartlett	Stakeholder
Jim McDougal	Desoto County	Memphis Model Steering Committee Member
Richard Merrill	Memphis MPO	
Kenneth Monroe	Kimley-Horn & Associates, Inc. (KHA)	Consultant
Paul Morris	Memphis MPO	
Pete Motolenich	Shelby County	Memphis Model Steering Committee Member
Clark Odor	City of Memphis	Memphis Model Steering Committee Member
Wayne Parrish	Mississippi Department of Transportation (MDOT)	Memphis Model Steering Committee Member
Melody Princess	Memphis MPO	
Bob Rock	Tennessee Department of Transportation (TDOT)	Memphis Model Steering Committee Member
Tom Rossi	Cambridge Systematics	Consultant
Guy Rousseau	Atlanta Regional Commission (ARC)	Peer review panelist
Howard Slavin	Caliper Corporation	Peer review panelist
Steven Sondheim	Friends of Shelby Farms	Stakeholder

Names	Affiliation	Role
Michelle Stuart	Memphis MPO	
Sarah Sun	Memphis MPO	Memphis Model Steering Committee Member
Katherine Turner	Memphis MPO	
Scott Young	Desoto County	Stakeholder
Valerie Champman	City of Millington	Stakeholder
Marty Lipinski	University of Memphis	Stakeholder
Jane Dembner	HNTB	Consultant
Craig Gresham	Kimley-Horn & Associates, Inc. (KHA)	Consultant
Tommy Hammer	HNTB	Consultant

Appendix D. Agenda

Memphis MPO Travel Demand Model Development

Peer Review Meeting
October 27-28, 2004

Objective of the Meeting: To discuss how to best achieve what has been laid out in the Memphis MPO Travel Demand Model Study Design – issues, obstacles and solutions.

	Time	Item
Wednesday	8:00 a.m.	Welcome and introductions *(Eugene Bryan, Memphis MPO)*
	8:30 a.m.	Schedule for the model and overall planning process – MPO *(Sarah Sun and Eugene Bryan)*
	8:45 a.m.	Stakeholder presentations
	9:30 a.m.	Overview of the peer review process and panel presentations (*Ken Cervenka, Guy Rousseau, Ed Granzow and Howard Slavin)*
	9:45 a.m.	Presentation of the model plan – KHA team
	12:00 p.m.	Lunch - to be provided
	1:00 p.m.	Presentation of the model plan - KHA team (continued)
	2:00 p.m.	Questions and answers
	5:00 p.m.	Adjourn
Thursday	8:00 a.m.	Committee deliberation (panel members only)
	10:30 a.m.	Panel presentation of findings and recommendations – *(Ken Cervenka)*
	12:00 p.m.	Lunch – to be provided
	1:00 p.m.	Discussion of panel findings *(Everyone)*
	2:00 p.m.	Next steps *(Everyone)*
	3:30 p.m.	Adjourn