Summary Report of the Third Peer Review Panel for the Southern California Association of Governments Travel Model Improvement Effort

January 9-10, 2006
Los Angeles, California

Sponsored by the
Travel Model Improvement Program
Federal Highway Administration

Prepared by the Volpe National Transportation Systems Center
U.S. Department of Transportation

Travel Model Improvement Program
Summary Report of the Third Peer Review Panel
for the Southern California Association of Governments
Los Angeles, California

Date:	January 9-10, 2006
Peer Review Host Agency:	Southern California Association of Governments 818 W. 7th Street, 12th Floor, (213) 236-1800 www.scag.ca.gov
Contact:	Deng Bang Lee, SCAG, lee@scag.ca.gov
Peer Review Panelists:	Frank Spielberg (Chair), BMI-SG, a VHB Company Mark Bradley, Mark Bradley Research Corporation Chandra Bhat, University of Texas at Austin Erik Sabina, Denver Regional Council of Governments Chuck Purvis, Metropolitan Transportation Commission Bruce Spear, Federal Highway Administration Jim Ryan, Federal Transit Administration

TABLE OF CONTENTS

EXECUTIVE SUMMARY

The Southern California Association of Governments (SCAG), through the Federal Highway Administration's Travel Model Improvement Program, requested a peer review panel to assess its current travel demand model and its application, and to obtain comments on model components under development. The panel was asked to concentrate on updated model components, especially trip distribution, mode choice, and trip assignment. The panel was also asked to recommend near- and long-term model enhancements. This report summarizes the January 2006 two-day peer review meeting held in Los Angeles, which was the third of three peer reviews.

The panel felt that SCAG 's current four-step model is consistent with the state-of-the-practice. The panel especially liked the plan for the freight model, the use of the "strategic work trip" purpose in trip distribution, and the use of four time periods in traffic assignment. It also felt that SCAG has done particularly well in data collection efforts. It recommended that SCAG make its extensive survey datasets available to other transportation planning agencies. The panel felt that the planned speed study was a good next step.

The panel's general recommendation was for SCAG to focus on near-term validation of the model. The suggested that SCAG assess the commuter rail nesting structure in the mode choice model as part of the mode choice validation process. SCAG should test its vehicle availability model, which might be too sensitive to the density variable. It recommended that SCAG consider a destination choice configuration for trip distribution. Finally, the panel said SCAG should consider adding model components for high-occupancy toll lanes and peak spreading.

I. BACKGROUND

The Southern California Association of Governments (SCAG) is the metropolitan planning organization for six Southern California counties: Los Angeles, Orange, San Bernardino, Riverside, Ventura, and Imperial. The region's population exceeds 16 million people over an area of more than 38,000 square miles.

To support the federally required Regional Transportation Plan and the Regional Transportation Improvement Program, SCAG maintains a travel demand model that predicts the impact of travel growth and evaluates potential transportation improvements. The current SCAG model follows the traditional four-step modeling structure. Three ancillary models feed into network assignment:

- An external trip model
- A regional airport demand allocation model
- A heavy duty truck (HDT) model.

In 2002, SCAG initiated an effort to use new data to update and recalibrate its travel simulation model. In January of that year, the first peer review of SCAG's model was conducted. At this time, the panel felt that SCAG's model was at the leading edge of the state of the practice. The panel recommended changes including adding trip purposes, creating a vehicle availability model, and modifying the mode choice model. SCAG has implemented or begun implementing most of the recommendations. The second peer review was held in November 2003. Topics reviewed during this meeting included validation targets, revised vehicle availability model, trip generation, external trips, and the selection of variables for the mode choice model.[1] Also in November 2003, Cambridge Systematics was awarded a contract to improve the current travel demand model.

During the third meeting of the peer review panel, documented in this report, SCAG requested that the panelists examine its current model and concentrate on assessing the model updates, including trip distribution, mode choice, and trip assignment. It also requested that the panelists assess the agency's plans for model improvements.

II. PRESENTATIONS AND DISCUSSION[2]

A. SCAG: Regional Transportation Model

1. Model Improvements

The main goal of the travel model improvement project was to improve policy sensitivity to refined behavioral characteristics and demographic characteristics, including:

- Household income
- Household size

[1] The reports from the first and second peer reviews can be found at http://tmip.fhwa.dot.gov/services/peer_review_program/status.stm#status

[2] Much of the information presented in this section comes from "SCAG Travel Model Improvement Program Model Update Documentation" Cambridge Systematics, Inc. with Urban Analytics, Inc. July 2005.

- Vehicle availability

- Number of people employed
- Number of students

The second important goal of the project was to increase network simulation accuracy through:

- Refined highway and transit network characteristics
- Enhanced capacity restraint volume-delay functions
- Separate peak and off-peak highway networks
- Multi-class vehicle network assignment
- Highway network equilibrium convergence

a) Previous Model Improvements

During the 1990s, SCAG embarked on the first comprehensive overhaul of its travel simulation capabilities since the mid-1970s. This included several major data collection activities and the development of new modeling components. The improvements included:

- Reestimating the trip generation and auto ownership models
- Reestimating the mode choice model with emphasis on expanding submodel components (toll roads, Metrolink, commuter rail, etc.)
- Updating the external trip model
- Validating the model
- Documenting the modeling process

b) Short-Term Model Improvements - 2004, 2005

In 2004 and 2005, SCAG improved the following model components:

- Auto availability
- Trip generation
- External trips
- Mode choice
- Trip distribution

Additionally, the model's zone system was expanded to include a larger area and the modeling platform was converted from TRANPLAN to TransCAD. This included updating the network path building processes and trip assignment methods.

c) Medium-Term Model Improvements - 2006

Improvement planned for the medium term include:

- Conducting model validation and sensitivity analyses
- Introducing a PC modeling platform – TransCAD, although CUBE and VISUM are also supported
- Using geographic information systems (GIS)-based highway network representation
- Refining the HDT model
- Creating a maglev alternatives analysis model
- Enhancing the overall modeling process, including measures, subarea analysis, and sketch planning

d) Long-term Model Improvements - 2008 and beyond

Proposed long-term model improvements include:

- Incorporating the San Diego Association of Governments region at a superzone level
- Integrating the transportation and land use models
- Conducting demand microsimulation for an activity-based model
- Introducing web-based modeling capability and network microsimulation for traffic modeling

2. Model Estimation Data

The SCAG model uses input from the following data sets:

- 1991 regional household travel survey
- Year 2000 post census regional travel survey
- Transit on-board origin-destination (O-D) surveys
- Regional cordon survey
- Street and highway inventory survey
- Arterial speed study
- Regional airport demand allocation model
- Regional screenline study
- Los Angeles Department of Transportation street inventory survey
- Trucking firm O-D survey
- Parking cost model
- High-speed rail stated preference survey with the Los Angeles County Metropolitan Transportation Authority

3. Arterial Speed Study

a) Research Objectives

- To determine the speed-flow curves (volume-delay functions) for predicting speeds on signalized arterial streets
- To develop a cost-efficient method for gathering speed data that can be used for model validation and possibly congestion monitoring for the various levels of arterials
- To determine the number of samples necessary to validate output speeds
- To conduct a pilot survey to demonstrate the practicality of the methodology and to begin building a regional speed database
- To develop a program that will continually gather speed measurements to update the regional arterial speed database and monitor speed changes over time

b) Data

Data were collected at eight sites in the city of Los Angeles. These included principal and minor arterials with 15-55K average daily traffic, 4-6 lanes, and 10-12 signals per mile. There are 54 directional segments between signals and four hours of observation for each direction. Two hundred sixteen hourly volume and speed observations were recorded for a volume-to-capacity range of 0.1-0.99 and a speed range 4-41 mph. Volume counts were recorded for signalized intersections at 15 minute intervals. Speed counts were recorded for global positioning system

(GPS)-equipped floating cars at three to ten samples per hour.

4. Model Validation

A full-scale model validation is being conducted to check the accuracy of the model inputs and outputs, and to determine the model's sensitivity to specific variables. Additionally, some validation tests were completed in 2004 and 2005.

a) Accuracy Check for Model Inputs

The accuracy check for the model will include validation of the following socioeconomic and parameter data:

- Population
- Employment
- Housing units
- Market segmentation (household income)
- Auto operating cost

The accuracy of the highway network will be validated by a review conducted by each county transportation commission. This will include the following activities:

- The number of lanes and access connections will be collected.
- Roadway gradients will be appended to the network.
- A review of the free flow speed and capacity will be conducted.
- Truck passenger car equivalents (PCE) will be reviewed.
- More screenlines will be added.
- Buses will be loaded on the highway network, which will lead to better highway assignments.

The accuracy of the transit network will be validated by the following:

- Transit fares and boardings will be compared by mode to data from transit agencies.
- Model estimation data will be compared to the TranStar transit itinerary database.
- Actual transit travel times will be checked against network-estimated travel times.

b) Accuracy Check for Model Outputs

The accuracy of the outputs for each model will be validated as follows:

i. Trip Generation

The percentage of trips for each trip type and vehicle availability will be checked against the O-D survey

ii. Trip Distribution

Trip length frequency distributions by purpose will be compared to the distribution by market segment. The percentage flows of work trips—strategic[3] plus direct—by county, regional statistical area, and community statistical area will be reviewed against the Census Transportation Planning Package (CTPP) data and O-D survey.

[3] A "strategic" work trip contains an intermediate stop between the origin and destination.

iii. Mode Choice

Trip end (production and attraction) percentage by mode will be compared against the O-D survey. Trip end percentage by mode by RSA will be compared against the O-D survey and CTPP. Sensitivity of mode split to changes in time and cost will be evaluated against expected ranges.

iv. Highway Assignment

Vehicle miles traveled (VMT) will be compared with the highway performance monitoring system database by air basin and county. Assigned volumes will be compared against the downtown cordon count report. Absolute and percent speed differences will be compared for the performance measurement system and the automated traffic surveillance and control database. Absolute and percentage volume differences by assignment group and mode will be compared against the screenlines. Modeled and count volumes will be compared based on:

- Absolute, average, and percent error
- Standard deviation
- R-squared
- Root mean square.

The comparison will use:

- Screenlines
- Volume groups
- Facility type
- RSA

v. Transit Assignment

Transit boarding counts by company and mode for the model output will be compared with actual bus ridership by company and with individual urban and commuter rail line ridership. Boarding counts will also be compared against the downtown cordon count report.

c) Sensitivity Analysis

The proposed sensitivity analysis for the model will include the following steps:

- Reviewing the base year emissions inventory
- Using new and old socioeconomic data as inputs to evaluate the changes in emissions due to the solvent emissions directive change
- Using the new and old networks to evaluate the changes in emissions due to network changes
- Using the new and old models to evaluate the changes in emissions due to model changes
- Running the existing model using TRANPLAN and TransCAD to evaluate the changes in emissions due to software changes
- Running the new model using the old zones to evaluate the impacts of zone changes
- Running 2010 baseline and evaluating the sensitivity of the full model stream

B. Overview of the SCAG Regional Modeling Process- Cambridge Systematics

This part of the presentation focused on the following elements of the SCAG regional model:

- Trip generation:
  - Vehicle availability
  - Household classification
  - Trip production and attraction
- Trip distribution:
  - Trip purposes
  - Home-based work strategic intermediate stops
- Mode choice
- External trips

The trip generation, vehicle availability, household classification, trip distribution, and mode choice components were recently updated. The first three were reviewed in a previous peer review; the current peer review focused on trip distribution and mode choice. Although validation and sensitivity testing of all model components was discussed during the presentation, the panel concentrated on the validation and sensitivity testing of mode choice.

1. Model Components Previously Reviewed

a) Vehicle Availability Model

A key descriptive characteristic of the SCAG model is the number of vehicles either available to or owned by households in the region. Household vehicle availability—the total number of motor vehicles available for use by household members—is more closely related to the level of household mobility than the more limited household vehicle ownership measure. The three discrete choice model structures tested were a multinomial logit model, a nested logit model, and an ordered response logit model. The multinomial logit and nested logit models produced good results, but the ordered response logit model could not be estimated because of the structure of the SCAG dataset. After model estimation, it was recommended that SCAG use the multinomial logit model structure.

The primary data source for the model is the 2001 SCAG household travel survey. The independent variables are:

- Persons per household
- Workers per household
- Household income
- Age of head of household: 16-64, and over 65
- Accessibility to highway and transit

The independent variables that were tested but not included in the model are accessibility and ethnicity.

The results from the model estimation suggest the following trends for each variable:

- *Income:* Vehicle availability increases with income.
- *Workers in household:* It is unlikely that the household will have more vehicles than workers.
- *Persons in household:* The more persons in a household, the more vehicles the household likely has available.
- *Age of head of household:* Households with a head aged 16-64 are more likely to have two to three vehicles available than households headed by an individual 65 or older.
- *Job accessibility:* Households with a worker whose place of employment is within 30 minutes by transit or six miles by highway tend to have fewer vehicles available.

b) Household Classification

The household classification model generates the percentage distribution of households for each trip purpose. To do this, it uses the Census Public Use Microdata Samples (PUMS) joint distribution of households to stratify the marginal distributions provided by SCAG. It estimates the following joint distributions of households:

- Workers per household (4)[4] by age of head of household (4) by household size (4)
- Persons per household age 18-24 (3) by income group (4)
- Persons per household age 5-17 (4)
- Persons per household (4) by income group (4) by vehicle availability (4)
- Workers per household (4) by income group (4) by household size (4)

c) Trip Generation

The SCAG model has ten trip purposes:

- Home-based work– direct
- Home-based work– strategic
- Home-based school
- Home-based university
- Home-based shopping
- Home-based social recreational
- Home-based other
- Home-based serve passenger
- Work-based other
- Other-based other

These match the original nine trip purposes in the previous SCAG model, with home-based serve passenger added based on a recommendation from the second peer review panel.

Three income groups were used for home-based work trips. These were split into home-based work-direct, and home-based work-strategic. Home-based work-strategic represents all "journey to work" tours that have one or more intermediate stops, regardless of duration.

SCAG conducted a GPS survey from a sub-sample of households along with the household travel survey. Based on the GPS information, trip generation by trip purpose was adjusted based on age, income, and trip duration. This resulted in a 17.7 percent overall increase in the number of trips.

[4] The numbers in parentheses indicate the number of categories in each variable.

d) Trip Production

The trip production model for SCAG was developed using cross-classification. The following independent variables were used for the various trip purposes:

- Number of persons in household
- Number of employed persons in household
- Household income
- Number of vehicles available to household members
- Persons in household in age group applicable to a specific trip purpose
- Age of the head of household

e) Trip Attraction

The trip attraction model was estimated by merging socioeconomic data with the SCAG household travel survey data by zone and then estimating linear regression models by trip purpose. Trip attractions were estimated at the zone, superzone, and regional statistical area level to understand the potential error or instability in the coefficients. The following independent variables were available at the zone level:

- Households
- Employment classified by low, medium, and high income
- Retail employment
- Finance, insurance, and real estate employment
- Education and health employment
- Arts and entertainment employment
- Other services employment
- K-12 school enrollment
- University enrollment

f) External Trips

As part of the ongoing model improvement project, external trip models were developed and integrated into the SCAG model system. In the trip generation step, final trip generation rates include all trips (including internal-external and external-external). External trips made by residents—estimated from the external survey by trip purpose—are subtracted from the trip generation results. Zones near the border have more trips subtracted than other zones to reflect that fact that trips in these zones are more likely to have an external end than trips that originate elsewhere in the region. External trips are subtracted from the productions and attractions so that, when the remaining internal trips are distributed, there are fewer internal-internal productions and attractions at border zones than other zones.

After time-of-day models are processed (post-mode choice), all external trips are added back as vehicle trips, since trip purpose is not used in highway assignment. These are separated by external-internal, internal-external and external-external trip types and by vehicle occupancy groups (1, 2, and 3+ occupants). The current trip production and attraction models were updated to reflect the external trips, which account for 0.02 trips per household based on the SCAG household travel survey.

2. Models Components to be Reviewed

a) Trip Distribution

Trip distribution uses a gravity model. The model is applied for peak and off-peak conditions for each trip purpose and by income group for work trips. It was developed using the 2001 SCAG household travel survey. New friction factors were calibrated to validate observed trip length frequency distributions, district-to-district flows, and percent of intra-zonal trips. Trip distribution is applied to the same ten trip purposes used in trip generation for both peak and off-peak conditions. As a model enhancement, the gamma function was adjusted for the trip duration distribution by trip purpose. Also, the logsum from mode choice was used in home-based work-direct trips.

b) Intermediate Stops

An intermediate-stop model is used to allocate home-based work-strategic trips to intermediate stops after mode choice. The intermediate stop model is a two-step process. It first estimates the distance from the home to the intermediate stop, and then estimates the location of the intermediate stop. The estimations are made using the SCAG household travel survey.

The distance to the intermediate stop is a log-linear distance decay function between the number of home-based work-strategic trips and the distance between home and the first intermediate stop. It is calculated using the formula:

$$\ln(\text{trips}) = 6.009 - 0.026 \times \text{distance}$$

The location of intermediate stops is calculated by using the formula:

$$\begin{aligned}\text{Trips attracted at stop} = {} & 0.375 \times \text{retail employees} + 0.120 \times (\text{education/health employees}) + \\ & 4.651 \times (\text{other service employees}) + 0.281 \times (\text{school enrollment}) - \\ & 0.388 \times (\text{professional/management employees}) + 0.232 \times (\text{public administration employees})\end{aligned}$$

c) Mode Choice

The mode choice model was originally estimated using the 1991 regional household travel survey for the home-based work, home-based school, home-based university, other-based other, home-based other, and work-based other. The first three trip purposes are nested logit models. The remaining two are multinomial logit models. The models each include the choice of motorized versus non-motorized modes. The auto mode is stratified by occupancy, and transit is stratified by mode of access (walk versus auto) and type of service (local versus express).

For the mode choice model, the six travel surveys were combined into a single estimation dataset. The weighted exogenous sampling maximum likelihood was used for estimation by mode and county. The following modes were included:

- Drive alone
- Shared ride 2
- Shared ride 3+
- Bike
- Walk

- Local bus (walk and drive access)
- Express bus (walk and drive access)
- Urban rail (walk and drive access)
- Commuter rail (walk and drive access and egress)
- High-speed rail (walk and drive access) for future year models

The model includes the following variables:

- In-vehicle travel time for auto, transit, walk and bike
- High occupancy vehicle (HOV) time saved
- Distance
- Highway terminal times
- Transit times
- Walk access and egress and transfer walk time
- Initial wait time (fewer than seven minutes, or seven minutes and greater)
- Transfer wait times
- Transit auto access and egress time
- Parking costs, transit fares, and auto operating costs per household income group
- Central business district type flag (attraction zone)
- Number of autos per person
- Peak period flag

For mode choice model validation:

- The mode choice module was estimated and validated. For validation, the estimated model parameters were examined for reasonableness. This included ensuring that they have the correct signs and relationships to one another (such as the value of time and the ratio of out-of-vehicle time coefficients to the in-vehicle time coefficient). Since most of the variables were constrained to expected ranges, the validation ensured consistency.
- Aggregate validation of the mode choice model was performed. The mode shares from the model were compared with the observed mode shares. A calibration matrix was developed for each trip purpose. This matrix is a cross-classification of mode shares (or trips) by the transit submode and access mode combinations (i.e., the alternatives in the mode choice model) and any market segments for which data were available.
- Sensitivity testing of the model was conducted at the aggregate level by comparing its aggregate elasticities against compilations of observed and estimated elasticities from other sources. The elasticities were within expected ranges. The elasticity with respect to parking cost is low, since the parking cost is zero for most trips.

C. SCAG Network Model Development – Caliper Corporation

The trip assignment model was updated by the Caliper Corporation. Updated model components include:

- Updated highway and transit network
- Path parameters and checking
- Volume delay functions
- Highway and transit trip assignment

- Feedback and equilibration process
- Post-processing and reporting

1. Updated, Geographically Accurate Networks

The updated highway network is derived from the SCAG 2000 base year and 2003 networks. Caliper realigned the networks to match high-resolution aerial photos. All the TRANPLAN attributes were preserved and new network attributes were developed. The network has approximately 72,000 line segments. New network attributes added include parking restrictions, grade percentages, and median presence. The link topology was standardized (north or east-based) during the update. SCAG staff is currently refining the network, providing quality control and adding screenline counts.

TranStar, the region's automated transit trip planning service, provides the routes, stops, and schedules for the entire region's transit. The transit routes lie on top of realigned road network. Headways and transit times were developed from the schedule data. The bus transit times are a function of congested highway speeds.

2. Highway and Transit Skims

Skims were developed from the new highway and transit networks. The congested highway and transit times were estimated from preliminary assignments carried out in two phases. Phase 1 was the initial user equilibrium highway assignment using the SCAG base model O-D matrix that was converted from 3000+ zone base model to 4000+ zones. In Phase 2, the user equilibrium highway assignment using 4000+ zone O-D matrix was developed from Cambridge Systematics' new trip generation, trip distribution, and mode split models.

In the highway skimming process, the travel costs are based on the congested peak and off-peak travel times in addition to the auto operating cost of 15.08 cents per mile. The free-flow speeds are based on functional class-area type tables with exceptions for certain classes and lane capacities. The congested costs are based on results from morning and mid-day highway assignment. SCAG conducted spot-checking of selected O-D pairs, which indicated reasonable congested travel times and paths.

Transit skims were developed using TransCAD's Pathfinder method. Most of the path parameters were inherited from earlier TRANPLAN models. Parking costs and an initial wait time function were added. The skims were provided to Cambridge Systematics for their final trip distribution and mode split model estimation.

A limited spot-checking by SCAG staff revealed some path anomalies, which were addressed by correcting data errors. SCAG plans to perform additional checking. Some Metrolink path problems still exist due to long initial wait times and higher fare costs

3. Highway Volume Delay Functions

The Akcelik[5] delay function was used for the arterial and freeway links. The delay parameters for each were estimated separately. Akcelik uses link length as an input parameter, so it is essential to ensure correct topology. For the centroid connectors, the unconstrained function was used.

4. Highway and Transit Trip Assignment

The highway assignment is based on multi-class user equilibrium for the following user classes:

- Drive alone
- HOV-2
- HOV-3
- Light trucks
- Medium trucks
- Heavy trucks

The Phase 1 assignments generally matched overall TRANPLAN results for VMT, vehicle hours traveled, delay, VMT by air basin, and volatile organic compounds by functional classification. The Phase 2 assignments are currently being evaluated. Screenlines and screenline counts are being coded by SCAG staff. The assignment aims to match daily and peak period counts.

Transit assignment is a production-attraction matrix on the peak and off-peak networks. The goal is to perform four-period assignments with correct park-and-ride accounting. The assignments will be compared with recently collected boarding count data.

5. Feedback and Equilibrium

Travel times were based on direct feedback of congested highway assignment results. The model uses the multiple successive average feedback technique. The number of feedback iterations will be determined as part of further calibration.

6. Reporting and Post-processing

Reporting and post-processing macros need to be developed to replicate standard SCAG reports after the model run. Links to the TransCAD SUMMIT procedure and air quality models also need to be developed.

D. Heavy Duty Truck Model Update – Cambridge Systematics

Cambridge Systematics presented an update of the HDT model. The topics covered during the presentation included:

- Overview of the existing HDT model
- Review of the internal model
- Review of the external model

[5]See "Urban Arterial speed-Flow Equations For Travel Demand Models" Michael Dowling and Alexander Skabardonis, presented at the Innovations in Travel Modeling Conference 2006, sponsored by the Transportation Research Board, Austin, TX, May 21-23, 2006. http://trb.org/Conferences/TDM/papers/BS2C%20-%20Urban%20Arterial%20Speed-Flow.pdf

- Review of the special generator models
- Improvements for trip assignment

1. Overview of the Existing HDT Model

The existing HDT model has three truck weight classes corresponding to trip purposes. The model has three main components for trip generation and distribution:

- *Internal model* – Trip rates are developed for each of the three weight classes by land use and gravity model.
- *External model* – Commodity flows by counties are converted to truck trips and then disaggregated to TAZs.
- *Special generator models* – The special generators included in the current model are ports and air cargo.

i. Conclusions from the review of the existing model

- The shipper and receiver surveys and trip diaries, used to develop trip rates, are not applicable for service, construction, wholesale, and retail trucks.
- The data was limited for trip length frequency distributions collected at the time the model was built.
- Warehouse and distribution sector activity is under-represented in the external model.
- Insufficient survey data exists at external cordons.
- The spreadsheets are linked for converting commodity flows to trip tables in the external model. This process needs improvement.
- Port trucks are under-represented and rail intermodal terminals have been excluded.
- The approach to the passenger car equivalent (PCE) factor application is not feasible.

ii. Recommendations for the internal model

- Trip rates for warehouse and distribution trips, local pickup and delivery trips, and service trips should be revised.
- A robust database on trip length frequency distributions and gravity model by gross vehicle weight should be incorporated.

iii. Recommendations for the special generator model and assignments

- The port special generator model should be updated.
- Trip tables for rail intermodal terminals should be developed.
- The time-of-day factoring should be revised.
- PCE factors and volume-delay functions should be updated.

2. Review of the Internal Model[6]

A review of the internal model highlighted the following areas for improvement.

- The data for estimating trip generation and distribution need to be improved.
- The introduction of new trip purposes for the trip generation and distribution models should be considered.
- Conversion to a new zone system should be done.

SCAG plans to conduct a HDT travel survey for use in updating the HDT model. The following new trips types should be added:

- *Manufacturing trips* -No new data collection is required to obtain these trips.
- *Warehouse and distribution centers* – These trips can be obtained from the TRANSEARCH precursor data, new interviews, and MTA TLN survey results.
- *Urban pickup and delivery trips* can be obtained using the trip diaries.
- *Service trip* can be obtained using the trip diaries.

The sampling frame is Department of Motor Vehicles registration data. The stratification of data will be conducted through weight class and business type (owner). The implementation of the survey will include:

- Recruiting by phone
- Phone and mail-back retrieval
- Incentives – Fleet coordinator and driver
- Use of GPS is being considered for verification of the data.

3. Review of the External Model

A review of the external model highlighted the following areas for further improvement.

- Warehouse flow representation.
- Updated data sources
- Code procedures in TransCAD

4. Review of the Special Generator Models

- Trip generation should be based on the port QuickTrip model and current cargo forecasts.
- The fixed O-D matrix from summer gate surveys should be used for the trip distribution model.
- For rail intermodal, trip tables should be based on carrier and shipper surveys conducted for LA Metro Cube Cargo model.

5. Improvements for Trip Assignment

The improvements required for trip assignment include simplifying the PCE factors, adjusting the time-of-day factors based on new survey results, and modifying the volume-delay functions.

[6]Much of this section is taken from "SCAG HDT Model Update Status Report" by Michael Fischer, Cambridge Systematics, presented to the Modeling Task Force, September 2005.

III. PEER REVIEW PANEL RECOMMENDATIONS

The peer review panel was asked to assess the current model and outline the strengths and weaknesses of the model and its application to transportation planning, concentrating on the updated model components including trip distribution, mode choice, and trip assignment.

The panel felt that SCAG has developed a "state-of-the-practice" four-step model. The panel highlighted several strengths, including the freight model, the strategic work trips, and the use of four time periods in assignment. The panel felt that SCAG has done a particularly good job in data collection, and that the planned speed study was a good next step. The following are specific recommendations on other model components.

Recommendation 1. Vehicle Availability Model
SCAG needs to do additional work to test the sensitivity of the vehicle availability model. The model may be too sensitive to the density variable. If necessary, it should be reestimated.

Recommendation 2. Mode Choice Model
The panel was concerned with the location of commuter rail in the nesting structure of the mode choice model. It recommended that SCAG reconsider this in combination with reestimation of the mode choice model. One panelist suggested that the use of auto access to transit might work as part of the mode choice nested structure. Two other panelists recommended exploring market segmentation, carried through further in the strategic trip patterns, and looking at the PUMS and CTPP datasets to examine commute time by income.

The panel recognized that SCAG has invested substantial resources in data collection and development of the mode choice model. However, the effort did not yield the mode choice form and structure that was expected. SCAG should consider reestimating the model using different structures. The mode choice model should be run for the year 2030 to ascertain if changes are reasonable.

Recommendation 3. Trip Distribution Model
The panelists were concerned that the gravity model is inadequate. As part of the long-term model improvement efforts, SCAG should consider developing and sensitivity-testing a destination choice formulation. The results should be compared against the current gravity model to determine which of the techniques should be used in the future.

Recommendation 4. Other Possible Model Improvements
The panel identified other opportunities for model improvement:

- Developing a methodology for including HOT lanes.
- Considering the incorporation of peak spreading and determining how the model behaves for trips of various lengths.
- Consider destination-choice for trip distribution.

Recommendation 5. Validation
The panelists felt that SCAG should plan to devote significant resources to validation of the overall model. SCAG should plan to spend a year on this effort, which should be based on a

carefully developed model validation scope of work and a plan for testing. The panel suggested that the scope address the following questions:

- Does the model correctly represent existing trip patterns?
- Does each of the components result in reasonable representations of travel behavior?
- Does the model set produce reasonable deltas, i.e., produce changes that occur when new projects are introduced?

Recommendation 6. Assigning On-board Survey Data

A good check of the transit network and impedances is assignment of a trip table developed from the on-board survey data.

Recommendation 7. Model Run Time

SCAG staff noted that a constraint in carrying out the validation process is that the agency plans to use the models within six months for the RTP. The panel suggested that SCAG carry out validation as thoroughly and as promptly as possible. Therefore, the model run time needs to be reduced. SCAG should to install hardware that is fast enough to permit efficient use of the models.

Recommendation 8. Survey Data Sharing

SCAG has an impressive set of survey datasets. The panel felt that SCAG should make these survey datasets available to other agencies.

Appendix A. SCAG Travel Model Improvement Plan Peer Review Agenda

DATE: Monday, January 9, 2006
TIME: 8:30 a.m. to 4:30 p.m.
PLACE: 818 W. 7th Street, 12th Floor, Los Angeles, CA 90017 (213) 236-1800

8:30 Continental Breakfast
9:00 Introductions
9:10 Welcome – Mark Pisano
9:15 Project Overview and Objectives – Keith Killough
9:30 Regional Model Improvement Project – Cambridge Systematics, Inc.
9:45 Review of Trip Generation Model – Cambridge Systematics, Inc.
- Vehicle Availability
- External Model

10:15 Break
10:30 Trip Distribution Model – Cambridge Systematics, Inc.
11:30 Model Choice Model – Cambridge Systematics, Inc.
- Estimation & Calibration
- Validation & Sensitivity Testing

12:00 Lunch
1:00 Model Choice Model – Cambridge Systematics, Inc. …Continued
2:00 Highway & Transit Assignment Model – SCAG & Caliper
- Network Development
- Path Parameters and Checking
- Volume Delay Functions
- Assignment

3:00 Break
3:15 Model Structure & Implementation – Caliper
- Feedback & Equilibration Process
- Application Option: Summit & Planning

4:00 Full Model Validation – SCAG
4:15 Current & Near Future Model Improvements – SCAG
4:30 Thank you – Day One Adjournment

DATE: Tuesday, January 10, 2006
TIME: 9:00 a.m. to 12:00 p.m.
PLACE: 818 W. 7th Street, 12th Floor, Los Angeles, CA 90017, (213) 236-1800

8:30 Continental Breakfast
9:00 Panel Deliberations
11:00 Panel Presentation of Findings and Recommendations
11:30 Discussion with SCAG Management
12:00 Thank you – Meeting Adjournment

Appendix B. List of Attendees

Name	Company Name	Telephone No.	Email Address
Dale Iwai	SCAG	213-236-1894	iwai@scag.ca.gov
Srini Bhat	SCAG	213-236-1863	bhat@scag.ca.gov
Mony Patel	LADOT	213-972-8484	mpatel@dot.lacity.org
Steve Smith	San Bernardino Associated Governments	909-884-8276	ssmith@sanbag.ca.gov
Teresa Wang	SCAG	213-236-1842	wang@scag.ca.gov
Guoxiong Huang	SCAG	951-784-1513	huang@scag.ca.gov
Mike Ainsworth	SCAG	951-784-1513	ainswort@scag.ca.gov
Steve Pickrell	Cambridge Systematics	510-873-8700	spickrell@camsys.com
Firooz Hamedani	Caltrans District 12	949-724-2230	firooz.hamedani@dot.ca.gov
Anup Kulkarni	Orange County Transportation Authority	714-560-5867	akulkarni@octa.net
Keith Killough	SCAG	213-236-1810	killough@scag.ca.gov
Shruti Mahajan	Volpe Center	617-494-3126	shruti.mahajan@volpe.dot.gov
Chandra Bhat	University of Texas at Austin	512-336-1072	bhat@mail.utexas.edu
Erik Sabina	Denver Regional COG	303-480-6789	esabina@drcog.org
Tony Van Haagen	Caltrans	213-897-1342	tvanhaag@dot.ca.gov
Jim Lam	Caliper	617-527-4700	jim@caliper.com
Howard Slavin	Caliper	617-527-4700	howard@caliper.com
Chaushie Chu	Metro	213-922-3059	chuc@metro.net
Jim Ryan	FTA	202-366-0954	james.ryan@fta.dot.gov
Chuck Purvis	Metropolitan Transportation Commission	510-817-5755	cpurvis@mtc.ca.gov
Bruce Spear	FHWA	202-366-8870	bruce.spear@fhwa.dot.gov
Frank Spielberg	BMI-SG a VHB Company	703-847-3071	fspielberg@vhb.com
Henning Eichler	Metrolink	213-452-0212	eichlerh@scrra.net
Deng Bang Lee	SCAG	213-236-1855	lee@scag.ca.gov
Paul Burke	SCAG	213-236-1938	burke@scag.ca.gov-
Mark Bradley	Mark Bradley Research Corporation	805-564-3908	mark_Bradley@cox.net
Michael Fischer	Cambridge Systematics	510-873-8700	mfischer@camsys.com
Maren Outwater	Cambridge Systematics	719-527-0755	moutwater@camsys.com