The Travel Model Improvement Program

Summary Report

Capital Area
Metropolitan Planning Organization
(CAMPO)

Travel Demand Model Peer Review

Austin, Texas
February 2010

Helping Agencies Improve Their Planning Analysis Techniques

TMIP
Travel Model Improvement Program

DISCLAIMER

The views expressed in this document do not represent the opinions of FHWA and do not constitute an endorsement, recommendation or specification by FHWA. The document is based solely on the discussions that took place during the peer review sessions and supporting technical documentation provided by the peer review host agency.

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Introduction

Report Purpose

A travel demand model peer review is conducted at the request of the agency hosting the peer review panel as a means of soliciting:

- External guidance on addressing identified issues
- Identification of possible model deficiencies
- Recommendations for potential model enhancements
- Experienced advice on model development and application

Moreover, as noted on the Travel Model Improvement Program (TMIP) website, "few individuals have had the opportunity to develop and apply more than one travel demand forecasting procedure. No individual can foresee all the issues that may arise in developing or applying a new model set. One approach to improving travel forecasting procedures has been the use of peer review panels. These panels, composed of individuals who have "hands-on" experience with both developing and applying travel forecasting models, assist local agency staff in both identifying possible problems and in developing workable solutions".

After a peer review panel meeting has been conducted, a summary report is prepared that documents the panel's findings, recommendations and suggested course of action. While this is the primary purpose of the report, a secondary purpose is equally valuable: to delineate the identified issues and workable solutions as a means of providing other modeling practitioners concepts and approaches to consider for incorporation into their own model set. Ideally it should offer new perspectives on standard assumptions regarding model development.

Report Structure

To facilitate assessing whether any noted recommendation is worth implementing, the peer review summary report does not extensively document the reviewed model's current structure. Instead, a brief summary of each model component is offered to place the topic of discussion in context. For the model currently under review, at the time this peer review was conducted the base year model calibration and validation effort had not been completed. The intent however, of the peer review was not focused on identifying and addressing model deficiencies, but rather looking forward and identifying model enhancements for the next model update given the current model structure. Consequently, most of the discussion for each given topic will focus on summarizing the current model approach and the perceived issue as a means of providing context for the panel's recommended approach or solution, as follows:

- Model Component
  - Overview of Existing Model Structure
  - Issue
  - Panel Recommendation

For the reader that desires a more comprehensive review of the existing model, Appendix A, CAMPO Model Documentation, lists relevant references that can be acquired.

Peer Review Panel Meeting and Recommendations

This report, Summary Report Capital Area *Metropolitan Planning Organization Travel Demand Model Peer Review,* documents the travel demand model peer review panel meeting held at the Capital Area Metropolitan Planning Organization (CAMPO) office in Austin, Texas, on June 11th and 12th of 2009. The one and one half-day peer review panel meeting was held as part of TMIP, sponsored by the Federal Highway Administration (FHWA).

The peer review panel consisted of six travel demand modeling experts (ref. Appendix B, List of Peer Review Panel Participants, for list of panel members and meeting participants).

Appendix C, Peer Review Panel Meeting Agenda, provides the meeting agenda. The meeting began with CAMPO staff providing an overview of the technical questions and issues that they wanted to discuss and which formed the basis of the peer review panel meeting. This was followed by staff presentations on the existing model structure and recent model improvements. Peer review panel discussion was based on questions and answers occurring throughout staff presentations, as well as model documentation provided prior to the meeting and the pre-defined set of questions provided at the inception of the meeting.

Apart from a brief model overview, the majority of this report summarizes the findings and recommendations of the peer review panel. Prior to discussing the identified issues and recommendations it should be noted that the peer review panel was appreciative and complimentary of the effort involved in developing and calibrating the CAMPO travel demand model. Panel members commended CAMPO staff for accomplishing particularly good results with limited staff resources. In addition, the panel noted that CAMPO staff is achieving consistent state-of-the-practice results which is a testimony to what can be accomplished with limited staff.

Structuring the peer review panel report to primarily focus on issues and recommendations may leave one with an impression that the model was not entirely sound; that is not the case nor is it the intent of this report. Rather, it is assumed that the typical reader is more interested in identified issues and model nuances that required thoughtful consideration and that more can be learned from discussing aspects of a model with potential for enhancement as opposed to reviewing existing model structure and what works. To that end, CAMPO staff have been gracious enough to openly share their current issues. Following the model overview, the remainder of the report documents the identified issues and peer review panel recommendations.

Model Overview

This section of the report offers a brief overview of the CAMPO model components to provide some context for the discussion comprising the remainder of the report.

Data

Household Travel Survey
A household travel survey comprised of 1,500 randomly selected households was conducted in 2006 to support model calibration efforts.

Workplace Travel Survey
During 2005 and 2006 a workplace survey collected information from 1,690 establishments.

Commercial Vehicle Survey
A commercial vehicle survey comprised of 342 commercial vehicles was conducted in the spring and fall of 2006.

External Travel Survey
In 2005 an external travel survey was conducted for 22 of the 42 external stations. In addition, 24-hour vehicle classification counts were collected at each external station on the survey day.

On-board Transit Survey
An on-board transit survey was conducted in 2005 to support the calibration of the mode choice model.

Traffic Counts
3,586 twenty-four hour traffic counts were collected to support model validation.

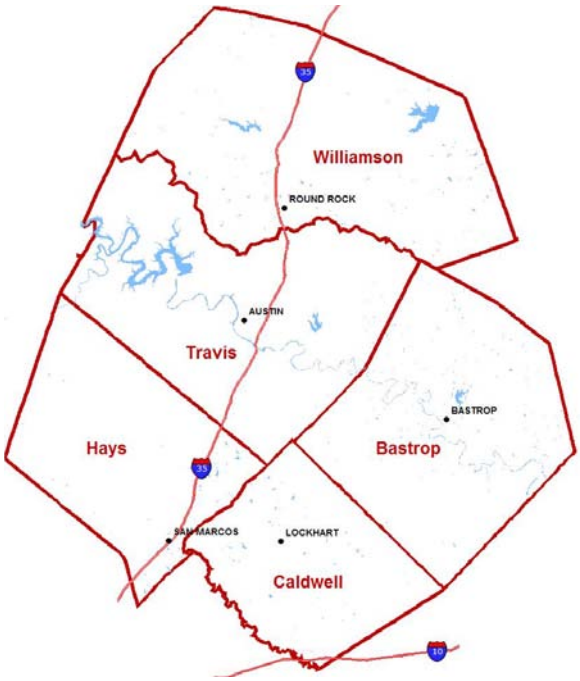
Speed Data
Posted speed limit data was inventoried.

Demographics
Population and household estimates for 2005 were estimated based on 2000 Census figures and building permit information. Base year 2005 population and household estimates were 1,458,641 and 548,126 respectively. Employment data was estimated at 698,399 for the base year. Estimates for the five counties comprising the CAMPO model study area are provided in Table 1 – 2005 Demographic Data.

Study Area

The CAMPO study area encompasses five central Texas counties: Bastrop, Caldwell, Hays, Travis and Williamson counties (ref. Figure 1). The five counties are divided into 1,413 internal traffic analysis zones (TAZs) with 49 external TAZs for a total of 1,462 zones.

Figure 1 - CAMPO Five County Area



Network

The 2005 model network is comprised of all facilities functionally classified as collector and above. The 2005 network consists of 10,745 non-centroid links. Network capacities were based on the Highway Capacity Manual 2000 for level of service E.

Table 1 - 2005 Demographic Data

Demographic Data	Bastrop County	Caldwell County	Hays County	Travis County	Williamson County	Total
Population	69,516	35,426	126,206	896,753	330,740	1,458,641
Households	24,517	12,123	42,807	354,155	114,524	548,126
Persons per Household	2.84	2.92	2.95	2.53	2.89	2.66
Employment	12,000	7,000	41,000	536,900	101,499	698,399
Employees per Person	0.17	0.20	0.32	0.60	0.31	0.48

Source: CAMPO, June 2009

Trip Generation

The trip production model is a cross-classification model; production rates are stratified by household size (1 to 5+) and five income ranges resulting in a cross-classification table of five household income categories and five household size categories.
The trip attraction model is also a cross-classification model with attraction rates stratified by four employment types (basic retail, service, and educational) plus households and five area types:

- CBD
- Urban Intense
- Urban
- Suburban
- Rural

There are twelve internal trip purposes:

- Home Base Work Direct
- Home Base Work Strategic
- Home Base Work Complex
- Home Base Non-work Retail
- Home Base Non-work Education1
- Home Base Non-work Education2
- Home Base Non-work University
- Home Base Non-work Airport
- Home Base Non-work Other
- Non-Home Base Work
- Non-Home Base Other
- Truck and Taxi

And five external trip purposes:

- External-External Auto
- External-External Truck
- Internal-External Auto
- Internal-External Truck
- Non-resident External Local

Trip Distribution

The trip distribution model is a gravity-based model. Friction factors were calibrated to 2005 household survey trip length frequency distributions by trip purpose. K-factors were used sparingly to calibrate the model.

Mode Choice

The CAMPO mode choice model is a nested multinomial logit model that was originally estimated based on 1997 home interview and on-board transit survey data. The model includes the following modes:

- Drive alone
- Shared-Ride 2-Person
- Shared-Ride 3+ Person
- Walk (non-motorized)
- Bike (non-motorized)
- Walk-Local Bus
- Drive-Local Bus
- Walk-Express Bus
- Drive-Express Bus
- Walk-University
- Drive-University
- Walk-Light Rail
- Drive-Light Rail
- Walk-Commuter Rail
- Drive Commuter Rail

Neither light rail nor commuter rail has been implemented in the CAMPO study area, so estimation for these modes was based upon inputs from other study areas. For the

current 2005 model update, the mode choice model is fundamentally based upon the 1997 estimation effort, with a recalibration based on 2005 on-board transit survey data.

Trip Assignment

A daily 24-hour assignment and two peak period assignments are run. The assignment procedures use a generalized cost multi-class user-equilibrium assignment process. The morning and evening peak period assignments represent the 7:00 to 9:00 AM and 4:00 to 6:00 PM time periods respectively. The base year 2005 model contains no toll roads; however, in 2006 the first regional toll road began operation. To ensure that the assignment process is functioning properly with respect to toll roads, CAMPO has developed a short-term interim-year 2008 forecast and has been comparing assignment results against 2008 traffic counts provided by the tolling agencies.

Issues and Recommendations

The Issues and Recommendations chapter concentrates on examining each of the technical issues that arose during the peer review meeting, its significance, and providing context for the peer review panel's recommendations.

Demographic Allocation

Overview
The previous CAMPO process for allocating forecasted demographic control totals was a modified Delphi panel process that relied on panel member's local knowledge and the ability of the panel to achieve consensus. The two primary issues with this approach were that:

- Replicating allocation results could not easily be accomplished
- Developing alternative allocation forecasts was problematic

In response to those issues the CAMPO demographic allocation tool has been developed; it provides a framework for a replicable process that affords the development of alternative growth scenarios. In addition the process is integrated with CAMPO's travel demand model, using model travel times as an input variable for accessibility and supplying the relevant TAZ-level demographic data for trip generation.

The forecast demographic allocation tool is a GIS-based computer program that takes user supplied demographic control totals and allocates the data from large geographic areas (e.g. counties) to smaller geographic areas such as traffic analysis zones.

The allocation process (ref. Figure 2) begins with an estimation of developable land followed by an iterative allocation process to small grid cells (each 36 acres) until forecast and density goals are achieved. Allocation to the five counties is performed independently based on county control totals. Three criteria determine the allocation process to individual grid cells:

- Total specified target growth for a pre-defined activity center or other area
- Individual acreage density goals
- Attractiveness rating of each grid cell

Factors that influence a zone's attractiveness rating include:

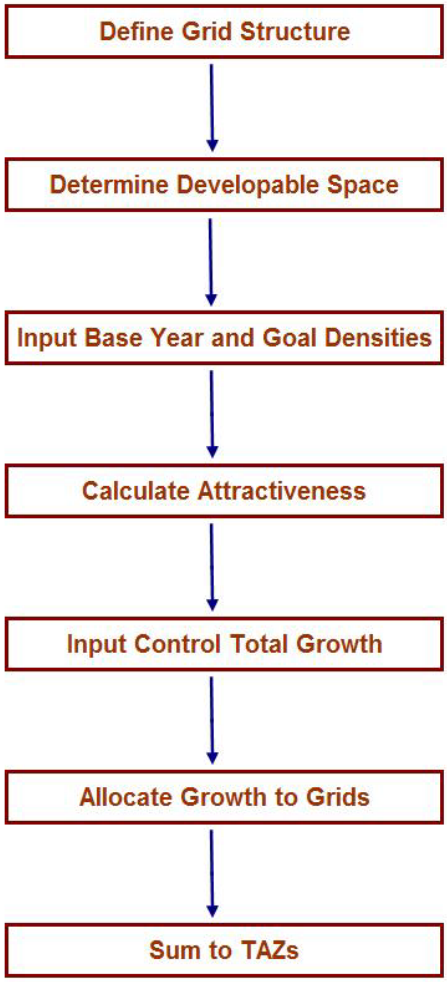
- Designation as an activity center (zones defined as activity center zones receive an additional attractiveness rating)
- Household attractiveness
- Employment attractiveness
- Potential detractor to development (e.g. landfills, airport noise zones)
- Retail and employment accessibility (i.e. travel model travel times)

Finally, the forecast demographic allocation process is implemented in ten year increments.

Issues
CAMPO staff were interested in investigating recommendations for improving the current forecast demographic allocation tool. The desire for improving the allocation process arose in part from observable allocation anomalies along county boundary lines. This was because the process of independently allocating by individual counties sometimes yielded inconsistent growth patterns on separate sides of a county line (i.e. different resulting densities on either side of the county line).

A secondary issue of interest was the efficacy of pursuing a new land use forecasting model for alternative growth scenario testing.

Figure 2 – Demographic Allocation Process



Source: CAMPO, June 2009

Panel Recommendation
In general, the peer review panel noted that the demographic allocation process was a very good approach; this was based on three elements:

- A data driven procedure
- A GIS-based approach
- A replicable process

The panel also stated that it was important for CAMPO to maintain staff ownership of the demographic allocation tool and process.

With regard to the county border anomalies resulting from independent county allocations, the panel recommended that CAMPO consider dropping the county control total constraint particularly when looking at alternative scenarios.

As a means of testing the demographic allocation tool's performance, the peer review panel suggested that CAMPO staff investigate reaction of the model to basic input changes and back cast or replicate the regional demographic changes that will have occurred between 2005 and 2010.

Additional recommendations for improving and/or supporting the forecast allocation process included:

- Maintaining access to building permit data, parcel data and zoning data for the five-county region
- Investigating including additional variables in the attractiveness index (e.g. neighborhood or economic factors)
- Involving local agencies in forecast reviews

Visualization

Overview
CAMPO is a proponent of visually summarizing data in a manner that is useful to the general public. To that end the agency uses graphs and thematic mapping techniques to present complex data or model results as a means of making the data more accessible to the public.

Their current data visualization practice relies primarily on the use of static maps. Long-range plan maps utilize a set of map templates for quality consistency which were made using Arcview 3.2. The traffic count maps that are provided to the public are based upon Texas Department of Transportation (TxDOT) data: either the annual average daily traffic (AADT) counts, or the more robust sample saturation counts collected by TxDOT every five years. CAMPO has also produced a series of isochronal environmental justice (EJ) maps that summarize modeled travel times in five-minute band widths. For a given map, time

bands emanate from either a randomly chosen non-EJ or EJ identified TAZ.

A recent effort to improve and build upon the use of static maps has been through the application of GIS Viewer to offer dynamic viewing capabilities. Once the Phase I effort is completed, users will be able to search physical addresses and view geospatial information for traffic counts and Transportation Improvement Projects (TIP), as well as plan projects with selected project attributes on-line. The Phase II effort will be expanded to include additional CAMPO projects.

Issues
CAMPO is interested in implementing and applying advanced data visualization techniques to support improved communication of complex data to the CAMPO Policy Board and the public.

Panel Recommendation
The peer review panel stated that the current static maps that CAMPO produces look good; however, the panel also noted that it was an advantageous idea to move towards the provision of web accessible data that incorporated more dynamic mapping features.

The panel cautioned CAMPO staff to be very careful about how forecasts (e.g. land use and transportation) are generally presented. Items to consider when developing presentation materials include:

- Level of aggregation; thought should be given to the level of detailed data that is provided
- Raw versus "scrubbed" model output; data results should be reviewed and appropriately summarized prior to public dissemination
- Appropriate caveats; forecasts should include disclaimers regarding supporting data sources, probabilities, and levels of confidence

Other panel recommendations for CAMPO included the following:

- Consider means of streamlining coordination with planning partners
- Post frequently requested data in graphical form on-line
- Consider ways to:
  - Feature special topics
  - Draw people to the CAMPO website
  - Illustrate regional planning goals

Trip Generation

Overview
As noted previously, CAMPO's trip production and trip attraction models are both cross-classification models.

Person trip production rates for eleven trip purposes are derived from a 2005 household travel survey (the twelfth trip purpose, truck-taxi, uses a control total number of vehicle trip productions derived as a function of the regional population). The production rates are stratified by household size and five income ranges, but for the three home-based work trip purposes (direct, strategic and complex) a third stratification is used that accounts for the number of workers in each household.

The three home-based work trip purposes are intended to provide additional insight into the mode choice decision. The definition of the three purposes is as follows:

- Direct - A direct home-based work trip is part of a trip "tour" that consists of both home-to-work and work-to-home trips as being direct. If either trip is not direct, then neither is considered to be direct. The exception to this rule has to do with "trip linking". If intermediate stops are present which are deemed "stops of convenience" (i.e. less than 5 minutes) then these are "linked out" and both the home-to-work and work-to-home trips remain a direct trip.
- Strategic - A strategic home-based work trip contains an intermediate destination to either drop off or pick

up a child at day-care, nursery school, baby sitter, pre-school, elementary or secondary school. If a traveler drops off their child at a day-care center in the morning yet proceeds directly home in the evening, then both trips are considered strategic. This is because the decision on mode for both trips is influenced by the need to drop off a passenger in the morning. This is the only case of serve passenger which is "linked out" to create a composite home-based work strategic trip.

- Complex - A complex home-based work trip is part of a trip "tour" that consists of one trip between home and work and another trip between home and work which involves an intermediate stop at any destination. In this case, the home-to-work leg of the trip chain would be coded as complex home-based work, the work-to-other leg of the chain would be coded as non-home based and the other-to-home leg of the chain would be coded as home-based non-work. Complex work trips are part of a trip "tour" where worker's choice of mode is conditioned to some extent on the tasks that the worker must accomplish on either one or both legs of the journey between home and work.

Three sub-models have been developed to process zonal demographic data to support the trip production model; these are:

- Household size model
- Household income model
- Workers per household model

The household size and income models generate required input data for the workers per household model. The output from the workers per household model (i.e. number of households with 0, 1, 2 and 3+ workers) is then input to the trip generation model.

Issues

The primary concern for CAMPO with regard to trip generation was how their process compared to the current state of the practice. Specifically of interest was whether:

- The existing models are suitable for the current urban area size, or the size they will achieve in the next 10 years; and whether
- Preferable techniques for handling trip generation relative to the size and diversity of the region are available

Panel Recommendation

The panel noted that CAMPO's current trip generation model conforms to the state-of-the-practice. Moreover, they advised that CAMPO should maintain the three distinct home-based work trip purposes, something CAMPO was considering abandoning.

Three recommendations provided by the peer review panel for improving the trip generation process were as follows:

- Reassess the trip purpose that combines truck and taxi trips into one purpose. The characteristics of commercial vehicle trips versus taxi trips were viewed as too distinct to warrant being grouped together
- Reconsider the need for the number of special generators. Twenty special generators are currently used in the CAMPO trip generation model; the panel thought that perhaps a fewer number could be applied.
- Reevaluate where auto ownership is used and introduced in the model. This recommendation was offered in the context of mode choice model performance. The issue was whether applying the autos per household model at the trip generation stage might lead to zero-car households making odd transit trips.

Trip Distribution

Overview
As mentioned previously, the CAMPO trip distribution model is a gravity-based model. The current model development process has incorporated a travel time feedback process from the traffic assignment step to trip distribution (feedback is discussed further in a subsequent report section).

Two separate travel time matrices (skims) are developed as input to the trip distribution process: peak hour and 24-hour travel times. The peak hour skims represent the 7:00 AM to 9:00 AM two-hour time period and are only used for the three home-based work trip distributions. The 24-hour skims are used for all other non-work trip purposes. In the application of the feedback methodology the first iteration skims are based on free-flow travel times; all subsequent iterations use resulting peak hour or 24-hour assignment travel times from the prior iteration depending on whether it is a home-based work or non-work trip purpose application. It should be noted that travel times are skimmed only from non-transit network links.

Friction factors were calibrated to 2005 household survey trip length frequency distributions by trip purpose. The truck-taxi and external trip purposes used commercial vehicle and external survey data respectively. K-factors were used sparingly to calibrate the model.

Issues
As with trip generation, the primary interest for CAMPO with regard to trip distribution was how their process compared to the current state of the practice. Likewise, CAMPO was interested in ascertaining whether better methodologies for addressing trip distribution for the size and diversity of the region are available and should be implemented.

Panel Recommendation
The primary peer panel observation was that the current trip distribution approach employed by CAMPO is consistent with the state-of-practice for trip distribution. On the other hand, since the model had not been completed by the time of the peer review panel meeting and thus documentation regarding model results and performance were not yet available, the panel also noted that it was not clear how well the model is functioning. Consequently, the peer review panel recommended that CAMPO should carefully validate the trip distribution model against available survey data and undertake the following tasks to assess model performance:

- Compare modeled work trip distributions to Census Transportation Planning Package (CTPP) data at a district level that was much finer than the five-county level (for example, 40 districts)
- Perform household survey trip table comparisons for non-work trip distributions
- Compare external-external and external-internal trip distributions to external survey data
- Assess trip length frequency distributions (TLFDs) by trip purpose; this assessment would include TLFDs at a district level using both time and distance
- Perform screenline comparisons to evaluate travel within regional corridors

In addition, the panel suggested that CAMPO staff should investigate whether the trip lengths and comparable friction factors for downtown attractions are fundamentally different. A further suggestion was to validate resulting trip patterns for special destinations (e.g. airport, University of Texas).

Time of Day

Overview
In essence, the existing CAMPO model is a 24-hour model that forecasts daily travel patterns and system volumes. Morning and evening peak-period trip tables for peak-period assignments are derived however, from the application of household travel survey diurnal factors against individual output trip purpose matrices from the mode choice model.

Previous model development efforts aimed at addressing time-of-day questions have been impeded from a lack of supporting data (e.g. peak period traffic counts). In response to prior impediments CAMPO is planning a data collection effort to support the development of the next base year (2010) model that will include a time-of-day component.

Issues
Given the proposed data collection effort to support the incorporation of a time-of-day methodology in the next travel model, the primary issue of concern was how best to address time-of-day questions. More specifically, CAMPO was interested in the efficacy of:

- Several time-of-day assignments based on trip tables derived from diurnal factors
- Discrete models for specific time periods (e.g. AM-peak, mid-day, PM-peak and off-peak)

Panel Recommendation
The peer review panel's recommendations stem from the viewpoint that a 24-hour time period based model is difficult to explain; for example, 24-hour speeds and capacities. Their recommendations for subsequent model enhancements included the following:

- Prior to mode choice or during the mode choice step use two time periods: peak and off-peak
- For traffic assignment establish four time periods (e.g. AM, Midday, PM, Night) that combined will represent 24 hours

To support these enhancements the panel also recommended the following actions:

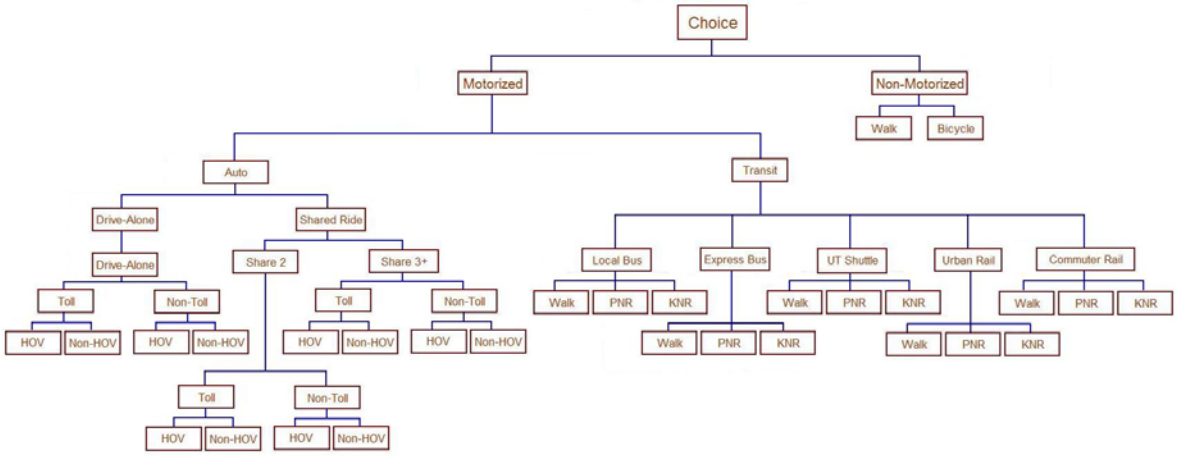
- Compile traffic counts and transit data by time period
- Estimate time-of-day splits using household travel survey
- Estimate time-of-day distribution based on time of arrival/departure at the attraction end of trips

Mode Choice

Overview
As noted previously, the CAMPO mode choice model is a nested multinomial logit model that has been recalibrated based on 2005 on-board transit survey data. The nesting structure is graphically displayed in Figure 3.

There are four levels of nests with the first level determining the choice between motorized and non-motorized. The second level differentiates auto from transit as well as walk from bicycle trips. The next level separates drive alone and shared ride auto trips.

Figure 3 – CAMPO Nesting Structure



Source: CAMPO, June 2009

On the transit side, the primary modes are specified by mode of access, including walk, park and ride (PNR), and kiss and ride (KNR). On the auto side the drive alone and shared ride choices have a choice of toll or non-toll below them, and the shared ride alternatives have a further choice of using HOV. For the current model update the toll nest is not used; instead, toll road users are determined as a path choice during trip assignment.

Walk and drive access and egress times are based on actual times skimmed from the highway network. In the case of walk, centroid connector walk times are based on a coded speed of three miles per hour but capped at a maximum time of ten minutes. Drive access times to park-and-ride, and kiss-and-ride lots are based on modeled highway travel times along network centroid connectors and links. Opportunity (market segmentation) for walk access to transit is determined by the aggregate percentage of households in each TAZ that reside within quarter-mile and half-mile buffers around available transit stops. A geographic information system (GIS) program is used to estimate the percentages that fall within each buffer. These market segments are subsequently apportioned into seven categories based on the length of the walk distance at both the origin and destination of the trip (short walk, long walk or no walk (i.e. no transit stop available within the allowed walking distance)):

- Short-Short
- Short-Long
- Long-Short
- Long-Long
- None-Short
- None-Long
- None-None

Issues

For the next model update, 2010, CAMPO intends to revise and improve their mode choice model. Consequently, they were primarily interested in options for enhancing the model beyond its current structure. Two issues were of particular interest:

- Use of three home-based work trip purposes. Three of the eleven trip purposes for which mode choice is applied are the three home-based work trip purposes. Due to a lack of specific work trip purpose on-board transit survey data however, the same mode choice parameters are applied to each of the three purposes thus negating their usefulness. For the next model update though, 2010 on-board surveys are planned to correct the data insufficiency issue.

- Use of auto ownership versus household income. The existing mode choice model estimates trips by mode stratified by auto ownership (0, 1 and 2+ autos) for each trip purpose. The recurring need to address environmental justice issues has led to the question of whether the use of household income categories instead of auto ownership levels would be preferable.

One additional item of concern was the appropriate level of detail or mode choice model structure to support New Starts applications. The current model addresses three transit modes: local bus, express bus, and university bus service. In the near future the transit system will be expanded to include commuter rail and bus rapid transit (BRT) service. The existing model can also account for light rail and commuter rail in future alternatives. Questions for future model applications included:

- Incorporating BRT by borrowing data from another region versus using coefficients from the existing model that are the closest to the proposed service type
- Applying a rail bias factor to represent the more likely propensity to use rail versus bus

Panel Recommendation
The panel noted that the mode choice model is consistent with the state-of-the-practice from several years ago, but that it now needs to be updated consistent with current Federal Transit Administration (FTA) requirements. Moreover, the on-going mode choice model improvements are a step in the right direction but will not be sufficient.

Further suggestions proposed by the panel included:

- Complete model validation. The panel recommended a full validation to understand how well the model is working. Example questions that need to be answered included:
  - Is the model replicating what is actually occurring?
  - Are the right people taking transit?
  - Are trips in the right place?
  - Do captive transit riders use the transit system?
- Significant restructuring of mode choice model constants is required; the current constants are not in keeping with the current FTA requirements for transit submode preferences
- Restructuring of the nesting structure may also be required

One final panel recommendation was to collect additional transit ridership data after the commuter rail service begins operating to support subsequent mode choice model enhancements.

Trip Assignment

Overview
As noted previously, the CAMPO trip assignment process consists of a daily 24-hour assignment and two peak period assignments. The assignment procedure uses a generalized cost multi-class user-equilibrium assignment process. The same value of time is used for mode choice and the generalized cost assignment procedure. The morning and evening peak period assignments represent the 7:00 to 9:00 AM and 4:00 to 6:00 PM time periods respectively. Only the daily and AM peak-period assignments are run during the feedback process. Currently, the mode choice output is aggregated so that the following modes are assigned:

- SOV (single occupant vehicles) Auto
- HOV (high occupancy vehicles, 2+ persons) Auto
- SOV Truck
- HOV Truck

The base year 2005 model contains no toll roads; however, in 2006 the first regional toll road began operation. To ensure that the assignment process is functioning properly with respect to toll roads, CAMPO has developed a short-term interim-year 2008 forecast and has been comparing assignment results against 2008 traffic counts provided by the tolling agencies.

Toll road links in the highway network are identified using a cost value in a year specific toll cost field. If a link is not a part of the toll system then the cost value is coded as a null value. This offers the ability to make toll road selection sets since toll roads are not coded as a unique functional classification. The cost value that is coded is defined by the rates set by the toll agencies and is only coded on links that represent the location where the cost is incurred (e.g. toll plazas). All of the regional toll roads are "closed" systems.

Issues
CAMPO is interested in understanding if preferred methods for addressing toll roads should be implemented.

Panel Recommendation
As mentioned in the Mode Choice section, the peer review panel stated that a 24-hour assignment is difficult to explain. In response, the panel suggested that in the next model update, CAMPO implement an assignment procedure comprised of four time periods.

The panel recommended that CAMPO document their volume-delay functions and network coding procedures. In addition the use of tighter closure criteria (i.e. a relative gap of 0.0001 and setting maximum iterations to 1000) during the assignment process was recommended.

With regard to model validation the panel recommended validating on the basis of both travel times and count data and not just count data as is currently practiced. The incorporation of additional count validation criteria (e.g. screenlines and root mean square error (RMSE)) was also suggested.

Finally, the panel recommended that CAMPO consider income stratification for trip tables and value-of-time with the caveat that this would require the following items:

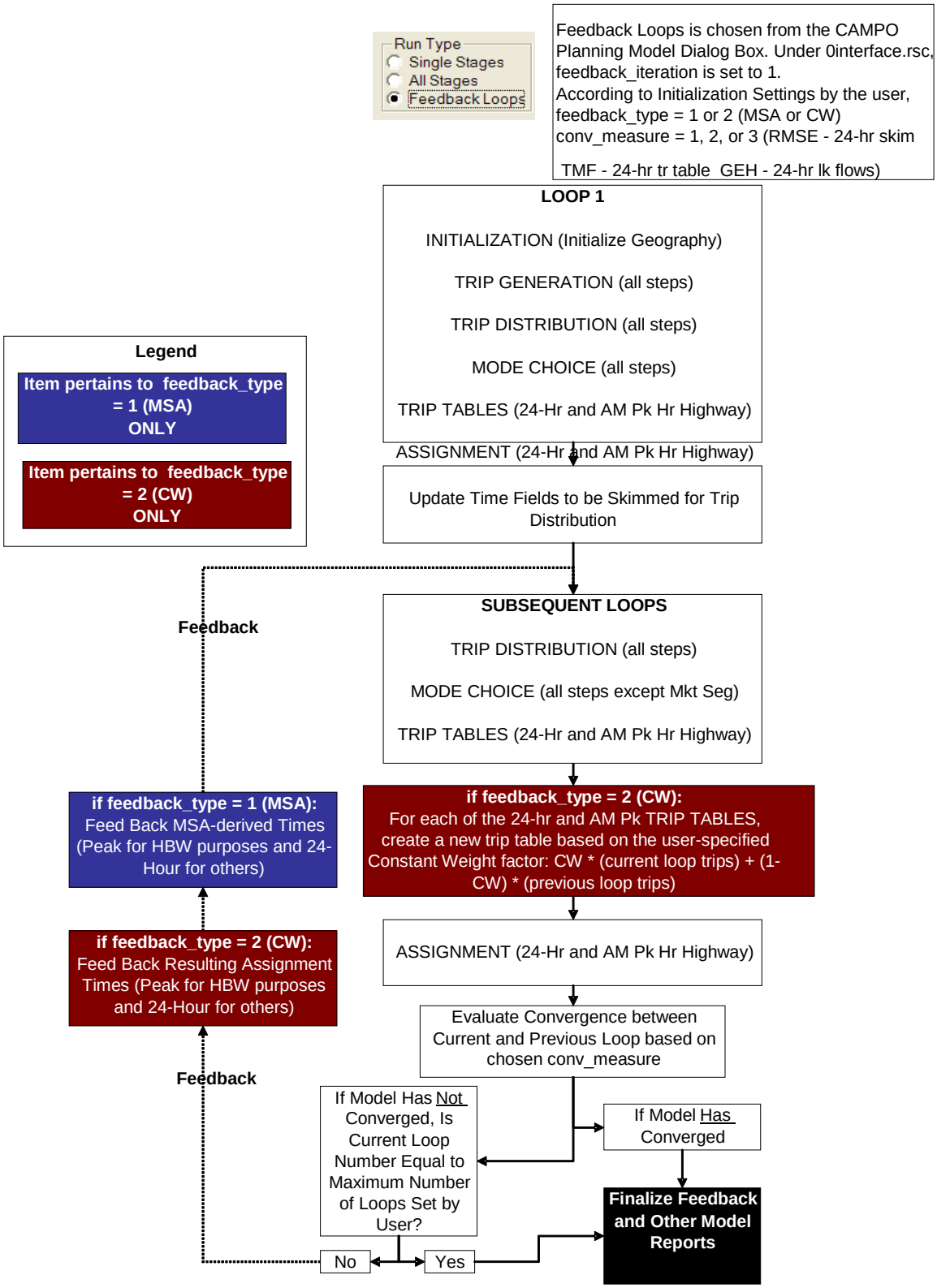
- Income stratification of trip distribution and mode choice models
- Multi-class assignment by income
- Separate values-of-time by income

Feedback

Overview
The current CAMPO model includes the implementation of a feedback loop using travel times from the assignment process and fed back to the trip distribution model. The incorporation of a feedback procedure arose from the desire to use consistent travel times during trip distribution and trip assignment. It was also based on a recommendation from a previous peer review conducted in 2001 though no guidance was offered at the time on an approach or means of implementation.

The implementation of CAMPO's feedback procedure has evolved through various phases beginning with the implementation of a simple or naïve feedback process. As the process evolved, several methodologies and convergence criteria were assessed but subsequently rejected based upon the practicality of maintaining reasonable model run times. The feedback procedure currently in use is graphically displayed in Figure 4 - CAMPO Model Feedback Flow.

Figure 4 - CAMPO Model Feedback Flow



Source: CAMPO, June 2009

At the inception of the feedback process, trip distribution is applied using free-flow travel times for the first iteration of the feedback loop. For subsequent feedback iterations peak congested times and 24-hour congested times from the previous assignment are used for home-based work and the other trip purposes respectively. Mode choice is also run during each iteration of the feedback loop. The process continues until convergence or a specified number of iterations are reached.

The feedback methodology is structured to allow the user to use either an MSA (multiple successive averages) or constant weight approach to process the times being fed back into distribution. The current process also offers the user a choice of three convergence criteria to use (all are reported):
RMSE (root mean square error)
TMF (total misplaced flows)
GEH statistic

The feedback methodology is structured to allow the user to start with either free-flow times ("cold start") or congested times by assigning previously generated peak and 24-hour trip tables ("warm start"). Presently, CAMPO procedure specifies starting with the free-flow times.

Issues
The potential or need for additional improvements or refinements to the current feedback process was the only issue of concern.

Panel Recommendation
The panel observed that the current approach is ahead of the state-of-the-practice. As a means of reducing run times the panel recommended the following:
Four to five iterations may be sufficient instead of the current eight
Use congested speeds for the first iteration instead of free-flow
Use looser assignment closure criteria during the first two iterations
Maintain the ability to run mode choice and assignment without running feedback

Additional Recommendations

General Observations

Apart from the previous recommendations that were offered in response to specific issues, the peer review panel also suggested the following actions grouped by high and low priorities:

Higher Priority Panel Recommendations:
Confirm reasonableness of survey data by doing the following:

- Assign the on-board survey trip data
- Review the survey data expansion process
- Review basic data tabulations (e.g. transfer rates, data outliers)

Validate model results against existing survey data and counts to accomplish the following:

- Tell a coherent story about regional travel behavior
- Verify performance of each model element
- Utilize travel time data

Prepare more thorough and complete model documentation including the following topics:

- Network coding methodologies
- Transit path-builder
- Volume-delay functions
- External truck traffic

Finally, investigate model run-times and hardware since the model appears unnecessarily slow.

Lower Priority Panel Recommendations:
Future methodological changes that CAMPO is considering implementing should be based on demonstrated deficiencies from high priority comparisons.

CAMPO should consider opportunities for across the board consistency by:

- Using the same impedance measures in distribution, mode choice, and assignment
- Using same values of time throughout the model chain
- Using the same time and cost weights in transit path builder and the mode choice model

Lastly, CAMPO should continue to work towards self-sufficiency and in the meantime consider opportunities for efficiency improvements in the software linkages.

In addition to the recommendations noted above the peer review panel also offered the following comments in response to several additional technical questions posed by CAMPO:

Activity-Based Models

Issue
Should CAMPO consider developing an activity-based model?

Panel Recommendation
The panel recommended that CAMPO closely monitor the evolution of the practice and in the interim, to concentrate their resources on improving the trip-based model.

Environmental Justice

Issue
CAMPO was interested in methodologies for better answering environmental justice issues.

Panel Recommendation
The panel suggested that CAMPO consider adopting the approach used in Denver and Dallas.

Freight Model

Issue
The question of whether the development of a freight model would benefit CAMPO was posed. Currently CAMPO has a truck trip purpose that is combined with taxis. No procedures exist to model freight movements within the region. In 2008 CAMPO undertook a needs assessment study for all modes of freight movements within the urban area.

Panel Recommendation
The panel recommended separating trucks from taxis in the development and application of the truck trip purpose. The panel informed CAMPO that they could consider a freight model, but that higher priorities exist for the time being.

Gas Price

Issue
What is the best method for accounting for gas price effects in the model?

Panel Recommendation
The panel noted that the current state-of-the-practice does not explicitly include gas prices; moreover, that it is not an easy variable to address. The panel did however recommend saving traffic count data and transit rider data before and after spikes in the gas price.

Microsimulation

Issue
CAMPO was interested in any improvements that could be implemented with limited funds.

Panel Recommendation
The panel recommended that CAMPO develop the ability to use microsimulation for a corridor or sub-area.

Appendix A

CAMPO Model Documentation

1. Capital Area Metropolitan Planning Organization (CAMPO). “CAMPO Demographic Allocation Tool Application Manual, Draft”, March 2008

2. Capital Area Metropolitan Planning Organization (CAMPO). “Model Procedures, Draft”, June 2009

Appendix B

List of Peer Review Panel Participants

Peer Review Panel Members:

Name	Affiliation
Erik Sabina	Denver Regional Council of Governments (DRCOG)
William Woodford	AECOM
Arash Mirzaei	North Central Council of Governments (NCTCOG)
John Lobb	RSG Inc.
Guy Rousseau	Atlanta Regional Commission (ARC)

Supporting Staff to Peer Review Panel Members:

Name	Affiliation
Phillip Reeder	Texas Transportation Institute (TTI)

Local Agency Staff:

Name	Affiliation
Joe Cantalupo	Capital Area Metropolitan Planning Organization (CAMPO)
Daniel Yang	Capital Area Metropolitan Planning Organization (CAMPO)
Kevin Lancaster	Capital Area Metropolitan Planning Organization (CAMPO)
Michael Dutton	Capital Area Metropolitan Planning Organization (CAMPO)
Cole Kitten	Capital Area Metropolitan Planning Organization (CAMPO)
Greg Goldman	Capital Area Metropolitan Planning Organization (CAMPO)
Greg Lancaster	Texas Department of Transportation (TxDOT)

Appendix C

Peer Review Panel Meeting Agenda

TRAVEL MODEL IMPROVEMENT PROGRAM
CAMPO PEER REVIEW MEETING
June 11 and 12, 2009—8:30AM
One Texas Center
505 Barton Springs Road
Austin, TX
June 11-12, 2009

JUNE 11, 2009

8:30 Welcome and Introductions

8:45 Demographic Allocation and Visualization

10:00 Morning Break

10:30 Trip Generation and Distribution

11:45 Lunch

1:15 Mode Choice and New/Small Starts Applications

2:30 Time of Day, Toll Assignment, and Feedback Loop

3:30 Afternoon Break

3:45 General Questions

5:00 Adjourn

JUNE 12, 2009

8:30 Panel Caucus – (Panelists Only)

10:00 Morning Break

10:15 Preliminary Findings/Recommendations from the Panel

11:30 Adjourn