The Travel Model Improvement Program

Summary Report

Cache Metropolitan Planning Organization

Travel Demand Model Peer Review

Cache County, Utah
January 2009

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
- The 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; that being to delineate the identified issues and workable solutions as a means of providing modeling practitioners concepts and approaches to consider for incorporation into their own model set. Ideally it should offer new perspectives to question our 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 the model component is offered to merely place the topic of discussion in context. The majority of discussion for a given topic will focus on summarizing the technical issue, its significance, and providing context for the recommended approach or solution. Thus, each topic of discussion will be structured as follows:

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

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

Peer Review Panel Meeting and Recommendations

This report, *Summary Report Cache Metropolitan Planning Organization Travel Demand Model Peer Review*, documents the travel demand model peer review panel meeting held at the Country Inn and Suites Hotel in Salt Lake City, Utah on August 26th and 27th of 2008. The two-day peer review panel meeting was held as part of the TMIP that is sponsored by the Federal Highway Administration (FHWA). The peer review panel consisted of four 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 Utah Department of Transportation (UDOT) staff and Cache Metropolitan Planning Organization (CMPO) staff presentations on existing model

structure and proposed 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 a pre-defined set of goals 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 CMPO travel demand model. Panel members commended Cache MPO staff and their consultants for their responsiveness and openness in establishing the current travel model status.

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, Cache MPO staff have been gracious enough to openly share their model's inner workings. 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 Cache Metropolitan Planning Organization (CMPO) model components to provide some context for the discussion comprising the remainder of the report.

The CMPO model was originally a 1995 base year model completed and calibrated in 1998. In 2002 the CMPO model was converted from MINUTP to CUBE. In 2007 the model was re-calibrated and validated to a 2004 base year using previously collected survey data. The CMPO model is a standard four-step model (trip generation, trip distribution, mode choice and trip assignment) used to predict average weekday traffic volumes.

Though the model was re-calibrated in 2004, only 1995 model documentation was provided to support the peer review process. Thus, panel discussion and this report focus primarily on the original 1995 model structure and supporting data.

Data

Household Travel Survey
A household travel survey comprised of 3,000 households was conducted in the fall of 1998 to support model calibration efforts.

On-board Transit Survey
A one-day 12 hour on-board transit survey was conducted for the Logan Transit District bus system.

External Station Roadside Survey
External origin and destination (O&D) roadside surveys were conducted at five of the external stations.

Traffic Counts
Vehicle classification counts were collected to supplement the UDOT average daily traffic (ADT) traffic counts and to support model validation.

Demographics
Population and household estimates for 1995 were estimated based on 1990 Census figures. Base year 1995 population and dwelling unit estimates were 82,453 and 25,764 respectively. Employment data was estimated at 36,472 for the base year. By the year 2020 population is expected to increase approximately 60 percent, to 132,046. Dwelling units increase 55 percent, to 40,000 and total employment is estimated at 34,005 for 2020. Estimates for the two years are provided in Table 1 – Demographic Data for 1995 and 2020.

Study Area

The CMPO study area encompasses Cache County in its entirety (ref. Figure 1) which is

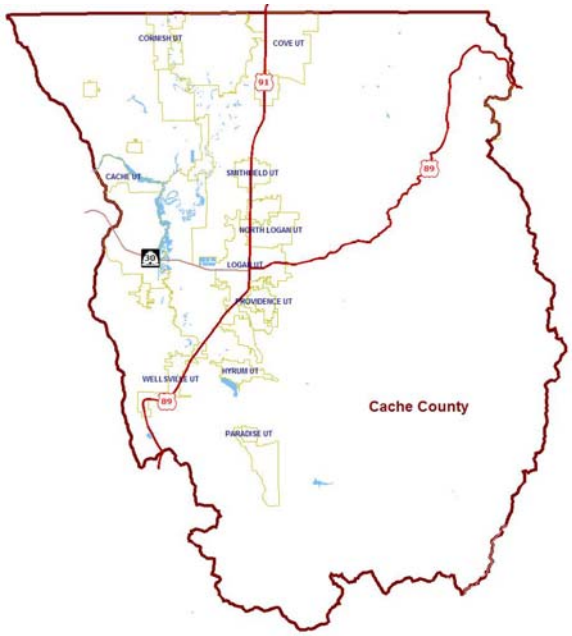
Table 1 - Demographic Data for 1995 and 2020

Demographic Data	1995	2020
Population	82,453	132,046
Total Dwelling Units	25,764	40,000
Single Family Dwelling Units	17,319	28,332
Multi-Family Dwelling Units	8,445	11,668
Person per Dwelling Unit	3.20	3.30
Total Employment	36,472	64,372
Retail Employment	7,143	12,606
Industrial Employment	10,041	17,761
Other Employment	19,288	34,005
Employees per Person	0.44	0.49

Source: "*Cache Valley Corridor Model Development and Validation Report", May 1999*

located in northern Utah along the Utah-Idaho state border. There are several urbanized areas within the study area, the largest being Logan, Utah. The study area is divided into 133 traffic analysis zones (TAZs) with the urbanized area of the county comprising 101 of those TAZs. In addition there are six external TAZs.

Figure 1 – Cache County



Networks

Highway Network
The 1995 base year model network is comprised of all facilities functionally classified as collector and above. The network also includes some local roads or residential streets. The 1995 network consists of 1,508 non-centroid links classified as one of four functional classifications:

- Principal arterial
- Minor arterial
- Urban/rural collector
- Residential street

Network capacities were based on the 1994 Highway Capacity Manual for level of service (LOS) C.

Transit Network
The local transit system primarily consists of ten routes circulating within Logan, Utah as well as two additional routes, a northern and southern route, which connect outlying towns to Logan. A transit network however was not coded.

Trip Generation

Zonal person trip productions and attractions are estimated using unique linear regression equations for each trip purpose. There are three internal trip purposes:

- Home Based Work (HBW)
- Home Based Other (HBO)
- Non-Home Based (NHB)

And two external trip purposes:

- External-external (EE)
- External-internal (EI)

The primary variables used in the linear regression equations are population, households and employment. The equations for the three internal trip purposes are as follows:

HBW Productions =
2.98*SFDU + 1.99*MFDU – 0.66

HBO Productions =
6.96*SFDU + 3.45*MFDU + 13.60

NHB Productions =
3.50*TOTHH + 5.00*RETEMP

HBW Attractions =
1.87*TOTEMP

HBO Attractions =
0.60*POP + 14.30*RETEMP

NHB Attractions =
3.50*TOTHH + 5.00*RETEMP

Where:
SFDU = single family dwelling unit
MFDU = multi-family dwelling unit
TOTHH = total households
RETEMP = retail employment
TOTEMP = total employment

Trip Distribution

The trip distribution model is a gravity model. Friction factors were initially derived from the comparison of resulting model trip length frequency distributions to observed trip length frequency distributions by trip purpose. An iterative process was used to calibrate friction factors for each trip purpose. K-factors were not used to improve model validation.

The trip distribution model was calibrated for all five trip purposes: HBW, HBO, NHB, EE, and EI, using free-flow times as the impedance measure. The model does not have a distribution-assignment feedback loop.

Mode Choice

Automobile percentage shares are estimated using unique linear regression equations for two of the three internal trip purposes, home-based work and home-based other. The two equations used for home-based work and home-based other are as follows:

HBW Auto Share = -17.17*Ln(TA) + 39.89*Ln(AOWN) – 120.14

HBO Auto Share = 0.0265*TVEH + 0.0117*POP + 99.81

Where:

- TA = transit accessibility
- AOWN = average vehicle ownership
- TVEH = total vehicle ownership
- POP = total population

For non-home base trips the automobile percentage share is calculated as a percentage of the home-based work share. For zones within the urbanized area 40 percent of the home-based work share is assumed and for the remaining zones the share is set equal to the home-based work share.

A model methodology report from 1998 describes a binomial logit model with corresponding utilities established for auto and transit modes. The aforementioned linear regression model was developed in lieu of a logit-based mode choice model.

Trip Assignment

A daily 24-hour assignment is applied. Model documentation indicates that an incremental assignment procedure is utilized; however, during the peer review panel meeting the MPO stated that the latest version of the model applies a user-equilibrium assignment process. The standard BPR (Bureau of Public Roads) volume-delay function is used with alpha and beta values of 0.15 and 4.0 respectively. A comparison with statewide counts (from UDOT) was completed in 2002.

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.

Survey and Demographic Data

Data Availability and Application

Issue Synopsis
There is a lack of data to support model calibration and model validation.

Overview
As noted in the Model Overview section of the report, a 1998 household survey and on-board transit survey were conducted to support model development. In addition, Cache MPO collected vehicle classification counts to supplement the available UDOT ADT traffic counts. Nevertheless during the course of the peer review several instances were noted for which the availability of additional observed data would have been beneficial for model calibration and model validation purposes. Examples of unavailable data included the following:

- Land use data
- Roadway characteristics
- Socio-economic data
- Origin-destination data by trip purpose
- Travel time and speed data
- Posted speed limit data
- Vehicle occupancy data
- Traffic counts

Issue Significance
The unavailability of certain types of data may impede or hinder the development of a sound and defensible model. For example, the lack of inventoried speed limit data constrains the development of a speed look-up table related to observed conditions. The absence of travel time and speed data in turn negates the ability to calibrate network speeds and travel times.

Panel Recommendation
Given the importance of observed data, the peer review panel recommended that the Cache MPO conduct a data inventory needs assessment.

Trip Generation

Trip Production Models

Issue Synopsis
The trip production models estimate a considerable number of person trips.

Overview
The trip production models primarily use single family and multi-family dwelling units or total dwelling units as the principal variable for estimating person trips by trip purpose. The linear regression equations (previously shown on page 4) yield a total of 13.9 person trips per dwelling unit; however, upon estimating the ratio of person trips to number of households this equates to a higher 15.1 person trips per household.

Issue Significance
The person trip production models are actually structured to use households instead of dwelling units. Households rather than dwelling units are typically used as a production variable since a number of dwelling units may actually be vacant depending on the vacancy rate for a given urban area. By substituting dwelling units for households in the trip production equations the estimate of person trip productions by trip purpose may be inadvertently over estimated and consequently yielding higher vehicle miles traveled (VMT) than observed conditions indicate.

Panel Recommendation
The panel recommended that households instead of dwelling units be used in the trip production models. The panel also cited the balancing of productions and attractions as an area of improvement worth considering.

Trip Attraction Models

Issue Synopsis
The person trip attraction models rely primarily on one type of employment to estimate attractions by trip purpose.

Overview
The Cache MPO inventories employment data by three categories: retail, industrial and other. However, two of the three internal trip purpose trip attraction models (HBO and NHB) only use retail employment to estimate trip attractions and HBW uses only total employment (ref. page 4).

Issue Significance
Though population (for HBO) and households (for NHB) are also variables used to estimate attractions it is conceivable that some zones might only have non-retail employment. Consequently for zones with non-retail employment trip attractions cannot be estimated. Similarly, for all zones that contain retail, industrial and other employment the number of trip attractions estimated is never a function of the two non-retail types of employment regardless of the preponderance the two non-retail employment types might have in a given zone. For example, if a zone has five retail employees, 200 industrial employees, 300 other employees and zero population or households, then the number of HBO and NHB attractions will be determined solely on the basis of the five retail employees.

For the HBW trip purpose the use of total employment as the only attraction variable overlooks the possibility of work attractions to individual households.

Panel Recommendation
The panel recommended incorporating other employment sources in the attraction models with careful validation of the resulting number of attractions.

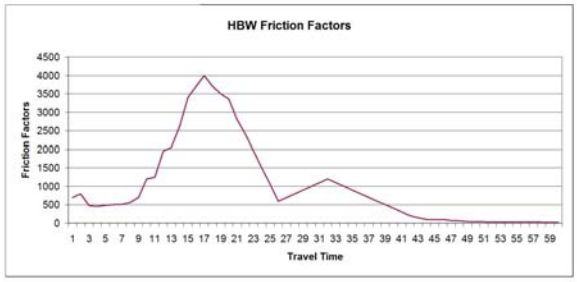
Trip Distribution

Friction Factors

Issue Synopsis
The shape of the friction factor curves is a non-traditional shape more reminiscent of trip length frequency distribution curves.

Overview
The Cache MPO friction factors were calibrated through an iterative process and adjusted so that the resulting model estimated average trip length reasonably matched observed household survey average trip lengths. This was accomplished for all three internal trip purposes. The resulting calibrated friction factors did not however exhibit the standard shape of a continuously declining curve as the value of time increases. Indeed, as is indicated in Figure 2 for the HBW trip purpose, the actual friction factors more closely resemble a trip length frequency distribution (TLFD). The pattern of resembling a TLFD is repeated for all three trip purposes.

Figure 2 – HBW Friction Factors

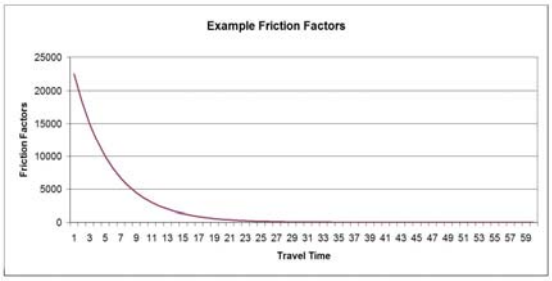


Source: RSG, Inc. Peer Review Panel presentation

Issue Significance
Friction factors represent the propensity to travel between zone pairs based on the impedance between zone pairs expressed in time. Consequently friction factors are inversely related to zone-to-zone travel times. Thus as travel time increases, friction factor values decrease resulting in a declining curve as shown in Figure 3.

The application of a friction factor curve as previously shown in Figure 2 will tend to under-represent the number of observed short trips (e.g. less than ten minutes) and over-represent mid-range trips. The expected overall impact would be modeled average trip lengths (ATL) that were longer than an observed ATL. Nevertheless, the Cache modeled average trip lengths were all less than the observed ATLs (ref. Table 2).

Figure 3 – Example Friction Factors



Source: TTI, 2008

Table 2 – Average Trip Lengths

Trip Purpose	Observed ATL	Modeled ATL
HBW	18.70	16.53
HBO	16.77	15.55
NHB	16.60	13.98

Source: "*Cache Valley Corridor Model Development and Validation Report", May 1999*

Panel Recommendation
The peer review panel recommended that the friction factors be recalibrated.

Internal Travel Matrices

Issue Synopsis
The trip distribution model validation process did not incorporate observed district-to-district flows.

Overview
It appears that the primary means of validating the trip distribution model centered on reasonably replicating observed average trip lengths for the three internal trip purposes as noted in the previous report section. Whereas, a summary and analysis of surveyed district-to-district flows does not appear to have been conducted as a means of comparing observed and modeled trip matrices to further support the validation of the trip distribution model.

Issue Significance
Without conducting an assessment of district-to-district flows based on observed data it will not be possible to fully evaluate the validity of the trip distribution results. Incorrect or illogical trip movements that do not represent actual trip patterns can subsequently underlie screenline mismatches in the assignment stage and play a role in the assignment model's inability to accurately replicate observed counts.

Panel Recommendation
It was recommended that model trip matrices correspond to survey expanded origin-destination (OD) matrices by trip purpose and to sparingly use K-factors if necessary to improve the replication of observed regional trip movements.

External Travel Matrices

Issue Synopsis
The base year external-internal trip matrix does not represent observed base year conditions.

Overview
The estimation of external-internal attractions was based on regression equations similar to the trip generation approach previously summarized on page 4. Control totals for each external station were set equal to the observed traffic count. The external-external portion of the control total volume was based on observed external-external trips derived from roadside surveys. The external-internal amount equaled the external station traffic count minus the surveyed volume of external-external trips at each external station.

The external-external trip matrix was developed using observed origin-destination (OD) data obtained during the external station roadside survey. In contrast, the external-internal trip matrix was synthetically derived without any verification of, or comparison to observed trip patterns and average trip length. Apparently, a summary analysis of the survey data was not completed to support the development of an external-internal trip matrix.

Issue Significance
Apart from external-external trips, external-internal and home-based work trips tend to have the longest average trip lengths which in turn impacts total vehicle miles traveled (VMT). In addition, for smaller urban areas external-internal trips can constitute an ample portion of total trips and associated VMT. Consequently, an external-internal trip matrix that has no relation to actual trip patterns can undermine the assignment validation process.

Panel Recommendation
The peer review panel recommended that the MPO review the previously collected roadside survey data to determine whether any information exists that would support an update of the external-internal trip purpose. If no observed data exists then the panel also recommends obtaining internal-external and external-internal data.

Mode Choice

Mode Choice Model Structure

Issue Synopsis
In some instances the mode choice model yields counter-intuitive results.

Overview
The Cache MPO mode choice model formulation is a binary choice between auto and bus. The model is comprised of three separate regression based equations, one for each internal trip purpose, that estimate the auto share for the given trip purpose. The bus percentage is subsequently estimated by subtracting the auto percentage from 100 (e.g. HBW bus percent = 100 – HBW auto percent). The primary variables in the equations are auto ownership, transit accessibility and population. Following are the HBW and HBO equations:

HBW Auto =
-17.17*Ln(TA)+39.89*Ln(AOWN)-120.14

Where:
TA = Transit Accessibility
AOWN = Average Auto Ownership

HBO Auto =
0.0265*TVEH+0.0117*POP+99.81

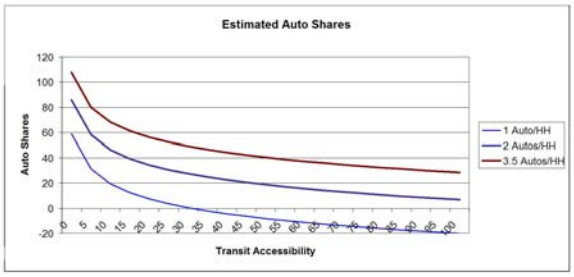
Where:
TVEH = Total Vehicle Ownership
POP = Population

NHB auto shares are estimated as a percentage of HBW auto shares.

Issue Significance
The structure of the HBW regression equation is such that estimated shares can exceed 100 percent or conversely be negative numbers. Figure 4 charts the estimated shares for one, two and 3.5

autos per household for a range of transit accessibility values between 0 and 100. For the one auto per household curve, estimated shares fall below zero past an accessibility value of 32. For 3.5 autos per household estimated auto shares are greater than 100 for accessibility values less than five. Previous experience with the model also suggests that the implied elasticities may be unreasonable, with nearly 25 percent of all zonal interchanges exceeding a 35 percent transit share. Mode choice errors are further exacerbated by the absence of time-of-day stratification to better account for variation in transit service levels.

Figure 4 – Estimated Auto Shares



Source: RSG, Inc. Peer Review Panel presentation

Panel Recommendation
The panel recommended that in the short-term the MPO replace the existing regression equations with a share-based pivot approach based on quality of service attributes. In the long-term it is recommended that the MPO implement a simple nested logit model that is either estimated or asserted as prescribed in the 1998 methodology report.

The peer review panel also recommended that the MPO gain a better understanding of transit markets and transit shares.

Trip Assignment

Vehicle Trip Table Factoring

Issue Synopsis
Prior to the traffic assignment step vehicle trip tables are factored to reduce the number of trips as a means of improving assignment results.

Overview
Model documentation is unclear as to whether auto-driver person trip tables are factored by auto occupancy to convert person trip tables to vehicle trip tables; however, model documentation does indicate that the internal trip purpose matrices are factored to reduce the overall number of trips, presumably as an indirect means of reflecting the presence of auto passenger trips. The peer review panel model presentation provided documentation that zone to zone volume interchanges are reduced between 1.3 percent and 15.2 percent resulting in an overall trip reduction of eight percent.

Issue Significance
Correcting an apparent model deficiency without investigating the underlying cause does not necessarily improve the overall model structure or model defensibility. In this instance, it appears that the model was yielding assigned volumes and vehicle miles traveled (VMT) considerably higher than observed data indicated as a result of the omission of auto-passenger, or other potential up-stream errors in the model. The approach taken to correct the problem was to reduce the number of trips input to assignment rather than ascertain whether the problem originated in prior model steps such as trip generation or trip distribution.

While the corrective action taken may have improved model results from a model validation perspective, the

inherent problem continues to exist and will be carried forward in future year model applications where the impact of correction factors may be less well understood. Consequently, the trip reduction factors that improved base year model results purely from a validation perspective may not be enough in future years such that forecasted traffic volumes may be over-assigned.

Panel Recommendation
The peer review panel recommended that zonal adjustment factors be eliminated and that the Cache MPO determine whether vehicle occupancy factors are applied at the end of mode choice to convert auto-driver person trip tables to vehicle trip tables.

Speed and Capacity Look-up Tables

Issue Synopsis
The network input speeds derived from the speed look-up table appear rather low. The capacity look-up table capacity values also appear low.

Overview
The Cache MPO model network input speeds vary by facility type and area type as shown in Table 3. Apart from centroid connector speeds, the speeds range from 32 miles per hour for principal arterials in rural residential areas to 20 miles per hour on residential streets in the central business district (CBD). Across facility types within a given area type and not including centroid connectors the look-up table speeds vary a maximum of four miles per hour. Across area types speeds vary eight miles per hour except for principal arterials which increase 10 miles per hour between CBD and rural area types. As a representative 24-hour network speed, the look-up table speeds appear to be low.

The hourly per lane capacities provided in Table 4 are based on the 1994 Highway Capacity Manual and are representative of level of service (LOS) C. These also vary by area type; however, as shown in Table 3 the residential street facility capacities are the same for all area types and collector capacities are only slightly higher for the CBD area type.

In reviewing the speed and capacity look-up tables it was noted that the values used in both tables appeared low.

Issue Significance
Network speeds traditionally play a key role in trip distribution and trip assignment. In trip distribution the speeds are applied to calculate travel times on all links which are subsequently used in determining minimum travel times for all zone pairs to develop the skims matrix or travel time matrix.

In the trip assignment step speeds are utilized to determine the first iteration minimum travel time path between all

Table 3 – Speed Look-up Table

	Facility Type				
Area Type	Principal Arterial	Minor Arterial	Urban/Rural Collector	Residential Street	Centroid Connector
CBD	22	22	22	20	10
Outer CBD	24	22	22	20	10
Rural/Residential	32	30	30	28	15

Source: "*Cache Valley Corridor Model Development and Validation Report", May 1999*

Table 4 – Capacity Look-up Table

	Facility Type				
Area Type	Principal Arterial	Minor Arterial	Urban/Rural Collector	Residential Street	Centroid Connector
CBD	650	550	550	450	10,000
Outer CBD	750	600	500	450	10,000
Rural/Residential	850	750	500	450	10,000

Source: "*Cache Valley Corridor Model Development and Validation Report", May 1999*

zone pairs and are the basis for the initial travel time on all links that is adjusted for all subsequent assignment iterations based on the applied volume to delay function.

Consequently, low speeds raise two concerns:

- Validity of travel times for all zone pairs
- Relationship of model speeds and resulting average trip length

Panel Recommendation

The peer review panel recommended that the Cache MPO revisit the speed and capacity look-up tables and that the derivation of speeds should be based on posted speed limits.

The limited use of only four functional classifications was questioned with regard to development of network capacities and speeds and overall assignment results.

Additional Recommendations

In addition to the recommendations noted above the Peer Review Panel also offered the following observations and comments:

Trip Generation

Two trip generation issues were highlighted by the peer review panel. One issue concerned different definitions of employment categories used in the base and forecast year. This arose from the possible omission of job categories from the three employment categories (e.g. including construction jobs in the forecast year employment definition but not in the base year). The second issue addressed the treatment of the university as a special generator and apparent double counting of trip attractions to the university. The panel suggested that additional trip purposes such as school and university may be worth considering.

Trip Distribution

The panel noted that a better understanding of travel markets, such as university student travel segments, would be beneficial for model development. The peer review panel also noted concerns regarding the use of a doubly constrained trip distribution model, the lack of terminal times and lack of a discussion in the model documentation regarding intra-zonal trips. In addition, the panel recommended that the MPO consider an analytical approach for future travel estimates such as frataring certain trip estimates (e.g. external-external trip matrices) and exploring approaches that include the incorporation of 'attractiveness' factors for each external gateway (NCHRP 365).

Transit Network

As noted previously, the local transit system primarily consists of ten routes circulating within Logan, Utah. There are also two additional routes, a northern and southern route, which connect outlying towns to Logan. During the review of the mode choice component the peer review panel noted the absence of a coded transit network as an issue for the Cache MPO to address during subsequent model updates. Further examination of existing ridership patterns for the student population will also likely be important for future model choice model development efforts.

Trip Assignment

Several peer review panel observations focused on addressing issues that would have immediate benefits in the traffic assignment step. It was noted that many side-by-side zones had centroid connectors coded to the same link node thus allowing trips to travel from one zone to the other without traversing a non-centroid link.

It was also recommended that the MPO ensure that the current model does indeed use an equilibrium assignment procedure and not an incremental assignment procedure as stated in the model documentation. Similarly, that the MPO consider its use of a single volume delay function for all functional classes, and to use the relative gap parameter in the CUBE software package.

Finally, it was recommended that time-of-day assignments such as peak and off-peak assignments also be considered, which will be particularly important as existing facilities that may be uncongested today experience traffic growth that will result from an anticipated increase in jobs and households.

Model Calibration and Validation

For model calibration the peer review panel recommended that the MPO attempt to control error propagation through stepwise calibration of each model component and that the MPO develop calibration standards for each model step.

The panel recommended that additional comparative checks against observed data be conducted during the model validation process. The following data sources were cited by the panel:

- Traffic counts, specifically the use of highway performance monitoring system (HPMS) data
- Transit ridership data
- District to district travel flows
- Route profile information such as boardings and alightings
- Auto occupancy data
- Trip rates sources such as ITE (Institute of Transportation Engineers)

Examination and review of observed and model travel times were recommended for highway and transit networks during peak and off-peak travel times. A comparison of model and observed speeds in key corridors was also suggested.

The panel also suggested that the transit on-board trip tables be assigned to check for reasonable results and that the MPO should take advantage of the Utah statewide model effort and the Wasatch Front Regional Council (WFRC) model efforts for additional data and guidance.

Sensitivity Tests

The peer review panel recommended that a number of sensitivity tests be conducted as part of the model development process; these included:

- Network changes
- Land use changes
- Other input assumptions
- Dynamic calibration

Future Model Development and Administration

It was suggested that for all future model development and applications that the MPO ensure consultant delivery of all required products including the following:

- Model users manual
- Model calibration report
- Model estimation data set
- Control mechanism for usage

The panel noted that a dedicated staff person should be available to run the model and that access to an up-to-date computing environment be provided. It was also suggested that an acceptance testing program be instituted to verify the validity of the delivered model.

Looking ahead the MPO should also plan for periodic model updates (e.g. every three to five years) and identify and incorporate local issues of significance. On the other hand, it was also noted that demonstrating roadway capacity need has become a critical step and the use of travel models have become the standard for establishing such needs; however, a small MPO such as Cache would require a considerable number of years to accumulate the necessary funds to improve their model. Consequently, an adequate travel model will not likely be developed without UDOT taking a stronger role in setting standards, providing support (financial and technical), and instructing their regional offices and project managers in the need to support the local modeling process.

Finally, the panel recommended that the existing large and rural zones be subdivided for the 2010 census.

Appendix A

CMPO Model Documentation

1. MK Centennial in association with Wilbur Smith Associates. “Cache Valley Corridor Model Development Methodology”, August 1998.

2. MK Centennial and Wilbur Smith Associates. “Cache Valley Corridor Model Development and Validation Report”, May 1999.

3. MK Centennial in association with Wilbur Smith Associates. “Cache Valley Corridor Model Data Collection Methodology”, May 1998.

Appendix B

List of Peer Review Panel Participants

Peer Review Panel Members:

Name	Affiliation
MaryAnn Waldinger	Community Planning Association (COMPASS)
Guy Rousseau	Atlanta Regional Commission (ARC)
Mick Crandall	Utah Transit Authority (UTA)
Eric Pihl	Federal Highway Administration (FHWA) Resource Center

Supporting Staff to Peer Review Panel Members:

Name	Affiliation
Phillip Reeder	Texas Transportation Institute (TTI)

Local Agency Staff:

Name	Affiliation
Walt Steinvorth	Utah Department of Transportation
Jeff Gilbert	Cache Metropolitan Planning Organization (CMPO)
Tim Boschert	Utah Department of Transportation
Curt Hutchings	Dixie Metropolitan Planning Organization (DMPO)
Lowell Elmer	Dixie Metropolitan Planning Organization (DMPO)
Kelly Lund	Federal Highway Administration
Stephen Law	Resource Systems Group, Inc.
Chad Worthen	Resource Systems Group, Inc.
John Lobb	Resource Systems Group, Inc.
Ivan Hooper	Resource Systems Group, Inc.
Matt Riffkin	Interplan
Michael R. Brown	WCEC Engineers, Inc.

Appendix C

Peer Review Panel Meeting Agenda

Travel Model Improvement Program (TMIP)
Cache MPO – Logan, UT and Dixie MPO, St. George, UT

August 26- 27, 2008
UDOT Region Two, 2010 South 2760 West Salt Lake City, UT 84104
Hurley Conference Room

AGENDA

August 26, 2008

I. Welcome / Introductions	Steinvorth	8:00 - 8:20 a.m.

TMIP participant introductions
Panel Introductions

- MaryAnn Waldinger, Community Planning Association (COMPASS)
- Mick Crandall, Utah Transit Authority (UTA)
- Guy Rousseau, Atlanta Regional Commission (ARC)
- Eric Pihl, Federal Highway Administration (FHWA)

II. Organization Structure / Model history	CMPO - Jeff Gilbert DMPO – Lowell Elmer	8:20 - 9:00 a.m.
III. Peer Review Key Objectives	Steinvorth / Panel	9:00 - 9:45 a.m.

- Model Uses
  - LRP / TIP Development
  - Infrastructure Growth
  - Air Quality / SIP
  - Project Analysis / NEPA
  - other

Break 9:45 - 10:00 a.m.

IV. Travel Demand Model Investigation	(CMPO)	10:00-12:00 p.m.

- Study Area
- Network Development
- Data Inputs and structure (demographics)
- Trip Generation / Trip Purpose
- Trip Distribution
- Mode Choice

Lunch		12:00-1:00 p.m.
V. Travel Demand Model Investigation ❖ Trip Assignment ❖ Daily / Peak Hour ❖ Transit Assignment/ other	(CMPO) continued	1:00 - 2:30 p.m.
Break		2:30 - 2:45 p.m.
VI. Travel Demand Model Investigation ❖ Study Area ❖ Network Development ❖ Data Inputs and structure (demographics) ❖ Trip Generation / Trip Purpose ❖ Trip Distribution ❖ Mode Choice	(DMPO)	3:00 - 5:00 p.m.

Adjourn 5:00 p.m.

<u>August 27, 2008</u>

Welcome Day Two		8:00 - 8:30 a.m.
VII. Travel Demand Model Investigation ❖ Trip Assignment ❖ Daily / Peak Hour ❖ Transit Assignment/ other	(DMPO) continued	8:30 - 10:30 a.m.
Break		10:30 - 10:45 a.m.
VIII. Current Model and Future Enhancements	(CMPO & DMPO)	10:45 - 12:00 p.m.
Lunch		12:00 - 1:00 p.m.
IX. Question and Answer – follow up ideas	(CMPO & DMPO)	12:00 - 1:00 p.m.

(Lunch work session to address any additional questions or discussion items from the current and previous day's information.)

X. PANEL CAUCUS – (PANELISTS ONLY)	1:00 - 3:00 p.m.
XI. PANEL REPORT AND DISCUSSION CMPO 3:00-4:00 p.m. DMPO 4:00-5:00 p.m.	3:00 - 5:00 p.m.
XII. WRAP-UP	5:00 p.m.

Dress is business casual