Review of Consultant Recommendations from FY 2012-2014 of the COG/TPB Travel Demand Modeling Consultant-Assistance Project

Task Order 15.1, Draft Report

prepared for

Metropolitan Washington Council of Governments/
National Capital Region Transportation Planning Board

prepared by

Cambridge Systematics, Inc.

June 30, 2015

Table of Contents

List of Tables

1.0 Introduction

The National Capital Region Transportation Planning Board (TPB) is the metropolitan planning organization (MPO) for the Washington, D.C. metropolitan area and is one of several policy boards that regularly meet at the Metropolitan Washington Council of Governments (COG). TPB is staffed by the COG Department of Transportation Planning (DTP). Since 2005 (FY 2006), COG/TPB staff has maintained a consultant-assistance project to provide assistance with the development and application of the COG/TPB travel demand model.

In 2012, COG/TPB staff performed a review of the first six years (FY 2006-2011) of the consultant-assistance project and documented the review in a report.[1] The report covered over 100 consultant recommendations that had been made over the first six years of the consultant assistance project. Recommendations were grouped into about 25 topic areas. For each topic area, the report included two sections:

- Summary of the consultant findings and recommendations;
- Discussion and COG/TPB staff response.

Following the release of the 2012 report, there were three more years of the consultant-assistance project (FY 2012-2014) during which the on-call consultant was AECOM. During this time, AECOM wrote three end-of-fiscal year reports:

- FY 2012 Report – henceforth referred to as "2012 Report".[2]
- FY 2013 Report – henceforth referred to as "2013 Report";[3] and
- FY 2014 Report – henceforth referred to as "2014 Report."[4]

[1] Mark S. Moran, Mary Martchouk, and Ronald Milone, *TPB Staff Review of Six Years of Consultant Recommendations from the Ongoing Consultant-Assisted Project for Models Development*, Final Report (Washington, D.C.: National Capital Region Transportation Planning Board, Metropolitan Washington Council of Governments, July 19, 2012).

[2] AECOM and Stump/Hausman Partnership, *FY 2012 Draft Final Report, COG Contract 12-006: Assistance with Development and Application of the National Capital Region Transportation Planning Board Travel Demand Model* (National Capital Region Transportation Planning Board, Metropolitan Washington Council of Governments, July 13, 2012).

[3] AECOM and Stump/Hausman Partnership, *Draft FY 2013 Final Report, COG Contract 12-006: Assistance with Development and Application of the National Capital Region Transportation Planning Board Travel Demand Model* (National Capital Region Transportation Planning Board, Metropolitan Washington Council of Governments, July 1, 2013).

[4] AECOM, *FY 2014 Final Report, COG Contract 12-006: Assistance with Development and Application of the National Capital Region Transportation Planning Board Travel Demand Model* (National Capital Region Transportation Planning Board, Metropolitan Washington Council of Governments, August 18, 2014).

Since COG/TPB staff has not yet had the time to prepare a formal document providing the COG/TPB response to the recommendations in these three reports, in August 2014, staff proposed to Cambridge Systematics, Inc. (CS), the current on-call consultant, that CS could review the three end-of-fiscal-year reports and write a memo or short report indicating whether CS agreed with or disagreed with the AECOM recommendations.

CS has now completed that review. This report compiles the recommendations made and provides a comment and assessment on each one.

The end-of-fiscal year reports from AECOM generally included a final chapter called "Summary of Recommendations." There were 16 recommendations or findings from FY 2012, eight recommendations or findings from FY 2013, and 11 recommendations or findings from FY 2014, for a total of 35 recommendations or findings.

To aid the reader of this report, we have used a numbering convention for recommendations that indicates which of the three reports contained the original recommendation, specifically:

<last two digits of fiscal year>.<recommendation number>

For example, the 2012 report included recommendations 12.1 through 12.16.

Note that some of the "recommendations" are not actual recommendations, but rather are findings or statements of fact. For example, recommendation 14.1 was "AECOM demonstrated that the percent walk to transit process using ArcPy and Cube was successfully integrated with the TPB modeling process while removing the dependency on a full implementation of ArcGIS, but still maintaining compatibility with it." This report addresses only the recommendations, not the statements of fact.

2.0 Discussion of Recommendations

Cambridge Systematics has divided the consultant problem statements and recommendations into five broad categories, as follows:

1. Software issues;
2. Model inputs;
3. Model components/structure;
4. HOT/managed lane modeling; and
5. Transit modeling.

Each model category comprises a variety of subcategories that are consistent with the subcategories in the 2012 COG/TPB report.[5] The relationship between categories and subcategories is represented in Table 2.1.

[5] Moran, Martchouk, and Milone, *TPB Staff Review of Six Years of Consultant Recommendations from the Ongoing Consultant-Assisted Project for Models Development*.

Table 2.1 Relationship between Model Categories and Subcategories

Model Categories	Model Sub Categories
Software issues	Review of Modeling Software
Software issues	Review of TPB Scripts
Software issues	Reducing Run Times
Software issues	Speed Feedback
Model Inputs	Model Inputs
Model Inputs	Aging Population
Model Inputs	Fuel Prices
Model Components/Structure	Trip Generation
Model Components/Structure	Trip Distribution
Model Components/Structure	Mode Choice
Model Components/Structure	Special Generators
Model Components/Structure	Time of Day
Model Components/Structure	Trip Assignment
Model Components/Structure	Externals
Model Components/Structure	Modeling Land Use/Smart Growth
Model Components/Structure	Socioeconomic Models
HOT/Managed Lanes	HOT/Managed Lanes
Transit	Transit
Not Addressed in 2012, 2013, or 2014 Reports	Data Collection/Surveys
Not Addressed in 2012, 2013, or 2014 Reports	Walk/Bike Trips
Not Addressed in 2012, 2013, or 2014 Reports	Sensitivity of Regional Model
Not Addressed in 2012, 2013, or 2014 Reports	Screenlines/ Cutlines
Not Addressed in 2012, 2013, or 2014 Reports	Trip Purposes
Not Addressed in 2012, 2013, or 2014 Reports	Activity-Based Modeling

The remainder of this section presents each of the AECOM recommendations, sorted by category and subcategory, along with

- the CS comment on the recommendation;
- the CS assessment of the recommendation;
- the level of effort (i.e., low, medium, or high); and
- the importance of the recommendation (i.e., low, medium, or high).

2.1 Software issues

2.1.1 Review Modeling Software

AECOM Recommendation 12.1

"AECOM recommends performing a TransCAD assignment using all of the network attributes and trip tables from a congested MWCOG Version 2.3 model application. This will provide a direct software comparison that could help Citilabs focus on any assignment convergence issues that may be identified" (2012 Report, p. 9-1). Discussion of this topic can be found on pages 2-1 to 2-5 of the 2012 Report.

CS Discussion

Comment

In 2011, the TPB Version 2.3 travel demand model (Ver. 2.3.18) used a traffic assignment stopping criterion of either 300 user equilibrium (UE) iterations or a relative gap threshold of 10^{-3}, whichever came first. Although this stopping criterion appeared to be suitable for most regional analyses, TPB staff did find that there were some studies where a more stringent stopping criterion, such as a relative gap threshold of 10^{-4}, was needed. TPB staff noted some cases where the relative gap values seemed to "flat line," instead of gradually dropping as more UE iterations are performed (see, for example, p. 2-2 of the 2012 Report). Citilabs provided a proposal to eliminate the flat lining (adding a COST function to the highway assignment script). The Citilabs' fix seemed to correct the convergence issues with the traffic assignment, but it also increased the run times by 50 percent.

AECOM recommended performing a TransCAD assignment using all of the network attributes and trip tables from a congested TPB Version 2.3 model application. Although AECOM did perform some test assignments using TransCAD, the tests were performed with the M-NCPPC TransForM model, not the TPB travel model. Subsequent to the 2012 Report, TPB staff did not follow up with AECOM to ask that the more formal TransCAD test be performed using the COG/TPB travel model.

Assessment

TPB implemented the "progressive relative gap" process with a bi-conjugate Frank-Wolfe algorithm in Version 2.3.52, using a relative gap threshold of 10^{-4} in the final speed feedback (SFB) iteration (iteration #4). This process has improved convergence in traffic assignment without significantly increasing run time (compared to using 10^{-3} in all five SFB iterations). Achieving a pure, direct software comparison would be challenging. It may, however, still be worthwhile to explore software options, including engaging with alternative packages through a variety of tests. Although several software vendors have offered to perform no-obligation benchmark testing of traffic assignment with the COG trip tables and networks, it might be preferable to have CS perform this work so that there is consistency of hardware across the tests.

- Level of Effort: Low
- Importance: High

2.1.2 Review of TPB Scripts

There were two recommendations offered under this subcategory, described below along with accompanying comments.

AECOM Recommendation 12.2

"AECOM recommends constructing fewer input files that directly serve the needs of multiple programs or scripts. We also recommend reconfiguring the programs and scripts to write fewer output files" (2012 Report, p. 9-1). Discussion of this topic can be found on page 2-8 of the 2012 Report.

CS Discussion

Comment

The Version 2.3 travel model includes a large number of input and output files. Some of the information contained in these files is redundant. For example, the station file (station.dbf), which is used in transit path-building and includes information about transit stations, and the station names file (station_names.dbf), which is used for transit assignment, contain redundant information (station names). Conceivably, one could re-configure a number of Cube Voyager scripts, inputs, and outputs to reduce both redundancy and the number of input and output files.

The recommendations to improve overall model efficiency included 1) constructing fewer input files that directly serve the needs of multiple programs or scripts 2) reconfiguring the programs and scripts to write fewer output files 3) Consolidating all of the various record types needed for coding TRNBUILD access links into a single file.

Assessment

TPB has streamlined the model file management and model procedures in the latest updates of the model (Version 2.3.52 and Version 2.3.57), including implementing more consistent naming of output files, deletion of intermediate/temporary output files, and update of four transit path-building/skimming scripts and the four "assemble skims" scripts to output matrix files in Cube Voyager format with proper names. However, more could probably be done in this area. Unfortunately, some of the efficiencies envisioned by AECOM are not explicitly spelled out, so there may be a modest level of work needed to spell out the desired steps to streamline, and then to carry out the work.

- Level of Effort: Low
- Importance: Medium

AECOM Recommendation 12.4

"AECOM recommends adding logic to the modeling process that minimizes the possibility of conflicts between multiple applications running on the same computer at the same time." (2012 Report, p. 9-1). Discussion of this topic can be found on pages 2-8, 2-9, 5-6, and 6-2 of the 2012 Report.

CS Discussion

Comment

Enhanced parallelization can improve model run times as discussed in the report. Adding logic to minimize conflicts between multiple applications could facilitate a greater degree of application stability when engaged in parallel processing. Ultimately, this could also benefit how much processing time is necessary for a set of model runs. Related recommendations include: 1) redesign of the process to utilize more CPUs and 2) fixing issues with batch processing where the batch files overwrite environment variables.

Assessment

TPB staff has taken steps to reduce model run times and improve efficiencies, including use of enhanced parallelization. To the extent that additional opportunities to address these issues remain present, it would be worthwhile to explore them further.

- Level of Effort: Medium
- Importance: High

AECOM Recommendation 12.5

"AECOM recommends that MWCOG consider some of the processing changes and software tools developed for the WMATA post-processor. We believe it is in the best interest of both agencies and the region to minimize the differences between the two modeling processes" (2012 Report, p. 9-1). Discussion of this topic can be found on pages 2-5 to 2-9 of the 2012 Report.

CS Discussion

Comment

The most significant change that AECOM made in its modeling work for WMATA was related to the mode choice model (2012 Report, p. 2-5). This is discussed later in this report in the "mode choice" section. AECOM also discussed issues related to Cube Cluster, for example:

Cube Cluster enables the software to execute some procedures in parallel. It uses a list of processor IDs to identify the processing instances that relate to a given application. For the most part, the WMATA process executes multiple instances of a given program rather than multiple threads within a program. There is, however, at least one matrix processing step that

takes advantage of Cube Cluster parallel processing. If two alternatives are running at the same time using the same processor IDs, Cube Cluster is unable to identify which processors belong to each program and as a result will close the second process prematurely when it exits the first process. This does not generate any error messages. (pp. 2-8 to 2-9 of the 2012 Report).

AECOM appears to be referring to a problem with the WMATA post processor model. It is not clear from the statement if this problem also afflicts the TPB model.

The AECOM recommendations include using "new software tools" (p. 2-9 of the 2012 Report) that are "distributed through the TRANSIMS Open Source site." It is presumed that AECOM is referring to the ModeChoice application program, the LINESUM transit summary program, and possibly others. The TPB model already makes use of LINESUM and preliminary work has been done to move to ModeChoice (see, for example, Chapter 10 of the 2013 Report).

Assessment

TPB has enhanced parallelization in Version 2.3.52, using multi-step distributed processing (MDP), intra-step distributed processing (IDP), and native Windows techniques. Additional exploration of improving parallel processing capabilities, however, could be worthwhile. Again, migrating from the AEMS mode choice application program to the ModeChoice program is discussed in the "mode choice" section.

- Level of Effort: Low
- Importance: Medium

2.1.3 Reducing Run Times

There were two recommendations offered under this subcategory, each discussed below.

AECOM Recommendation 12.9

"AECOM recommends implementing Intra-step Distributed Processing (IDP) and Multi-step Distributed Processing (MDP) to the fullest extent possible. We also recommend making [it] easier to use more than four CPUs when the computer resources are available and the results are not affected by the change" (2012 Report, p. 9-1). Discussion of this topic can be found on pages 5-1 to 5-11 of the 2012 Report.

CS Discussion

Comment

Utilizing intra-step distributed processing (IDP) and multi-step distributed processing (MDP) capabilities in Cube was recommended. According to the Cube Voyager Reference Guide (ver. 5.1.3), IDP breaks up zone-based processing in a single step into zone groups that can be processed concurrently on multiple computing nodes (p. 976). MDP breaks up blocks of one or more modeling steps and distributes them to multiple computing nodes for processing (p.

977). Unlike IDP, which can be used only with HIGHWAY and MATRIX steps, MDP can be used for any modeling step.

Implementing IDP and MDP to the fullest extent possible was recommended. It was also recommended to make it easier to use more than four CPUs when the computer resources are available and the results are not affected by the change.

Assessment

TPB has enhanced parallelization in Version 2.3.52, using MDP, IDP, and native Windows techniques. To the extent that additional opportunities to address these issues remain present, it would be worthwhile to explore them further.

- Level of Effort: Medium
- Importance: Medium

2.1.4 Speed Feedback

AECOM Recommendation 13.4

The availability of better-quality observed speed data, such as provided by INRIX, has served only to further highlight the fact that static models do not generate realistic speeds. Since the primary purpose of estimating speeds in a static assignment model is to produce reasonable traffic volumes, it is inadvisable to be overly ambitious in calibrating volume-delay functions that reproduce observed speeds at the expense of reproducing observed traffic counts. (2013 Report, p. 11-1)

Discussion of this topic can be found in Chapters 5 and 6 of the 2013 Report.

CS Discussion

Comment

The availability of observed speed data does create increased pressure to work to address validation of this modeling dimension. Model travel times are used as an important input to trip distribution, the output of which, in turn, serves as an input to traffic and transit assignment processes. Reviewing modeled travel speeds for their relationship to observed data could be informative. According to a TMIP white paper on the subject of travel model validation practices, "many regions attempt to develop traffic assignment procedures that produce valid traffic speeds concurrently with valid traffic assignments."[6] However, the same white paper says that traditional model validation tends to focus on demonstrating sufficient ability to reproduce highway counts and transit line volumes. The white paper includes

[6] Cambridge Systematics, Inc., "Travel Model Validation Practices Peer Exchange White Paper," Prepared for Federal Highway Administration, 2008 http://www.fhwa.dot.gov/planning/tmip/publications/other_reports/travel_model_validation/model_validation.pdf accessed April 2015.

suggestions to improve validation practices, including looking at speed and travel time matching.

Assessment

Since there can be difficulty matching travel times through a network with a standard static assignment model, a balance should be maintained between spending resources on obtaining and validating to observed speed data (which may also prove more difficult) and obtaining and validating to observed counts. Supporting the notion of balancing the level of resources devoted to this effort, a body of literature exists documenting efforts, particularly to incorporate dynamic effects into models, to improve on static assignment methods to arrive at better travel time representations in networks[7]. Thus, regarding the idea of re-calibrating volume-delay functions so that they better reproduce observed traffic speeds, the following assessment has been made:

- Level of Effort: High
- Importance: Low

AECOM Recommendation 13.5

The fact that the MWCOG model generates consistently lower peak-period speeds on freeways, compared to the INRIX data, suggests it may be desirable to adjust the volume-delay function used for freeways to generate more realistic speeds and travel times. Additional detailed traffic counts on freeway facilities where INRIX speed data are available would need to be collected to properly calibrate the volume-delay function. (2013 Report, p. 11-1)

Discussion of this topic can be found on pages 6-21 and 6-22 of the 2013 Report.

CS Discussion

Comment

Pursuing this recommendation would potentially improve a dimension of validation for the regional model. Having a closer match to observed data on grade-separated facilities could enhance confidence in using the model for future scenario decision support.

Assessment

It seems worthwhile to pursue if data and resource limitations permit. However, there are other current model limitations that we would suggest be given a higher priority to address if resources are a constraint.

- Level of Effort: Medium

[7] Youngblom, Eric, "Travel Time in Macroscopic Traffic Models for Origin-Destination Estimation" (2013). *Theses and Dissertations. Paper 185.* (http://dc.uwm.edu/cgi/viewcontent.cgi?article=1188&context=etd&sei-redir=1 accessed April 2015)

- Importance: Medium

2.2 Model Inputs

2.2.1 Error Checking Automation

AECOM Recommendation 12.3

"AECOM recommends including additional error checking in the process to minimize the possibility of application errors" (2012 Report, p. 9-1). Discussion of this topic can be found on page 2-8 of the 2012 Report.

CS Discussion

Comment

Improved error checking was recommended, accompanied by an example:

The current TPB process assumes the node number assigned to a Metrorail station is between 8001 and 8150. If the number is greater than 8150, the station-to-station distance calculations are all zero and the Metrorail fare to any station is zero. This makes the Metrorail ridership too high. In addition, each Metrorail station is assigned a 5000 series "zone" number as part of the drive access time calculation. A highway path builder is executed to build a path from each origin zone to these station zones. If the station zone number is not included in the highway skim file used by the drive access routine, the drive time to the station is zero. This leads to excessive park-and-ride and kiss-and-ride demand at the station. (2012 Report, p. 2-8)

Assessment

Where possible, error checking should be automated in order to maintain efficiency. TPB has continuously refined the model network, including the node numbering system such as a latest modification in node numbering allocation to LRT, BRT, and streetcar stations.

- Level of Effort: Low
- Importance: Medium

2.3 Model Components/Structure

Five of the eight recommendations under this category fell under the Mode Choice subcategory, discussed first. The three remaining subcategories are discussed after the mode choice recommendations.

2.3.1 Mode Choice

AECOM Recommendation 14.11

The initial attempt to re-calibrate the mode choice model [for WMATA] raised a number of data preparation challenges that should be revisited and researched in more detail. In particular the distribution of incomes by mode and geographic market segment was difficult to estimate accurately. One possible approach to addressing this complication may be to reduce or replace the number of geographic market segments. Migrating to a Pedestrian Environment Factor (PEF) concept may be helpful in this regard. The PEF approach can capture some of the sensitivities represented by the geographic market segments, but is also able to consider how future changes in land-use patterns and development densities impact transit demand. (2014 Report, p. 8-2)

CS Discussion

Comment

The current COG/TPB mode choice model (Ver. 2.3.57) uses three types of market segmentation: household income, geography, and access to transit. The market segmentation by geography is based on seven superdistricts, developed by AECOM in 2004-2005, which are combined into 20 origin/destination market segments.[8] AECOM has recommended migrating away from the 20 geographic market segments, which is now out of favor with the FTA, toward a zone-based variable, such as the Pedestrian Environment Factor (PEF). As noted earlier in the report, the most significant change that AECOM made in its modeling work for WMATA was related to the mode choice model (2012 Report, p. 2-5). For example, first, AECOM migrated from using the Fortran AEMS mode choice application program to using the C++ ModeChoice mode choice application program. Second, AECOM changed from using 20 geographic market segments to a scheme that made use of pedestrian environment factors (PEFs). Third, AECOM uses six models (HBW peak, HBW off-peak, HBO peak, HBO off-peak, NHB peak, and NHB off-peak), compared to COG's five models: HBW for the peak period and the other purposes (HBS, HBO, NHW, and NHO) for the off-peak period. WMATA has expressed interest in COG/TPB moving to the PEF approach.[9]

It has been the view of the TPB staff that, before considering making these changes, especially the move to the PEF, staff would like to see documentation on the associated mode choice calibration/validation work. COG/TPB staff has had difficulty obtaining formal documentation on the calibration/validation work. COG/TPB staff met with AECOM staff at AECOM on September 18, 2009 to discuss the PEF approach. At that time, COG/TPB staff were provided

[8] See pp. 169-172 of Milone, Moran, and Seifu, *User's Guide for the MWCOG/NCRTPB Travel Forecasting Model, Version 2.3, Build 57: Volume 1 of 2: Main Report and Appendix A (Flowcharts)*.

[9] Mark S. Moran to Ronald Milone et al., "Meeting Summary and Points of Agreement from the February 11, 2015 Meeting between WMATA and COG/TPB Staff Regarding Transit-Related Improvements to the COG/TPB Regional Travel Demand Model," Memorandum, (March 2, 2015).

with a document from a study where the approach was used,[10] but, after reviewing this 2008 documentation, COG/TPB staff continued to have a number of unanswered questions.[11] Consequently, COG/TPB staff did not feel that they understood the PEF approach well enough to consider it ready for inclusion into the regional model. On October 4, 2011, AECOM notified COG/TPB staff that there was, in fact, no formal validation memo/report on the PEF approach. In its place, AECOM sent COG/TPB staff a portion of a presentation that was made for a Columbia Pike transit study, which included a discussion of the use of the PEF approach.[12] About a month later, AECOM provided a memo that discussed the modeling work it had done for WMATA, including a description of the work it had done with the PEF. Although none of these documents is equivalent to a formal validation report, they do provide the starting point for considering the pros and cons of moving from the 20-geographic-market-segment approach to the PEF approach.

Assessment

Reducing or eliminating geographic market segment constants is desirable. Such constants dampen the model's sensitivity to change and have been frowned upon in other applications. For example, regarding mode choice and the use of geographic constants, the Peer Review for the North Jersey Transportation Planning Authority (NJTPA) noted, "Mode and geographic constants should be changed to reflect more realistic expectations for precision or replication. NJTPA should be careful not to get too involved in accurate calibration."[13] PEFs have been used in some MPO models, but there are potential resolution and forecasting issues and a wide range of other variables are considered for use in current nonmotorized and mode choice modeling[14]. Careful consideration will need to be given to what indicator variables to use to help move away from geographic constants and also to how to set future year values for these variables.

- Level of Effort: High
- Importance: High

[10] AECOM Consult, Inc., "VRE Haymarket Extension Model Update," Technical Memorandum, (November 2008).

[11] Mark S. Moran and Mary Martchouk to Files, "Questions for AECOM Consult Regarding the WHATS/VRE Nested-Logit Mode Choice Model with the Pedestrian Environment Factor," Memorandum, (September 22, 2009).

[12] AECOM Consult, Inc., "Columbia Pike Transit Initiative (pp. 7-26, an Excerpt of the Full Presentation)," June 21, 2010.

[13] Volpe National Transportation Systems Center, "Summary Report of the Peer Review Panel for the North Jersey Transportation Planning Authority Travel Model Improvement Effort," prepared for U.S. Federal Highway Administration Travel Model Improvement Program (2005). (http://www.fhwa.dot.gov/planning/tmip/resources/peer_review_program/njtpa/ accessed April 2015).

[14] Liu, Feng, John E. (Jay) Evans, and Thomas Rossi. "Recent Practices in Regional Modeling of Non-Motorized Travel," Transportation Research Record 2303, Transportation Research Board (2012).

AECOM Recommendation 12.13

"Stump/Hausman recommends that the air passenger model be recalibrated (for all modes) using the most recently available air passenger survey." (2012 Report, p. 9-2).

CS Discussion

Comment

As new air passenger survey data becomes available, adjustments should be made in the regional model to take advantage of the new data.

Assessment

- Level of Effort: High
- Importance: Low

AECOM Recommendation 13.8

"Migrating the MWCOG mode choice model from the AEMS software to the ModeChoice program will reduce processing time, increase flexibility, simplify calibration efforts, and improve software maintenance." (2013 Report, p. 11-2). Discussion of this topic can be found in Chapter 10 of the 2013 Report.

CS Discussion

Comment

This recommendation was implemented only in terms of testing in Task Order 13 in FY 2014. See Recommendation 5, below.

Assessment

- Level of Effort: N/A (See next recommendation)
- Importance: N/A (See next recommendation)

AECOM Recommendation 14.10

The ModeChoice software was able to replicate the results of the AEMS software near perfectly while reducing run times by 50 percent or more. The ModeChoice software offers many additional advantages that recommended it as well. The user interface approach and the expanded calibration features are among the more important. (2014 Report, p. 8-2)

Discussion of this topic can be found on page 7-19 of the 2014 Report.

CS Discussion

Comment

Migrating from the legacy mode choice program provides greater transparency and serviceability. The migration demonstration to ModeChoice appears to show the ability to replicate the legacy program. In the short term, COG/TPB staff could incorporate the new ModeChoice application program in the existing COG model, without any new re-calibration (as discussed in Chapter 7 of the 2013 Report). Over the long term, once the migration to PT is complete, one could recalibrate the mode choice model using the travel time matrices derived from PT. The mode choice model calibration should also be considered in the broader context of options for improving the transit modeling capability. Additional information regarding the benefits of the user interface approach and the expanded calibration features are needed. The level of effort needed to mechanically insert the new ModeChoice model should be relatively low. The level of effort needed to re-calibrate the ModeChoice model would be "medium."

Assessment

- Level of Effort: Medium
- Importance: High

2.3.2 Airport Choice Model

AECOM Recommendation 12.14

"A partial Airport Choice model was recommended to address the portion of travelers that choose an airport based on distance and/or travel time." (2012 Report, p. 9-2).

CS Discussion

Comment

Developing an air passenger model that has policy and service level sensitivity could enable the regional model to provide additional decision support. Air passengers tend to have different travel patterns and values of time compared with commuters. Thus, an airport choice model can be developed as an external module and then integrated just before the assignment step (i.e., produce a model-derived air passenger trip table rather than a static one).

Assessment

- Level of Effort: High
- Importance: Low

2.3.3 External Model

AECOM Recommendation 12.15

Stump/Hausman suggests that MWCOG investigate revising the external trip model so that it estimates person trips instead of only vehicle trips. This includes changes to transit network coding and the mode choice model to permit that model to specifically include external trips. (2012 Report, p. 9-2)

CS Discussion

Comment

This improvement could help address considering travel options for long-distance commuter markets. TPB has been investigating use of the AirSage data for its potential use in estimating external travel, in combination with vehicle counts at external stations; new data sources could enhance the ability to develop more sophisticated external trip models.

Assessment

- Level of Effort: High
- Importance: Low

2.3.4 Visitor Model

AECOM Recommendation 12.16

"Stump/Hausman recommends that a separate four-step model of Visitor travel be developed for the MWCOG region." (2012 Report, p. 9-2).

CS Discussion

Comment

Although the 2010 Air Passenger Survey could serve as one data source, a separate visitor survey or other appropriate data source would be needed to develop a visitor model. This is a relatively large undertaking and, depending on TPB's priorities, could be considered as a long-term goal. TPB has been investigating use of the AirSage data for its potential use in estimating visitor travel, which could prove to be a viable option for improving the representation of visitor travel in the short term.

Assessment

- Level of Effort: High
- Importance: Low

2.4 HOT/Managed Lanes Modeling

AECOM Recommendation 12.10

AECOM still believes that it "should" be possible to assign non-HOV and HOV3+ trip tables in the same multi-class assignment step. We recognize that implementing this process using the current trip tables underestimates HOV volumes. We recommend that MWCOG consider potential adjustments to trip distribution and path-building parameters that are likely to improve the HOV volumes generated by a multi-class traffic assignment process. (2012 Report, p. 9-1)

Discussion of this topic can be found on page 5-14 of the 2012 Report.

CS Discussion

Comment

The two-step HOV assignment process has been used to represent HOT lane pricing policies in Virginia designed to provide reliable speeds for HOV users. However, this modeling approach is time consuming and can lead to inconsistencies in mode choice results. Work has proceeded towards fully eliminating the two-step process through subsequent work (see below recommendations).

Assessment

- Level of Effort: N/A
- Importance: N/A

AECOM Recommendation 13.1

AECOM demonstrated that an HOV choice model can be calibrated to achieve desired HOV volumes on the HOV facilities. One of the benefits of such a change is the ability to eliminate the "two-step assignment," where HOV3+ trips are assigned separately from other user classes during the AM and PM peak period which should help reduce model run times. However, a careful review of the HOV count data and additional calibration work must be conducted before integrating an HOV choice model into the MWCOG modeling process. (2013 Report, p. 11-1)

Discussion of this topic can be found in Chapter 3 of the 2013 Report.

CS Discussion

Comment

CS experience with project application work in the Washington Metropolitan area has been that using a single-step multi-class assignment process in forecast application work has provided more consistent mode choice results, particularly where HOT lanes are involved. We believe

moving towards dispensing with the two-step assignment process in the regional model would be beneficial.

Assessment

- Level of Effort: Medium
- Importance: High

AECOM Recommendation 13.2

"AECOM recommends integrating an HOV choice model and multi-class assignment procedure into the current mode choice and assignment setups to reduce processing time and improve behavioral sensitivity of the model." (2013 Report, p. 11-1). Discussion of this topic can be found on pages 3-4 and 3-5 of the 2013 Report.

CS Discussion

Comment

Task Order 8 of the FY 2014 final report[15] moved to address this recommendation. The production COG/TPB model, though, was not changed. Thus, in terms of the assessment, from the view point of AECOM, this work has been completed. However, from the view point of COG/TPB staff, which has been running and testing the proposed model updates, there was a fair amount of work to be done. The testing by COG/TPB staff has recently been completed and documented in a memo, which COG/TPB staff plans to share with AECOM.

Assessment

- Level of Effort: Medium
- Importance: High

AECOM Recommendation 14.3

The HOV choice model proved effective in replicating observed HOV demand for HOV facilities; ensuring that travel speeds for the HOV 3+ traffic on HOT lanes are not degraded by the other traffic using the HOT lanes; and eliminating the need for "multi-run" and "two-step" assignments. This modeling approach is worth serious consideration by TPB. (2014 Report, p. 8-1)

Discussion of this topic can be found on pages 4-10 and 4-11 and also on pages 5-22 to 5-24 of the 2014 Report.

[15] FY 2014 Final Report, Assistance with Development and Application of the National Capital Region Transportation Planning Board Travel Demand Model

CS Discussion

Comment

The COG/TPB mode choice model does not currently include tolled and non-tolled branches. AECOM advocated for adding toll choice to the COG/TPB model, but, instead of adding it directly to the mode choice model, it added a separate toll choice model that would be applied after mode choice. This option was viewed as an interim solution until there was more time to add toll choice more explicitly to the mode choice model (see page 5-3 of the 2014 Report). The main point of AECOM's recommendation was to find a way to eliminate both the "two-step" assignment technique and the "multi-run"/"HOV 3+ skim substitution/replacement" technique. The "two-step" traffic assignment technique is used in the COG/TPB model to better estimate HOV volumes on HOV facilities (see page 200 to page 202 of the current user's guide) [16]. The "multi-run" or "HOV3+ skim substitution/replacement" technique is used to model HOT-lane facilities (see page 31 to page 32 and page 68 to page 76 of the current user's guide). CS also recommended eliminating the "multi-run" assignment technique, since it would significantly reduce model run times. [17]

At the end of FY 2014, AECOM delivered a revised travel demand model that included both an HOV choice model and a routine for performing automated toll setting. The prototype methodology appeared to be promising, but several areas of concern were found during testing of the proposed modeling procedures. The testing has been documented in a memo that will be shared with AECOM. However, COG/TPB staff should review their concerns with the proposed methodology, particularly with regard to arriving at the non-HOV demand for HOT facilities (i.e., the toll facility choice). Alternative techniques are being used in other regions that have managed lanes which may need to be considered. For example, the 2013 FHWA TMIP Peer Review Report, "Florida Department of Transportation (FDOT) Express Toll Lane Modeling Workshop" discusses approaches considered for that effort.[18]

Assessment

Preliminary results of the testing by COG/TPB staff indicate that the model runs that use the automated toll setting can take multiple days. At this point, it is not clear that the estimated toll values are superior to the toll values estimated using the previous method.[19] Additionally,

---

[16] Ronald Milone, Mark Moran, and Meseret Seifu, *User's Guide for the MWCOG/NCRTPB Travel Forecasting Model, Version 2.3, Build 57: Volume 1 of 2: Main Report and Appendix A (Flowcharts)* (Washington, D.C.: Metropolitan Washington Council of Governments, National Capital Region Transportation Planning Board, October 17, 2014).

[17] Cambridge Systematics, Inc., *Fiscal Year 2010 Task Reports*, Final Report (Washington, D.C.: National Capital Region Transportation Planning Board, November 16, 2010), page 3–20, http://www.mwcog.org/transportation/activities/models/review.asp.

[18] FHWA, Florida Department of Transportation (FDOT) Express Toll Lane Modeling Workshop: Peer Review Report, 2013. http://www.fhwa.dot.gov/planning/tmip/resources/peer_review_program/fdot/ accessed June 2015.

[19] Jinchul Park to Files, "HOT Lane Modeling Process of MWCOG/TPB (Draft)," Memorandum, (October 12, 2012).

taking the next step and estimating a more formal toll choice model could require a sizeable level of effort to complete, assuming the data already exists, especially because the model will have to be recalibrated.

- Level of Effort: Medium
- Importance: High

AECOM Recommendation 14.4

The HOT lane analysis used observed data (counts) for the year 2010, which does not have any HOT-lane facilities and therefore is not modeled with a "multi-run" in the TPB model. It will be important to re-calibrate the HOV choice model once data from the newly opened HOT lanes becomes available. (2014 Report, p. 8-1)

CS Discussion

Comment

When and if appropriate HOT lane usage data is made available, consideration should be given to verifying that the model represents existing conditions well and has the appropriate level of sensitivity to change.

Assessment

- Level of Effort: Medium
- Importance: High

AECOM Recommendation 14.5

For application purposes, the HOV choice model and the multi-class assignment procedures were integrated into the current mode choice and assignment procedures. Restructuring of the overall mode choice model within a common software platform (i.e., AEMS to ModeChoice) is needed to integrate the HOV/HOT lane and PT/mode choice enhancements into the TPB process. (2014 Report, p. 8-1)

Discussion of this topic can be found on pages 4-16 and 4-17 of the 2014 Report.

CS Discussion

Comment

Shifting application platforms can contribute to improved transparency on the mode choice application and can better support future enhancements to the trip based model. The level of effort is influenced by the status of the ongoing testing of the improvements that are recommended.

Assessment

- Level of Effort: Medium
- Importance: High

AECOM Recommendation 14.6

Additional testing of the toll-setting parameters for different future years is recommended to determine the most reliable configuration, most "seasoned" seed tolls. This testing may also include noting the impact/effectiveness of using toll-setting only for the final speed-feedback iteration versus all speed-feedback iterations and/or the impact of using lowered relative gap cutoff thresholds for toll-setting in different speed feedback iterations. (2014 Report, p. 8-1)

Discussion of this topic can be found on page 5-1 of the 2014 Report.

CS Discussion

Comment

The toll-setting procedure has been tested by COG/TPB staff. The work has been documented and the documentation will be shared with AECOM staff.

Assessment

- Level of Effort: Medium
- Importance: High

2.5 Transit Modeling

AECOM Recommendations 12.11 and 12.12

AECOM recommends formally starting the conversion process from TRNBUILD to PT. It is also recommended to make this a coordinated and cooperative effort between TPB, WMATA, and the consultant team. (2012 Report, p. 9-2)

Section 6.5.1 outlines a five phase work program for implementing the PT conversion and upgrading the transit modeling process to take advantage of PT capabilities. The five phases include: transit network preparation, transit path building and loading, transit fares, mode choice calibration, and advanced applications. AECOM recommends pursuing at least the first two phases during fiscal year 2013. Phases 3 and 4 can be implemented if funds and time permit, but Phase 5 is perhaps more appropriate for fiscal year 2014. (2012 Report, p. 9-2)

Discussion of this topic can be found in Chapter 6 of the 2012 Report.

CS Discussion

Comment

The conversion process from TRNBUILD to PT has been implemented and will need further testing by TPB before it can be fully integrated with the TPB modeling process. Work was undertaken in FY 2015 by CS and its subcontractor, Gallop Corporation, to make progress in the migration to PT.

Assessment

- Level of Effort: High
- Importance: High

AECOM Recommendation 12.6

AECOM believes modeling all trip purposes by time of day is important for WMATA's transit modeling. It is less clear how important this is for TPB's modeling needs. At a minimum, however, AECOM would recommend adding the Pedestrian Environment Factor concept to the mode choice models and recalibrating these models with fewer geographic market segments and constrained constants. (2012 Report, p. 9-1)

Discussion of this topic can be found in Section 3.1.1 of the 2012 Report.

CS Discussion

Comment

CS recommends elimination or at least minimization of using geographic market segments in the mode choice model, and also recommends explicit use of land use and urban design variables in the travel demand model.

Assessment

- Level of Effort: High
- Importance: High

AECOM Recommendation 12.7

"AECOM recommends converting the transit summary processing from LineSum 2.3 to LineSum 5.0.11." (2012 Report, p. 9-1). Discussion of this topic can be found on pages 4-2 and 4-3 of the 2012 Report.

CS Discussion

Comment

As part of the build 41 of the COG/TPB Version 2.3 travel model, COG migrated to using what was, at the time, the latest version of LineSum (ver. 5.0.17).

Assessment

- Level of Effort: Completed
- Importance: Completed

AECOM Recommendation 12.8

As a short-term solution, AECOM recommends adding logic to the TRNBUILD walk access scripts (or the TransitAccess program) to connect stations to nearby zones and sidewalk nodes and adding transfer prohibitions in the path-builder to force transfers to or from bus routes to use these new links to access the station. This would enable the model to distinguish bus transfers from walk access at Metrorail stations. (2012 Report, p. 8-1)

Discussion of this topic can be found on page 4-5 of the 2012 Report.

CS Discussion

Comment

Stations have been connected to nearby zones[20]. The work related to TRNBUILD is no longer needed/relevant.

Assessment

- Level of Effort: Completed
- Importance: Completed

AECOM Recommendation 13.6

The reconfiguration of transit access links around Metrorail and commuter rails stations provides the necessary connections to enable the PT Generate statement and path building procedures to construct transit paths with various access mode restrictions and line-haul mode options. Initial attempts to implement park-n-ride access to bus routes suggests that a similar process may be needed for bus park-n-ride lots if the PT Generate statement cannot be forced to use connection links between park-n-ride nodes and bus stops. A variety of potential

[20] AECOM, *FY 2014 Final Report, COG Contract 12-006: Assistance with Development and Application of the National Capital Region Transportation Planning Board Travel Demand Model* (National Capital Region Transportation Planning Board, Metropolitan Washington Council of Governments, August 18, 2014).

solutions to this concern should be investigated before the PT access procedures are finalized. (2013 Report, p. 11-1)

Discussion of this topic can be found in Sections 7.4 and 7.5 of the 2013 Report.

CS Discussion

Comment

This recommendation has been addressed in FY 2014 tasks[21]

Assessment

- Level of Effort: Completed
- Importance: Completed

AECOM Recommendation 13.7

The PT fare calculation options cannot replicate the current fare calculation methods within the TPB model, but do offer a number of features that could be useful in designing a new fare estimation process. These options require further analysis and implementation testing especially if fares are included in selecting the path. (2013 Report, p. 11-1)

Discussion of this topic can be found in Chapter 9 of the 2013 Report.

CS Discussion

Comment

One of the major steps of the transit fare development process (FARE2) requires an on/off indicator for each production/attraction zone pair. Initially, it was thought that this capability did not exist in PT. COG/TPB staff, however, found that this capability does, in fact, exist in PT.

Assessment

- Level of Effort: Medium
- Importance: High

AECOM Recommendation 14.2

"Preparation of other GIS-based transit network inputs to the TPB model, such as PEF (pedestrian environment factor), could be implemented using ArcPy as well. Further

[21] AECOM, *FY 2014 Final Report, COG Contract 12-006: Assistance with Development and Application of the National Capital Region Transportation Planning Board Travel Demand Model* (National Capital Region Transportation Planning Board, Metropolitan Washington Council of Governments, August 18, 2014).

investigation into improving the ArcPy processing times may also be worth considering." (2014 Report, p. 8-1). Discussion of this topic can be found on page 3-12 of the 2014 Report.

CS Discussion

Comment

Further work with ArcPy is recommended to be incorporated as part of the ongoing work program.

Assessment

- Level of Effort: Medium
- Importance: High

AECOM Recommendation 14.7

The conversion of the TPB transit network from TRNBUILD to PT proved successful. Changes to the way TPB prepares network and support links and codes some transit routes is necessary, but worth implementing. Improvements to path building and transit access and transfer details will be very useful for detailed transit applications. (2014 Report, p. 8-1)

Discussion of this topic can be found in Section 6.8 of the 2014 Report.

CS Discussion

Comment

Specific details of the converted procedures need to be further reviewed and refined.

Assessment

- Level of Effort: Low
- Importance: High

AECOM Recommendation 14.8

An extensive calibration effort is recommended for adjusting the parameters used by the PT process. The PT transit path structures, travel times, and ridership should be compared with the latest on-board transit survey. The calibration process helps to adjust the parameters used by PT to develop non-transit legs and find the best transit path for a given origin-destination pair. (2014 Report, p. 8-1)

Discussion of this topic can be found in Section 6.6 of the 2014 Report.

CS Discussion

Comment

PT parameter calibration should be incorporated into the work program. Work was undertaken in FY 2015 by CS and its subcontractor, Gallop Corporation, to make progress in the migration to PT.

Assessment

- Level of Effort: High
- Importance: High

AECOM Recommendation 14.9

AECOM's experience with using the PT process in other travel demand models suggests that an additional step is helpful after transit paths are built for all zone to zone interchanges. A path conditioning step drops transit paths between a pair of origin and destination zones if the total travel time of that path is longer than the walk-only path between the zone pair. (2014 Report, p. 8-2)

CS Discussion

Comment

This recommendation could be refined as there could exist valid transit paths which are longer than walk paths. Transit is used for a variety of reasons – convenience, weather, saving time, etc. It is also possible that a walk path does not exist on a transit path, such as a transit tunnel. This topic should be further evaluated as part of the on-going consultant task orders.

Assessment

- Level of Effort: Low
- Importance: Medium

3.0 Conclusions and Next Steps

This review will serve as input to other tasks in the Cambridge Systematics work program, including the development of a strategic plan for model development that is being drafted as part of the FY 15 work program. A summary of the review has thus been prepared as Table 3.1 to facilitate this further effort. The "Next Step" column offers a summary recommendation regarding proceeding with implementing the recommendation as a next step. "Refine" is used to indicate recommendations that should be refined further before undertaking. Items appear in the table below in the same order that they appear in this report.

Table 3.1 Summary of Review

Recommendation	Year	Level of Effort	Importance	Next Step
Software Issues				
12.1: Review Modeling Software	2012	Low	High	Yes
12.2: Review of TPB Scripts: Improve model input efficiency	2012	Low	Medium	Refine
12.4: Reducing Run Times: Batch process improvements	2012	Medium	High	Yes
12.5: Review of TPB Scripts: Changes to mode choice model	2012	Low	Medium	Yes
12.9: Reducing Run Times: Enhance usage of parallelization	2012	Medium	Medium	Yes
13.4: Speed Feedback: Enhance focus on speed validation	2013	High	Low	Refine
13.5: Speed Feedback: Adjust volume delay functions for freeways	2013	Medium	Medium	Yes
Model Inputs				
12.3: Error Checking Automation	2012	Low	Medium	Yes
Model Components/Structure				
14.11: Mode Choice: Revise model specification and calibration approach	2014	High	High	Refine
12.13: Mode Choice: Air passenger model for all modes	2012	High	Low	Yes
13.8: Mode Choice: Migrate to ModeChoice	2013	N/A	N/A	N/A
14.10: Mode Choice: Migrate to ModeChoice	2014	Medium	High	Yes
12.14: Airport Choice Model	2012	High	Low	Yes
12.15: External Model	2012	High	Low	Yes
12.16: Visitor Model	2012	High	Low	Yes

Recommendation	Year	Level of Effort	Importance	Next Step
HOT/Managed Lanes				
12.10: Improve single step assignment results	2012	N/A	N/A	N/A
13.1: Demonstrate benefits of HOV choice model	2013	Medium	High	Refine
13.2: Test integration of HOV choice model and multi-class assignment procedure	2013	Medium	High	Refine
14.3: Pursue improvements in HOV/managed lanes modeling	2014	Medium	High	Refine
14.4: Recalibration of HOV choice model with count data from HOT lanes	2014	Medium	High	Yes
14.5: Shift application platforms for better integration and enhancement potential	2014	Medium	High	Refine
14.6: Refinement and testing of toll-setting procedure	2014	Medium	High	Refine
Transit Modeling				
12.11 and 12.12: Start conversion process from TRNBUILD to PT	2012	High	High	Yes
12.6: Mode choice segments	2012	High	High	Refine
12.7: Move to latest LineSum software	2012	Completed	Completed	N/A
12.8: Enhance walk access scripts	2012	Completed	Completed	N/A
13.6: Reconfiguration of transit access links to support PT	2013	Completed	Completed	N/A
13.7: Design and implement PT fare calculation methods	2013	Medium	High	Yes
14.2: Further enhancement of ArcPy scripts	2014	Medium	High	Yes
14.7: Document TRNBUILD to PT conversion procedures	2014	Low	High	Yes
14.8: Calibrate PT parameters	2014	High	High	Yes
14.9: Path conditioning	2014	Low	Medium	Refine