The Travel Model Improvement Program

Summary Report

Delaware Valley Regional Planning Commission (DVRPC) (Philadelphia MPO)

Travel Demand Model Peer Review

Philadelphia, PA
September 2009

Helping Agencies Improve Their Planning Analysis Techniques

TMIP

Travel Model Improvement Program

Table of Contents

List of Tables

Appendices

Report Purpose

This report summarizes the results of a peer review of the Delaware Valley Regional Planning Commission (DVRPC) travel demand forecast model. The peer review was supported by the Travel Model Improvement Program (TMIP), which is sponsored by the Federal Highway Administration (FHWA). The peer review of a travel model can serve multiple purposes, including identification of model deficiencies, recommendations for model enhancements, and guidance on model applications. Given the increasing complexities of travel demand forecasting practice and the growing demands by decision-makers for information about policy alternatives, it is essential that travel demand forecasting practitioners have the opportunity to share experiences and insights. The TMIP-supported peer review provides a forum for this knowledge exchange. DVRPC is in the midst of a significant model update process. Having recently converted the model system from TRANPLAN to VISUM, the agency is considering a number of short-term and long-term model enhancements. The primary purposes of this peer review were to: 1) solicit expert panel opinion on the prioritization of short-term and long-term improvements; 2) provide an independent assessment of the model system, and 3) compare the model system with current industry practice. This report documents the peer review discussion and recommendations.

Travel Demand Forecast Modeling at DVRPC

DVRPC has a long history of developing, maintaining, and applying a set of travel demand forecasting models "in-house." Any travel demand forecast modeling in the region is typically performed by DVRPC staff – no cities or counties in the region maintain their own models. A statewide model for Pennsylvania has been developed, but DVRPC staff have had little interaction with this model. However, both NJ Transit and the New Jersey Department of Transportation maintain models which incorporate portions of the DVRPC region.

As travel demand forecast modeling practice has continued to progress, DVRPC staff recognized that the agency's model system needed to be upgraded to keep pace with recent developments, and to provide the policy sensitivities required by decision-makers. Because DVRPC is the site for essentially all regional travel demand forecasting, DVRPC staff determined that any model system improvements would need to be implemented in a phased manner, so as to be able to continue to support ongoing project analysis efforts. DVRPC developed an approach involving four primary phases, and solicited consultant support for implementing these four phases.

The first phase of the model improvement project involved converting the model system software from TRANPLAN to VISUM, which was primarily performed by PTV, a DVRPC consultant. In the process of converting the model system, some basic model enhancements were implemented, and the VISUM model system was revalidated to match or exceed the TRANPLAN validation results. The second phase of the model improvement project involved identifying key analysis needs by soliciting input on desired model capabilities from a steering committee comprised of local agencies, state departments of transportation, transit operators, and other interested entities. DVRPC also solicited guidance on model requirements from in-house staff as well. A survey of model needs, described in a subsequent section, provided a basis for the initial prioritization of potential model improvements. The model improvement project consultant, Cambridge Systematics, subsequently developed a list and prioritization of both short-term and long-term model improvements. A primary purpose of the

DVRPC peer review panel was to consider the proposed improvements and provide guidance on which would likely be of greatest value to DVRPC. Upon receiving the feedback from the steering committee, the project consultant, and the peer review panel, DVRPC and consultant staff will implement the prioritized improvements in Phase 3, and in Phase 4, staff intend to improve data management practices.

Peer Review Panel Members:
David Boyce, Northwestern University
Keith Killough, AZDOT
Maren Outwater, PSRC
Richard Walker, Portland METRO

DVRPC Participants:
Chris Puchalsky, DVRPC
Charles Dougherty, DVRPC
Tom Walker, DVRPC
Jon Kugel, DVRPC
Matt Gates, DVRPC

DVRPC Consultants:
Thomas Rossi, Cambridge Systematics
Wolfgang Scherr, PTV America

DVRPC Responsibilities

DVRPC functions as the metropolitan planning organization (MPO) for the 9 counties that comprise the greater Philadelphia region. The MPO is a transportation planning and policy-making organization comprised of representatives from local transportation and other government agencies. The primary role of the MPO is to develop a long-range plan that prioritizes regional transportation improvements, and to distribute Federal funds to selected projects through shorter-term programming documents. DVRPC's travel demand forecast model is used by staff and consultants for a number of purposes, including the development of the aforementioned long and short range plans and programs, highway traffic studies, air quality conformity assessments, and FTA New Starts projects

Current DVRPC Model

DVRPC Model Data

The following sections provide descriptions of the primary data elements used in the development and application of the current DVRPC model, followed by a description of the core components of the model system.

Household Survey

A household survey is a critical data source required for the development of a travel demand forecast model. This survey provides detailed information about travel demand and patterns that are the basis for the predictive components of the model system. The most recent household survey was collected for DVRPC in the year 2000, in partnership with the MPO for southern New Jersey. This survey was comprised of the responses of approximately 4,300 DVRPC-region households, representing a sample rate of approximately 1 in 466. The data were collected and processed into a format compatible with the development of an activity-based model system, but thus far have been used only to refresh a handful of the exiting model components. Specifically, the survey was used to update trip rates in the trip generation model, update the friction factors used in trip distribution, and to recalibrate the vehicle occupancy assumptions.

A key question posed by DVRPC staff to the peer review panel was whether it is necessary to update the household survey every ten years. The purpose of collecting new household survey data is to have a snapshot of current travel patterns, which can change significantly over decades. In addition, the survey provides explicit information about key travel demand values and the relative elasticity of these values. In the travel demand forecasting field, there appears to be a general consensus that every ten years is a good interval, but there is no explicit guidance that this is necessary

or required, and if a region is not experiencing significant growth or change, it may not be necessary to undertake a new survey with that frequency. Peer review panel members suggested that an alternative approach to performing a new survey would be to request an add-on to the next National Household Travel Survey (NHTS).

Demographic and Census Data

DVRPC maintains zone-based information on population and employment by sector. This information is developed by both DVRPC and other local land use planning agencies. DVRPC staff have spent some time indentifying inconsistencies in the data, and performing reasonableness checks, such as comparing employment totals against state labor department numbers.

Transit On-board Survey

DVRPC staff described that no transit on-board survey data are currently available. It has typically been the responsibility of transit agencies, rather than the MPO, to collect this data, though DVRPC staff intend to coordinate with SEPTA and NJ Transit in order to guide the development of surveys that can be used to support modeling purposes. In the past, the transit planning data needs of the transit agencies and the modeling needs of DVRPC have not always been consistent. A key question posed by DVRPC staff to the peer review panel is what data useful for modeling may be derived from a transit on-board survey.

Transit Counts

Transit counts used by DVRPC for model validation are provided by SEPTA and NJ Transit. At present, most transit validation is performed at a route and operator level, although the model enhancement consultant team has advised DVRPC staff that much more detailed transit count data can be used. Initially, DVRPC intends to look at station level data for major transit station data, but anticipates exploiting the wealth of data that is anticipated as automated passenger count (APC) data collection and smart card implementation efforts are completed.

Traffic Counts

DVRPC has a rich regional data warehouse for traffic counts. This warehouse is populated with data from a variety of origins, including freeway sensors, individual counties count programs, DVRPC's count program (which includes regular cordon counts every 5 years), and other sources. However, the quality of the count data varies widely, and as yet DVRPC is still investigating ways to better exploit this resource. A limited amount of speed data are also available, primarily from the mid-1990's. DVRPC staff are seeking ways to refresh this speed data, particularly looking at newer technologies such as Bluetooth monitoring and video logging.

Truck Data

DVRPC staff reported that the current truck model, which considers light-duty and heavy-duty commercial vehicles, was based on the most recent truck survey, which dates from 2000 / 2001. However, staff also reported that there were issues with the survey due to low response rates. The next truck survey is planned for 2012, and is being coordinated with DVRPC's freight planning group. In addition, the Pennsylvania Turnpike Authority may also have some additional truck data collected through intercept surveys.

The key question posed by DVRPC staff to the peer review panel was how to go about acquiring good data on commercial and freight travel. Panel members indicated that this is a current topic of university research, and that some significant advances have been made. For example, a number of freight and good movements companies are selling GPS data to Washington State,

though in other states they've been less willing to make this data available. Although this information often requires significant amounts of processing and cleaning, it can provide invaluable information on truck movements, as well as provide other information, such as system performance.

External Surveys

The most recent survey (2001) was used to develop the current external models. This data included information on trucks, though no data was collected on what these vehicles were transporting. At present, there is no intention to collect new data again until 2020. When forecasting, growth rates are simply applied to the baseline condition.

Taxi Survey

DVRPC staff indicated that a survey of taxis was last collected in 1960. More recent surveys from other cities were used to support development of the taxi purpose in the model. Taxis are a significant portion of traffic only in the central business district (CBD).

Tourist Survey

At present, there is no tourist survey data available to support model development. However, DVRPC recognizes that there has been significant growth in tourism in the region, especially from Europe, and it is DVRPC's intention to implement a tourist survey in 2017/2018.

Pedestrian / Bicyclist Survey

DVRPC is planning a survey of pedestrians for 2015/2016. In addition, DVRPC is considering revisiting a bicycle survey that agency staff recently administered.

Airport Survey

The Philadelphia International Airport (PHL) conducted a survey of passenger access in 2001. This survey is used to generate and distribute passengers to and from PHL in the DVRPC model.

Aerial Photography

DVRPC maintains a rich historical dataset of aerial photography, dating back as far as 1960. One of the primary datasets derived from the survey is an inventory of land cover and land use.

GIS Data

Currently, DVRPC has access to GIS-based parcel level data for the region, although the level of detail associated with parcels varies widely, as does the quality of the parcel data. The peer review panel confirmed that working with parcel data can be very difficult and time consuming, typically with every attribute requiring scrutiny. In addition, DVRPC maintains information on other transportation system attributes in a GIS, such as the location of bike paths.

Other Data

DVRPC staff were interested in identifying additional survey or other data that may be useful for both short-term and long-term model development. Peer review participants suggestions included:

- Stated preference survey data that could be used to establish values of time for use in enhanced choice models;
- LIDAR, which adds the z-dimension to aerial photography, providing information on building heights, street grade and related attributes.
- Employer surveys or HOV surveys, which can provide information on regional ridesharing, although there are

currently no HOV or HOT facilities in the region.

DVRPC Model Components

After reviewing the data available to support model development, enhancement, and application, DVRPC staff presented information about each of the individual model components currently in use. The following sections summarize the information provided by DVRPC staff, as well as comments from peer review participants.

Trip Generation

The current version of the trip generation model includes three internal person trip purposes, which are based on trip rates by area type. These area types are based population and employment information, and are updated to reflect land use alternatives and forecast year changes. At present there is no cross-classification of trip rates that would reflect important market segmentations. As land use type and development intensity change, the area types are updated to reflect these changes. The year 2000 household survey was the basis for these trip rates. Non-motorized trip rates were also developed, although these trips are not modeled beyond trip generation. A key enhancement identified by DVRPC staff is the explicit inclusion of non-motorized trips in the remainder of the modeling process.

Time-of-Day

The 2000 survey was also used to develop the fixed factors that are used to disaggregate trips produced by the trip generation step into three time periods: a combined AM and PM peak, midday, and evening. All subsequent models, including trip distribution, mode choice, and assignment, are segmented using these three time periods. Peer review panel members had two primary suggestions for improving upon the current methodology. The first was that the AM and PM peaks should be split into two distinct time periods, based on the fact that these two peak periods typically experience different levels of congestion, and are associated with different mixes of trip purposes. The second suggestion was that DVRPC may want to consider moving the time-of-day factoring to later in the model chain. DVRPC staff explained that the current placement is so that the feedback through distribution is reflective of the different time period levels of service. Peer review panel members suggested that additional segmentation, such as income, could be more easily accommodated in trip generation and distribution if the time-of-day factoring were later in the model stream. The panel also suggested that DVRPC consider using a weighted composite impedance for trip distribution.

Trip Distribution

DVRPC currently uses a gravity model to perform distribution, using generalized cost as the impedance measure. Transit impedances are incorporated through the use of a transit adjustment factor. This adjustment factor is determined by calculating the difference between auto and transit times and costs, and the factor is constrained to fall between 0.8 and 1.2. In converting from TRANPLAN to VISUM, it was also necessary to make some modifications to the friction factors, transitioning from using bins to a continuous function. A logsum measure was not used as a composite impedance measure because the previous version of DVRPC's mode choice model was not a conventional logit mode choice model and thus could not produce a logsum measure. The peer review panel identified two primary concerns about the current distribution process. First, the panel wanted to better understand the transit access bias adjustments, and specifically whether the current process had been validated in any way. Second, the panel expressed that

greater market segmentation would improve the sensitivity of the model; particularly to the type of pricing alternatives that DVRPC has expressed an interest in evaluating in the future.

Mode Choice

DVRPC staff explained the significant changes in the mode choice model that were implemented as part of the transition from TRANPLAN to VISUM. The old version of the model involved two binary logit models whose results were then averaged to predict drive, walk-access transit, and drive-access transit. The new model contains a simple nested logit model that incorporates all three choices. However, the model still splits off "captive" transit and highway riders before exposing a subset of the population to the choice models. The determination of captive shares is based on area types and OD pairs, and was not based on any empirical data analysis. Rather, this segmentation was implemented to help with model validation, and the assumptions held constant in future year runs. Peer review panel members expressed some concern about this method of identifying captive riders, and the implications for future year forecasting and alternatives analysis. DVRPC staff also explained that the mode choice model doesn't predict vehicle occupancy levels, but rather uses a purpose specific function that is capped.

Panel members inquired about the values of some of the coefficients used in the mode choice model. For example, the coefficients on impedance for transit-walk and transit-auto were higher than typically expected. In addition, the coefficients on the dummy variables indicating heavy rail and regional rail appeared to be somewhat high. The panel also expressed reservations about the use of the OD-based area type "mode choice "correction variables" which essentially function as k-factors in mode choice. The panel advised that careful review of mode choice assumptions and values will ensure that model is acceptable when subject to scrutiny by FTA or others.

Highway Assignment

DVRPC staff described the current highway assignment methodology. The roadway networks are based on the original TRANPLAN networks, with the capacity and speed assumptions based on area type and facility type. The standard BPR volume delay function is used in assignment, although an exponent of 7 is used instead of the more standard exponent of 4, which panel members identified as relatively aggressive. Instead of a traditional Frank-Wolfe user equilibrium assignment methodology, the model uses VISUM's route-based assignment algorithm, which is comprised of outer iterations (which perform path building) and inner iterations (which perform flow balancing). The assignment is single-class, without restrictions or segmentation by truck or vehicle occupancy. No intersection delay is represented in the assignment, although DVRPC staff indicated that some preliminary analyses showed that volumes were in excess of intersection capacity, and panel members pointed out that dynamic traffic assignment methodologies, which are increasingly attractive to regional planning agencies, typically incorporate such delay. Peer review panel members expressed concerns about two aspects of the current assignment methodology. Panel members felt strongly that the use of a combined AM and PM peak was not desirable or consistent with current practice, for the reasons expressed earlier in this report. In addition, panel members indicated that manual adjustments made to reflect peak spreading are subjective, and may compromise the validity of forecasts and alternatives analyses.

Transit Assignment

The transit assignment methodology used by DVRPC is schedule-based, rather than headway-based, and uses AM peak,

midday, and evening-specific transit networks. Part of the motivation for using a schedule-based assignment method was to better represent the complex fare structure in the region, though it was still necessary to in some instances to develop average transfer fares. Panel members suggested that DVRPC should be sensitive to the possible effects of using average fares in the mode choice model. A key point of discussion was transit travel times. These times are currently based on transit schedule information. DVRPC staff have developed a "synthesized schedule" that distills transit service across broad 5+ hour time periods. An important concern expressed by panel members was that the transit travel times are not linked to roadway congested transit travel times. For future year runs, transit times are adjusted based on increases in roadway congestion, but this analysis isn't systematically implemented on a link-by-link basis, which may lead to inconsistencies in mode choice. An additional concern of peer review panel members was the treatment of drive access transit trips. Two suggested enhancements were: 1) the dynamic generation of access links, rather than relying on hardcoded links, and 2) the assignment to the roadway network of the drive access legs of drive access transit trips.

An enhancement suggested by the peer review panel, in order to support future mode choice enhancements, was the disaggregation of transit skims by submode, in addition to access mode. Currently, all transit modes are available in pathbuilding and the time on each individual submode tracked.

Feedback and Convergence

In addition to the iterative feedback within the assignment step that ensures assignment convergence, the current model also incorporates a fixed number of model system iterations. Output impedances from a given iteration are averaged with pervious iteration output impedances and fed back to the distribution and subsequent steps. DVRPC staff and consultant staff performed an investigation into convergence, testing different fixed weights. Ultimately, a fixed weight of 0.5 was selected as the best, and this same weight is used for all of the time period segments in the model.

Validation

DVRPC's goal for the validation of the new translated VISUM model was to meet or exceed the validation of the original TRANPLAN version of the model. DVRPC and consultant staff were able to satisfy this goal, though they identified a number of issues in the validation process. For example, they discovered that there appear to be too many short transit trips. In previous versions of the model, these trips were discarded, but are being preserved in the current version of the model. A more complete summary of the revised model validation can be found in the consultant report entitled "DVRPC Travel Demand Model Upgrade: VISUM Model Translation Documentation."

Land Use Modeling (Uplan)

In addition to developing and maintaining the travel demand forecast model set, DVRPC staff have implemented a land use allocation tool called Uplan. Uplan was developed by university researchers and is not an urban growth model, but rather a planning decisions support system. The GIS-based heuristic model simulates a synthetic auction of undeveloped land – there are no changes to land use in already developed areas, and the model is concerned only with new footprint development. The model incorporates various GIS-based data reflecting population, housing, employment, spheres of influence and other factors. The model is loosely linked to the travel demand forecast model via the incorporation of V/C ratios and proximity to interchanges, transit stations, and bus lines, though there are no explicit accessibility measures. No

statistical validation of the model has yet been completed.

Thus far, the model has primarily been used for scenario planning – DVRPC staff have developed a comprehensive plan scenario reflecting the input of local land use planning agencies. The model has not yet been systematically integrated with the travel demand forecast model. However, it has recently been expanded to include the entire state, and can trade off growth amongst different counties. The model is also being revised to consider redevelopment in areas already developed, which will improve the capabilities of the model in urbanized areas such as Philadelphia.

Model Improvement Process

DVRPC has engaged in a multi-faceted model improvement process over the past year. One aspect of this improvement process has been to assemble a steering committee of all travel model stakeholders in order to solicit information on model sensitivity and development needs. In addition, feedback on model needs were discussed with internal model users, such as DVRPC's planning group. Another significant element of the model improvement process has been working with Cambridge Systematics, a travel demand forecasting consulting firm, to convert the model from TRANPLAN to VISUM, and to identify and prioritize a set of short-term and long-term model enhancements reflective of model users needs.

Model User Needs Survey

The primary instrument for determining required model capabilities was a survey of model users to determine their analysis needs. According to the steering committee, the most important requirement of the model is its continued ability to support highway alternatives analyses. In addition, the steering committee, which was comprised of a diversity of public agencies and private entities, indicated that transit operations modeling is also critical. Finally, the steering committee identified sensitivities to road pricing alternatives and to transportation-land use interactions as essential model capabilities. DVRPC's internal model users concurred, stating that sensitivity to transportation-land use interactions is a key model requirement. This group also indentified induced demand as a critical question, and agreed that the ability to support transit operations planning was an essential model sensitivity, as well as New Starts, road pricing, and CMP multimodal alternatives analysis capabilities.

The DVRPC model needs survey also provided the opportunity for respondents to offer qualitative feedback about model sensitivities and performance. FTA suggested expanding the number of zones in the region significantly, while NJ Transit suggested that externals could be represented in the model as large zones. DVRPC staff indicated that much of the region's growth is occurring at the periphery, which initiated a discussion by the peer review panel of development of a mega-regional model that would more accurately capture the interaction of the Philadelphia and New York regions. DVRPC staff indicated that there was no strong impetus to develop such a model, and some peer review panel members expressed hesitation about the data complications that would doubtlessly arise with a regional expansion. Other issues identified by survey respondents included concerns about activity-based model data needs, output quality, and simulation variation, as well as the calibration of integrated land use-transport models and the desire, in general, for more model validation and checking.

Regarding the survey method and results, the peer review panel suggested that when soliciting information from the steering

group or other parties, it can be useful to frame any discussion in terms of specific project questions and evaluation measures – not a generic list of improvement needs. Some panel members expressed surprise that climate change was not cited as a key concern, but DVRPC staff responded that this had been raised as an issue in internal staff discussions, in the context of both transportation policy as well as land use policy (such as transit-oriented development). There was consensus that most current models need significant enhancements in order to make them more fully sensitive to land use configurations.

Peer Review Panel Open Discussion

Following the presentation and discussion of survey results, DVRPC staff and peer review panel members had an open conversation about key data and practice issues. The peer review panel then convened privately to offer specific recommendations for DVRPC's short-term and long-term model improvement efforts.

Household Survey

The peer review panel explained that major changes in how household surveys are performed have occurred in the past few years. Most importantly, GPS-based data collection is now present to some extent in most recent household survey data efforts in coordination with traditional survey methods, but in some cases all household survey data collection has occurred using GPS. Although the costs for GPS data collection may still be higher than for a traditional survey, these costs are declining rapidly. In addition, GPS-based data collection can also provide new insights in travel patterns, such as day to day variation.

Time-of-Day

The panel was unanimously of the opinion that it is essential to separate the AM and PM peak periods, and more broadly suggested that the model should include more time periods, including more level-of-service detail by time of day. At a minimum, this could be accomplished by enhancing the existing allocation process, networks, and skim building and assignment procedures. However, the panel also suggested that a more comprehensive treatment of time could be more readily accommodated in the context of an activity-based model system.

Trip Distribution

DVRPC staff indicated that they are committed to enhancing the current trip distribution process in a number of ways. They intend to first expand the number of purpose-specific models, and to incorporate the use of a logsum composite impedance measure to replace the current transit bias adjustment process. Panel members emphasized the DVPRC may also want to consider income segmentation in distribution. Panel members also suggested that transitioning to a destination choice model formulation may be advantageous because it provides the opportunity to include more variables, such as person-level income information. Although destination choice models can be applied in an aggregate framework, panel members suggested that these models are logically applied in a disaggregate context such as an activity-based model system.

Mode Choice

Panel members felt that the current mode choice model is too complex, not intuitive, and not consistent with state-of-the-practice. They indicated that changes to the model should be guided by policy analysis needs. A more in-depth discussion of the mode choice model and specific recommendations followed in the peer review's private discussion.

Assignment

DVRPC staff expressed a commitment to reviewing the current volume delay functions, and to considering implementation of a multi-class assignment procedure to provide more information on truck travel. The panel reflected on the desire for more pricing sensitivity in the model system, and that a set of related improvements would need to be implemented across the entire model system and not just in assignment. Trip purpose and traveler income are two of the most important model aspects that would need to be enhanced, and a method for capturing improved travel time reliability, which is often cited as a goal of pricing, would need to be implemented. Finally, the peer review panel suggested that the drive-access portions of drive-transit trips should be assigned, and that DVRPC should consider preloading transit vehicles.

Special Generators

In addition to the airport traveler special generator model currently maintained by DVRPC, staff expressed some interest in potentially developing other special generator models as well. Peer review panel members indicated that they had found little value in implementing special generator models, with two exceptions: airport access models, and special event models often associated with New Starts proposals.

Activity-Based Models

Peer review panel members suggested that DVRPC policy analysis requirements should be the primary influence on whether and how to develop and implement an activity-based model system. In response to the articulated concerns about data requirements and validation, panel members explained that activity-based models are comparable to traditional aggregate models, although they confirmed that the software necessary to implement advanced models is significantly more complex. Panel members also explained that simulation variation can be easily controlled. There was consensus amongst the panel members that activity-based models represent in the most integrated manner the interrelated travel choices amongst travelers in a given household, as well as the interrelationships amongst trips on a given traveler's tours. However, the panel also acknowledged that implementation of a new activity-based model system involves additional costs and time associated with model development and maintenance.

Peer Review Panel Recommendations

Following the open discussion of model development issues, the peer review panel convened separately to discuss specific long-term and short-term model development goals. Not all of the model development tasks proposed by DVRPC and their consultant team were addressed by the panel, however, and in some instances the peer review panel suggested additional model development efforts not proposed by DVRPC. The peer review panel first discussed long-term model development goals because it was felt that these goals may impact the identification and prioritization of short-term goals.

Long-Term Improvements

Activity-Based Model Development

There was consensus amongst peer review panel members that, in principle, the DVRPC should include development of an activity-based model system as a long-term goal. However, the specifics of the design of this next generation model system (such as the representation of intra-household activities) do not need to be established at

this point. Significantly, the need to implement many of the short term model enhancements, such as to the time-of-day and trip distribution models, would be obviated were DVRPC to engage soon in development of an activity-based model system. However, the panel did not recommend skipping the short-term model improvements and did not recommend proceeding straight to activity-based model development

DTA / Traffic Simulation

Peer review members described that at a recent dynamic traffic assignment (DTA)/traffic simulation conference, many developers were suggesting that DTA holds more promise as a regional traffic assignment enhancement than traffic microsimulation. The data development, network debugging, model calibration effort, and runtime issues associated with regional microsimulation render this approach problematic.

Integrated Land Use-Transport Model

The usefulness of an integrated land use-transport model is influenced by the agencies land use or growth management responsibilities. If DVRPC has no purview over land use, then it is more difficult to justify the expense and effort required to develop an integrated model. In addition, it was the panel's understanding that the region was not experiencing significant growth. There was consensus among panel members that development of an integrated model, given the huge resource requirements required to properly build and calibrate, should not be a high priority long-term goal.

Recommendations

- Pursue activity-based model development in conceptual form, with the details/specifics to be worked out as the project develops;
- Consider mesoscopic dynamic traffic assignment (DTA) methodologies for regional assignment improvement, rather than microsimulation;
- Apply and improve existing land use allocation methods, rather than undertake development of an integrated land use-transport model.

Short-Term Improvements

Data

The panel agreed that there is no clear guidance suggesting that household surveys must be performed every ten years, and indicated that the current survey was probably sufficient to support many of the proposed short-term model improvements. However, household surveys are significant undertakings, and typically require large budgets, so the panel suggested that DVRPC begin to plan for a new survey, within the next five years. One panel members suggested DVRPC do an add-on to the next NHTS. The panel also recommended that DVRPC develop a coordinated count and speed dataset to the extent possible.

Trip Generation Model

All panel members felt that the trip purposes in trip generation step should be further disaggregated. The existing household survey data should be sufficient to support this effort. A proposed disaggregation scheme included home-based work, home-based shop, home-based other, home-based school, home-based university, non-home-based work, and non-home-based non-work. Finally, it was suggested that the revised generation model should use cross-classification reflecting of household income, auto ownership, and household

workers, and should include non-motorized trips.

Auto Availability Model

The panel felt that DVPRC should develop an auto ownership/availability model because it would provide needed policy sensitivities, and would likely require few resources to estimate and calibrate. Ideally, this model would incorporate accessibility measures such as a logsum, and could also incorporate other attributes such as urban form.

Time-of-Day Model

The panel debated the merits of the placement of the time-of-day process in the overall model stream. The panel considered tradeoffs between including the time-of-day process earlier in the process, which potentially provides some enhanced sensitivity, but results in the proliferation of many more model files, versus placing the time of day models later in the model stream, which provides less sensitivity but also results in less computational and storage overhead. In addition, the panel members discussed the expansion of the number of modeled time periods to five. Ultimately, the panel reached consensus that DVRPC should consider using different time period definitions for different model stages. For example: continuing to use two time periods for distribution, but using up to five time periods for traffic assignment. One panel member described the use of two time periods in distribution, in which the impedance measure was a weighted logsum by purpose, which was sensitive to the fact that, for example, not all work trips occur during peak periods.

Destination Choice Models

The panel felt that the current gravity model used by DVRPC was not sufficiently sensitive to individual traveler attributes or reflective of differences amongst trip purposes. The panel recommended that DVRPC consider either developing a more segmented gravity model in which user attributes could begin to be captured, or developing a destination choice model. In addition, the panel recommended use of logsums as an accessibility measure.

Mode Choice Models

The panel felt that revisions to the mode choice models should be amongst the highest priorities in the short term, specifically to better reflect the complexity of the region's transit system. It was agreed that a new set of nested logit mode choice models needed to be estimated from survey data, even if that survey data may not be of the most recent vintage. The new mode choice models should include transit submodes, as well as greater market segmentation. The panel also felt strongly that non-motorized modes should be explicit in the new mode choice model. The panel suggested, though less strongly, that it probably made sense for the revised models to explicitly identify drive alone versus shared ride trips. Even though the DVRPC region does not currently have any HOV or HOT facilities, this is a common attribute of most large regional mode choice models, and would provide policy sensitivities that will likely be useful in future applications of the model systems. Finally, the panel recommended that the revised mode choice model include a toll/no toll nest for the drive modes. The inclusion of toll/no toll nests would provide the model with greater sensitivity to pricing alternatives, though care must be taken to ensure that the entire model system addresses pricing in a consistent manner, such as reflected in generalized cost functions in assignment and all associated level-of-service measures.

Traffic Assignment

The panel suggested a number of aspects of traffic assignment that warranted further consideration and investigation. Perhaps

the highest priority item is to ensure that generalized costs, inclusive of tolls and per mile auto operating costs are considered consistently throughout the entire model stream. In addition, it was felt that the link speed assumptions, link capacity assumptions, and volume delay functions be reconsidered. A lower priority issue, but which is increasingly the focus of planning and research efforts, involves the evaluation and inclusion of reliability of facility travel times. Data describing travel time reliability can often be extracted from ATR data, but has rarely been exploited. If a reliability measure is incorporated into the generalized costs, it can be fed back to other model components. Finally, if the revised mode choice model includes a toll/no toll choice for the drive modes, this structure must be carried forward to the traffic assignment stage as well.

Transit Assignment

The panel recommended that transit speeds should be based on congested roadway speeds, and that the drive access component of drive-access transit trips should be assigned to the networks. In addition, the drive-access impedance data reflecting access and egress times, costs and distance that is used in mode choice should be based on and consistent with the assignment of drive-access trips to the networks. Finally, it was recommended that DVRPC consider pre-loading transit vehicles where appropriate.

Recommendations

- Disaggregate trip purposes in generation;
- Estimate and implement new mode choice models that explicitly represent transit submodes, vehicle occupancy modes, and non-motorized modes, and consider toll/no toll choices for the auto modes;
- Research regional travelers values of time using stated preference surveys and incorporate results into estimates of cost in the model;
- Significantly enhance current gravity models, or develop and implement new destination choice models;
- Estimate and implement a new auto ownership model;
- Consider the use of two time periods in trip distribution, 3 (or more) time periods for mode choice, and 5 (or more) periods for traffic assignment;
- Ensure a comprehensive and consistent treatment of generalized costs in traffic assignment and throughout the entire model system;
- Review traffic assignment volume delay functions, as well as speed and capacity assumptions;
- Consider incorporation of reliability measures into assignment and components, contingent on data availability.

Model Documentation

DVRPC staff and consultants have prepared extensive model documentation and descriptions of the proposed improvements. Two documents in particular were invaluable in the preparation of this report and are available from DVRPC. The first, “DVRPC Travel Demand Model Upgrade: VISUM Model Translation Documentation” prepared by Cambridge Systematics and PTV America includes extensive descriptions of the current model configuration. The second, a memorandum from Cambridge Systematics to DVRPC entitled “Preliminary draft of proposed DVRPC model enhancements” describes potential model enhancements, and is

referenced in Tables 1 and 2 as “Model Memo.”

Table 1. Short-term Model Enhancements

	Model Memo		Peer Review Panel	
	Recommend	Optional	Recommend	Optional
DATA				
Plan for updated HH survey	x		x	
Develop comprehensive traffic count database	x		x	
Plan for speed studies	x		x	
Plan for Onboard survey	x			
NETWORKS & ZONES				
Check/refine zones and networks	x			
Review speed and capacity assumptions			x	
Evaluate node/intersection delay	x		x	
Automate highway and transit network development	x			
Revise transit acces/egress	x		x	
Revise transit transfer method	x			
Implement new fare structure	x			
Develop new area types	x			
Develop 2010 base year dataset		x	x	
AUTO AVAILABILITY				
Develop auto availability model		x	x	
TRIP GENERATION				
Disaggregate purposes	x		x	
Develop cross-classification generation model	x		x	
Fully incorporate non-motorized	x		x	
TIME OF DAY				
Separate AM and PM peaks	x		x	
Increase number of time periods			x	
Consider alternative placement in model stream			x	
TRIP DISTRIBUTION				
Validate purpose trip length frequency distributions	x		x	
Evaluate / incorporate logsum accessibility measure		x	x	
Implement destination choice model		x		x
Add market segmentation to destination choice or distribution model		x		x
MODE CHOICE				
Develop new nest logit mode choice model	x		x	
HIGHWAY ASSIGNMENT				
Review and revised volume delay functions	x		x	
Implement multiclass assignment	x		x	
Incorporate pricing sensitivity	x		x	
Evaluate LUCE assignment approach	x			
Incorporate reliability measures				x
TRANSIT ASSIGNMENT				
Link transit times to congested roadway times	x		x	
Assign drive legs of drive access transit trips			x	
Preload transit vehicles				x
MODEL VALIDATION				
Revalide entire model	x			
SPECIAL GENERATORS				
Evaluate need for special generator models		x		x
TRAFFIC MICROSIMULATION				
Develop time-of-day distributions		x		
Apply determiistic methods available in VISUM		x		
Post-process travel model output for external traffic simulation		x		

Note: Due to time constraints, the peer review panel did not discuss all of the recommendations included in the memo from Cambridge Systematics to DVRPC “re: Preliminary draft of proposed DVRPC model enhancement list.”

Table 2. Long-Term Model Enhancements

	Model Memo		Peer Review Panel	
	Recommend	Optional	Recommend	Optional
DATA				
Implement HH survey	x			x
Implement onboard survey	x			x
Perform speed and count studies	x		x	
ACTIVITY / TOUR-BASED MODELS				
Design model system		x	x	
Consider phased implementation		x	x	
Develop application software		x	x	
TRAFFIC MICROSIMULATION				
Implement regional time-dynamic assignment		x		x
Apply stochastic or simulation-based highway assignment method		x		x
INTEGRATED LAND USE-TRANSPORT MODELING				
Evaluate integrated land use -transport modeling approaches		x		x

Appendix A

List of Peer Review Panel Participants

Peer Review Panel Members:

Name	Affiliation
David Boyce	Northwestern University
Keith Killough	Arizona Department of Transportation
Maren Outwater	Puget Sound Regional Council
Richard Walker	Portland METRO

Local Agency Staff:

Name	Affiliation
Chris Puchalsky	DVRPC
Charles Dougherty	DVRPC
Tom Walker	DVRPC
Matt Gates	DVRPC
Jon Kugel	DVRPC

Local Agency Consultant Staff:

Name	Affiliation
Thomas Rossi	Cambridge Systematics
Wolfgang Scherr	PTV America

Supporting Staff to Peer Review Panel Members:

Name	Affiliation
Sarah Sun	FHWA Travel Model Improvement Program
Joe Castiglione	Resource Systems Group, Inc

Appendix B

Peer Review Panel Meeting Agenda

September 29th 2009
8AM – 5PM
New Jersey Conference Room
The ACP Building - 8th Floor
190 N. Independence Mall West
Philadelphia, PA 19106

Introduction

8:00 – 8:15	Meet at DVPRC in the New Jersey Room; Continental Breakfast
8:15 – 8:30	Welcome and Introductions

Description of Current Model

8:30 – 9:15	Model Input Data – socioeconomic, traffic counts, household travel survey, etc.
9:15 – 10:00	Trip Generation and Trip Distribution Models
10:00 – 10:15	Morning Break
10:15 – 11:15	Highway and Transit Networks, Assignment Models, Feedback, and Convergence
11:15 – 11:45	Validation Results
11:45 – 12:00	Land Use Modeling with UPlan
12:00 – 1:00	Lunch (on-site)

Future Direction

1:00 – 2:00	Review of Cambridge Systematics Recommendations and Steering Committee Feedback
2:00 – 2:45	Open Discussion and Questions
2:45 – 4:00	Peer Review Panel Internal Discussion
4:00 – 5:00	Preliminary Findings/Recommendations from the Panel