Puget Sound Regional Council (PSRC)

Peer Review

January 2016

TMIP

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Puget Sound Regional Council (PSRC)

Peer Review

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16. Abstract This report details the proceedings of a peer review of the Puget Sound Regional Council's (PSRC) transportation model. The peer review was intended to help guide the modeling activities PSRC pursues and to aid PSRC in transitioning to its new regional activity-based travel model.		
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1.0 Introduction

1.1 Disclaimer

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

1.2 Acknowledgments

FHWA would like to acknowledge the peer review members for volunteering their time to participate in this peer review. Panel members included:

- Joe Castiglione—San Francisco County Transportation Authority (SFCTA);
- Clint Daniels—San Diego Association of Governments (SANDAG);
- Rick Donnelly—Parsons Brinckerhoff (PB); and
- Josie Kressner—Transport Foundry.

Additional biographical information of each peer review panel member is located in appendix C.

1.3 Report Purpose

This peer review was supported by the Travel Model Improvement Program (TMIP), sponsored by FHWA. TMIP sponsors peer reviews in order that planning agencies can receive guidance from and ask questions of officials from other planning agencies across the nation. The peer review process is specifically aimed at providing feedback to agencies on travel modeling endeavors.

The primary objective of the PSRC peer review was for PSRC to receive guidance on transitioning from their aggregate, trip-based travel model to their activity-based model, which currently is operational, but not used as the official model for the agency. Further, PSRC received feedback on several other modeling tools (e.g., visualization) and future directions (e.g., dynamic traffic assignment).

The peer review panel convened for one day and one-half day (November 5, 2015 to November 6, 2015). During that time, PSRC presented background information and asked for guidance in specific areas of their modeling practices, and the panel discussed these items and offered a series of formal recommendations to PSRC.

1.4 Report Organization

The remainder of this report is organized into the following sections:

- **Overview of the Puget Sound Regional Council (PSRC)—**This section highlights the responsibilities of the agency as well as some key characteristics of the Greater Seattle region.
- **Travel Modeling Needs—**This section discusses PSRC's modeling needs assessment, including stakeholders, uses of the model, and users of the model. In addition, this section details the agency's goals for the peer review.

- **PSRC's Travel Models—**This section details PSRC's travel models, including an aggregate, trip-based model and the operational activity-based model.
- **Peer Review Discussion—**This section details the key discussions had by the peer review with PSRC over the course of the one-and-one-half-day peer review meeting.
- **Peer Review Recommendations—**This section highlights the official recommendations made by the peer review panel. Some of the key discussion points are revisited here, but some new details also are added.

Four appendices also are included:

- Appendix A—List of Peer Review Panel Participants;
- Appendix B—Peer Review Panel Meeting Agenda;
- Appendix C—Peer Review Panel Member Biographies; and

2.0 Overview of Puget Sound Regional Council (PSRC)

2.1 PSRC Responsibilities

PSRC functions as the federally designated metropolitan planning organization (MPO) for the Seattle region. The primary responsibilities of the MPO's transportation modeling group include the following:

- Conformity analysis and long-range planning;
- Activities related to the Transportation Improvement Program (TIP); and
- Providing planning and technical support for planning partners;
- Developing and maintaining the region's transportation model.

2.2 Regional Characteristics

PSRC is the planning organization of the Greater Seattle region in Washington, which includes 4 counties and over 70 cities and towns. The region covers 6,290 square miles and has a population of roughly 3.8 million people. By 2040, the population is projected to reach 5 million. Figure 2-1 shows the geography of the region.

Figure 2-1 PSRC Geography

(Source: http://www.psrc.org/assets/11419/PSRCmpo.pdf?processed=true.)

The region's urban core is located in Seattle and represents the region's largest activity center. However, Tacoma in the south, Everett in the north, Bellevue in the east (across Lake Washington), and Bremerton in the west (across Puget Sound) are all major activity centers as well, as shown in Figure 2-2.

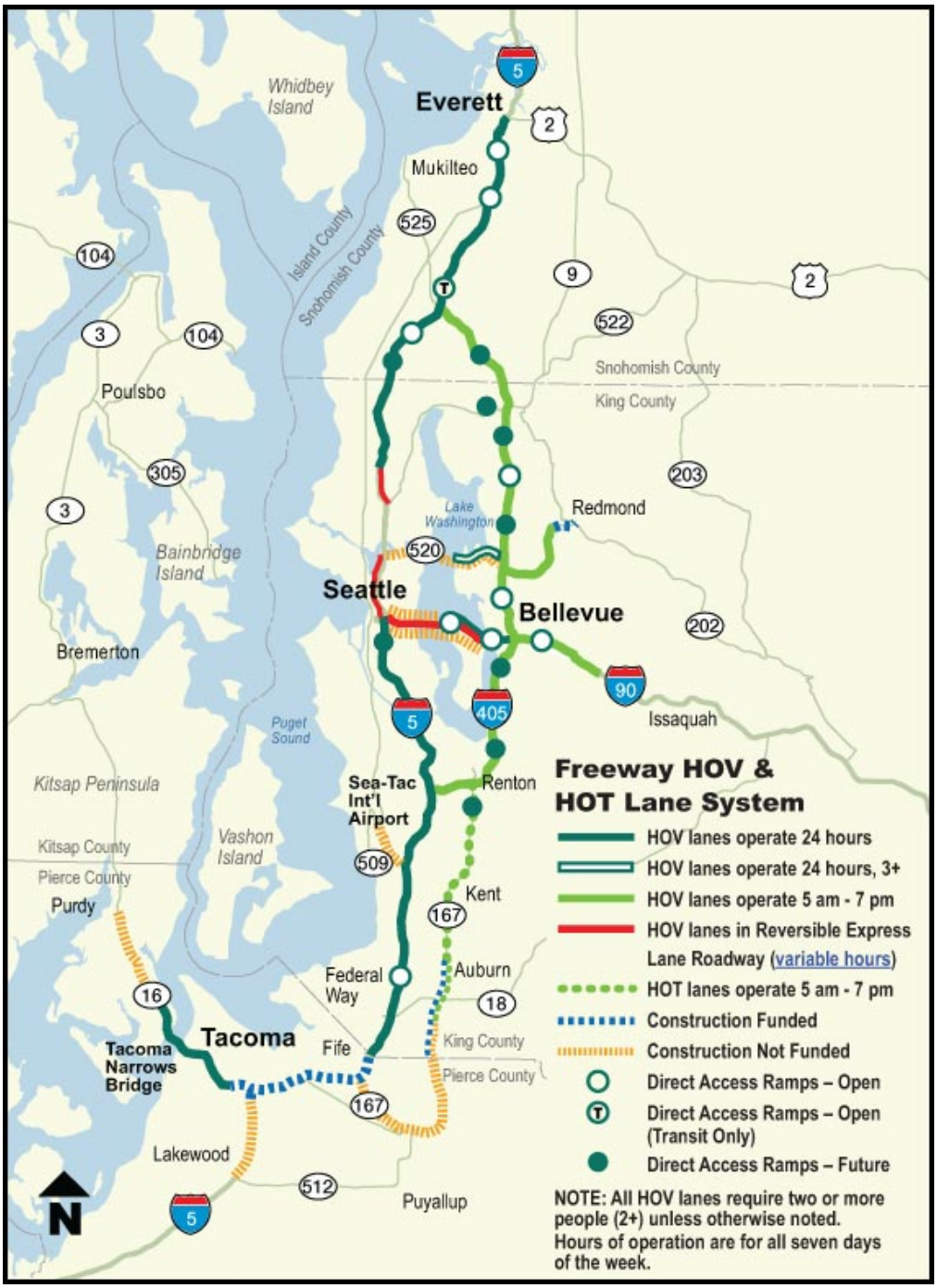

Figure 2-2 HOV Facilities

(Source: http://depts.washington.edu/hov//.)

While the region has only two toll roads, there is consideration about implementing tolls on many of the region's limited access facilities (mostly existing roadways) by 2040. In fact, a recent Traffic Choices study was designed for PSRC to get a better sense of how travelers in the region would respond to tolls. The region has a number of managed/high-occupancy vehicle (HOV) facilities, including facilities along major stretches of I-5 and I-405, the two major north-south highways connecting Everett in the north and Tacoma in the south to Seattle and Bellevue. The region's HOV and high occupancy-toll (HOT) facilities are shown in Figure 2-2.

The region's ferry system (shown in Figure 2-3), operated by Washington State Ferries, is one of the largest in the world, offering major connections between Seattle and Bainbridge, Seattle and Bremerton, Edmonds and Kingston, and Faunt and Southworth. The region's ferries serve over 20 million riders each year.

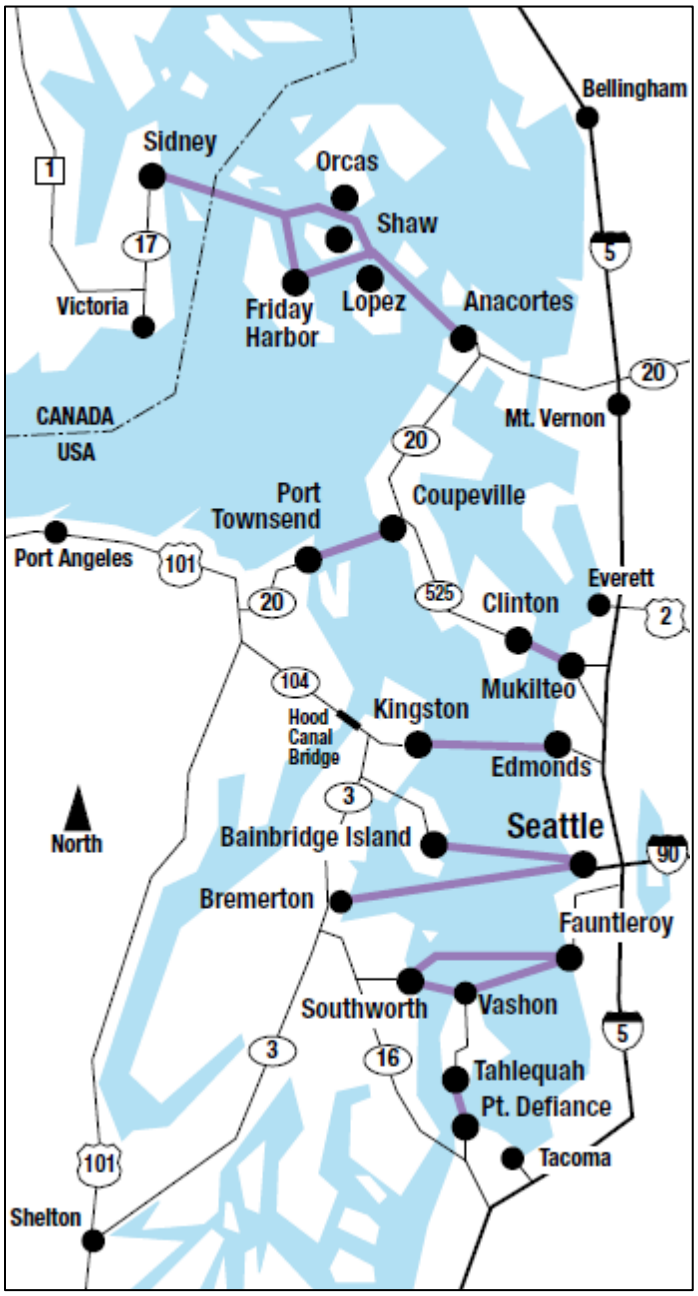

Figure 2-3 Ferry Network

(Source: http://www.wsdot.wa.gov/ferries/pdf/2015Fall.pdf.)

The network of ferries speaks to the immense number and level of physical barriers in the region. Puget Sound, and its various inlets and bays, forms a barrier between Kitsap and King Counties. But the region also contains a number of other smaller water barriers, as well as mountains, that surround the region to the north, south, and east. These physical barriers have resulted in a number of unique transportation issues, like the ferry system and need for transit.

3.0 Travel Modeling Needs

PSRC's travel modeling activities serve a variety of groups and various needs. This section outlines those needs and identifies the stakeholders in the regional travel modeling activities (this information comes mostly from an internal needs assessment document distributed to panel members prior to the meeting). In addition, this section describes the objectives PSRC has for the peer review based on those needs.

3.1 Modeling Needs Assessment

As part of PSRC's ongoing activities, they performed interviews with stakeholders in the region over the course of about one year. Through this process, PSRC identified a variety of needs. Model users were interested in seeing better model documentation, making the models easier to run, and getting better performance/speed from them. Several project types were of particular importance to stakeholders, including tolling and road user charges, transit system design, and operational improvements to highways. In addition, planning partners were interested in having web-based and interactive data products from PSRC's modeling group.

3.1.1 Stakeholders

There are three key stakeholders of the travel model in the PSRC region:

- Internal stakeholders at PSRC
- Member government planners
- Travel modeling groups in the region

Within PSRC itself, there are separate groups focused on long-range planning, short-range planning, and growth management. Government members include various city governments and planning departments and the region's transit agencies. The travel modelers include the Washington Department of Transportation, local municipal modelers and consultant firms.

3.1.2 Long Range Transportation Team

The long-range transportation planning team is the primary user of PSRC's model, and they use the model for a variety of planning purposes. Tolling has been a hot topic in the region, primarily because it is not clear how the region will pay for maintenance of its existing infrastructure. The long-range planning team is very interested in being able to answer questions about the affect of road user charges on travel behavior.

This team also has a lot of interest in better understanding operational highway improvements, including ramp metering, incident response, traveler information, etc. They would also like to enhance the benefit-cost analysis capabilities to quantify congestion, health, freight, and social equity impacts of transportation decisions.

In the coming years, PSRC will be generating its first long-range plan for transit, and many transit-related questions are of interest, including the following:

- Better configuring the network (or future network) to maximize its usage
- Identify when transit-priority treatment is needed at the corridor level
- Quantitatively assess transportation needs of special-needs population
- Identify capacity constraints in the system

Lastly, the long-range transportation team would like to better understand freight movements in the region.

- Identifying the freight corridors
- Identifying the types of freight moving in the region
- Examining goods-based models of freight movement
- Truck safety
- Truck trip patterns

3.1.3 Short Range Transportation Team

The short-range transportation team performs air quality conformity analysis and relies on travel model run outputs of short-term runs. These analyses are typically needed about once or twice per year. A key requirement of the short-range team is model stability, since they need similar outputs from the travel model each time the analysis is performed. This can be challenging as model enhancements/adjustments are being made on a continuous basis, as modeling issues are identified.

3.1.4 Growth Management Team

The primary responsibility of the growth management team is to develop the region's long-range growth management strategy, name VISION 2040. This is a strategy developed on the basis of the growth vision of the region's stakeholders. This team relies on mode share estimates provided by the modeling team.

3.1.5 Model Users Group

The model users group consists of agencies and entities that actively run the PSRC travel model. The users group typically meets four times per year. As part of the modeling needs assessment, a survey was conducted of model users. Figure 3-1 through Figure 3-4 summarize the responses of model users to survey questions.

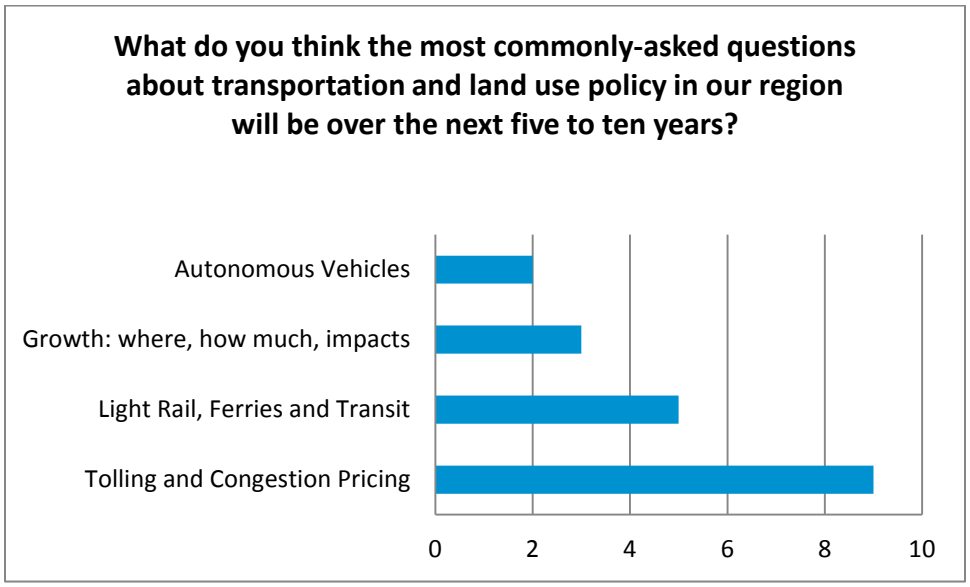

Figure 3-1 Most Common Transportation and Land Use Policy Questions in Near Future
(Source: Reference materials distributed by PSRC to peer review panelists.)

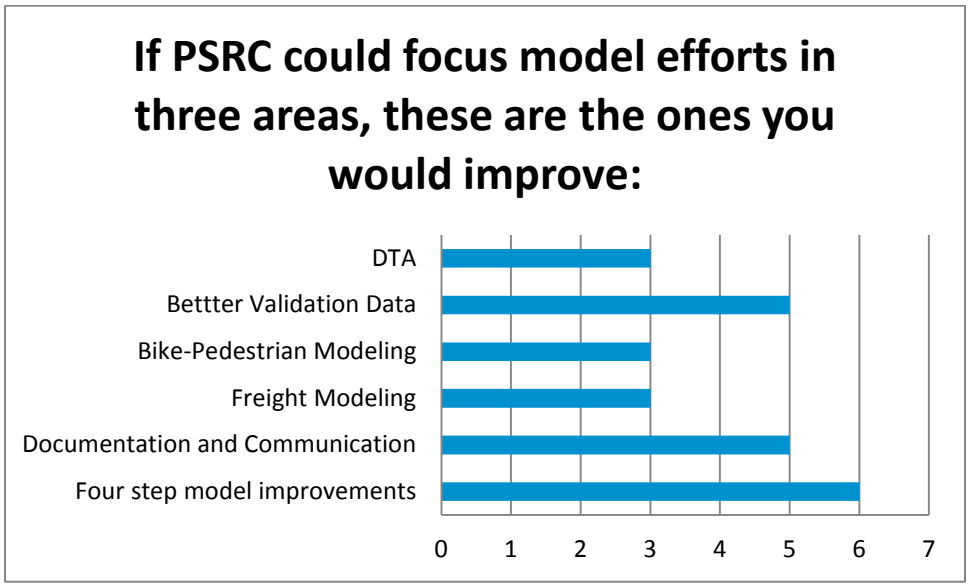

Figure 3-2 Most Important Areas for PSRC Model to Be Improved
(Source: Reference materials distributed by PSRC to peer review panelists.)

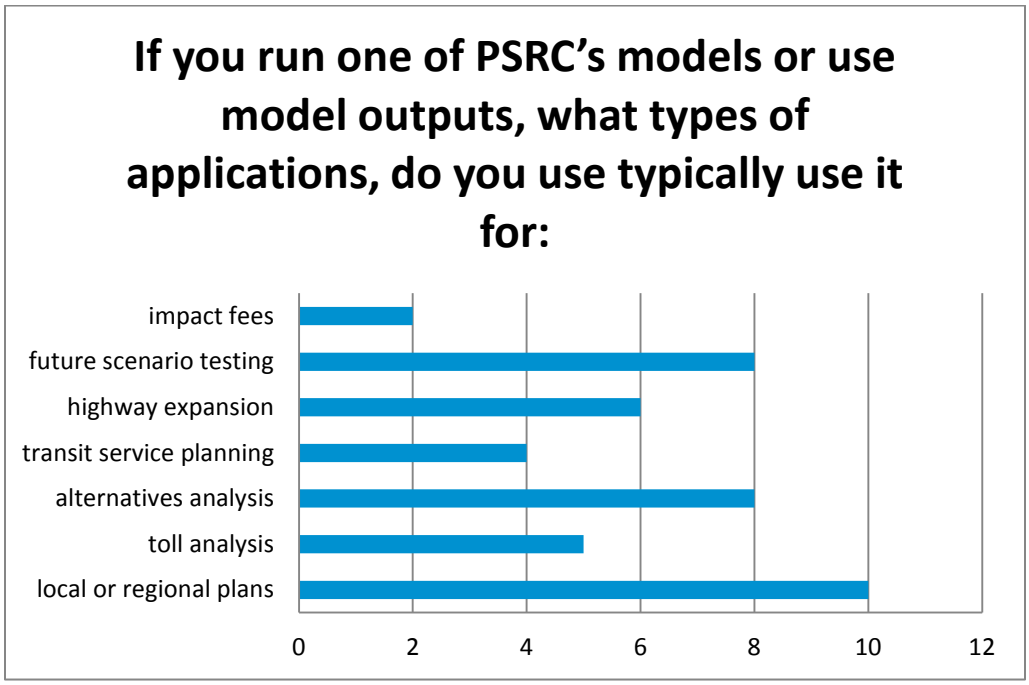

Figure 3-3 Typical Model User Applications

(Source: Reference materials distributed by PSRC to peer review panelists.)

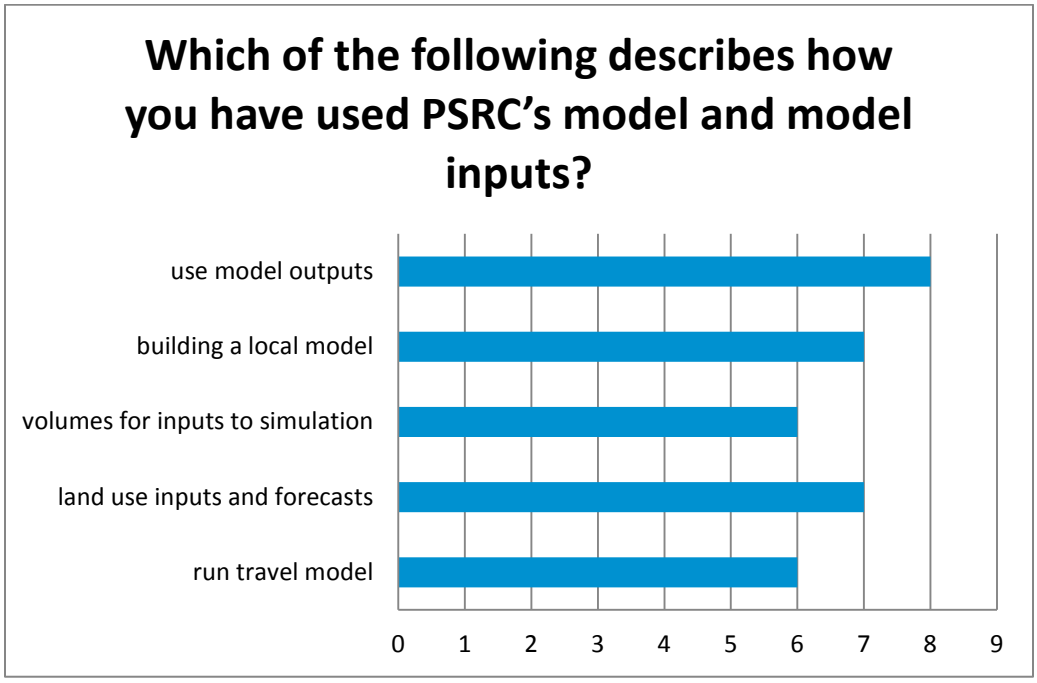

Figure 3-4 Model User Uses of Model and Inputs

(Source: Reference materials distributed by PSRC to peer review panelists.)

The survey also found that modelers that did not use the PSRC model typically did not because a smaller scale was needed for the applications of interest. A number of respondents suggested that model run times and performance were an issue that should be improved.

3.2 PSRC's Goals for the Current Peer Review

While formal goals for the peer review were not set prior to the meeting, it was clear that several topics were of particular importance and PSRC wanted feedback on those topics. In particular, PSRC invited guidance on building the travel model improvement program over the next few years, specifically advanced modeling components. Two key questions that PSRC had related to their activity-based model system, which has been operational for several months and is under testing, are:

- How can PSRC make the transition from the trip-based model to the activity-based model?
    - How long should PSRC maintain both models?
    - When should the trip-based model be retired?
    - How can PSRC encourage the region's stakeholders to use the model?
- What level of effort should be put toward updating the activity-based model using the latest household survey?
    - The current model was estimated and calibrated using the previous household survey.
    - PSRC is considering re-estimation of all model components and validation and calibration of the entire model system. They are also considering validation and calibration without re-estimation.

PSRC was also very interested in getting feedback from panel members regarding a number of other topics, including the following:

- Freight modeling
- Land-use planning and forecasting
- Visualization
- Dynamic traffic assignment
- Data
    - Highway travel time and speed data
    - Survey data
    - Origin-destination data
    - Network data
- Other tools

4.0 PSRC's Travel Models

PSRC began development of an activity-based model (ABM) for the region several years ago. The ABM has been operational for several months, and in that time PSRC has been testing it in a variety of ways, often running it in parallel with the 4-step model when that model is run, and comparing results. Since the completion of new household travel survey for the region for the year 2014, PSRC plans on updating the ABM accordingly, possibly re-estimating each of the model components, and definitely calibrating/validating the model to the latest survey data. This section details the features of the current trip-based model as well as the ABM.

4.1 Trip-Based Model

PSRC's trip-based modeling platform (named 4K) is a typical, aggregate, 4-step travel model with the following key model components.

- **Trip Generation**—The trip generation model generates trip productions and trip attractions for each of 5 home-based trip purposes and 2 non-home-based trip purposes. For trip production, trips are generated on the basis of a cross-classification model that segments households across several key dimensions. For trip attraction, trips are generated on the basis of total households and employment by type in each zone. Several key special generators are also considered, including the SeaTac airport, Tacoma Dome, Seattle Center, and Exhibition Center. External trips with one trip end that is internal to the region are also generated by the trip generation model. In addition, the trip generation model generates truck trips.
- **Trip Distribution**—The trip distribution model uses a gravity model approach, segmenting trips across the seven purposes identified above for trip generation. Impedances for the model consider both generalized cost and distance. Truck and external trips are also distributed via gravity models.
- **Mode Split**—The mode choice model apportions trips by mode of travel. Multinomial logit (MNL) models are used for these purposes. Mode utilities consider travel time and travel cost, as well as segmentation variables that account for observed heterogeneity across travelers. Modes identified by the model include single-occupancy private auto, two-occupant private auto, three or more occupant private auto, transit via walk access, transit via drive access, walking, and bicycling.
- **Time of Day**—The time of day model considers 32 time periods, every 30 minutes between 5 AM and 8 PM and additional periods for evening and overnight. There are three key steps of the model:
    - Divide auto access to transit trips into auto and transit portions of the trip
    - Develop daily trip tables by vehicle type (e.g., single occupant vehicle, HOV with two occupants, HOV with three or more occupants, trucks, and transit)
    - Develop time period trip tables for carpool, non-carpool, transit and truck trips

  Fixed factors are used to distribute college, school, and non-home-based trips into time periods, as well as trucks, transit, and non-motorized travel. MNL models are used to distribute the remaining trip purposes. For traffic assignment, the 32 periods are collapsed to five larger time periods.

- **Traffic Assignment**—Traffic assignment generates estimates of vehicular volumes on all links in the network. Highway assignment uses a multi-user class procedure that considers distinct values of time by trip purpose, income, and trucks. It uses volume-delay functions developed by the Bureau of Public Roads (BPR), which rely on free-flow link travel times and capacities to calculate congested travel times. The assignment procedure also considers turn penalties. Transit assignment considers several transit attributes including in-vehicle time, access and egress travel time, wait time, and number of transfers.

4.2 Activity-Based Model

PSRC's activity-based model (ABM), called SoundCast, was developed in order to answer more diverse transportation planning and policy questions than the trip-based predecessor. It accounts for the drivers of travel demand in a more direct way than the trip-based model, considers more variables that are important for travelers' behaviors, and does so at a much finer grain of detail. The model has been operational for several months but has not been used in an official capacity. The model was estimated and calibrated using 2006 travel survey data and a variety of 2010 base year data. As part of SoundCast's deployment, it is being revised based on a 2014 household travel survey. It is not yet determined whether the model components will be re-estimated. Whether they are or not, the model will be revalidated using the new data.

The overall ABM structure is shown in Figure 4-1. The system uses a population synthesizer to simulate characteristics and locations of households, DaySim models the "within region" travel of residents, and additional external and commercial trips are added to the trip tables prior to network assignment. Emme is used for network assignment and network skimming processes. Key inputs to SoundCast include the transportation networks and household and employment data, which comes from UrbanSim (a separate land use model).

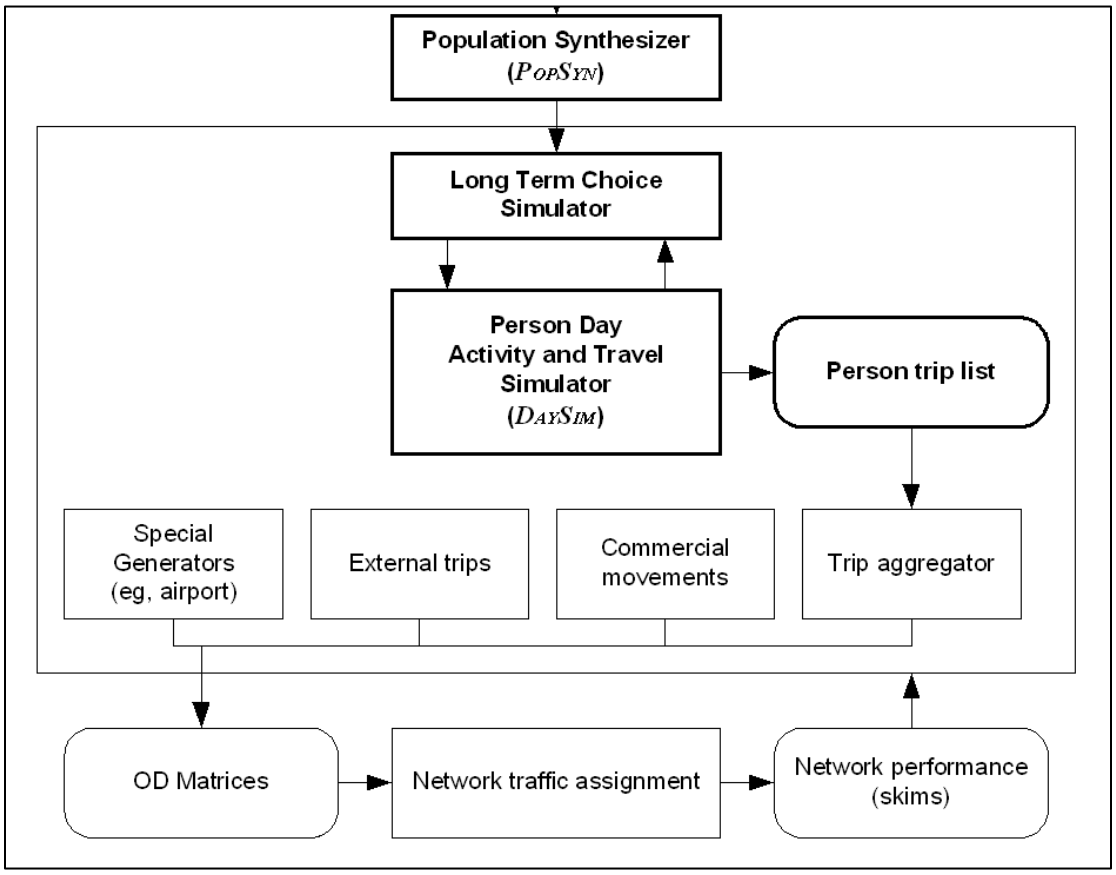

Figure 4-1 SoundCast – Activity-Based Model System Architecture

(Source: Reference materials distributed by PSRC to peer review panelists.)

DaySim, the demand model, basically replaces the first three steps of the 4-step model, including trip generation, trip distribution, and mode split. It also replaces the time of day model component, which is not part of the traditional 4-step modeling process. These models are replaced with a number of new models that work at different levels of travel behavior, including long-term choices, day activity level choices, tour level choices, and trip/stop level choices. The model components and structure are shown in Figure 4-2 and Figure 4-3.

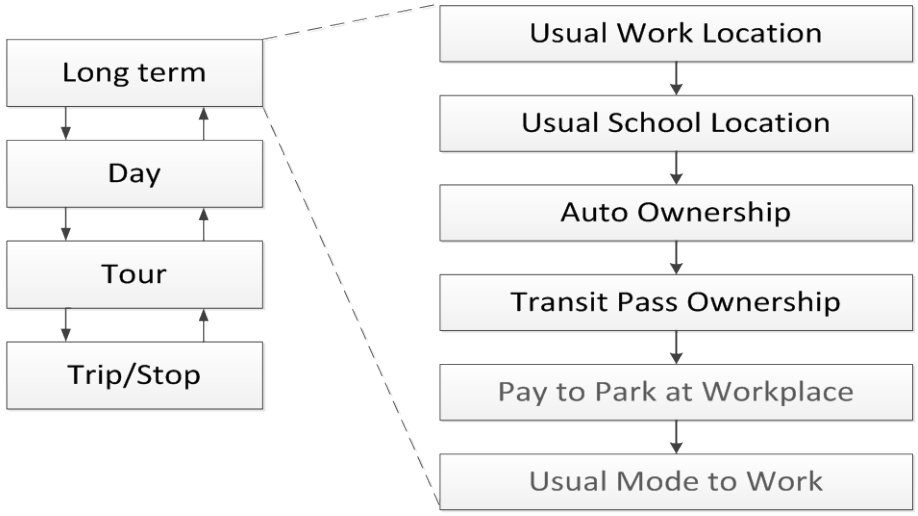

Figure 4-2 DaySim Long-Term Model Component Structure

(Source: Presentation materials used by PSRC during peer review meeting.)

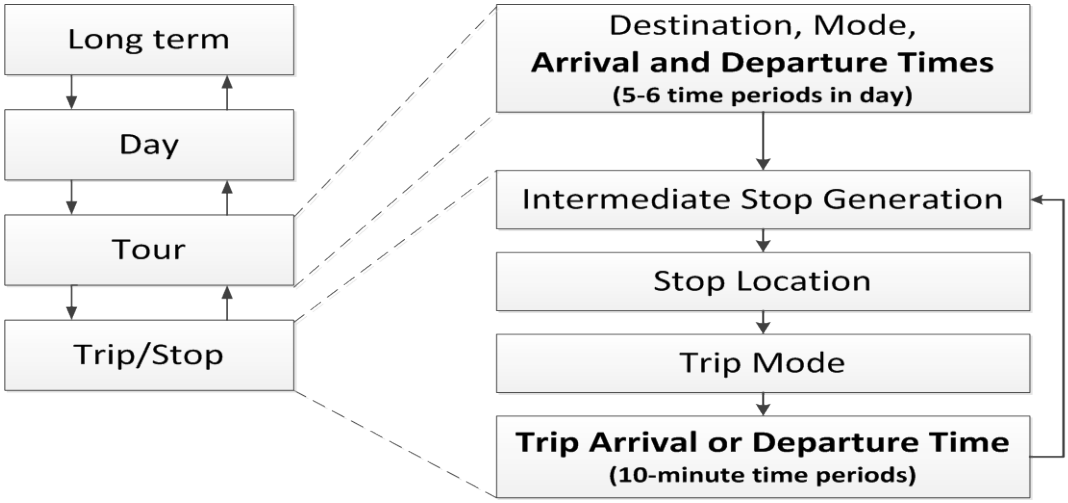

Figure 4-3 DaySim Tour and Trip/Stop Level Model Component Structure

(Source: Presentation materials used by PSRC during peer review meeting.)

DaySim considers a number of variables in the models, including household variables, person variables, tour variables, and trip variables. Household variables include the household location, income, household size, number of workers, and number of vehicles. Person variables include age, gender, worker and student status, hours worked, and work and school locations. Tour and trip variables include the location, tour primary purpose, tour and trip mode, and trip timing.

Once DaySim runs and the supplemental trips are generated (e.g., truck trips and external trips), trips are assigned to the network and new skims/impedances are generated on the basis of the estimated demand. The new skims/impedances are fed back to the demand system and the process repeats, as shown in Figure 4-4.

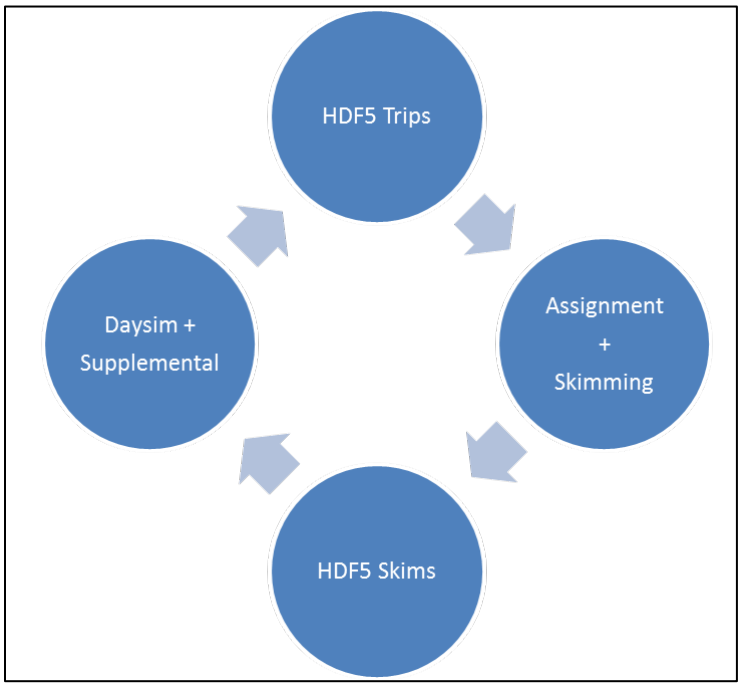

Figure 4-4 SoundCast Data Exchange

(Source: Reference materials distributed by PSRC to peer review panelists.)

The time periods from the SoundCast model are defined as in Table x. Skims are generated for several time periods. For highways, six primary periods are skimmed:

Table 4-1 SoundCast Time Periods

Mode	Time Period	Time Period Definition
Roadway	Early AM	5:00 am – 6:00 am
	AM Peak Hour 1	6:00 am – 7:00 am
	AM Peak Hour 2	7:00 am – 8:00 am
	AM Peak Hour 3	8:00 am – 9:00 am
	AM Peak Hour 4	9:00 am – 10:00 am
	Midday	10:00 am – 2:00 pm
	PM Peak Hour 1	2:00 pm – 3:00 pm
	PM Peak Hour 2	3:00 pm – 4:00 pm
	PM Peak Hour 3	4:00 pm – 5:00 pm
	PM Peak Hour 4	5:00 pm – 6:00 pm
	Evening	6:00 pm – 8:00 pm
	Overnight	8:00 pm – 5:00 am
Transit	AM	6:00 am – 9:00 am
	Midday	9:00 am – 3:00 pm
	PM	3:00 pm – 6:00 pm
	Evening	6:00 pm – 8:00 pm
	Night	8:00 pm – 6:00 am
Walk	All day	6:00 am – 6:00 am
Bike	All day	6:00 am – 6:00 am

Highway skims are generated for each of 12 periods and transit skims for 5 periods as shown in Table x. Skim attributes include travel times, travel costs, and travel distances for highways, and in-vehicle times by transit vehicle (e.g., ferry, commuter rail, etc.), wait times, access and egress times, transfer times, and number of transfers for transit.

All of the individual DaySim model components were calibrated to match the 2006 household survey, 2010 Census Transportation Planning Products (CTPP), 2010 highway counts, 2006-2010 ACS, and 2010 boarding data. As mentioned above, PSRC has a new 2014 household survey, which will be relied upon to update the model.

5.0 Peer Review Discussion

The first day of the peer review panel meeting included time for PSRC presentations to the panel members as well as discussion of key topics. This section documents the key points that were discussed.

5.1 Regional Travel Model Needs

PSRC presented details of their modeling needs to the panel. One of the key points of emphasis for PSRC in the transition from their trip-based model to ABM is consistency in results and maintaining credibility with partner agencies. This might be particularly challenging, since their model is being used in a variety of ways by different groups. In addition, some users do not need detailed model results at all, instead using only population and employment data, transit coverage, or future transportation project information.

Another topic presented to the panel was information related to the survey PSRC conducted groups using the model. One panel member asked about the relationship between PSRC and the Washington DOT. PSRC noted that Washington DOT is the biggest user of the travel models supported by PSRC, but their modeling work is usually performed by consultants, rather than PSRC. Washington DOT does stress that they want consistency in what they do and the work PSRC does, even though the DOT is more focused on corridor type analyses, while PSRC looks at a more regional view typically.

One key point was offering better access to the information and data PSRC has available to them and sharing that information more effectively. One panelist noted the importance of being able to create data products and update those products in a timely manner for a MPO. PSRC has been investing in getting staff to script so that analyses and processes performed routinely or multiple times can be accomplished more quickly. Even so, PSRC noted that at this point, they are more reactive to the needs of the planners at the agency and modeling partners. This may change as their partners get a better idea of what PSRC is capable of. One of the panel members voiced similar struggles in that panel member's region, but agreed that scripting is very important. In that panelist's region, money was invested in training staff in Python and SQL. A couple other panelists suggested R as a good scripting tool, particularly for visualization.

5.2 UrbanSim

PSRC uses UrbanSim in two ways. The first is called baseline mode where land use forecasts are produced. This represents a market-based forecast, reflecting past trends and current land use. The second is to allocate growth, where growth is determined by a land use visioning process. The visioning process helps to ensure the land use futures used in modeling are consistent with the vision the stakeholders, policy-makers, and citizens have for the region. The perception of the baseline is that it represents a future that nobody wants. The approach is also used as a gap analysis, to evaluate how the forecasts can be affected so they look more like the vision. Several panelists liked this approach, noting that the baseline only has credibility for backcasts, to show the tool works. The baseline does not have credibility for forecasts, because it does not match political vision. On the other hand, the panelists cautioned that judgment was needed, since the visioning approach may not be suitable for all needs and objectives. One panel member noted that investment bankers, for instance, may not care about the vision, and so PSRC should maintain a land use scenario that captures those interests.

PSRC noted that UrbanSim has its own work location choice model, but the ABM also has a work location choice model. One panelist suggested that there could be a compelling case for including the work location model in UrbanSim, since the ABM does not have residential location choice, but UrbanSim does. However, UrbanSim and the travel model are not very well integrated due to difficulty in running them both, which means the accessibility variables fed to UrbanSim may be inadequate inputs for work location choice. Another panel member argued that since PSRC's implementation of UrbanSim is vision-based, then the work location should be in the ABM so that it is sensitive to policy.

Two panelists asked about calibration/validation of UrbanSim. PSRC suggested that the overall model was calibrated well and adequately responded to policy levers. One of the panel members expressed concern that the calibration and validation data sources were truly independent, particularly as it related to work location, and suggested AirSage data might be a good option as a completely independent data source. Another panelist argued that the AirSage and CTPP data were bound to be inconsistent in many ways, and suggested the CTPP may be more reliable due to the much larger sample size.

PSRC's synthetic population for the ABM is created to match certain control totals, as opposed to actively aging the population in forecast years, which a couple of panel members agreed was unnecessary anyway. One panel member cautioned that some of the longer term choice constructs might be changing due to things like the "gig economy" (e.g., people working from home and shifting jobs more often).

PSRC had a number of questions related to the integration of UrbanSim with the travel model. PSRC's current approach runs the models iteratively for every 10 years. There is also questions about which accessibilities to use in UrbanSim. One panel member suggested that they set the integration time frame so that PSRC can run the whole system within several days, and that the accessibilities that are passed to UrbanSim be tested as it may not even make much difference. Another panelist mentioned that buffered or decayed measures are simpler to compute than logsum accessibilities, and could be beneficial. In addition, careful consideration should be given to decide on segmentation variables to use for the accessibility measures, which measures make sense for each model component, and to ensure comparability in the measures used for UrbanSim and the ABM. Another panelist suggested that while land use models are useful for decision making, integrating tightly with travel models is problematic and usually prohibitive.

5.3 DaySim

In general, the ABM specification, as described in Chapter 4, was already set at the time of the peer review meeting, but several points were discussed.

Several comments were made on the long-term choice model components of the ABM. One panelist commented that a toll transponder ownership model could be useful to obtain good toll related results. While it can be difficult to model, another panel member mentioned that pay-to-park at one's workplace is an area of considerable interest in that panel member's region, due to the vast number of parking options. This may be a modeling area to explore for PSRC. Shadow pricing on the work location model (so that the number of workers in a zone better aligns with the number of individuals choosing to work there by the model) was also discussed. PSRC believes it can be difficult to calibrate and time consuming. One panelist liked the idea of using shadow prices, since it should give reasonable results for certain types of policy analyses (like adding jobs to a particular zone). The alternative to shadow pricing (while maintaining

equilibration between jobs and work locations) is to take jobs out of the pool during simulation, but the panel noted that this can lead to problems.

Another key area of concern for PSRC is the path type model, which is used for the logsum generation that feeds many of the model components. Path types include toll or no toll choice for auto modes, premium and basic transit mode options, park and ride path type, as well as bike and walk path types. These alternatives appear as alternatives under main travel mode options, but the alternatives are not actually selected in simulation. Instead, they are used to represent the diversity in lower level alternatives across the main modes. The actual choices for these options are made by the assignment models. A couple of the panel members found this to be confusing, and believed it would be better to simulate the choices at the mode level rather than in assignment.

PSRC has had to deal with the toll or no toll choice component issues resulting from the types of toll scenarios they typically examine. The toll scenarios typically have tolls everywhere in the network, so the choice is not really one of toll versus no toll, but one toll versus another toll. PSRC posed the question of whether it would be better to remove the toll choice component from mode choice and consider it only in assignment. One panel member believed it to be problematic to consider the toll choice only in assignment and not mode choice. Another panel member noted that treatment in assignment only would result in losing information about who is using the toll road, which can be important for environmental justice issues.

Several panel members brought up the concern that reliability would be particularly important for the types of toll scenarios PSRC is examining (e.g., tolls everywhere). One of the key motivations of pricing is better reliability, with one panelist noting that one can see people shifting to use managed lanes earlier than expected based on the model due to reliability issues not captured by the model. One issue is that measures of reliability are not easy to extract from network assignment, particularly since they are not additive. Even so, the panel suggested that an ABM has the granularity needed to look at the tradeoffs between travel time and reliability.

5.4 ABM Calibration

PSRC described that new household survey data was collected for the region in the previous year, but this data had yet to be utilized in either the existing trip-based model or the ABM. They are committed to moving forward with using the data for the ABM only, not wanting to continue maintaining two separate travel models, but they will face political pressure if they wait too long. One panel member's region now has an operational ABM and the transition to the ABM was rather simple. When the transition was made, the trip-based model was retired. The panelist conceded that there were problems with the model, as one would expect, but they are working on it and are open about the issues.

PSRC was still debating whether to re-estimate all of the ABM model components and perform model calibration and validation with the new survey data or whether to embark on calibration and validation tasks only. For political reasons, PSRC needs an operational model by August of 2016, and they prefer that model to be the ABM. One panelist strongly believed that re-estimating the ABM model components would be a mistake, and PSRC should only perform calibration and validation (other panelists agreed). There simply would not be enough time, and they can have a 2014 model without explicitly estimating the model on the data, as long as calibration is based on the 2014 data. Moreover, the panel member suggested PSRC carefully consider what targets would need to be hit for the calibration and validation processes to be considered a success. PSRC may also benefit from applying the ABM and getting experience

with it to better understand how re-estimating model components would be valuable (e.g., what aspects of the model do not perform as well as PSRC would like).

One of the main concerns of PSRC, as described in Section 5.1, is credibility, and part of that deals with the model consistency and performance. For calibration, one panel member suggested that PSRC make a list of calibration priorities by thinking about where credibility problems currently exist. Another panel member emphasized that people care about aggregate measures, and those deserve particular scrutiny during model calibration.

PSRC has struggled in the past with transit validation, often finding that transit shares from the household travel survey do not match the model. Several of the panel members commented that this was not satisfactory. One panel member suggested PSRC invest in an on-board transit survey, and another suggested backward engineering the number of transit trips from boardings data if possible in order to assert targets. Panelists agreed that transit validation is an issue for many regions.

Panelists debated the impacts of commercial vehicles and how those are treated in models. One panel member offered that certain types of commercial vehicles (e.g., taxis, Ubers, UPS trucks, etc.) may not be represented very well by truck/commercial vehicle models. But panel members agreed that commercial vehicles are important, making up 10-15% of a region's overall VMT. In one panel member's region, ride sharing has replaced taxi to a large extent, with taxi ridership down on the order of 70%. Overall, ride sharing plus taxi in that region has remained relatively stable, with only a small combined increase in trips. Another panel member suggested that taxi and ride sharing are viewed differently, with people using the modes in very different ways. Nonetheless, these different modes should be able to be included in ABMs rather easily, since wait times and costs are easily represented.

5.5 Freeway Times

One measure of model performance that PSRC has been looking at is link travel times from the model and comparing to observed freeway travel times. They have found the model is not performing well. One panelist pointed to network coding issues as a likely culprit, suggesting this is a common issue.

Another panel member offered that the issue may be the volume-delay function (VDF), which is a mathematical way travel models predict congestion levels for specific demand levels on network links. These VDF functions suggest that travel times monotonically increase with volumes, but that is not how actual traffic responds. As congestion levels reach level-of-service E or F (per the Highway Capacity Manual), the curve will tend to bend back on itself. That is, there is a point where as congestion worsens (i.e., travel times increase), volumes get smaller. There is no way around this issue with a static assignment model, though a more dramatic curve could help.

One panelist suggested that, in addition to link level delay, a better representation of intersection delay could help. Another panel member's region had issues with intersection delay, later finding there was a simple miscoding issue of a parameter. PSRC noted that they do not have information about signals versus stop sign intersection treatments, which could be problematic for modeling intersection delays.

Several panel members agreed that this issue was not a particularly important one in the grand scheme of things. Given that PSRC has only several months to get the model ready, there are plenty of other more important areas of the model to focus on. One panel member concluded,

noting that static user equilibrium assignment was designed to distribute vehicles on paths, not get accurate travel times on congested links.

5.6 Shadow Casting

SoundCast has been operational for several months (though not calibrated to the 2014 data). In this time, PSRC has been applying the model simultaneously with the trip-based model whenever that model is run. Results between the two models can then be compared for the following purposes:

- To understand how well SoundCast is working;
- To see what improvements need to be made for re-estimation next year with 2014 household survey; and
- To determine when PSRC can switch to SoundCast to use as its primary travel model.

One panelist suggested that PSRC not worry about how well the two models match. However, for PSRC, this goes back to an issue of credibility, and if the two models differ too much, it could hurt the agency's credibility.

PSRC described that the aggregate model results have generally shown that the two models are very similar across VMT, average trip lengths, time of day splits, and mode shares. This was surprising to the panel, since other regions' comparisons have not been nearly so consistent.

The panel made a few other recommendations. One panel member suggested making special considerations for military bases, since their travel patterns are different from other households, and PSRC has two military bases, including one that is quite large. Another panel member suggested that the ABM developers may know about certain issues related to the time of day model components of DaySim, and suggested contacting them. However, adjusting time of day constants would not be a good use of time, since they would not change the models' sensitivities to policies. One panelist suggested that for calibration, PSRC should adjust the weights to better reflect different geographies for which PSRC is interested.

5.7 Travel Surveys

In the spring of 2014, PSRC began collection of a new household travel survey, covering a minimum of 4,700 households. The sampling plan included targets for specific segments of the population. The survey was conducted fully online, and included an automated geocoder for selecting travel locations in the diary data. PSRC found that the new data suggested a sizable difference in the transit and non-motorized trip numbers between 2006 and 2014, which was concerning. One panelist suggested that pedestrian (and bicycle) counters could be helpful to verify such results and this type of data is being collected more and more in many regions.

The household survey data was supplemented with an add-on survey of 1,200 households conducted in the spring of 2015, which also included a GPS sample of 250 drawn from the 2014 survey effort. The GPS data was collected using a smartphone app developed for the project. PSRC did note that the app for GPS data had some bugs. For instance, the app would sometimes not recognize the start of trips. They also found that some stops would not be recognized as stops because their durations were too short.

One panelist commented that the survey may not capture certain activity purposes well, and the GPS data can be useful in validating the household survey data. PSRC was not sure that was the case, and also found that the modal shares suggested by the GPS data were similar to

those found in the household travel survey. Another panel member was concerned that the GPS data app would ask too many questions (10 in total) of respondents whenever they completed a trip, and this may be a deterrent to answering the questions.

PSRC is planning on shifting to a more continuous data collection strategy, rather than the typical large surveys that are conducted by regions every five to ten years. They are also considering collecting this data mostly through smartphones in order to avoid gaps due to under reporting or misreporting of trips. There are issues PSRC is working through on this front, including how to combine data across years for use in model estimation and ensuring comparability of different methods.

5.8 New Directions in Modeling

One area that PSRC is investing resources is in some new modeling directions including the following:

- Automation of outputs, particularly visualization tools
- Web mapping
- Open Street Maps
- Modeling management and dashboard efforts
- Bike modeling

Visualization Tools

Tableau is a tool PSRC has explored for developing visualizations of model outputs, but it has some drawbacks including that it is rather rigid in how it is programmed, making it difficult to adapt easily. One panelist commented that another issue is that it is public, and there are certain types of information that an MPO may not want public for certain scenarios, or there could be issues with proprietary data. Another panel member thinks RStudio is a very good visualization tool, noting that it can be scripted and is free. However, it requires a certain amount of overhead cost to get comfortable with coding in JavaScript.

In addition, to Tableau, PSRC is experimenting with iPython Notebook, which they have found to be easy to use, interactive, and a powerful visualization tool. One panel member had different opinions, noting that it would be a challenge to use as an end script with the full model to produce automatic summaries.

Web Mapping

PSRC has experimented with CityPhi 3D visualizations available with the Emme software package. They have found that it can generate some impressive graphics but have not figured out how to tell a coherent story with it or how to make it really useful to them.

Open Street Maps

PSRC has been experimenting with Open Street Maps, which is a free world map created by volunteers with local knowledge. PSRC thinks this could be a way to ensure consistency in the networks used across partner agencies, including a repository where partner agencies could put new projects for forecast year networks. On the other hand, PSRC is concerned about the time and effort required to make such a tool work, as well as data oversight concerns since the tool is publicly accessible. A couple panelists agree that it could be challenging to generate networks directly from Open Street, but noted that there are others working on this very issue, so there could be information or resources to start from. The New York region may be the furthest along

in this regard, so PSRC might reach out to someone there. Overall, the panel thinks that resources like Open Street Maps should be embraced, since they have so much of the information that MPOs like PSRC need.

Modeling Dashboard

PSRC has developed a model dashboard, which allows for managing model runs remotely. The tool archives run inputs and outputs, controls runs submitted by external users, and avoids privacy issues for employment data (since it need not be shared for a model user to submit a run). The tool is a GitHub repository, written in Python. Currently, it is not completely finished, and PSRC has only used it internally to this point. PSRC believes the tool will help with reproducibility of model runs, because it takes a snapshot of inputs, which will be helpful when PSRC starts allowing other partner agencies to use the tool. However, there are a number of roadblocks to getting the tool operational, including the web front end to specify and run models, that some of the data used by the model is proprietary, model run times, and licensing issues with Emme software. Despite these obstacles, the panel members were generally positive about the tool and encouraged PSRC to continue its development.

Bicycle Modeling

PSRC has begun doing some of the initial steps that will be needed for modeling bicycle trips. This includes coding perceived travel times on links, which accounts for important bicycle attributes like slope, facility type, and vehicle volumes. Model coefficients have been calibrated, starting with those used in the Portland Metro area. PSRC currently has the ability to run bicycle assignment (using the perceived travel times) and pass skims into the mode choice model. One challenge they have found is that the network does not include many local, minor roadways, which bicycles often utilize more than automobiles do. Panelists suggested that Open Street Maps might be useful to this end.

5.9 Freight Modeling

At present, PSRC has a simple truck model. However, there are stakeholders in the region that would like a more sophisticated model. PSRC is currently collecting more truck count data so that they can better calibrate the existing model, but they are not actively working on advancing model capabilities. PSRC was interested in finding out from the panel whether there were incremental improvements that they could make to improve the model, and in finding out when a more sophisticated model might be valuable from a planning perspective.

While freight is a major part of the region's economy, the questions typically being asked of PSRC related to freight are simple and typically short-term. For instance, they may get questions related to routing of trucks through Seattle or truck movements in and out of ports or major industrial areas. A couple of panel members thought that a behavioral freight model was not needed to answer these types of questions. PSRC only needs a simple tool to answer strategic questions about truck movements. One panelist suggested that PSRC try to get local carriers to submit to the American Transportation Research Institute (ATRI) to get good origin-destination (OD) data on truck movements. Overall, the panel generally agreed that freight modeling was not a particularly important avenue of modeling improvement for PSRC at this time.

5.10 Dynamic Traffic Assignment

Dynamic traffic assignment (DTA) is a procedure that PSRC ultimately wants to incorporate into SoundCast. However, it is a question of when should PSRC do this and when can they do it.

One panel member argued that PSRC should wait on adopting DTA and learn from what other regions have done. At this time, there are not many regions with DTA experience. In the experiences this panelist has had with regional DTA, there have been huge issues, including calibration, run times, and responsiveness of the model (e.g., too much congestion predicted).

Another panel member suggested taking a step back and thinking about the purpose of implementing DTA. Static assignment does not produce reasonable delays with heavy congestion, is not useful for many operational strategies, cannot work with reliability measures well, and does not give enough information back to the demand model. This panel member's experiences have been more positive, though on much smaller scales (e.g., regions with 100,000 population, as opposed to several million). In larger regions, sub-area analysis with DTA is possible, though it does not allow for speed feedbacks with the demand model and supply/demand equilibration. This panelist would like to implement a simplified DTA (e.g., that does not consider signals) in a large region with ABM, thinking that this would provide considerable gains over static assignment.

In the San Diego region, a regional DTA implementation project is already underway. However, this region is smaller, has simpler geography than Seattle (which has mountains and large bodies of water), and has a number of data advantages, like automatic signal timing information from a large portion of signals in the region. Even still, one panel member believes the San Diego region is still at least two years away from having an integrated DTA with the ABM.

One panelist suggested testing INRO's (the makers of Emme transportation modeling software that PSRC is already using) DTA solutions. Multiple panel members suggested MATSim as an alternative. While it is not really a DTA, regions like Toronto have found success with it. In that case, the region settled for a simpler demand model but wanted a DTA, due to a different set of priorities for the region. The panelists suggested that MATSim can get up and running fairly quickly without a great deal of effort (e.g., several days). As MATSim is free, this would also have the added benefit of removing proprietary software from the modeling process, since that software's primary use is static assignment.

5.11 Other Tools

PSRC has studied and experimented with a number of other analytical tools. These include the following:

- Benefit-cost tools
- Health impacts models
- Highway operational strategies with static assignment
- Impacts of pavement conditions on travel models
- FAST-TrIPs
- Transit sketch planning tools

Benefit-Cost Analysis Tool

PSRC's benefit-cost analysis tool translates a variety of transportation measures onto a common scale to evaluate projects and policies. The measures used by the tool include the following:

- Travel times
- Auto operating costs

- Auto ownership costs
- Tolls
- Transit fares
- Parking costs
- Active transportation health impacts
- Safety impacts
- Air quality impacts

One panelist really liked the idea of being able to look at a portfolio of projects in an economic framework, comparing them side-by-side. Other regions are doing similar things. In the San Diego region, work has been done with a similar style tool that streamed benefits depending on when projects are forecast to come online, and included things like discount rates.

One issue that can come up with benefit-cost analyses, as pointed out by one panel member, is how to deal with travel time changes. The problem arises when a change actually worsens travel times, but utilities are improved (due to other factors). PSRC noted that they would really like to be using mode-destination logsums as evaluation measures rather than travel times, since those would incorporate any change to the utility functions and can be valued using the marginal rates of substitution between utility and costs. However, PSRC has struggled to operationalize it. One of the panelists suggested that no matter how you compute benefits and costs, something will always be missed. The challenges are what to include, how to value it, and how to reconcile that mobility changes are going to dominate no matter how benefits and costs are computed.

PSRC stressed that their aim with this tool is to tell a coherent story about how a project affects people. There are challenges with this. One panel member suggested that for many people, certain projects will not actually provide benefits and may actually harm them (e.g., a new transit line only helps the people that use it, and could hurt those that do not use it, but pay for it in taxes). Another panelist noted that it can be problematic that the models are always looking at an average day, and on average, a project may only save one minute. On the other hand, if cumulative benefits (over the life of a project) were presented, the numbers would appear more substantial, but would not be as relatable. Another challenge emerges when a project generates revenue, as the impact to individuals may be typically negative.

Health Impacts Modeling

PSRC has been experimenting with the World Health Organization's (WHO) online health impact tool known as Health Economic Assessment Tool (HEAT) for evaluating health impacts of active transport modes. They chose this tool because it is very user friendly and is interactive.

One of the panel member's regions has looked at health with a tool integrated with the ABM. While this tool is new for the region, the panel member's region had a champion for its implementation in the health department. This panel member was skeptical of the value of tools like this, cautioning that the correlation between health and regional travel may not be very significant. In this case, the panel member sought guidance from health experts to make valuations of the impact that additional walking and biking can have. Relying on health experts removes some of the risk for the MPO.

Another panel member cited experience in one region, where valuations of health benefits were performed by health experts, but those numbers were ultimately discounted by a significant amount (e.g., an order of magnitude). Other regions have used valuations as is, without discounting. Overall, this panelist believed that in order to obtain satisfactory benefit valuations for walking and biking, health benefits have to be part of the equation, since these modes will never compete along the dimension of travel times.

Highway Operational Modeling

Operational improvements on the highway side have replaced mega-projects as the way forward, for the simple fact that there is not sufficient money to invest in new infrastructure and maintain what already exists. PSRC would like the ability to capture operational improvements in static traffic assignment model component. Two panelists offered that increasing capacities on network links to approximate operational strategies with static assignment would tell the wrong story, and cautioned against it. In one region, a panel member noted that operational strategies are going to be considered in the model until dynamic traffic assignment (DTA) is implemented. Another panel member suggested that DTA will be easier to implement, the longer PSRC waits, since they will benefit from the experience other regions have with implementing DTA.

Pavement Condition Impacts on Modeling

One issue PSRC is struggling with is that a large portion of the transportation funds available for roadways in the region (e.g., about 60%) is dedicated to maintenance. They would like a way to quantify the tradeoff in the level of operations and maintenance investments. Unfortunately, PSRC does not have pavement data. While Washington DOT does have some data, it is only for state routes. The panel did not have many comments on this topic.

FAST-TrIPs

FAST-TrIPs is a dynamic transit assignment tool that is schedule-based and disaggregate. PSRC would like to use it to account for the effects of crowding, reliability, and taste variations across riders. The work PSRC is currently doing is more on the research side of things, teaming with San Francisco County Transportation Authority (SFCTA) and Metropolitan Transportation Commission (MTC). One panel member commented that PSRC already has all they need to implement FAST-TrIPs with SoundCast, since the ABM is disaggregate and includes all the traveler information that would be used by FAST-TrIPs.

Transit Sketch Planning Tools

PSRC talked briefly about some sketch tools they have developed in-house as well as potentially new ones. They are unsure whether to expend much effort investing in such tools or whether focus would be better spent on the regional model. PSRC has built sketch tools for transit agencies in the past, but those agencies found the tools were not working for them, and ultimately invested in other tools.

Conveyal (conveyal.com) was one tool mentioned by the panelists, which is a data-driven, open source transportation planning tool. This sort of tool could be useful for transit providers that are interested in simple tools that they have access to easily. One panel member suggested that any sketch tools developed by PSRC should be connected to SoundCast. PSRC should avoid situations where internal consistency between SoundCast and sketch tools is not achieved. The panelist also suggested focusing on a limited number of tools, but making sure the tools PSRC maintains really perform well, which will also help with credibility.

6.0 Peer Review Panel Recommendations

On the last half day of the meeting, the peer review panel took about one hour in an executive session, closed to all participants of the meeting except for the panel members. The reason for this was to allow panel members to speak freely and openly among themselves while developing formal recommendations. This section details the recommendations of the panel. Section 6.1 details the panels overall findings. The remaining three sections are organized around three key themes – tasks and activities PSRC must do, tasks and activities PSRC should do if they can, and tasks and activities that the panel is not convinced are priorities for PSRC.

6.1 Overall Findings

The panel made the following findings during the peer review panel meeting:

- SoundCast demonstrably meets or exceeds performance of the trip-based model;
- Model credibility is established by making model inputs and outputs easy to consume, and by educating other agency staff about model capabilities; and
- PSRC is on the leading edge of travel modeling in the USA. PSRC outlined issues and limitations, but the panel sees PSRC as a model for other MPOs across the country to emulate.

6.2 Must Do

6.2.1 Trip-based model retirement and SoundCast implementation

- PSRC has all the evidence needed that SoundCast meets or exceeds the calibration requirements set for the trip-based model. It acceptably replicates observed behavior, within the limits of data at the aggregate total, county, or district levels for which PSRC has made comparisons.
- Retire the trip-based model. Expected key applications include traveler response to pricing and congestion, and their equity implications – something for which microsimulation activity-based models are demonstrably superior to trip-based models. No amount of recalibration of the trip-based model will enable it to inform these issues.
- Looking forward, focus on what PSRC can do at the detailed level that could not be done with the trip-based model. Bring in other datasets to see how SoundCast is doing at smaller, more detailed levels than districts.

6.2.2 Focus on tools that make SoundCast more accessible to local stakeholders

- The web front-end model controller and other visualizations will bring more stakeholders to the table. However, PSRC needs to ensure that visualizations and other periphery software and tools are consistent with a larger strategic plan.
- Evaluate what is important to PSRC's model users and do what they would do first. Be one step ahead. For example, what will the revenue and tolling users do to evaluate PSRC's data? Post that information in PSRC's online documentation.
- Accept that, in the end, it is not possible to track, develop, and support every tool that external stakeholders find interesting.

6.2.3 Estimation and calibration/validation

- Given the August 2016 schedule for having an operational model, re-estimation with 2014 survey is likely not feasible or necessary.
- Instead, focus on re-calibration to the 2014 household survey.
- Calibration should first ensure alignment between synthetic population and expanded household survey population.
- The general process should involve a first pass through all the models to calibrate to un-adjusted survey targets, including network assignment.
- Adjustments to household survey targets will likely be necessary to account for discrepancies between key model outputs (e.g., traffic counts and transit volumes by time of day).
- Adjustments to household survey targets should ideally be based on adjustments to household expansion factors to ensure consistency across all model summaries.
- Calibration should be focused on some components such as activity generation, destination choice, mode choice, and auto ownership.
- Issues observed in initial calibration and validation included:
    - Time of day distributions
    - Activity generation in some areas such as Kitsap County
    - Consistency of synthetic population and expanded survey
- Consider network validation procedures to ensure that estimation / calibration inconsistencies are not related to network inputs.
- Going forward, expand PSRC's estimation dataset to include transit on-board surveys (in lieu of over-sampling transit-oriented households in the next household travel survey).

6.2.4 Utilize other data sources

- Other datasets could be useful to externally validate SoundCast at a level that was not possible with the trip-based model.
- Presenting comparison results online in an interactive way could improve PSRC's credibility. For example:
    - Get more detailed person-level data than ACS/CTPP or the Decennial Census can offer from one of the many marketing databases that exist. A 50% sample, even if biased, will point toward ground truth much better than 1% of a 1% sample will.
    - Look at an OD matrix (GPS-based, triangulated signal, or some combination thereof). Use 20% of the OD pairs to calibrate SoundCast more. Then use the remaining 80% to show that the base year validates well.
    - Use real travel times from directions APIs to validate travel times in SoundCast. Compare these to OD pairs that happen to appear in the household travel survey.

6.2.5 Invest in outreach and wetware

- Open documentation is commendable, both in concept and quality of implementation.
- Other strategies to connect with model user community include:
    - Informal or incremental peer review: periodic external review of modeling program milestones, guiding Innovations in Travel Modeling Conference (ITM16) discussions.
    - Formal SoundCast user training for external users (at executive and user levels).
    - Continue training PSRC staff in scripting, data mining, and visualization of data.

- Making products accessible online: data, modeling summaries, visualization of model outputs.
- Stakeholder-defined workshops: bring in outside users, help them construct model runs, run and interpret the outcomes with them.

6.2.6 Focus on improving the run-time performance of the model

- Reliability of model runs is a higher priority than run-time performance.
- Do some basic profiling of the entire model run stream to determine which parts of the model to focus on for performance tuning.
- Look at high-level model flow: reduce the number of feedback loops by warm-starting the model, as well as shadow pricing within it.
- Ensure the adequacy of hardware, and examine whether bottlenecks in run time can be overcome with AWS or other easily scalable solutions.
- Determine if more hardware will help if licensing issues can be escaped (another reason to consider MATSim)

6.3 Should Do (if possible)

6.3.1 UrbanSim

- Until SoundCast model run times are reduced significantly, it will be a challenge to run an integrated land use and transportation forecast through time.
- If PSRC desires a continuously integrated platform, PSRC will have to live with run times of a week or more.
- The most useful implementation of UrbanSim is a framework that allows PSRC to evaluate what policy it would take to meet its land use vision goals.

6.3.2 Workplace Location

- Workplace location should continue to come from SoundCast.
- SoundCast implementation of workplace location is also easier to calibrate and change to reflect alternative land use scenarios.

6.3.3 Transit Submode Placement

- Transit submode choice can occur in either the DaySim demand model or the network supply model.
- Placement of submode choice in DaySim provides users with easy means to calibration of submodal shares.
- Placement of transit submode choice in the network model will facilitate integration with FAST-TrIPs.
- Current implementation validates reasonably well (and significantly better than the trip-based model).

6.3.4 Shadow Pricing

- Shadow pricing setup should be reviewed to ensure:
  - Reasonable run times
  - Convergence and stability
  - Effects on other components such as skims is reasonable

6.3.5 Sensitivity Testing

- Upon completion of 2014 calibration / validation, model system should be subjected to a set of sensitivity tests that address key model capabilities, including:
    - Pricing sensitivities (investigation of changes in activity-making, flows)
    - Capital investments
    - Land use and demographic changes
    - Simulation variation

6.3.6 Health Modeling / Active Transportation Modeling

- This is a commendable goal to implement tools around health and active transportation.
- Be careful to not overstep the bounds of what the data would allow or suggest. Easy first steps are travel model performance measures around walking and biking (e.g., time spent walking) compared to sedentary travel behavior (e.g., time spent traveling in a car).
- Engage experts from the public health community.
- If transportation-related public health data does not exist for Washington or Seattle, consider looking at California Health Interview Survey (CHIS) data and Integrated Transport and Health Impact Modeling (ITHIM) implementations at MTC, Sacramento Area Council of Governments (SACOG), and SANDAG.
- There are a lot of well-established methodologies to measure particulate matter and ozone exposure for sensitive communities. Continue to expand the practice, but do not reinvent the wheel.

6.3.7 Dynamic Network Models

- ABM-DTA integration is a hot research topic, but years away from successful, much less market-ready, implementation.
- It is unquestionably the future of travel forecasting and will be capable of meeting PSRC's desire for finer operational details that cannot be modeled adequately otherwise.
- Substantial conceptual and methodological hurdles remain.
- Consider incremental changes: MATSim and planning-level DTA.
- Explore ways to use network models as sketch tools (e.g., define population affected by a local project, and then replan just those individuals rather than re-simulating entire population).

6.3.8 Consider Open Street Maps for Networks

- Consider investigating tools that utilize Open Street Maps (OSM) for networks and building footprints. Use General Transit Feed Specification (GTFS) for transit networks at the same time.
- Look to New York City; they are doing a lot with this.
- There are scripts that exist that can convert OSM to networks. They would be a good starting point.
- There also may be good data for bike modeling stored on OSM.
- This will also make it easier to publish web-based visualizations (credibility, user interaction, etc.).

6.3.9 Employment Data Restrictions

- Use of Longitudinal Employer-Household Dynamics (LEHD) Origin-Destination Employment Statistics data instead of Quarterly Census of Employment and Wages (QCEW).

- Continue with planned investigation of LODES data before doing this. Others will benefit from PSRC's analysis of the LODES data to date. It has gone through significant changes since the last TRB publications on the dataset.

6.3.10 Benefit-Cost Analysis

- Ongoing refinement of ABM-based BCA methods is occurring in San Francisco, San Diego, and Tampa regions.
- PSRC can look to these agencies for guidance and lessons learned.

6.4 Not Priorities

6.4.1 Truck and Commercial Vehicles

- The Quick Response Freight Manual is widely used, with no success stories of approaches that are small, incrementally better.
- Any improvements will require extensive data collection efforts.
- State of the art is tour-based truck models that incorporate all commercial vehicles – easily as large an effort as person-based ABM development.
- If work is absolutely necessary here, focus on short-term operation strategies that can be completed outside of the SoundCast framework.
- Partner with Portland Metro.

6.4.2 Sketch Planning Tools

- Spend resources making SoundCast / UrbanSim a platform that can answer these questions in a reasonable and accessible manner.
- Think about the ways PSRC can adapt SoundCast process to do sketch planning. (Perhaps topic for ITM16 roundtable or specific research work item). This will likely tie in with PSRC's visualization strategies and dashboard implementation. Aim to make those solutions solve PSRC's sketch planning tool needs.

Appendix A List of Peer Review Panel Participants

This section lists all individuals who attended the meetings, including panel members, PSRC staff, and peer review support staff.

A.1 Peer Review Panel Members

Panel Member	Affiliation
Joe Castiglione	San Francisco County Transportation Authority (SFCTA
Clint Daniels	San Diego Association of Governments (SANDAG)
Rick Donnelly	Parsons Brinckerhoff (PB)
Josie Kressner	Transport Foundry

A.2 PSRC Staff

Name	Affiliation
Billy Charlton	Puget Sound Regional Council (PSRC)
Suzanne Childress	Puget Sound Regional Council (PSRC)
Craig Helmann	Puget Sound Regional Council (PSRC)
Mark Simonson	Puget Sound Regional Council (PSRC)
Brice Nichols	Puget Sound Regional Council (PSRC)
Neil Kilgren	Puget Sound Regional Council (PSRC)

A.3 TMIP Peer Review Support Staff

Name	Affiliation
Sarah Sun	Federal Highway Administration (FHWA)
Jason Lemp	Cambridge Systematics, Inc.

Appendix B Peer Review Panel Meeting Agenda

Table B-6-1 November 5, 2015 Agenda

Time	Description
8:00 a.m. to 8:30 a.m.	Arrive + Light Breakfast
8:30 a.m. to 9:00 a.m.	Welcome, peer review goals, and modeling context at PSRC – Billy
9:00 a.m. to 9:15 a.m.	Identified modeling needs in the past year – Craig
9:15 a.m. to 10:00 a.m.	Panel questions about documentation and open discussion of goals of review
10:00 a.m. to 10:30 a.m.	Model design introduction
10:30 a.m. to 10:50 a.m.	Trip-based model design – Craig
10:50 a.m. to 11:30 a.m.	DaySim design – Suzanne
11:30 a.m. to 12:00 p.m.	Skimming, assignment, trucks design – Stefan[1]
12:00 p.m. to 1:00 p.m.	Lunch
1:00 p.m. to 1:45 p.m.	Review and discussion of SoundCast calibration results – Suzanne
1:45 p.m. to 2:30 p.m.	Review and discussion of sensitivity tests with SoundCast – Suzanne
2:30 p.m. to 3:00 p.m.	Open discussion of calibration, validation and sensitivity tests
3:00 p.m. to 3:15 p.m.	Break
3:15 p.m. to 3:45 p.m.	Household survey – Neil
3:45 p.m. to 4:15 p.m.	New directions in modeling – Brice + Stefan[1]
4:15 p.m. to 5:00 p.m.	Other modeling tools discussion – Craig

[1] Stefan ultimately could not attend the meetings.

Table B-6-2 November 6, 2015 Agenda

Time	Description
8:00 a.m. to 9:00 a.m.	Review and extra time for topics not covered on November 5 • Extra time for topics from the day before that the panel is interested in • Land use modeling • Ideas and questions from the panel
9:30 a.m. to 11:00 a.m.	Panel develops recommendations
11:00 a.m. to 12:00 p.m.	Panel reviews recommendations with PSRC

Appendix C Peer Review Panel Member Biographies

C.1 Joe Castiglione, San Francisco County Transportation Authority

Joe Castiglione is a Deputy Director for Technology, Data and Analysis at the San Francisco County Transportation Authority (SFCTA) with 18 years experience in the development, application and refinement of advanced travel demand forecasting models. Prior to joining the SFCTA, he served in a variety of technical roles on travel forecasting and transportation planning projects in both the public and private sectors, focusing on activity-based travel demand forecasting models and their integration with advanced dynamic roadway and transit network models. He has extensively applied these model systems to transportation and land use planning and investment analyses.

C.2 Clint Daniels, San Diego Association of Governments

Clint Daniels is a Principal Researcher at the San Diego Association of Governments overseeing the forecasting and modeling group. Clint is responsible for developing long range forecasts of San Diego's population characteristics and demand for new infrastructure. Clint's recent projects include developing California's first Sustainable Communities Strategy, forecasting to support a new trolley extension from downtown San Diego to UC San Diego, and a traffic and revenue study to support the construction of a new port of entry between San Diego and Tijuana. Clint graduated from the University of Illinois with a Bachelor of the Arts in Urban and Regional Planning. Clint earned his Master of City and Regional Planning from Rutgers University in New Jersey, and he holds a Master of Business Administration from the Rady School of Management at University of California – San Diego.

C.3 Rick Donnelly, Parsons Brinckerhoff

Rick Donnelly is a Vice President at WSP Parsons Brinckerhoff. He has 29 years of experience developing, implementing, and applying travel forecasting, dynamic network, and freight and logistics models. His recent work has focused on the development of activity-based microsimulation models of freight and logistics systems, as well as statewide and metropolitan areas. This work has involved agent-based models built using machine learning techniques as well as more traditional formulations. Rick is actively involved in the Transportation Research Board, where he co-chairs their committee on travel forecasting resources. He is also a member of the freight and logistics committee of the Association for European Transport, is a visiting scientist at Los Alamos National Laboratory, and senior fellow at the University of Melbourne.

C.4 Josie Kressner, Transport Foundry

Josie Kressner started Transport Foundry in 2014 to enable transportation planners to use "big" data. Her efforts focus on new ways to utilize passively collected data. In particular, the National Science Foundation and the Transportation Research Board have funded projects to synthesize travel diaries from multiple passive data sources, including consumer and mobile phone data. She has a Ph.D. in Transportation Systems Engineering from Georgia Tech, B.S. in Civil Engineering from Washington University in St. Louis, and a B.A. in Architecture from Washington University in St. Louis.

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