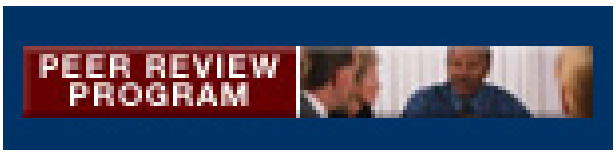
SACSIM IMPROVEMENT PROGRAM PEER REVIEW

PEER PANEL:
Guy Rousseau, Atlanta Regional Commission (Panel Chair)
William Charlton, San Francisco County Transportation Authority
Stephen Lawe, Resource System Group
Keith Lawton, Independent Consultant
Maren Outwater, Puget Sound Regional Council

Panel Convened
November 17 and 18, 2008
Board Room of Sacramento Area Council of Governments
1415 'L' Street, 3rd Floor
Sacramento, CA 95814

Peer Review Sponsored by
FHWA Travel Model Improvement Program
And
Sacramento Area Council of Governments



Background

SACOG has developed the Sacramento Activity-Based Travel Demand Simulation Model (SACSIM) for use in metropolitan transportation planning and analysis. The model was developed by a consultant team including DKS Associates, Mark Bradley, and John Bowman. SACSIM was used for preparation and evaluation of the recent long range transportation plan update. SACOG is considering what major improvements to make to SACSIM over the next five to ten years, and sought assistance from the TMIP Peer Review Program to assemble a peer review program to review the current model system, and to provide technical advice on these improvements.

Peer Review Panel

SACOG and FHWA assembled panel of five nationally-known, respected travel demand modelers and modeling program managers.

The primary panelists were:

Guy Rousseau, Atlanta Regional Commission (Panel Chair)
William Charlton, San Francisco County Transportation Authority
Stephen Lawe, Resource Systems Group
Maren Outwater, Puget Sound Regional Council
Keith Lawton, Independent Consultant

The panelists were selected based on the following criteria:

- Familiarity with activity-based modeling
- Demonstrated ability to develop and manage ambitious model development programs
- Experience in applying state-of-the-art travel demand models for complex project evaluations and policy studies
- None had direct involvement in the development of SACSIM

SACOG and FHWA also included in the review presentations and discussions three widely-respected travel demand modelers, who have had direct involvement in the development of DAYSIM (the activity-based tour model software within SACSIM) and the application shell which runs SACSIM:

John L. Bowman, Transportation Systems and Decisions Sciences
Mark Bradley, Bradley Research and Consulting
John Gibb, DKS Associates

These individuals were included in the review discussions based on the following criteria:

- National and international experience in developing and applying activity-based travel model systems

- Familiarity with the estimation and model structure for SACSIM
- Familiarity with the programming of DAYSIM, the activity-based tour model software within SACSIM
- Familiarity with the application and equilibration regime used for SACSIM

Because of the direct involvement of these three individuals in the development of DAYSIM and the SACSIM application, they were excluded from the private panel deliberations. They were involved in the presentation of SACSIM to the panel, and participated fully in the open discussions.

Representing FHWA for the duration of the panel was Supin Yoder.

SACOG staff present for all open panel discussions were:

- Gordon Garry, Director of Research and Analysis
- Bruce Griesenbeck, Principal Transportation Analyst
- Raju Penmetsa, Assistant Transportation Analyst

Biographical information for each participant is provided in Appendix A.

Panel Agenda and Preparations

SACOG staff prepared and provided to the panelists comprehensive documentation on SACSIM, and all technical memoranda from the DAYSIM (activity model) estimation work.

Gordon Garry worked directly with Guy Rousseau to prepare an agenda for the two-day panel, which was provided to the panel in the week prior to the panel dates. The agenda was structured to provide detailed presentations and discussion on the SACSIM model system as-it-is on the morning of first day, and to present information on the policy context for transportation modeling and analysis moving forward in the afternoon of the first day. The first private panel deliberations were held on the afternoon of the first day. The morning of the second day was spent reviewing questions from the panel which arose the first day, and finalizing presentation of the model itself. The afternoon of the second day included a second round of private deliberations of the panel, and the formal reporting of the panel findings and recommendations.

The agenda is provided in Appendix B. The only significant deviation from the agenda was that the presentation and discussion of the model as-it-is took approximately two hours longer than originally planned; the time was made up by shorter discussions of the list of potential model improvements (Appendix C).

Presentations to the Panel

Copies of the main presentation of SACSIM as-it-is are provided in Appendix D, as well as an informational handout on SB375 provided to the panelists. The main presentation to the panel was a comprehensive, but brief, chapter-by-chapter review of the SACSIM Model

Report, with major model components highlighted for each chapter. This allowed for panelists to question or comment on any of the major model components.

A second presentation was made by SACOG staff, to provide a review of the subset of major policy priorities with specific implications for travel demand modeling for the panel to consider. This was intended to provide the panelists with a framework for evaluating potential benefits to the agency of specific improvements to the model. The following priorities are highlighted:

- Promotion of coordinated land use and transportation planning (or generally, Blueprint planning), e.g.:
  - Transit-oriented development
  - Land use mix and density
- Strategies for meeting greenhouse gas targets for the region, e.g.:
  - SB375
  - GHG reduction
- Accounting for total transportation user costs and affordability
  - Fuel prices and price volatility
  - Transit fares
  - Vehicle ownership costs
- Transportation planning for specific demographic sub-groups
  - Age (especially the old and the very young)
  - Income (especially lower income groups)
- Transportation pricing, e.g.
  - HOT lanes
  - Toll facilities
  - Transit fares
  - Parking pricing
- Support of local agency project priorities, e.g.:
  - New Starts applications
  - Capacity and operations projects to alleviate congestion

Open Discussions of the Panel

As mentioned above, the presentation and discussion of SACSIM as-it-is took significantly longer than planned. This was due to an unusually high degree of interest by members of the panel in fully understanding various aspects of the model, and the active discussion which their questions elicited. Because so much time was devoted to this portion of the agenda, Appendix E includes consolidated notes of the open sessions from SACOG staff. The most active discussions took place regarding the following general issues:

- Representation of costs in the model (reliance on single-point averages, values of time, etc.)
- Use of distance coefficients in destination choice submodels.
- Potential benefits of explicitly modeling intra-household dynamics.
- Refinements to the highway and transit networks and assignment processes, to better reflect true level-of-service by time-of-day, and to better capture variation in responses to time, distance and cost.

- Sensitivity of the model to policy variables, and random variation inherent in the modeling system.

Preliminary Findings of the Panel

The panel held closed discussions at the end of each day. The discussions at the end of the first day resulted in a list of specific questions which were discussed and resolved at the beginning of the second day. The discussions at the end of the first day resulted in preliminary findings and recommendations of the panel, which were reported in open session and are attached as Appendix F.

The panel commended SACOG on the following aspects of the SACSIM modeling system:

- Parcel-based approach
- Tour-based approach (day-trip, time of day)
- Treatment of universities throughout the model (UC-Davis and Sacramento State Univ.)
- Coding treatment of ramp metering in the model and highway network
- Air passenger ground access model
- The rigorous sensitivity testing performed

The panel recommended the following short-term improvements

- Develop land use model, PECAS, sub-allocated at the parcel level
- Re-vamp coding of free-flow speed and distance for the highway networks

The panel listed as high priority the following improvements:

- Related to pricing user costs:
  - Update value-of-time coefficients, and add cost in all model parts
  - Move to distributed values-of-time
- Related to destination choice:
  - Reduce reliance on distance coefficients, rely more on logsums
- Other submodels:
  - Move toward adding more specific pedestrian and bicycle supply variables to the model

The panel listed as medium priority the following improvements:

- Until a new commercial vehicle submodel can be developed, implement incremental improvements to the current submodel to better reflect different truck types.
- Create an early evening time period, convert transit networks to origin-destination format, and validate time-of-travel submodel.

The panel included the following as lower priority and/or higher risk improvements:

- Improve population synthesizer to control for more variables (e.g. presence of children in household, etc.)

- Accounting for vehicle type and transaction in auto ownership submodel
- Modeling parking access explicitly (e.g. choice of parking location relative to usual workplace, walk distance from parking location to usual workplace, etc.)
- Micro-simulation of traffic assignment, dynamic traffic assignment, etc.

Final Panel Recommendations

The following tables provide the final recommendations of the panel to SACOG, as input into the development of a long-range program of improvements to SACSIM. Numbered improvements were those suggested for consideration by SACOG staff prior to the panel. Lettered improvements were added by the panel during the course of the review. The improvements are grouped into priorities using three criteria:

- Potential benefit to agency, based on policy priorities as represented by SACOG staff
- Level of effort in development or implementation
- Difficulty or risk of failure in development or implementation

The potential benefit to the agency

Note that the level of effort, difficulty or risk applies only to the development and implementation of the submodel functionality, but not to its use or application for policy studies. For example, scenario analysis (item #10) is relatively straightforward to implement, and with little difficulty. However, the results of such an analysis as actually perceived and used by professionals and policy-makers in the course of transportation planning projects or studies is not predictable.

The "Implementation Priority" is a summary evaluation, combining the potential benefit to the agency, level of effort, and risk.

Two potential improvements / enhancements were taken of the starting list:

- The treatment of access to park-and-ride lots, while not technically a choice model, was viewed to be an elegant solution to the issue of park-and-ride lot capacity, utilization, and choice. No further improvement was recommended.
- During the course of the peer review, the need to adapt SACSIM for use in New Starts project evaluations was discussed. The panel advised continuing to use SACMET for New Starts submittals, although SACSIM should be used for New Starts service planning.

Six improvements / enhancements were added to the starting list by the panel, shown as lettered improvements "A" through "E" in the table below:

A. Finalizing development and implementation of PECAS was recommended as the highest priority improvement to SACOG's forecasting program. This recommendation was based on the prevalence of land use and land use / transportation interaction in the presentation of future policy needs.

B. The panel expressed concerns regarding coding of distances and free-flow speeds for the highway networks, and the number of iterations for final highway assignments.
C. Concerns were expressed regarding destination choice, especially for usual work locations and work tour destinations. The main concern was that these choice models may to be too reliant on fixed distance constants insteady of logsums.
D. Concerns were expressed that the values-of-time were too low in general, and especially too low for commercial vehicles, trucks and freight haulers. The recommendation was to consider higher values-of-time with any work related to "C", above.
E. A backcast was recommended to validate the generation of the representative population file, and to validate the overall model system.

Review Panel Recommendation Summary

No.	Improvement	Potential Benefit to Agency	Level of Effort	Difficulty/ Risk	Implementation Priority
A	Develop/Implement PECAS	High	High	Medium	**High**
B	Highway Network/Assignment Improvements	High	Medium	Low	**High**
C	Destination Choice Re-Estimation	High	Medium	Low	**High**
D	Update Values-of-Time	High	Medium	Low	**High**
3	Distributed Parameters (VOT, Costs)	High	Medium	Low	**High**
4	Generalized Cost Assignments	Low	Low	Low	**High**
5	Capacity to Analyze Road Pricing	High	Medium	Low	**High**
9	Pedestrian Environment/Street Design Variables	High	Varies	Varies	**High**
F	Transit Network/Assignment Improvements	High	Medium	Low	**Medium**
10	Scenario Analysis/Risk Assessment	High	Low	Low	**Medium**
13	Commercial Vehicle/Freight Submodel	Medium	Medium	Low	**Medium**
1	Vehicle Ownership, Acquisition and Use Submodel	High	High	Medium	**Low**
2	Time-of-Travel Submodel Enhancements	Medium	Medium	Low	**Low**
6	Improved Treatment of Transit Fares	Low	Medium	Low	**Low**
8	Parking Access Submodel	Medium	High	High	**Low**
11	Population Synthesizer Improvements	Low	Low	Low	**Low**
12	Dynamic Traffic Assignment	Medium	High	High	**Low**
E	Backcast	Medium	Medium	Low	**Low**
7	Park-and-Ride Lot Choice Submodel	n/a	n/a	n/a	**Current OK**

Source: SACOG, December 2008.
Lettered improvements (A through F) were added by panel during the review.
Numbered improvements were suggested by SACOG staff prior to the panel.

APPENDIX A: THE PANELISTS

Primary Panel Members:

Guy Rousseau (Panel Chair), Atlanta Regional Commission
Guy Rousseau has over 20 years of experience working with and managing modeling and traffic engineering teams. He currently works as the Modeling Manager for the Atlanta Regional Commission (ARC). In this position, he oversees modeling of the long range transportation plan updates. This process involves network coding, trip generation, trip distribution, modal split, and traffic assignment and emissions analysis for a variety of network year analyses, as well as base year calibrations and validations involving the population synthesizer. Mr. Rousseau also manages the traffic modeling efforts feeding into air quality modeling and related emissions analysis, as well as some post-processing methodology and traffic micro-simulations. Mr. Rousseau has a Bachelors of Science. in Civil Engineering from the University of Montreal, a Masters of Science in Civil Engineering from Laval University in Quebec, and has finished all coursework at Tulane / University of New Orleans towards a doctoral degree in civil engineering and transportation planning, with a dissertation remaining. Mr. Rousseau is the current Co-Chair of the TRB Committee on Travel Survey Methods.

Maren Outwater, Puget Sound Regional Council
Maren Outwater is the Director of Data Systems and Analysis at the PSRC. Ms. Outwater specializes in the planning, evaluation, and modeling of land use, transportation and air quality systems. Ms. Outwater has 23 years of experience in developing passenger forecast models for transit and highway systems, forecast models of goods movements, and land use forecasts for regional and state governments. Ms. Outwater also has 18 years of progressive experience in managing complex multi-modal development efforts. At PSRC, Ms. Outwater is leading the current efforts to integrate land use, travel, and air quality modeling to improve the agency's ability to model climate change and address pricing studies. Prior to working at PSRC, Ms. Outwater was a Principal at Cambridge Systematics. Ms. Outwater has a Masters of Urban Planning in Transportation Planning and a Bachelors of Science in Civil Engineering from the University of Michigan. Ms. Outwater is a member of the TRB Committee on Urban Transportation Data and Information Systems.

Keith Lawton, Transport Modeling Consultant.
Keith Lawton is the past Director of Technical services, Metro Planning Department, Portland, OR. Mr. Lawton has been active in model development for over 40 years, including direct involvement in the application of TRANSIMS in Portland. Mr. Lawton led the development of the first tour-based activity model for an MPO, and has been a leader in developing and applying an integrated land-use and transportation model in Portland. Mr. Lawton led the move to include the effects of urban design on transport demand, and to embed these model elements in the Portland trip-based models. Mr. Lawton received a BSc. in Civil Engineering from the University of Natal (South Africa), and an M.S. in Civil and Environmental Engineering from Duke University. Mr. Lawton is a member emeritus and past Chair of the TRB Committee on Passenger Travel Demand Forecasting.

Billy Charlton, San Francisco County Transportation Authority

Billy Charleton is the Deputy Director for Technology Services at SFCTA, and leads all of the agency's land use and travel modeling activities. Since 1991 Mr. Charlton has been devoted to travel forecasting, and for the past six years has spearheaded the extensive use and development of SF-CHAMP, the Authority's advanced tour-based model. Mr. Charlton drives the short- and long-term development objectives of modeling tools at the Authority, including recent upgrades to enhance sensitivity to roadway pricing alternatives and and for estimation of non-motorized travel. Mr. Charlton has an extensive background in major software development and brings almost two decades of systems design and operation experience to the field of travel demand forecasting. As part of his information technology background, Mr. Charlton is an expert in the implementation of teamwork tools for geographically dispersed workgroups. Mr. Charlton is well known for frequent presentations at the Transportation Research Board and other state and federal meetings on topics ranging from the day-to-day usage of models in a planning context, to advocating technical tools that make model results less error-prone and more accurate. Mr. Charleton is a current member of the TRB Committee on Passenger Demand Forecasting.

Stephen Lawe, Resource Systems Group

Stephen Lawe is the managing director of RSG's Travel Demand Modeling practice and a modeler with over 20 years experience. Over the years, Stephen has worked on several advanced modeling practices ranging back to integrated GIS-based land-use models when GIS was first introduced. Currently, he leads a research effort at the University of Vermont integrating UrbanSim with DaySim, TRANSIMS, and MOVES. He is also developing advanced techniques for modeling carbon emissions, and is managing the SACOG DaySim activity based model-TRANSIMS integration project. Prior to the FHWA-funded project for SACOG, Stephen served on the TMIP peer review panel for the SACOG Activity Based Model implementation. In addition to his work with RSG, Stephen is an assistant professor at Vermont Law School, where he teaches land-use and transportation policy. This understanding of the legal issues surrounding modeling is being applied in RSG's current project for the FHWA developing guidelines for best modeling practices to be used in land use and transportation forecasting of projects under NEPA. Stephen also recently co-facilitated a series of peer workshops on best practices in asset management, climate change, policy, and other related topics for MPOs and DOTs across the nation.

Other Discussants:

Mark Bradley, Bradley Research and Consulting
Mark Bradley is an independent consultant based in Santa Barbara, California. He has a B.S. in Operations Research from Cornell University, an M.S. in Systems Simulation Modeling from Dartmouth College, and an M.S. in Mythological Studies and Depth Psychology from Pacifica Graduate Institute. For more than twenty years, he has carried out consulting projects to apply state-of-the-art travel demand modeling methods. He spent ten years working in Europe with Oxford University and Hague Consulting Group before returning to the United States in 1995. Since then, he has helped to create activity-based travel demand model systems for use in Portland, San Francisco, Sacramento, Columbus, and Atlanta.

John L. Bowman, Ph.D, Transportation Systems and Decision Sciences
John Bowman is best known for his development and ongoing improvement of the activity schedule approach for the forecasting of regional passenger travel demand, and for enabling planning agencies to develop knowledge, skills, models and software needed to implement and use the approach. He develops market demand simulators (based on customer and stated choice data), airport access models and commuter rail demand forecasts, and evaluates models developed by others. Dr.Bowman contributes to the field through publications, presentations and journal reviews, and has taught occasionally at MIT, where he earned graduate degrees (MST 1995, PhD Transportation Systems and Decision Sciences 1998).

John Gibb, DKS Associates
John Gibb is a transportation engineer specializing in the development and application of travel demand models. Mr. Gibb developed the application system for SACSIM, SACOG's activity-based travel demand simulation model, including all the auxiliary trip models, a new park-and-ride methodology, trip compilation and assignment processes, and techniques for reaching system equilibrium. Mr. Gibb also was the chief developer of SACMET, SACOG's trip-based, "four-step" regional model, and participated in numerous updates and improvements, including an update based on a regional household survey of 2000. Mr. Gibb adapted and applied SACMET to calculate user benefits for light rail new-start projects using FTA Summit methodology. Mr. Gibb adapted SACMET for use in detailed traffic studies of proposed Placer Parkway alternatives, for detailed studies of one-way to two-way conversion alternatives in Downtown Sacramento, and to evaluate transit system alternatives for the Sacramento Regional Transit District. Additionally, Mr. Gibb has applied regional models for multi-modal Major Investment Studies, with alternatives involving HOV lanes, light and rapid rail transit, and express busses for several metropolitan areas around the country. Mr. Gibb has been chief developer of travel demand models for jurisdictions in Alameda, Placer, Fresno, Shasta Counties, and others.

FHWA Representative:

Supin Yoder, Federal Highway Administration
Ms. Yoder has over 19 years of experience in transportation planning and travel demand modeling that has been gained both in the consulting world and the public sector. Currently, Ms. Yoder is a Travel Demand Forecasting and GIS Specialist with the Federal Highway Administration. Before Joining FHWA four years ago, Ms. Yoder was a senior transportation modeler with Wilbur Smith Associates and principal modeler with the Chicago Regional Transportation Authority. In addition, Ms. Yoder was an independent contractor for Bechtel performing ridership forecasting on a commuter rail project in Hong Kong and a high speed rail study in Taiwan. Ms. Yoder received the Institute of Transportation Engineers (ITE) Transportation Planning Council's Best Practices Award twice, once in 1999 while she worked at the Chicago RTA and once in 2003 while at Wilbur Smith Associates.

SACOG Staff Presentors and Hosts:

Gordon Garry, SACOG Director of Research and Analysis
Gordon Garry has been with the Sacramento Area Council of Governments since 1990, developing and managing an increasing array of data and forecasting programs to support the agency's transportation, air quality, land use planning, and more recently, climate change efforts. Mr. Garry is responsible for modeling projections and analyses in these areas that meet local, state, and federal planning requirements. Prior to joining SACOG, Mr. Garry worked for the city of Santa Rosa, California; SRF Consulting in Minneapolis, Minnesota; and the South Dakota Department of Transportation. Mr. Garry received his B.S. in Economics at South Dakota State University and his Masters in City and Regional Planning from the Harvard Kennedy School of Government.

Bruce Griesenbeck, SACOG Principal Transportation Analyst
Bruce Griesenbeck holds a bachelor's degree in Sociology from Swarthmore College, and master's degrees in Civil Engineering and in City and Regional Planning from U.C. Berkeley. Mr. Griesenbeck has 20 years experience in transportation planning and travel demand modeling, working directly for public agencies (City of Hayward, CA; Sacramento Area Council of Governments) and as a consultant (Wilbur Smith Associates' San Francisco office; DKS Associates' Sacramento office). As Principal Transportation Analyst for SACOG, Mr. Griesenbeck leads the transportation forecasting and analysis team, and transportation monitoring team. Over the last three years, Mr. Griesenbeck has lead the development and implementation of SACOG's regional activity-based travel demand model, the first such model to be based on parcel-level land use data. Mr. Griesenbeck is also serving as an advisor to the National Cooperative Highway Research Program for NCHRP 08-61 (*Travel Demand Forecasting: Parameters and Techniques*).

Raju Penmetsa, SACOG Assistant Research Analyst
Raju Penmetsa holds a Bachelors degree in Civil Engineering from Indian Institute of Technology, India and a Masters degree in Civil Engineering from University of Cincinnati, OH. Mr. Penmetsa has over 4 years of experience in travel demand modeling and statistical

analysis, working as a consultant at Cambridge Systematics, Inc. before joining SACOG as an Assistant Research Analyst. He has assisted in the implementation of SACSIM, performed numerous GIS analyses, and supported a host of regional modeling and monitoring activities at SACOG.

APPENDIX B: AGENDA FOR PANEL MEETING

Travel Model Peer Review

November 17-18, 2008
Sacramento Area Council of Governments
1415 L Street, Suite 300, SACOG Board Room
Sacramento, CA

Monday, November 17

8:30 Welcome and Introductions Mike McKeever, SACOG Executive Director
Gordon Garry

8:50 Peer review objectives and schedule
Guy Rousseau, Panel Moderator

9:00 Summary of SACSIM07
Bruce Griesenbeck
An overview of the first iteration of tour-based travel model in Sacramento

11:30 Planning and policy context for model development
Bruce and Gordon
Transportation, land use, and emissions policy issues drove the need for a tour-based model and continue to pose demands for additional improvements

12:00 Lunch

1:00 Next Steps, list of SACSIM improvements
Bruce, Gordon, Raju
While we have moved ahead on the demand side of modeling, we need much improvement on the supply side

4:30 End of first day [Closed session for panel deliberations]

7:00 Dinner

Tuesday, November 18

8:30 Review of first day
Guy Rousseau

9:00 Continued discussion of SACSIM improvements
Bruce, et.al.

12:00 Lunch

1:00 Peer review panel meet and prepare recommendations (Closed Session)
Guy Rousseau

3:00 Peer review panel report
Guy Rousseau

4:30 Conclusion

APPENDIX C: Listing of Potential Improvements

1. **Vehicle Ownership, Acquisition, and Use Submodel**. Currently SACSIM predicts one dimension of vehicle ownership: how many vehicles are held by a household at a given point in time. The following enhancements would improve the representation of auto operating cost, and allow for better tracking of fleets for emissions modeling:
    a. Vehicle type—what factors influence what type of vehicles are held by a household? Fuel price should be included among the factors.
    b. Intra-household vehicle allocation—what factors influence who uses a particular vehicle from among all those available within a household?
    c. Vehicle transactions/acquisitions—what factors influence when a household decides to purchase a new vehicle, replace an old one, or sell off a vehicle, etc. Again, fuel price should be a part of this equation, as well as location and accessibility.

2. **Time of Travel Sub-Model Enhancements**. Currently SACSIM operates on 30-minute time slices for activity begin/end points in time. However, our assignment/skim model only includes four distinct time periods and levels-of-service. This creates a "boundary" problem between LOS time periods. A part of the solution for us probably involves adding at least one (and possibly more) time periods to our assignment/skim model.

3. **Implementation of Distributed Parameters (e.g. Value of Time)**. It has been a known issue for years that representation of values of time as category averages rather than distributed values is a huge compromise on the veracity and behavioral integrity of travel demand models. Truly disaggregate modeling based on synthetic populations now provides a viable alternative to category averages. For pricing, having distributed values are probably necessary (though not sufficient) to doing a decent job of modeling demand. SACSIM is currently a fixed, category average VOT model. We should consider options for moving toward distributed VOT and other parameters.

4. **Generalized Cost Assignments**. This refers to using a time+distance cost values in skims and assignment, to more fully represent cost in trip distribution and assignment. Doing this is part of having the capacity to do real evaluation of pricing, since it explicitly treats income, cost and VOT in building paths for skims and assignment. PSRC has been doing this for some time. We would need to move toward the Citilabs' PT module to do generalized cost transit skims and assignment.

5. **Capacity to Analyze Road Pricing**. This improvement combines one or more of items 1 through 4 above, plus network coding, skimming, and assignment changes to allow for evaluation of tolls and road pricing, varied by location, time-of-day, or congestion levels. Items 1 through 4 are discrete submodel improvements; this item involves putting all the pieces together to reasonably represent tolls and road pricing.

6. **Improved Treatment of Transit Fares**. Like most zone-based, four-step travel demand models, transit fares are represented in SACSIM as single-point, average fares for all transit users. In reality, transit fares actually paid vary widely by person type. For example, students and seniors pay discounted fares, monthly passes are provided free to many residents receiving welfare assistance from Sacramento County; and some commuters work for organizations which are highly likely to partially or fully subsidize transit usage (e.g. government agencies). The synthetic population approach allows for better representation of actual transit fares by explicitly representing person type. Including this in SACSIM would expand the number of skims needed, and would need to be implemented in concert with the generalized cost skims and assignment mentioned above.

7. **Park-and-Ride Lot Choice Submodel.** SACSIM currently uses a generalized-cost, capacity-constrained assignment process to skim drive-transit paths/assign drive-transit trips to appropriate park-and-ride lots. This process is probably better modeled as a true choice model, with some capacity constraint. However, the equilibration of capacity constrained park-and-ride lot assignments would require some real work.

8. **Representation of Parking Supply, Cost and Access**. Paid, off-street parking supply is included as an area variable, which enters several of the DAYSIM choice models. Unpaid off-street parking supply, and all on-street parking supply, is not represented explicitly. In no case is access between parking and final destination represented in any way. It would be useful to explicitly simulate parking choice for some trip purposes and locations, and explicitly represent cost, supply and access to parking. This would greatly expand our ability to represent parking supply and policy.

9. **Pedestrian Environment / Street Design Variables.** Currently, a crude representation of street pattern is included in DAYSIM. The variable is the density of street intersections of three different types in the area surrounding a given parcel. The types of intersections are defined in an abstract, GIS-oriented way: the number of "legs" a given intersection has. No treatment of presence/absence of sidewalks or other more tangible pedestrian environment variables are used. Also, other than a few key ped/bike-only facilities like the Guy West Bridge, the Jedediah Smith Bridge, and the ped crossings over the freeways, very few pedestrian facilities are included. On-road bike facilities are not represented at all. Explicitly including more tangible ped/bike facilities in the street pattern variables in SACSIM would expand our ability to evaluate pedestrian and bicycle projects.

10. **Scenario Analysis and Risk Assessment**. At the 2008 TRB Innovations in Modeling conference, Michael Wegner, Keith Lawton, and the entire toll/revenue forecasting panel strongly recommended that travel demand forecasters do more forecast risk analysis and scenario testing than we currently are.

11. **Population Synthesizer Improvements**. There are three areas we should work on. One (already started) is controlling for university students clustered near universities. Second, we need to implement more controls in allocating households to parcels within TAZ's—this process is currently random within TAZ's, but we should be using placetype (the menu of land use categories in the I-PLACE^{3}S planning model) to do a more targeted allocation from TAZ to parcel. Third, we need to have a more elegant process for controlling for key demographic variables in the synthesis process, possibly a la the ARC synthesizer.

12. **Dynamic Traffic Assignment**. DTA is a catch-all term for a range of micro-simulation traffic assignments, with are distinct from the static, equilibrium assignment SACOG currently utilizes by: explicitly representing time; b) representing to some degree agents (i.e. vehicles and drivers) rather than aggregate flows; and c) accounting to some degree for operational considerations in the assignment. Each travel model software vendor has some sort of DTA product available for use; results of regional applications are mixed.

13. **Improvements to Commercial Vehicle and Freight Submodel.** The DAYSIM submodel within SACSIM operates using a synthetic population and activity-based, tour approach to representing internal, personal travel (i.e. all travel made by residents of the region in the course of the daily activities within the region). The commercial vehicle and freight components of the model are adapted from SACMET (SACOG's zone-based, four-step travel demand model), and implemented within SACSIM on that basis. Commercial vehicle trip generation is in production-attraction format, with vehicle trip ends estimated through regression formulas. Trip distribution is a simple gravity formulation. There is no equivalent of mode choice in this submodel. Trips are split to time periods using fixed factors, and zonal trip tables are added to zone-aggregated personal travel by vehicles coming out of DAYSIM. Other areas (e.g. Calgary) have moved towards commercial vehicle or freight tours, which would be more consistent with SACSIM.

APPENDIX D: Presentations to the Panel

TITLE

SACSIM Overview

Peer Review
Improvement Program for the SACSIM Travel Model
SACOG, November 17-18, 2008

SLIDE 1

Background

- Focus of peer review is prioritizing potential improvements to SACSIM
- Starting points--Panel needs to have:
  1) Good understanding of SACSIM as currently implemented
  2) Background on current and anticipated policy issues which will face SACOG
- This presentation focuses on addressing #1

SLIDE 2

Parcel/Point Land Use Data

- Chapter 1 of report
- SACOG iPlace3s provides detailed, parcel-level land use data for base year and forecasts
  - Dwellings (split by SF, MF 2-4, MF 5+)
  - Employment by sector
- Post-processing of file to get remaining variables

SLIDE 3

Parcel/Point Data (cont'd)

- Added variables:
  - School enrollment and employment
  - Medical employment (split out of total)
  - Street pattern
  - Transit proximity
- Questions/comments

SLIDE 4

Representative Population File

- Chapter 2 of report
- Random draw from PUMS to match TAZ-level controls
  - # persons/hh
  - # workers/hh
  - Income class (5)
  - Age (head of hh GE or LT 55 years)
- TAZ-level controls built up from base year observed splits

SLIDE 5

Representative Pop. File (cont'd)

- Control file forecasted to future using dwelling unit type
  - Control demographics attached to dwelling type and geography
  - Dwelling unit type projected to future w/ iPlace3s scenarios
- Control only to TAZ—allocation of households>parcels is random w/in TAZ
- Questions/comments

SLIDE 6

Highway Networks

- Chapter 3 of report
- Fairly standard TAZ-based, link network
- Key variables
  - Length (straight line)
  - Travel lanes
  - Functional class
  - Free-flow speed

SLIDE 7

Highway Networks (cont'd)

- Link-level congestion functions (i.e. no junctions…)
- Complex freeway coding: HOV and aux lanes coded separately
- 4 time periods: AM, midday, PM, evening
- Questions/comments

SLIDE 8

Transit Networks

- Chapter 4 of report
- TP+® TRNBLD format
- Fairly standard "overlay" on highway network
  - Buses use congested link time
  - Exclusive ROW modes (rail) use hard coded times
- Key variables
  - Service headway
  - Stop locations
  - PNR lot locations, capacities

SLIDE 9

Transit Networks (cont'd)

- 2 time periods, based on P>A orientation
  - Peak (AM + PM) based on AM service
  - Off-peak (midday + evening) based on midday service
- Access differentiated by bus/rail:
  - Rail access mediated through "funnel" links
  - Bus access direct from TP+ generated access links to stops
- Questions/comments

SLIDE 10

Bike/Walk Networks

- Chapter 5 of report
- Non-motorized links coded to highway network
- B/W skims distance based on highway network (include NM links, exclude freeways)
- SACSIM blending of TAZ skims and orthogonal parcel-to-parcel distance
- Questions/comments

SLIDE 11

Auto/Transit Costs

- Chapter 6 of report
- Auto operating cost per mile ('00 $)
  - 2000=$0.12/mile
  - 2005=$0.15/mile
  - 2035=$0.20/mile
- AO cost built up from:
  - Fuel price (including real increase into future)
  - Avg. mileage (including higher mileage in future)
- AO cost goes in as single point average for all

SLIDE 12

Auto/Transit Costs (cont'd)

- Transit cost based on:
  - Blended basic + monthly pass fare/trip
  - Assumed % subsidized (+/-20%)
  - No increase over time
  - No accounting of person type differential (e.g. student, senior discount)
  - Questions/comments

SLIDE 13

SACSIM Submodels

- Chapter 8 of report
- Four main submodels
  - DAYSIM
  - Airport passenger ground access
  - Commercial vehicles
  - External travel

SLIDE 14

DAYSIM

- DAYSIM
  - Person-day tour simulation
  - No explicit intra-household dynamics
  - Intra-regional, household-based travel only
  - Seven purposes
    - Work, School, Escort
    - Personal Business, Shop, Meal, Social/Recreational

SLIDE 15

DAYSIM (cont'd)

- Hierarchical choices:
  - Fixed: place of residence
  - Long term choices:
    - Usual workplace
    - Usual school
    - Auto ownership
  - Short Term Submodels
    - Day pattern
    - Tour destination
    - Tour main mode
    - Tour activity scheduling
    - Intermediate stops
    - Trip location
    - Trip mode
    - Trip scheduling

SLIDE 16

DAYSIM (cont'd)

- Unique features
  - Parcel/point data inputs, outputs
  - Parcel value + buffered value variables
  - Street pattern variables
    - 1, 3, 4 leg intersections
    - Good intersection ratio [(3's + 4's) / total]
  - Transit proximity
    - Distance to nearest transit station/stop
    - Distance to nearest rail station

SLIDE 17

DAYSIM (cont'd)

- Unique features (cont'd)
  - Parking supply/cost (off street + paid only)
  - "Doubly constrained" work destination
    - Current = deduct process + reduced choice sets
    - In process = shadow price + uniform choice sets
  - "Singly constrained" else destination
  - Questions/comments

SLIDE 18

Airport Passenger Ground Access

- Psuedo-simulation for passengers to/fr SACOG region, based on 2002 airport passenger survey
- Generation step = enumeration of survey sample to reflect future population, employment
- Mode choice based on combined RP/SP estimation. Modes:
  - Drive/park (resident); return rental car (non-resident); drop-off at airport; taxi; van/shuttle
  - Walk-to-transit; transit (drive/park); transit (drop)

SLIDE 19

Airport Pass. Grnd. Access (cont'd)

- Modeled are departures (i.e. leaving residents, returning non-residents); arrivals assumed symmetrical
- Vehicle trip factoring accounts for "deadheads" (e.g. return trips for drop off)
- Passengers to/fr outside region = exogenous, flat mode split
- Questions/comments

SLIDE 20

Commercial Vehicle

- Simple 4-step, TAZ based model
- Vehicles only (not tonnage, etc.)
- Daily only, with P>A, A>P symmetry
- 2 classes of vehicles:
  - 2 axles (service pickups, vans, smaller single units, etc.)
  - 3+ axles (larger single units, tractor/trailers)

SLIDE 21

Comm'l Vehicle (cont'd)

- Gravity distribution
  - 2 axles shorter, 3+ axles longer
  - 3+ axles high share = IX/XI (25%)
- Questions/comments

SLIDE 22

External Travel

- Exogenous gateways
  - Matched to observed Year 2000
  - Growth factored up from 2000
- Gravity distribution (TAZ-based)
  - Work travel a "take off" from employment for DAYSIM (to reflect intra-jobs held by non-res workers)
  - Non-work household-based travel overlaid on DAYSIM
  - Commercial vehicle distributed in separate tables, added to household-based for assignment
  - Through trips overlaid on all other purposes
- Questions/comments

SLIDE 23

Trip Tables & Assignment

- Trip Tables
  - DAYSIM, airport, commercial, external trip converted to vehicles, split by time period for assignment
  - Highway: 4 time periods, O>D orientation
    - AM (3 hrs)
    - Midday (5 hrs)
    - PM (3 hrs)
    - Late evening/early morning (13 hrs)

SLIDE 24

Trip Tables & Assign.(cont'd)

- Trip Tables (cont'd)
  - Transit: 2 time periods, P>A orientation
    - Peak (AM 3 hrs + PM 3 hrs)
    - Off peak (Midday 5 hrs + Lt.Eve/Early AM 13 hrs)
    - Four tables:
      - Peak / Walk Access
      - Peak / Drive Access
      - Off-Peak / Walk Access
      - Off-Peak / Drive Access

SLIDE 25

Trip Tables & Assign. (cont'd)

- Highway Assignment
  - Link-based capacity constraint
  - Static Equilibrium assingment
    - Modified conical delay function
    - Multi-class
      - SOV+Carpools not using HOV
      - HOV+SOV violators
      - Non-motorized vehicles

SLIDE 26

Trip Tables & Assign.(cont'd)

- Transit Assignment
  - Unconstrained, single-shortest path
  - Paths based on time only
    - For rail, times hard coded
    - For bus, times based on congested auto time x bus time factor
  - Four loaded networks combined post-assignment for daily volumes
  - Capacity accounted for by post-assignment equilibration

SLIDE 27

System Equilibration

- SysEq = feedback loops of entire modeling system to achieve:
  - Output LOS/skim matrices very similar to the input LOS/skim matrices for final loop
  - Declining loop-to-loop differences in I-to-J times and volumes (i.e. convergence)
- Overall SysEq approach
  - MSA used to combine current w/ cumulative prior loop results

SLIDE 28

System Equilibration (cont'd)

- Overall SysEq approach (cont'd):
  - For DAYSIM, progressively higher % of households simulated, until final loop = 100%
  - "Frozen" random seed (i.e. no randomization of seed through loops
- Current "recipe":
  - 9 loops
  - MSA factor = 0.5 (i.e. 50% of current + 50% of cumulative prior loops)
  - Ratio of HH's sim'd = 1: (128, 64, 32, 16, 8, 4, 2, 1, 1)

SLIDE 29

System Equilibration (cont'd)

- Tracked Variables are:
  - Total VHT
  - Total vehicle trips
  - Largest change in O-to-D travel time

SACOG STAFF SUMMARY OF KEY PROVISIONS OF SB375

The bill integrates and aligns planning for housing, land use, transportation and greenhouse gas emissions for the 18 Metropolitan Planning Organizations in the state through amendments to several provisions in existing law.

Regional Transportation Plans (RTP): The California Air Resources Board (CARB) by September 1, 2010, after considering the recommendations from a broadly based advisory committee, will provide targets to the MPOs for greenhouse gas emissions for cars and light duty truck trips from the regional land use and transportation system. The MPOs, through significant involvement with the public and their member cities and counties, will prepare a Sustainable Communities Strategy (SCS) as a component of their RTPs that meets the target if feasible. They must use transportation and air emission modeling techniques consistent with guidelines prepared by the California Transportation Commission to document the greenhouse gas emissions. If the SCS does not meet the target the MPO must adopt an Alternative Planning Strategy that does. However, the MPO is not required to implement the APS because it may include amounts of transportation funding and changes to land use patterns that go beyond what federal law allows. The CARB may accept or reject the MPOs determination that the SCS or APS meets the target, but it does not approve the SCS or APS and it may not suggest or require that the MPO make changes to either document. The adopted RTP must be an internally consistent document and current requirements that transportation funds may only be spent on projects consistent with the RTP are unchanged. Projects already programmed in the STIP through 2011 and projects, program and categories of projects in any county sales tax approved by the voters prior to December, 2010 are expressed exempted from the provisions of the bill. Several safeguards in the bill are included to preserve local government land use authority.

California Environmental Quality Act (CEQA): The methods of CEQA analysis that are required for residential and residential- mixed use projects that are consistent with an SCS or APS that CARB accepts as meeting the greenhouse gas target are changed. 1) Such projects would not have to analyze their growth inducing impacts or their impacts on global warming or on the regional transportation network. A lead agency would not be required to address a reduced density alternative because of car and light duty truck trips. Residential and residential-oriented mixed use projects consistent with an SCS or APS that meets the greenhouse gas target. 2) A limited set of projects that meet a very stringent series of environmental and other criteria would be exempt from any CEQA analysis. 3) A more limited CEQA review than normal would be available to projects with a density of 20 dwelling units/acre that are within 1/2 mile of current or planned high quality transit service for any impacts that are sufficiently analyzed in the RTP EIR and provide adequate mitigation. 4) Local governments would be able to establish their own mitigation standards for local traffic impacts.

Regional Housing Needs Assessment (RHNA): Each MPO's process for updating RHNA would occur every 8 years instead of every 5 years to sync it with updates to RTPs, which occur under federal law in 4 year increments. The HCD process for setting the regional housing allocations for the MPOs is amended to encourage providing sufficient housing to match the projected employment growth in a region, and the way the MPOs allocate the housing to each of the cities and counties must be consistent with the SCS. Local governments would be required to rezone their properties to be consistent with their updated Housing Element within 3 years (4 years if the local government has completed 75% of its rezoning by the third year and meets one of three conditions: circumstances out of its control, lack of infrastructure to serve the sites, need for major update to General Plan to meet its RHNA allocation). If a local government does not update its housing element within 120 days of the statutory deadline then it will have a 4-year RHNA update cycle instead of an 8 year cycle.

APPENDIX E: SACOG STAFF NOTES FROM OPEN DISCUSSIONS OF THE PANEL

The following is an assemblage of notes on the panel discussions during the course of the two days from SACOG staff present during the open portion of the panel. These notes include some concerns stated by individual panelists, which were not included in the formal findings and recommendations at the end of day two; however, many of these concerns may merit specific consideration and follow-up by SACOG.

- Regarding the preparation of the representative population file, there was a lot of active discussion. The following suggestions and comments were offered by individual panelists:
    - Consider modeling university student residential choice from the university
    - The top income category in the control file ($75,000 +) is probably too low
    - Year 2000 (the base year for the creation of the population control file) was an odd year in both San Francisco and Seattle, due to the recently burst "tech bubble"; in both regions, employment and demographic changes from 2000 to 2005 were difficult to project.
    - Consider adding presence-of-children controls to the population synthesis process.
    - Consider adding person characteristics to the household characteristic controls.
- Highway network:
    - Concern expressed regarding lack of area type and speed lookup.
    - Concern expressed regarding reliance on straight-line, node-to-node distance calculations rather than GIS or "true-shapes" distances.
    - Street geometrics in capacity and functional class lookup
- Transit network:
    - Regarding difficulty in using Citilabs TRNBLD for O>D assignment, Citilabs PT may allow for O>D assignment more gracefully.
    - Concerns about having two highly aggregate time periods were expressed
- Costs
    - Serious concerns about using fixed cost-per-mile factors were expressed; since it doesn't vary, it becomes a stand in for distance (income effects excepted).
    - Higher costs should be used for commercial vehicles
- DAYSIM long term submodels
    - Work location
        - Concerns expressed about the array of distance coefficients used, in addition to logsums—perhaps overspecified?
        - Consider allowing the logsum coefficient to assume a value other than 1.0.
        - Too much is made about validation: a model is only valid if it predicts change well.
        - Consider using more income ranges (three used)

        - Suggestion to use buffered densities, not TAZ densities, in the model.
- School location
    - More natural for university to predict choice of residence from the university site, rather than choice of school location from the residence location
- Auto Ownership/Availability

- Day pattern
    - Discussion of intra-household dynamics (not explicitly modeled in DAYSIM).
        - All agreed ideally intra household dynamics should be in the models.
        - All agreed there was no perfect way of doing so.
    - A range of possibilities and preferences expressed:
        - Not worth the added complexity, adequately captured by person type/household composition variables
        - At least make the connection between child activities and tours and the escorting parent explicit by household.
    - Regarding survey adjustment and calibrating "up" the level of activity in this model:
        - In concept, understood; perhaps other ways of doing same thing
- Work destination choice
    - Lots of discussion about Census vs. household survey bias in reported work distances and times, and the reported discrepancy in Sacramento between Census and household survey
        - Some didn't have high confidence in Census as calibration or validation data source
        - Some had very little discrepancy in their home regions comparing the two sources
        - General agreement that Census-reported times are not trustworthy for model calibration
        - Merits further investigation
    - Consider performing calibration of logsums (rather than distance constants) for trip length
- Other tour purpose destination choice
- Tour main mode choice
    - More income categories should be considered
    - Concern that the values of time should be higher
    - Concern about fixed coefficients for some key variables (e.g. time coefficients for work tours, etc.). Likely explanation on need for constrained constants: too few cases of transit trips in estimation dataset.

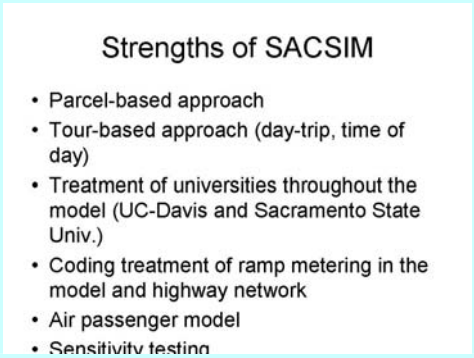
        - Nested logit with sub-modes for auto (e.g. tolled vs. untolled) and transit (rail, std. bus, commuter bus, etc.) should be considered
    - Time of travel
        - Consider including cost (e.g. toll) as a shift variable—critical for analysis of tolls and time-of-day pricing.
        - PSRC does 30 minute time-slice assignments within peak period—more nuanced LOS skims, more time periods, to deal with LOS interfaces.
- Airport passenger ground access submodel
    - Consider controlling total passenger trips from enplanement/deplanement projections rather than from population/employment growth.
- Commercial vehicle submodel
    - Consider using more than 2 vehicle classes, aggregated up from FHWA 13-bin classification (see http://www.tfhrc.gov/pavement/ltpp/reports/03088/12.htm#table4)
    - Would be better to re-build model from some data on commodity or shipment flow data
- External travel
- Trip tables and assignment
    - Lots of questions and discussion on treatment of HOV's in assignment—especially regarding the fixed "split" between HOV users/non-users
    - General concern that the number of assignment iterations (40) too few. Consider ramping up numbers through the system equilibration.
    - Consider split out of commercial vehicles through assignment
    - Consider adding a chapter on skims and logsums to model documentation
    - Consider doing observed transit trip table (built from OB transit survey) assignment as part of validation
    - Consider splitting tables by different value-of-time ranges, and doing generalized cost assignment.
    - Consider rail vs. bus skims (or other nested mode treatment)
- System equilibration
- Sensitivity testing
    - Some cases may need additional iterations to deal with random effects
    - Revisit highway capacity testing after assignment iterations increased
    - Consider including dynamic validation (a la Fehr & Peers Las Vegas work) as part of sensitivity testing
    - Consider doing some testing of time-of-travel choice
- Documentation
    - Consider adding a chapter on skimming and use of logsums

APPENDIX F: Preliminary Panel Findings and Recommendations

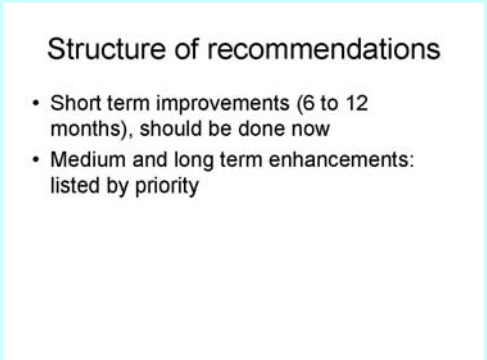
The following findings and recommendations were drafted by the panelists during the review session, and reflects the consensus of the panel at the end of the two-day meeting. Since the panel meeting in November 2008, SACOG staff has had a chance to digest the preliminary findings and recommendations, provide comments and responses to the panel, and the panel has revised the preliminary findings and recommendations.

TITLE

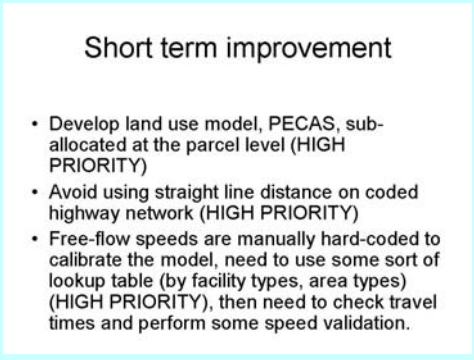
SLIDE 1



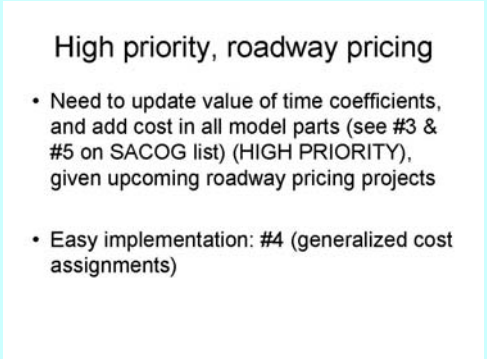
SLIDE 2



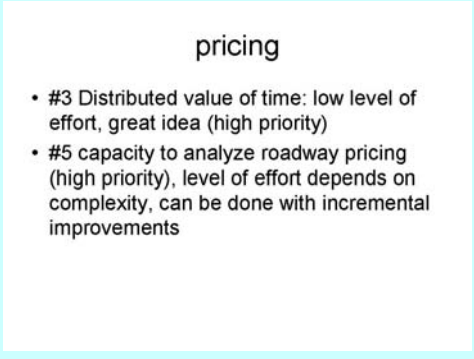
SLIDE 3



SLIDE 4



SLIDE 5



SLIDE 6

Destination choice high priority

- Too many distance variables, and limited use of logsum, in destination choice: Look for measures of accessibility, and impedance measures, for all modes, not necessarily the logsum, would trigger recalibration

SLIDE 7

High priority

- #9 pedestrian environment / street design: medium level of effort (high priority)

SLIDE 8

Medium priority, Commercial vehicle model

- #13 commercial vehicle & freight model: high level of effort for original model development, medium level of effort for intelligently borrowed approach, medium to high priority, and with new model, go from 2 to 3 truck types

SLIDE 9

Medium priority, time of day

- #2 (time of travel sub-model enhancement); separate evening from night time of day period, validate the 30-minute time slices: low to mid level of effort

SLIDE 10

Long term choice models and low priority

- Need to update the population synthesizer to include presence or absence of children in households, as it affects travel patterns (LOW PRIORITY), see #11 on SACOG list
- Great idea but low priority and high level of effort: #1 (vehicle ownership / acquisition, & use sub-model)

SLIDE 11

Parking

- #8 parking supply, cost and access: relatively high level of effort (low priority)

SLIDE 12

Traffic micro-simulation

- TRANSIMS
- Great idea but low priority and huge level of effort: #12 (DTA)

SLIDE 13

Model applications

- #10 scenario analysis & risk assessment: medium priority of model applications, level of effort could vary based on desires of the region, get input from Board and committees
- Consider backcasting, or forecasting to a current year, could be illuminating (LOW PRIORITY)

SLIDE 14

Transit modeling

- Need to further enhance transit coding practice (time of day periods, PA OD format, use multi-path transit assignment, skims for rail and bus, etc…) (MEDIUM PRIORITY)
- Consider separate model (SACMET) for FTA New Starts applications (easy implementation) (LOW PRIORITY)

SLIDE 15

transit

- Don't bother: #7 (PNR lot choice submodel), existing method is ok
- #6 improved treatment of transit fares (low priority) low level of effort

SLIDE 16

THANKS!

Billy Charlton, SFCTA
Stephen Lawe, RSG
Keith Lawton, Consultant
Maren Outwater, PSRC
Guy Rousseau, ARC