A Snapshot of Travel Modeling Activities:

Atlanta Regional Commission (ARC)
Mid-Ohio Regional Planning Commission (MORPC)
North Central Texas Council of Governments (NCTCOG)
Puget Sound Regional Council (PSRC)
Sacramento Area Council of Governments (SACOG)

Helping Agencies Improve Their Planning Analysis Techniques

TMIP
Travel Model Improvement Program

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∎ Introduction

Background

Most Metropolitan Planning Organizations (MPO) use travel demand models in some form to assist with transportation planning activities. The use of travel demand models and their outputs in regional decision-making was initiated in the mid- to late-1950s and has become a standard for many aspects of planning, including the development of regional transportation plans, air quality conformity determinations, corridor and subarea planning, alternatives analyses, Federal Transit Administration (FTA) Section 5309 New Starts analyses, and detailed project planning.

Over the past 50 years, the "four-step" travel demand modeling process has provided the basis for most travel forecasts performed by MPOs. While this framework has worked well over the years, particularly for the analysis and evaluation of large projects such as new roadways and transit systems, the four-step model has come under increasing criticism recently. This is due primarily to its limited capability to respond to emerging questions regarding traveler behavior, and its insensitivity to policy and pricing alternatives. Indeed, the recent National Academies of Science (NAS) study commissioned to assess the current practices and future direction of metropolitan travel forecasting concluded that the demands on forecasting models have grown significantly in recent years as a result of new policy concerns, and that existing models are inadequate to address many of them.[1]

MPOs have taken different approaches to address these issues, including refining the traditional four-step travel demand modeling process to improve internal consistency, providing additional analysis capabilities, and redeveloping travel demand models wholesale to focus on individual traveler behavior.

Federal Highway Administration (FHWA) and contractor staff visited five Metropolitan Planning Organizations (MPO) in March 2008 to determine how travel demand models and the resulting travel forecasts have been used in the regional planning process, and how the travel demand models are used to address emerging issues. MPOs were chosen based on recognized leadership in the industry and a history of considering travel forecasts in the development of regional plans, rather than simply using them as means to show that air quality conformity requirements are being met. Each of the five MPOs has indicated its commitment to use travel demand models to support the regional planning process through

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[1] *Metropolitan Travel Forecasting: Current Practice and Future Direction*, Transportation Research Board, Washington, D.C., December 2007, page 3.

the continued refinement of current travel demand models and the development of advanced travel demand forecasting tools:

- **Atlanta Regional Commission (ARC) (Atlanta, Georgia)** is currently using and making improvements to the four-step travel model while simultaneously developing an activity-based travel forecasting model and updating the land-use forecasting process;

- **Mid-Ohio Regional Planning Commission (MORPC) (Columbus, Ohio)** is currently using a state-of-the-art activity- and tour-based travel forecasting model;

- **North Central Texas Council of Governments (NCTCOG) (Dallas-Ft. Worth-Denton, Texas)** is currently using and making improvements to the four-step travel model while simultaneously planning for the incremental development of an activity-based travel forecasting model;

- **Puget Sound Regional Council (PSRC) (Seattle, Washington)** is currently using and making improvements to the four-step travel model while simultaneously planning for the development of an activity-based travel forecasting model; and

- **Sacramento Area Council of Governments (SACOG) (Sacramento, California)** is currently developing an activity-based travel forecasting model while simultaneously using and maintaining the four-step travel model.

Table 1 provides an overview of the five regions.

Traditional and Emerging Modeling Processes

The traditional four-step travel modeling process focuses on average, or aggregate, trip making characteristics of relatively homogeneous groups of travelers. Typically, the homogeneous groups are defined as people living in households with similar demographic characteristics such as household size, autos owned, income group, or combinations of these groupings. Homogeneous groups might also be defined as employees by business classification or areas dedicated to specific land uses. The socioeconomic data are aggregated into small geographic areas typically referred to as Traffic Analysis Zones (TAZ). The four steps comprising the traditional process are:

- **Trip Generation –** Determining how many trips are made;

- **Trip Distribution –** Linking together where the generated trips begin and end;

- **Mode Choice –** Determining how the linked trips are made; and

- **Trip Assignment –** Determining the specific paths used for the trips.

Emerging travel forecasting modeling methods being applied by MPOs include improving the internal consistency of the models, providing additional analysis capabilities, and increasing the precision of the models through more detailed zone structures, transportation networks, or socioeconomic groupings.

Table 1. MPO Description

	ARC	MORPC	NCTCOG	PSRC	SACOG
Number of Counties	20	2 whole and 2 partial	10	4	6
Area (Square Miles)	5,300	1,100	5,000	6,400	6,200
Population					
2000	4,228,000	1,334,000	5,067,000	3,276,000	1,896,000
2030	6,972,000	1,720,000	9,107,000	4,544,000	3,045,000
Annual Growth Rate	1.7%	0.9%	2.0%	1.1%	1.6%
Population/Square Mile	798	1,213	1,013	521	306
Employment					
2000	2,276,000	810,000	3,158,000	1,760,000	920,000
2030	3,849,000	1,150,000	5,417,000	2,498,000	1,452,000
Annual Growth Rate	1.8%	1.2%	1.8%	1.2%	1.5%
Major Employers	UPS, Delta Airlines, Home Depot, Coca-Cola, Cox Enterprise, Georgia Pacific	Ohio State Government, Ohio State University	Lockheed Martin, American Airlines, Parkland Health and Hospital, Southwest Medical Center, Texas Instruments	Boeing Corporation, Microsoft, University of Washington	California State Government
Air Quality (Nonattainment Status)					
Eight-Hour Ozone	Nonattainment	Nonattainment	Nonattainment		Nonattainment
One-Hour Ozone					
CO				Maintenance	Maintenance
PM$_{10}$				Maintenance	Nonattainment
PM$_{2.5}$	Nonattainment	Nonattainment			

MPOs are increasingly investigating the wholesale redevelopment of travel demand models to focus on individual activity patterns of people in the region. In contrast to four-step travel demand models which consider aggregate numbers of trips made by homogeneous groups of households, these activity-based models consider daily travel patterns, or daily tours, of individual household members. Thus, activity-based models consider a person traveling from home to work, from work to a recreational activity, and from the recreational activity back home as one complete home-based tour with three segments rather than as three independent trips.

While four-step models focus on explaining *travel patterns*, activity-based models focus on explaining *traveler behavior*. Thus, the activity-based modeling framework allows for understanding the impacts of the transportation system and transportation policies on underlying traveler behavior, which determines travel patterns in the region.

Activity-based models provide a significant improvement over four-step models in explaining the demand resulting from traveler behavior. Traditional assignment procedures do not consider the time dependency of travel – the reality that a person traveling from home to work moves across the roadway network during the 15 to 20 minutes required by the journey. Activity-based models that have been developed or are currently under development have been linked with traditional traffic assignment procedures. These models must be linked with time-dependent network models such as a simulation or dynamic traffic assignment to fully address current policy issues.

All MPOs were aware of the need to link activity-based models with time-dependent network models, and several had examined possible approaches. However, since substantial resources are required for the development of activity-based travel demand models, several of the MPOs have used incremental approaches until the additional commitment of resources to link the activity-based models with time-dependent network models can be undertaken at a future date.

Table 2 lists the types of travel demand models used by the five MPOs, along with one- or two-word descriptions of the specific model forms used to implement each four-step model component (trip generation, trip distribution, mode choice and assignment). The short descriptions of the models have been included to demonstrate that each four-step travel demand model can have unique characteristics. The modeling steps used in MORPC's activity-based model do not correspond directly to the steps comprising traditional four-step models. Nevertheless, the activity-based components included in the MORPC model have been equated to the four-step model components described for the other four MPOs.

Travel models are frequently supported by ancillary models used to forecast population and employment, travel made for commercial purposes, or travel made by nonresidents of the region. Table 2 also provides short descriptions of the ancillary models for each MPO.

Table 2. Descriptions of Existing MPO Travel Demand Models

	ARC	MORPC	NCTCOG	PSRC	SACOG
Model Form	Four-step	Activity-based	Four-step	Four-step	Four-step
Trip Generation	Logit- and cross classification-based	Logit-based	Cross classification-based	Cross classification-based	Cross classification-based
Trip Distribution	Gravity model	Destination choice model	Gravity model	Gravity model	Destination choice for HBW; gravity model for other purposes
Mode Choice	Nested logit	Multinominal logit	Nested logit	Multinominal logit	Nested logit
Highway Trip Assignment	Equilibrium	Equilibrium	Equilibrium	Equilibrium	Equilibrium
Time-of-Day Model (Highway Assignment)	Diurnal-direction split factors; four time periods	Logit-based time-of-day choice aggregated to five time periods	Diurnal-direction split factors; three time periods	Logit-based time-of-day choice aggregated to five time periods	Diurnal-direction split factors; four time periods
Land Use Model	IPEF/DRAM-EMPAL	GIS-based allocation model	DRAM-EMPAL	DRAM-EMPAL	None
Truck Component	Truck generation, distribution, and assignment based on local data	Quick Response Freight Model (QFRM)-based	Truck generation, distribution, and assignment based on local data	Truck generation, distribution, and assignment based on WSDOT FASTruck Model	Truck generation, distribution, and assignment based on local data
Freight Model	Yes	QFRM-based	No	Based on WSDOT FASTruck Model	No
HOV Analysis Capability	Yes	Yes	Yes	Yes	Yes
Toll Analysis Capability	Yes	Yes	Yes	Yes	Yes

Model Applications

MPOs use travel demand models in transportation planning activities for various purposes. For some agencies, analyses of travel forecasts form an integral part of the planning process while for others travel models are applied and travel forecasts analyzed only at the end of the planning process, often to justify planning decisions. While the travel forecasting models are used for varying purposes and in varying ways, each of the five MPOs interviewed by the FHWA for this project uses the model as an integral part of the planning process, from the early stages of project planning to determining and prioritizing projects to be included in regional transportation plans.

Table 3 provides an overview of some of the applications for which the travel demand forecasts are used in each of the five MPOs. Each MPO uses the travel models for many of the same tasks and activities, although possibly in different ways. Appropriate use of the model is sometimes limited or enhanced by its structure; for example, the MORPC and PSRC models might be more appropriate for the evaluation of transportation system management (TSM) and travel demand management (TDM) strategies—particularly those related to pricing. Since both of these models include a time-of-day choice component that forecasts when trips begin, the MORPC and PSRC models can "allow" travelers to choose to travel at a different time of day to avoid additional costs associated with peak-period pricing. Analyses of peak-period pricing using the other models would ignore this travel option, or it would have to be represented through additional ad hoc analysis.

Table 3. Typical Applications Aided by Travel Forecasts

	ARC	MORPC	NCTCOG	PSRC	SACOG
Conformity Analysis	●	●	●	●	●
Project Prioritization	●			●	●
Environmental Impact Statements	●		●	●	●
Long-Range Transportation Plans	●	●	●	●	●
State Implementation Plans		●	●		●
New Starts	●	●	●	●	●
TSM and TDM Programs		●			●

■ Overview of Exemplary MPOs

Each of the five MPOs visited by FHWA staff was questioned about the use of travel models and travel forecasts in its transportation planning process. Questions focused on the following four major topic areas:

- The role of the travel model in the MPO's transportation planning process;

- Primary challenges and emerging issues facing the MPO regarding its use of travel models and travel forecasts in the planning process;

- Support for the travel modeling process; and

- Future plans for travel model updates.

Role of the Travel Model in the Transportation Planning Process

Based on the interviews with the five MPOs, it is evident that travel forecasts produced using the regional travel model play a central role in the transportation planning process. This role has become even more pronounced as funding for needed transportation improvements has lagged behind project needs. The following MPO interview notes underscore the importance of travel model forecasts in the planning process:

- **ARC –** The region is currently facing a $4.3 billion funding deficit in their fiscal constraint project budget for needed transportation projects. There is a strict process in place, supported by the models, for project selection in the transportation planning process. The model is used for prioritization of projects included in the regional transportation plan.

- **MORPC –** An estimated $22 billion in needed transportation improvements was identified for the region but funding for only $3.5 billion was available. The funding shortfall resulted in a project selection process for the regional transportation plan that was even more quantitative than the process used for previous plan development.

- **NCTCOG –** There are two long-range plans developed in Texas: a financially constrained long-range plan as required by Federal law, and a needs-based plan that shows the Texas Department of Transportation (TxDOT) the funding shortfalls for transportation. The needs-based plan is very general and uses the units of "freeway lane-miles" to quantify the overall system capacity needed to climb out of Level of Service F (LOS F represents congested, forced traffic flow) conditions. The constrained long-range plan is a very detailed, and prioritizes projects based on three categories of goals: transportation, quality of life, and financial. Where appropriate, the NCTCOG model is used to evaluate the efficacy of projects or plans in fulfilling these goals.

- **PSRC –** A Washington State regulation mandates that transportation plans must be based on a "least-cost planning methodology," which PSRC interprets as benefit-cost ratios. Each project is ranked by multiplying a measure's costs and benefits by its assigned weight and comparing its score to other projects. Thus, the long-range transportation plan (LRTP) scenario analysis and transportation improvement plan (TIP) project ranking use direct outputs from the modeling process.

- **SACOG –** Projects in the constrained LRTP are entered in three phases ranging from design to construction. As financial resources have become increasingly constrained,

more reliance has been placed on the model results to help justify the inclusion or exclusion of specific projects in the LRTP. SACOG has worked hard to develop a culture of underpinning planning choices with data and information. The constrained LRTP must go through the environmental process. Model results are used not only to develop the plan, but also to evaluate impacts such as air quality.

Primary Challenges and Emerging Issues Facing the MPOs Regarding the Use of Travel Models and Travel Forecasts

There are a number of challenges facing MPOs regarding the use of travel models for the transportation planning process. These challenges can be divided into two broad groups: a) challenges and issues that are addressed with ad hoc analyses using the region's existing travel model, with major assumptions regarding traveler response, or with less detail than desired; and b) challenges and issues that cannot be credibly addressed with the existing model. In either case, the development of enhanced modeling techniques such as an activity-based model, a time-dependent network model, or a combination of the two would be useful to improve or provide the analysis capabilities required to address the challenges. The MPOs are addressing the challenges in the following ways:

- *ARC* modeling staff must address several emerging issues in the region, including the analysis of the transportation impacts of managed lanes, ramp meters, peak spreading, and freight. The current four-step model cannot directly be used to respond to these issues. Rather, model post-processing and other ad hoc procedures are used to analyze the impacts of managed lanes and peak spreading; analysis of ramp metering and freight movements cannot be preformed using the existing travel model. An issue facing the ARC modeling staff is lack of data. Both short- and long-term updates to the regional travel models continue to be required for the support of the region's air quality conformity determination. It is important to ARC to ensure that the four-step model continues to be improved to maintain a state-of-the-practice status to address current planning requirements, while concurrently developing pieces of the activity-based model to better address emerging issues.

- *MORPC* uses the model more for analysis of growth strategies and expansion of the transportation network than traffic operations and other congestion management approaches. The major issue facing central Ohio is overall travel growth. The ability to examine time-specific issues such as peak spreading has explicitly been built into the activity-based model but more detailed operations analyses are not a current concern. Increased truck travel associated with a number of large distribution centers moving to the Columbus area will impact travel in general and will need to be addressed in future planning. The current travel forecasting model uses a truck component based on Quick Response Freight Manual (QRFM) methods but it might be important to update the truck modeling procedure to use information from the statewide freight model currently being developed.

- *NCTCOG* considers the existing travel model to have good capabilities for responding to many of the issues of concern in the region. At the same time, NCTCOG recognizes

the limitations of the model and does not attempt to use the model to respond to issues that it is not capable of addressing. For example, the model addresses tolling only in the traffic assignment step. NCTCOG is satisfied with results of the process for scenarios where tolls are not varied by time-of-day but realizes that its travel model cannot properly address pricing conditions where tolls are varied by time-of-day or as congestion increases. Ad hoc analysis procedures are required when analysis needs outstrip the model's capabilities.

- *PSRC* has been directed by its board to focus on addressing two issues: pricing and climate change. PSRC has proceeded with making short-term model improvements to address these issues and other increasingly complex policy questions, including using existing models to provide input for hypotheses regarding the direction or type of variation in travel resulting from a policy change. In the long term, PSRC is working towards a fully integrated land use and activity-based model with dynamic operational analysis capability integrated with a next generation air quality model. These long-term changes will continue to respond to questions regarding pricing and climate change.

- *SACOG* uses both a traditional four-step model and an activity-based model for transportation planning. SACOG was driven to using an activity-based model for a number of reasons, including the need for in-depth examinations into the factors that influence travel changes and the productions of greenhouse gases. In the long term, SACOG wants to refine the traffic operations side of the activity-based model to be concordant with the demand side.

Support for the Travel Model

Support for the travel model is strong in each of the five MPOs. While support by decision-makers and public officials is difficult to quantify, the overall level of support is demonstrated by the funding allocated to the travel modeling activities such as model applications, model development, and data collection. Table 4 summarizes and compares the financial level of support for the five MPOs. The annual budgets shown in Table 4 do not include funds for special studies obtained through special grants or other sources.

Table 4. Average Annual Support for Travel Modeling and Transportation Planning[1]

	ARC	MORPC	NCTCOG	PSRC	SACOG[2]
Number of Staff					
Model Applications	4	2			2
Model Maintenance and Development	3	2	7		2
Transportation Planning	17	5+	10		1.5
Data Collection and Maintenance	2	4[3]	2		1.5
Land Use Modeling	2		2		4
Total Staff	**28**	**12+**	**19**	**20**	**10 to 12**
Budgets					
Travel Modeling	$1,040,000	$400,000	$1,200,000	$2,200,000	$600,000
Transportation Planning	$2,920,000	$600,000	N/A		$225,000
Data Collection and Maintenance	$450,000	$500,000	$1,000,000	$700,000	$225,000
Land Use Modeling	$380,000				$600,000
Consultant Assistance	$500,000			$250,000	$200,000
Other	$310,000	$500,000	$1,750,000	$300,000	
Total Budget	**$5,600,000**	**$2,000,000[4]**	**$3,950,000**	**$3,450,000**	**$1,850,000**

N/A = information not available.

[1]   Staff allocations and budgets for the MPOs are annual averages. Since the MPOs use different accounting methods, staff allocations and budgets may not be directly comparable.

[2]   SACOG staff stated in the average number of person years expended per year on task.

[3]   Data Collection and Maintenance staff are also assigned the Land Use Modeling function at MORPC.

[4]   Core PL funding only. Excludes local and STP funds allocated to travel modeling and transportation planning support.

Future Plans for Travel Model Updates

As implied by the support for travel modeling discussed above, each of the five MPOs allocates significant resources to the development and maintenance of its regional travel models. Two of the MPOs (MORPC and SACOG) have developed activity-based models to address emerging issues and the other three have initiated the development of these models. Although all five MPOs will have activity-based models in the near future, each continues to pursue other model enhancements to respond to current and emerging issues:

- **ARC –** The current plan for updating and redeveloping models is to maintain a parallel track for both the four-step model and the activity-based model. While the activity-based model is currently under development, there are no plans to switch

over to the activity-based model in the near future. Rather, the ARC planning staff intends to continue improving the four-step model as much as possible during the development of the activity-based model. The ARC planning staff is also working to upgrade their land use forecasting model.

- **MORPC –** Although MORPC does not currently cite a need to model traffic operations, building these capabilities into a future version of the model is being considered. As mentioned previously, the truck travel associated with the large distribution centers moving to the Columbus area has elevated the importance of improving current procedures for including truck movements in the travel modeling process.

- **NCTCOG –** Motivations for improvements in NCTCOG's model are driven by an increased need for efficiency and quality control, and by the types of policy questions that are being asked. NCTCOG is taking a deliberate approach to the development of future travel models. Three primary models have been identified for future development: a land use model, a person-based (activity- or tour-based) travel model, and a commercial vehicle travel model. NCTCOG anticipates that the development of a new travel model will take at least five years after the specification and design of the modeling framework. Its timeline includes overlapping periods of three years for collection of survey data, four years for model development, and one year for the development of reporting tools, applications interface procedures, and diagnostic reports.

- **PSRC –** Climate change and pricing have motivated most of PSRC's recent model improvements. Since VMT and speed are the major inputs to most air quality models, PSRC has focused on improving the credibility of regional totals and emissions sources in its forecasting. These efforts are intended to provide the information necessary to craft more effective mitigation policies. PSRC has initiated the development of a full-scale activity-based model. Improvements to existing traffic assignment techniques are being considered in this model development effort. In the long-term, PSRC is working towards a fully integrated land use and activity-based model that considers traffic operations in the traffic assignment process.

- **SACOG –** SACOG wants to refine the traffic operations side of its activity-based model to be concordant with the demand side. This includes exploring the possibility of dynamic traffic assignment or the use of large-scale microsimulation models (such as TRANSIMS). Other long-term, but as yet unfunded, improvements include the development of a tour-based goods movement (or commercial vehicle) model, and an update to the vehicle ownership model.

■ Emerging Issues Identified in TRB Special Report 288

The NAS study, *Metropolitan Travel Forecasting: Current Practice and Future Direction*, identified five emerging issues that four-step travel models cannot address:

- Time chosen for travel;

- Travel behavior;

- Non-motorized travel;

- Time-specific travel volumes and speeds; and

- Freight and commercial vehicle movements.

The MPOs were asked how their models were used to address a number of specific examples relating to the five emerging issues and to describe any improvements necessary to address them in the modeling process. The emerging issues and examples are shown in Table 5 along with any plans being made to address them with future model development efforts.

Time Chosen for Travel

The first emerging issue, time chosen for travel, can be addressed with models that include a component indicating the time of day each travel choice occurs. Time of day travel choice is typically viewed as a traveler response to peak-period travel congestion, or peak spreading. Traveler response to peak-period congestion might also be reflected through the decision to travel or where to travel. Time-of-day choice models are explicitly considered in activity-based models. As demonstrated by the PSRC four-step model, time-of-day choice also can be explicitly considered in traditional four-step models. However, activity-based models improve upon four-step models by more readily incorporating choices regarding whether and when to travel. Thus, time choice cannot be fully addressed until time-dependent network models are integrated with activity-based models. ARC, NCTCOG, PSRC, and SACOG have all indicated their intent to incorporate time-dependent network models with future activity-based models.

Travel Behavior

The second issue, travel behavior, must be addressed through the development and use of activity-based models. As noted by PSRC, existing four-step models can only be used to provide input for educated hypotheses regarding the direction or type of variation in travel resulting from a policy change. Road pricing and land use scenarios (such as increasing development densities) are actions that are directed at producing a change in traveler behavior. Uncertainty in estimates has been included under travel behavior since it relates directly to how travelers respond to various situations.

Non-Motorized Travel

Non-motorized travel has been considered in traditional four-step models and is considered in the models used by four of the five MPOs. In the ARC region, non-motorized travel is separated from motorized travel in the trip generation steps based primarily on measures of density. PSRC and SACOG include non-motorized modes in the

trip distribution and mode choice steps, thus providing more capability of analyzing policies that might affect the use of motorized and non-motorized modes.

While ARC, PSRC, and SACOG consider non-motorized travel in their four-step models, activity-based models such as the one used by MORPC are necessary to fully integrate non-motorized travel choices into the modeling process. Activity-based models achieve full integration through the consistent use of accessibility information throughout the modeling process. For example, in most four-step models, the introduction of parking charges at a destination would only impact mode decisions and, possibly trip distribution decisions. However, in an activity-based model, the imposition of parking charges at a destination might produce mode changes, destination changes, time-of-day of travel changes, and even decisions regarding whether or not to travel. Each of these affected decisions could impact the use of non-motorized modes.

Time-Specific Traffic Volumes and Speeds

Time-specific traffic volumes and speeds are emerging issues that are not explicitly addressed though the development of activity-based models. ARC, NCTCOG, PSRC, and SACOG have identified the need to incorporate dynamic traffic assignment or simulation procedures into their advance modeling. While MORPC has an activity-based model, it currently sees little need to develop the detailed network analysis and assignment techniques to fully estimate the impacts of time-specific traffic volumes and speeds in networks.

Freight and Commercial Movement

Finally, while all five MPOs have existing truck modeling techniques, they have identified the need for more accurate freight modeling. There are both inter-regional and intra-regional components to this issue. Much of the freight modeling work performed in the US to date has been on an inter-regional basis, typically focusing on county-to-county movements at a statewide or multi-state level. PSRC has addressed this issue by explicitly considering commodity flows into and from the PSRC region. MORPC has indicated a desire to extract truck trip movements from the Ohio statewide freight model.

One portion of the intra-regional component is related to the level of detail of analysis. While some MPO regions such as ARC or NCTCOG cover numerous counties, county-to-county freight and truck movements do not provide sufficient detail for analysis of travel impacts on most roadways. Thus, disaggregating county-to-county truck movements to a finer level of detail is one area for improvement.

A second portion of the intra-regional component is similar to the difference between four-step and activity-based models. Truck models explain truck trip patterns while freight models are intended to explain the need for truck movements. Improved MPO-level freight models analogous to activity-based models will be required to respond to issues of:

- Freight policies designed to help move or restrict the movement of freight for the public good such as the designation of truck routes or special truck lanes, heavy truck restrictions, and time-of-day restrictions on truck movements;

- Freight movement, or more specifically, shippers' or carriers' determinations regarding how to move freight, such as decisions on the use and location of trans-shipment facilities or changes in truck sizes used for deliveries in response to fuel or labor costs; and

- Goods movement or the production or consumption of goods that need to be moved as freight along with the distribution of those goods from producers to consumers.

As with activity-based models, the issues associated with freight and commercial vehicle movements cannot be fully addressed until time-dependent network models are integrated with freight models.

Table 5. Ability to Address Emerging Issues Existing and Planned Future Travel Models

Emerging Issue/Examples	ARC		MORPC		NCTCOG		PSRC		SACOG	
	Existing Four-Step Model	Future Activity Model	Activity Model		Existing Four-Step Model	Future Activity Model	Existing Four-Step Model	Future Activity Model	Existing Four-Step Model	Future Activity Model
			Existing	Future						
Time Chosen for Travel										
Peak spreading		✓	p	p		✓	p	✓		✓
Travel Behavior										
Road pricing	p	✓	✓	✓	p	✓	p	✓	p	✓
Land use scenarios	p	✓	✓	✓	p	✓	p	✓	p	✓
Uncertainty in estimates		p	p	p		p		p		p
Non-motorized Travel	**p**	✓	✓	✓		✓	**p**	✓	**p**	✓
Time-Specific Traffic Volumes and Speeds										
Time dependent changes in speed and volume	p	p*	p	p*	p	p*	p	p*	p	p*
Improvements in traffic operations		p*		p*		p*		p*		p*
Time-specific issues – (parking, reversible lanes, HOV lanes, telecommuting)	p	p*	p	p*	p	p*	p	p*	p	p*
Dynamic conditions		p*		p*		p*		p*		p*
Freight and Commercial Vehicle Movements (Production and consumption of goods, government policies affecting freight, and shipper or carrier decisions regarding freight movement)	p	p	p	✓	p	✓	p	p	p	✓

✓ = can be addressed using the model.

p = can be partially addressed using the model along with ad hoc analysis, major assumptions regarding traveler response, or reduced detail.

p* = dynamic traffic assignment or traffic microsimulation must be combined with the activity-based models to fully address these issues

Blank = cannot be addressed using the model.

■ Conclusions

Travel model results are highly valued and support the decision making process in each of the studied regions. Each area has a strong modeling staff and allocates substantial resources to the modeling process. The modeling staffs in the MPOs are cognizant of the questions that they can and cannot answer with the travel models. Based on the interviews with the five MPOs, the following specific conclusions can be drawn:

Increasing Importance of Objective Evaluation Criteria

Funding short-falls and increasing travel demand require the use of reliable travel forecasting models to help decision makers select the most beneficial or cost-effective projects from several alternatives. These decisions may be among alternatives proposed for specific corridors or locations, or among competing projects proposed for different parts of a region.

Establishing Credibility of Forecasting Results

The five MPOs have gained public and decision maker support for the travel models and travel model results through consistent attention to quality and resources, along with clear communication of reasonable expectations regarding the accuracy and efficacy of model forecasts. It is critical to communicate the importance of reliable quantitative analysis techniques to the public and decision makers, and to establish the credibility of forecasting results.

Limited Ability of Four-Step Model to Address Emerging Issues

Existing four-step travel models cannot fully respond to emerging policies such as congestion pricing, High Occupancy Toll lanes, or parking policies. Ad hoc analysis procedures are required when analysis needs surpass model capabilities. Recognizing the limitations of the traditional four-step model, all five MPOs have developed various post-processing, spreadsheet or other procedures to compensate. However, these MPOs seek advanced modeling techniques to fully address the emerging transportation issues.

Short-term solutions include using existing models to provide input for educated hypotheses regarding the direction or type of change in travel resulting from a policy change. In some cases, modifications to the modeling process have also been made to provide better information on variations in travel resulting from policy changes. NCTCOG, for example, uses the model to address tolling only in the traffic assignment step, and is satisfied with results of the process for scenarios where tolls are not varied by time-of-day.

Incremental Approaches to Improve Travel Modeling Capabilities

While activity-based models show promise for addressing the emerging issues, the models have not been widely adopted. It may take several years to develop a fully functional activity-based model. The challenge is maintaining current modeling needs to meet regulatory requirements while develop advanced models to better address emerging issues. Only one of the MPOs, MORPC, has a fully adopted activity-based model. While other MPOs have developed or are developing activity-based models, they are doing so in parallel with the maintenance, enhancement, and application of existing four-step models.

There are numerous reasons for developing advanced travel models such as activity-based models. Several of the MPOs would like to use the models to better address emerging issues such as congestion management and pricing. A primary reason MORPC developed its activity-based model was to provide improved modeling capabilities for a transit New Starts analysis. One of SACOG's initial uses for its activity-based model was to provide information on the transportation impacts of alternative land use development strategies for Placer Vineyards.

More Resources Needed to Develop Advanced Models

The development, maintenance, and application of advanced travel models is costly, and the computer run time for advanced models is drastically increased. Each of the five MPOs has substantial budgets for the development, maintenance, and application of travel models. In addition, three of the five MPOs had received significant outside support for either data collection or model development, which allowed them to progress on advanced model development further than they may have otherwise.

Advanced Network Models Needed to Address Supply Side of Travel Modeling

Staffs from each of the MPOs realized that the issues associated with congestion pricing were complex and could not be fully answered by activity-based tour models alone. To better address more complex issues such as dynamic pricing, there is also a need for advanced network modeling such as time-of-day choice models, dynamic traffic assignment or micro-simulation, and, possibly, detailed land use models. At the time of the interviews, none of the agencies had initiated the development of advanced network models, though several of the MPOs were working on improved land use models. Each agency acknowledged that even with these tools, the observed data necessary to determine land use changes resulting from congestion pricing might not be available.

Need for Quality Data

Quality data are essential to the development of reliable travel models. The acquisition of these data is an expensive endeavor that has been performed or is being performed by each of the MPOs. The three-year data acquisition plan established by NCTCOG provides

a prime example. NCTCOG anticipates spending an average of $1,000,000 per year for data acquisition and maintenance, including the collection of a regional household survey, transit on-board surveys for the Dallas and Fort Worth transit systems, travel time surveys, and traffic count data. NCTCOG's data collection efforts are supplemented by data collection efforts performed by toll road agencies and TxDOT.

Need for Freight Models

The development of freight, goods movement, and truck models is a challenge that must be addressed somewhat separately from changes to the passenger travel forecasting process. Both MORPC and SACOG have identified the need to develop improved freight and truck models now that they have activity-based models in place. The development of these models is complicated by the need to consider the movement of freight into, out of, and through regions in addition to intra-regional freight movements.

MPO Profiles – Atlanta, Georgia Region

■ Background

The Atlanta Regional Commission (ARC) functions as the Federally designated Metropolitan Planning Organization (MPO) for 18 Georgia counties, including Cherokee, Clayton, Cobb, Coweta, DeKalb, Douglas, Fayette, Forsyth, Fulton, Gwinnett, Henry, Paulding, and Rockdale counties and parts of Barrow, Bartow, Newton, Spaulding, and Walton counties. These 18 counties along with Carroll and Hall counties comprise the 20-county eight-hour ozone nonattainment area designated by the U.S. Environmental Protection Agency.

About 80 percent of the MPO's population resides in 10 "core" counties: Cherokee, Clayton, Cobb, DeKalb, Douglas, Fayette, Fulton, Gwinnett, Henry, and Rockdale. The core county population has increased from 3.43 million people in 2000 to 4.03 million people in 2007. The population for the entire 20 county area has been forecasted to grow from 4.23 million in 2000 to 6.97 million in 2030 – a 65 percent increase. Similarly, employment for the 20-county area has been forecasted to grow from 2.28 million in 2000 to 3.85 million in 2030 – a 69 percent increase.

From 1990 to 2000, the Atlanta region experienced the fourth highest percent change in average travel time to work in the nation. The average commute time increased 20.2 percent, from 26 minutes in 1990 to 31.2 minutes in 2000. The regional growth and extensive roadway network have contributed to the designation of various portions of the Atlanta region as nonattainment areas for different pollutants under the 1990 Clean Air Act Amendment's (CAAA) National Ambient Air Quality Standards (NAAQS).

■ Current Travel Forecasting Model Practice

Travel Forecasting Model

The regional travel model supports the development of the Federally required long-range Regional Transportation Plan (RTP). This plan forms the basis upon which a short-range Transportation Improvement Plan (TIP) is developed. ARC's transportation demand model also helps ARC and its partners assess how potential transportation improvements affect air quality conformity.

The current travel forecasting model for the ARC region is a trip-based model, with a logit-based trip production model, a cross-classification-based trip attraction model, a gravity-based trip distribution model, a nested-logit mode choice model, a diurnal/direction-split distribution time-of-day model, and static equilibrium highway assignment. Truck modeling is performed using linear regression models based on a commercial vehicle survey conducted by ARC.

A land use model for the region is currently run separately from the travel model to provide population and employment forecast inputs to the travel model. The land use and travel models are currently applied without feedback from the travel model to the land use model. The land use forecasting methods used by ARC are divided into two distinct efforts: regional forecasting, which is used to develop the control totals for population and employment for the entire region, and small area forecasting, which allocates the population and employment to traffic analysis zones (TAZ). Currently, the regional forecasting uses the IPEF (interactive population and econometric forecasting) model and the small area land allocation model uses DRAM/EMPAL.

ARC is responsible for travel model maintenance and model updates. The most recent calibration was performed using data from a 2001 household survey with 8,069 samples, a 2006 on-board transit survey with 25,000 samples, a 1998 workplace survey with samples from 277 establishments, a 1996 commercial vehicle survey, and a 1994 to 1995 external station survey. The current model validation focuses on matching observed vehicle-miles of travel (VMT) and traffic counts collected for the Highway Performance Monitoring System (HPMS). The model is also validated against speed data from 1,629 locations collected via a study performed by the Georgia Regional Transportation Authority (GRTA) in fall 2000 and time and delay data from 63 routes collected in fall 2001.

The model can be used by any organization demonstrating the ability to apply it properly. Agencies sometime modify the networks and zone structures to fit their local needs. The revised networks and zone structures are reviewed by ARC and added to the model for future use, as appropriate.

Travel Forecasting Model's Role in Transportation Planning Process

The region is currently facing a $4.3 billion funding deficit in the fiscal constraint project budget for needed transportation projects, resulting in a strict procedure for project selection in the transportation planning process. The first step in the process for initial or continued project funding is an assessment of any progress on project development such as environmental work or preliminary engineering. If no work has been performed, it is likely that the project will either be dropped from consideration or considered in a future plan.

The second step for project prioritization and selection is the determination of how specific projects perform against others in terms of solving or easing transportation needs. Project prioritization is based on results from the regional travel forecasting model and consists of three main criteria. The first criterion is a composite measure with 70 percent of the criterion based on congestion relief and the remaining 30 percent based on other factors. The second criterion is a travel time index, and the third criterion is a cost/benefit ratio. The cost/benefit ratio is based on the reduction in travel time and fuel cost for both trucks and autos compared to the cost of the project.

Due to time constraints, only one model run is typically performed to determine the prioritization criteria for project selection. While the model is used for prioritization, little testing is performed on different groupings of projects or new alternative projects at the

project selection phase of the planning process. The model is used to test different alternatives for corridor studies and when Environmental Impact Statements, Interchange Justification Reports, and Interchange Modification Reports are prepared.

ARC board members and MPO technical and policy committee members are well-informed regarding the modeling requirements imposed on project selection by air quality mandates. The ARC board, technical committee and policy committee members have confidence in the modeling staff and model results due to their reliance on the travel model results to help resolve air quality nonconformity issues in the 1990s. ARC staff present the modeling results to the board so that board members are familiar with the modeling process.

Support for Travel Forecasting Models

ARC employs four staff in its model development group and three staff in its model applications group. In addition, ARC allocates approximately $0.5 million per year towards outside consulting assistance for modeling, which is performed on a task order basis. Recent tasks undertaken by both in-house staff and consultants include estimation of destination choice models, disaggregation of socioeconomic data, conflation of street centerlines, freight modeling, and continued efforts on the development of an activity-based model. Ongoing data collection efforts include vehicle classification data, speed and travel time data collection through the congestion management process and obtaining counts from the Georgia Department of Transportation (GDOT). ARC obtains input in the modeling process from GDOT and local governments, and maintains an informal relationship with the Georgia Institute of Technology.

■ Primary Challenges and Emerging Issues

ARC modeling staff must address several emerging issues in the region, including the transportation impacts of managed lanes, ramp meters, peak spreading, and freight. Managed lanes include both mandatory truck lanes and toll lanes. Truck lanes are currently analyzed using a traffic assignment postprocessor spreadsheet, which assumes that all trucks use the mandatory truck lanes. Toll lane use and prices are also set using an assignment postprocessor spreadsheet to simultaneously optimize travel speed and toll revenues.

Ramp metering is an emerging traffic demand management tool for the region, which introduces a time-specific element into the modeling process. However, there is no method for incorporating the time-specific impacts of ramp metering into the model since the process would require more site-specific analysis of corridors than is currently feasible under the regional model.

Peak spreading has not been addressed in the trip-based model. A static time-of-day model that includes four time periods has been incorporated into the current modeling process to enable the consideration of directionality in peak-period travel. The time-of-

day model was developed using 24-hour traffic count data stratified by 15-minute intervals along with household travel survey data to determine time-of-day factors. While the time-of-day model is an improvement over a daily travel model, it is a static model that does not consider time-of-day of travel choice in the modeling of peak spreading.

Freight is another emerging issue under scrutiny in the region. As noted above, the current model uses regression-based truck models and traffic assignment postprocessors to estimate truck travel in the region. Thus, the current model does not directly address freight movements. A freight model that considers commodity movements rather than trucks is currently being developed with the help of a consultant. However, the majority of the work associated with the development of this model is scheduled to take place in 2009.

A common issue inhibiting the ARC modeling staff's ability to address emerging issues in the region is lack of data. For example, in the case of managed lanes, there is a lack of data on traveler response to varying tolls in the region, which makes it impossible to properly incorporate toll road choice into the mode choice model. The most frequently questioned travel model component is the transit component of mode choice, but the on-board survey data used to estimate ARC's mode choice model was collected in 2002, and is outdated for many purposes, including New Starts analysis. This specific data issue will be addressed through the collection of a new transit on-board survey in 2008.

One of the many driving forces of model improvement is air quality conformity. However, the air quality conformity issue can also be an impediment to model innovations because the State's Implementation Plan and conformity demonstration are different processes administered by different agencies. Improved models may create inconsistencies between emissions forecasts and the current State Implementation Plan (SIP) budget established using a previous model. One solution to this issue would be the establishment of an emissions budget for each specific generation of the travel model.

Finally, uncertainty in travel forecasts is an issue of concern. While ARC modeling staff has communicated the fact that there is uncertainty in travel model forecasts, they believe the quantification of this uncertainty is a task more properly undertaken by the research community rather than MPOs.

■ Future Plan for Travel Forecasting Model Update

Motivation for the Major Model Update

The driving force for both short- and long-term updates to ARC's regional travel models is the determination of air quality conformity. The current plan for updating and redeveloping the models is to maintain a parallel track for both the four-step model and the activity-based model, which is not yet used for project planning or the regional transportation plan development. ARC modelers believe it is important to ensure that the four-step model continues to be improved to maintain a state-of-the-practice status to

address current planning requirements, while concurrently developing components of the activity-based model to better address emerging issues.

Future Model

The ARC planning staff is working to upgrade both components of their land use forecasting model. The regional forecasting method will be upgraded to a Regional Economic Models, Incorporated (REMI) process, using IMPLAN, which will be integrated with the travel model. The small area allocation model will be updated to the PECAS model (Production, Exchange, and Consumption Allocation System), which also will be integrated into the travel model. The integration of both land use model components into the travel modeling process will be accomplished using feedback loops.

While the activity-based model is currently being developed, there are no plans to convert travel forecasting to the activity-based model in the near future. Rather, the ARC planning staff intends to continue improving the four-step model as much as possible during the development and testing of the activity-based model. One anticipated change to the four-step model is the addition of light rail and commuter rail to the mode choice procedures.

While the data used for the estimation of the activity-based model are becoming dated, the plan is to estimate the entire model system with the old data to establish a modeling framework and then update the model coefficients and adjust the model based on new household survey data when those data become available after 2010.

To address the lack of current data, a household travel survey is performed every 10 years in conjunction with the Census, and a transit on-board survey is planned for 2008. An establishment survey was performed in the 1990s, and though a new establishment survey could provide useful data, none is currently planned.

MPO Profiles – Columbus, Ohio Region

■ Background

The Mid-Ohio Regional Planning Commission (MORPC) and the Licking County Area Transportation Study (LCATS) comprise the Columbus, Ohio MPO. The MPO covers Franklin and Delaware Counties, the City of Pickerington, Bloom and Violet Townships in Fairfield County, Etna Township and the City of Pataskala in Licking County, and the Newark/Heath urbanized area. The total population of the MORPC study area was 1.34 million in 2000.

Year 2000 employment in the region was 810,000. Major employers in the region include the State of Ohio and Ohio State University. Franklin County continues to be home to the majority of the employment and businesses in the region but is expected to see lower future growth in comparison to the other counties in the region. Delaware County is the fastest growing county in the region.

In 2004, the U.S. EPA designated the region a nonattainment area for failing to meet the minimum air quality standards for ozone established under the National Ambient Air Quality Standards (NAAQS) of the 1990 Clean Air Act Amendments (CAAA). The area is also a nonattainment area for particulate matter less than 2.5 microns in diameter ($PM_{2.5}$).

■ Current Travel Forecasting Model Practice

Travel Forecasting Model

The MORPC region developed a state-of-the-art activity-based model in 2004. The new model is a disaggregate, tour-based model applied with the microsimulation of each individual household, person and tour. The model area is divided into 1,805 internal and 72 external zones and includes Franklin, Delaware, and Licking counties, and parts of Fairfield, Pickaway, Madison, and Union counties. The primary inputs to the model are transportation networks and zonal data, where each zone features the standard socioeconomic characteristics that would normally be found for use in a four-step travel demand model. The MORPC activity-based models differ from activity-based models in other regions in that it utilizes zonal data rather than parcel-level data. MORPC selected the level of detail for input data after considering data availability and forecasting capabilities.

Land use forecasting is performed using a Geographic Information Systems (GIS)-based allocation model developed by MORPC to allocate land uses on a quarter-mile grid. The GIS-based model uses local communities' land use projections as input and adjusts those projections to match control totals specified by the State of Ohio. The GIS-based model considers accessibility and the availability of water and sewer resources in the allocation

process. After conducting a final review of the allocations, planning staff further allocates land uses to TAZs using GIS. Staffs from local communities then review and approve the TAZ-level forecasts prior to final adoption by the MPO.

The travel demand model has been validated to traffic and transit count data, Census Transportation Planning Package (CTPP) place-of-work by place-of-residence (worker flow) tables, on-board transit survey data, data from a 1999 home interview survey data of 5,525 households, and data from the Ohio Department of Transportation (ODOT) 1995 external cordon origin-destination roadside survey.

Due to its complexity, MORPC maintains tight control over who can run the model. Currently, the model can be run by MORPC, ODOT and qualified, contracted consultants who can demonstrate a need for the entire model. For transit studies, the complete model has been provided to the (qualified) consultant. For highway studies and National Environmental Protection Act (NEPA) purposes, consultants request data (traffic projections, etc.) from MORPC or ODOT. The activity-based model has not been provided to consultants for any highway studies. When conducting initial planning studies, the basic model output is often used to screen and reduce conceptual alternatives. However, for forecasted design hour traffic volumes, the raw model output are always adjusted and refined using NCHRP 255 procedures. ODOT has developed a spreadsheet tool used to develop design volumes for projects from the model results.

Dublin, Ohio, a community within the MPO region, has developed a basic travel model for public use and for the development of its comprehensive plan. Dublin coordinated with MORPC to ensure that its model used a compatible zone structure to the MORPC model. Dublin provides land use data to MORPC and MORPC provides data from the regional model for Dublin's external-external and internal-external trips.

Travel Forecasting Model's Role in Transportation Planning Process

MORPC uses the travel model extensively to provide a quantitative underpinning for decision-making in the transportation planning process. This approach is in accord with the support provided by ODOT for modeling and analytic methods.

MORPC has three goals for the Long-Range Transportation Plan (TPlan): improving transportation efficiency, improving the multimodal aspect of the network, and improving the quality of life in the region. Each of these goals has associated measures which are used to help rank projects. The quantitative measures derived directly or indirectly from the model for each of the three goals are:

- **Transportation Efficiency –** Average 2030 peak travel delay reduction per person, improvement in both 2015 and 2030 Levels of Service (LOS) in corridors, efficiency improvement, and percentage of trucks;

- **Multimodal Measures –** Pedestrian connections, bicycle connections, travel demand management (TDM) measures, and service to intermodal facilities;

- **Quality of Life –** Equality and justice for transportation disadvantaged, air quality impacts, fuel consumption reduction, and nonretail jobs served.

In addition to the TPlan, the measures have been applied for New Starts applications, major corridor Environmental Impact Statements (EIS), and Interchange Justification Studies. The model results are used to estimate measures such as travel delay, changes in mode use, and changes in travel patterns and behavior.

The development of the TPlan starts with the collection of information from local communities regarding needed improvements. While many of the needed improvements are supported by special studies conducted for proposed projects, there is no requirement that modeling be used for the studies. Projects might also be identified via other studies such as corridor and subarea studies or regional studies used to identify transportation system deficiencies.

The next step of the process is to determine the potential projects included in the TPlan. The selection process considers the following factors:

- Listing of the project in the TIP and whether the project is past the concept stage;

- Quantitative evaluation of the project based on results from the regional travel model and GIS-based factors.

The quantitative evaluation yields a score using the measures associated with the TPlan's goals. TPlan projects are prioritized using this score along with non-model factors such as safety considerations, impact on freight movement, ITS improvements, regional or local security concerns, general community support, and financial support.

The most recent TPlan process is the first in which funding played a major role. An estimated $22 billion in needed transportation improvements was identified for the region but funding for only $3.5 billion was available. The funding shortfall caused the project selection process for the regional transportation plan to be even more quantitative than the process used for previous plan development.

While the TPlan is directly influenced by the quantitative element of the model, the quantitative results can also be used to indirectly influence projects included in the plan. For example, model results prepared during the preliminary engineering and EIS stage recently recommended that a two-lane roadway should be widened to five lanes to handle forecast traffic. Although the project was included in the TPlan, the road went through a suburban community that opposed the road widening. Since funding for a road less than the required five lanes was not authorized, the project was not included in the next TPlan update, and did not proceed. There are no specific instances of a project being removed from the TPlan as a direct result of model results. Those decisions are made earlier in the projection identification process.

Detailed model results are used in special studies conducted prior to the TPlan selection process. Summaries of these results are then presented to the board's special committees reviewing or overseeing the study. Projects must be supported by a study, including

modeling, performed prior to consideration for the TPlan. In this way, every project under consideration has been justified through modeling, whether it is ultimately included or not. The public has responded positively to using model data to justify decisions made in the analytical process.

Support for Travel Forecasting Models

MORPC receives about $2 million per year from FHWA Metropolitan Planning (PL) funds, excluding funds for special projects. The PL funds are allocated as follows: data staffing receives about a $400,000 to $500,000 for four full-time staff; model assistance and maintenance receives about $400,000 for four staff; short-range planning, which includes multimodal planning, management and operations, and safety planning, receives about a $300,000; the TIP, including implementation, transportation data, and models, receives about $500,000; and long-range planning, including multimodal planning, public service and involvement, receives about $300,000.

Major model updates have been funded out of special studies. For the past two to three years, approximately $60,000 in additional funds has been allocated for the collection of traffic data. The activity-based model was developed using Surface Transportation Program (STP) funds as a supplement. The most recent household travel survey also was performed using STP funds.

MORPC has a close relationship with ODOT for model support. It also has an informal relationship with Ohio State University (OSU) and close ties to the engineering department. MORPC works closely with the Central Ohio Transportation Authority (COTA), the regional transit authority, and performs the modeling required for the development of COTA's long-range plan.

◼ Primary Challenges and Emerging Issues

The major issue faced by central Ohio is overall travel growth resulting from rapid economic expansion in the region. MORPC uses the model primarily for analysis of growth strategies and expansion of the transportation network.

Traffic operations and other congestion management strategies have not been a primary focus of travel modeling. By law, the Ohio Turnpike is the only tolled road in Ohio. Since this is not anticipated to change anytime soon, pricing has not been an issue considered by MORPC. The activity-based model includes the cost of travel (including tolls) as an explanatory variable and the traffic assignment process has the capability to include tolls through the coding of link attributes in the roadway network. Since the model includes equilibration, the resulting travel costs are fed back into the activity-based model.

MORPC does not currently model traffic operations although building these capabilities into a future version of the model is being considered. If the region was more static with respect to growth, traffic operations modeling and dynamic traffic assignment might be

more of an issue due to the need to optimize existing facilities. Since the area is growing, the primary issues being considered relate to increasing capacity and adding new transportation facilities in the region. Special studies and ad hoc analyses can be used to investigate traffic operations in a particular corridor or project area.

A number of large distribution centers are moving to the Columbus area. The truck travel associated with these centers will impact travel in general and will need to be addressed in future planning. The current model has a truck component based on Quick Response Freight Manual (QRFM) methods. One improvement being considered for the activity-based model is the extraction of truck trip tables from the statewide freight model. The statewide freight model is anticipated to be completed by the end of 2008. MORPC is interested in freight modeling information, including commodity mode shifts, mode use by distance, pricing data, estimated rail system capacity with comparisons to road system freight capacity, and the impact of intermodal facilities on traffic, and through trips.

Even though MORPC does not consider congestion management strategies such as pricing as a major focus in travel modeling, its activity-based model structure does have the built-in capability to examine time-specific issues from the demand side. MORPC's activity-based model can model travel demand for each of 15 hourly periods (from 5:30 am to 11:30 pm). Since the model includes a feedback loop into the tour generation phase of the model, trips are allowed to shift out of the peak hour(s). This modeling approach makes it possible for the agency to partially investigate time-specific issues such as parking, telecommuting, reversible lanes, and high-occupancy vehicle (HOV) lanes; time dependent issues such as changes in travel speeds and volumes; and peak spreading issues in highly congested networks. The time-of-day model, operating in conjunction with the destination choice model, allows trips to shift from the peak period to the off-peak period through the use of three global iterations of the model system. The 15 hourly periods are aggregated to four periods for assignment (AM peak, Midday, PM peak, and Night). A one hour peak within the peak period is assumed for the static equilibrium traffic assignment process. However, there is no dynamic assignment or traffic simulation process that allows peak spreading within the existing assignment process.

Uncertainty in travel forecasts is currently addressed by MORPC through the documentation of all assumptions, particularly on the land use side. Whenever traffic assignment results are distributed, traffic volumes are rounded to convey the uncertainties inherent in the numbers.

■ Future Plan for Travel Forecasting Model Update

Motivation for the Major Model Update

The region just recently completed the development of the activity-based travel model. The primary reason for updating the previous four-step model was the evaluation of light rail transit options for the region.

Future Model

Several short-term updates to the regional model are planned, including: a validation of the model by time-of-day (most likely to the four time periods used for assignment) against observed 2005 data; network coding to the intersection level of detail (requested by ODOT for all regional travel models in Ohio); and an update of the mode choice model component of the activity-based model using data from a transit on-board survey planned for 2009.

As described above, there is a desire to improve freight and goods movement modeling for the region, and to add more operations-related modeling capabilities to the regional model, if possible. The design of an improved goods movement model and the collection of data required to estimate the model have not been thoroughly examined, and would be included in the long-range model improvement plan. One long-term model applications change being considered is the migration of the model from Java to Cube scripts. This migration will be performed by segments to evaluate and assess the impacts of differences in model run times.

MPO Profiles – Dallas-Ft. Worth-Denton, Texas Region

■ **Background**

The North Central Texas Council of Governments (NCTCOG) is the MPO for one of largest areas of the country in terms of geographic area and population covered. The MPO currently serves all of Collin, Dallas, Denton, Rockwall, and Tarrant counties and portions of Ellis, Johnson, Kaufman, and Parker counties. In 2008, the MPO will be expanded to include all of Ellis, Johnson, Kaufman, and Parker counties and portions of Hood, Hunt, and Wise counties. This will increase the area served from 4,969 square miles and about 5.1 million residents to 9,441 square miles and about 6.5 million residents. After the expansion, the area covered by the MPO will be second in the U.S. in terms of size and fourth in the U.S. in terms of population covered.

The U.S. EPA has designated 9 of the 12 counties in the expanded region as a nonattainment area for eight-hour ozone levels under the NAAQS of the 1990 CAAA. The three counties not included in the nonattainment designation are Hood, Hunt, and Wise.

■ **Current Travel Forecasting Model Practice**

Travel Forecasting Model

The NCTCOG regional travel model is a trip-based model that represents approximately 5,000 square miles of land area with 4,874 TAZs. The roadway network is coded to the local street level and all transit services in the region are included in the model. The travel model includes traditional cross-classification-based trip production and attraction models, a gravity-based trip distribution model, a nested-logit mode choice model, a diurnal/direction-split distribution time-of-day model, equilibrium-based, generalized-cost highway assignment, and multipath transit assignment. The travel model includes a speed postprocessor and feedback loop for equilibration purposes.

Airport and external trips are not considered in the trip generation module but are specially treated in the trip distribution module. Truck trips are explicitly modeled through trip generation rates, gravity-based trip distribution, and incorporation into the traffic assignment process.

NCTCOG uses DRAM/EMPAL as its general land use model. The base-year land use is tied to a sophisticated building permit database that includes geographic referencing. The files for each local jurisdiction are sent to NCTCOG for review and comment. The travel model is used to create a logsum-based accessibility measure that is converted to in-vehicle travel time and fed into the DRAM/EMPAL land use model. These accessibilities are created for both the base and base-plus-five-year networks and are used to calibrate the land use model.

The travel model is used to provide forecasts and information for thoroughfare planning, transit planning, New Starts analyses, air quality conformity analyses, noise analyses, emissions analyses, toll revenue analyses, high-occupancy vehicle lane analyses, truck modeling and goods movement analyses, and emergency analyses. The model is not currently used to address integrated land use/demographic forecasting, sustainable and transit-oriented development analyses, parking studies, congestion pricing, transit revenue analyses, or evacuation planning. Existing applications of the model include the Mobility 2030 Recommendations Transportation Plan, which include multimodal improvements.

Travel Forecasting Model's Role in Transportation Planning Process

Two long-range plans are required in Texas: a financially constrained long-range transportation plan (LRTP) as required by Federal law, and a needs-based plan that shows TxDOT the funding shortfalls for transportation. The needs-based plan is very general and uses the units of "freeway lane-miles" to quantify the additional system capacity needed to ensure that no roadways operate under Level-of-Service (LOS) F conditions. The LRTP is a very detailed plan that prioritizes projects based on how they support three categories of goals: transportation, quality of life, and financial. Where appropriate, the NCTCOG model is used to evaluate the efficacy of projects or plans in fulfilling these goals.

The transportation planning process is initiated with a travel forecast for the future year with the current transportation system assumed. The first funding priority is maintenance of the current system. After the future transportation system needs are identified, projects that maximize the current transportation system efficiency are evaluated. The evaluation criteria include measures such as reduced demand for single-occupant vehicle travel, reduced traffic congestion, and improved travel times. Transportation system efficiency projects include those using congestion mitigation through transportation system management (TSM) and Travel Demand Management (TDM). Additional transportation system needs are addressed as much as possible by rail system enhancements and expansion followed by projects that increase auto occupancy such as HOV and managed lanes. Projects that take care of the remaining single-occupant vehicles have the last funding priority.

For a project to be entered into the TIP, it must be included in the financially constrained LRTP. Other rating criteria are dependent on the requirements and goals of the various federal and state matching money pools (e.g., Congestion Mitigation and Air Quality, or CMAQ). Rating criteria include the level of emissions, the total volume of the roadway, and mobility improvement.

The model is used to analyze projects based on quantitative measures such as person-throughput, mode share, and travel times. Full model runs are performed for very large projects such as transit rail extensions, corridor highway improvements, and HOV studies. Frequently, a project proposed for the TIP is qualified based on traffic counts or, if no counts are available, the modeled traffic volume. For traffic operations projects (e.g.,

a coordinated signal system for a corridor) the model volumes are used as an input to an operational analysis.

The model is also used to help in scenario analysis for the preparation of Environmental Impact Statements (EIS). Travel model output used for the EIS analyses includes traffic volumes, traffic speeds, travel times, and congestion levels. For the environmental justice aspect of the EIS evaluation, the accessibility of various groups to employment is calculated based on travel times for highway and transit and compared across scenarios. An EIS for a roadway or transit project may take a long time and several updates to the mobility plan may occur in the interim. The project will also change shape over time as available land is identified or avoidable impacts are uncovered. Therefore it is often necessary to rerun the model analysis several times as the EIS progresses, each time with the current versions of the project and the current mobility plan. The model provides objectivity for contentious projects and has often been used to help refine the required number of roadway lanes, transit service refinements, and HOV facility locations.

Support for Travel Forecasting Models

The current total five-year model development budget is $7 million, $5 million of which is earmarked for data collection. Six NCTCOG staff are dedicated to model development and maintenance. Four staff are dedicated to network coding although six to eight have such capabilities. Two NCTCOG employees are responsible for preparing the land use inputs into the model. Consultants are used for all data collection efforts and training efforts to enhance the technical capability of the model development staff.

The planning department budget is separate from the model development budget. Over 20 people in the planning department have the capability to apply the travel model and some have the ability to modify the implementation code. Approximately 50 to 60 percent of the planning department staff time is devoted to applying the model, at a cost of about $800,000 a year. NCTCOG performs model runs for other agencies such as the Dallas Area Rapid Transit Authority (DART), the Tarrant County Transit Authority (the T), and the Denton County Transit Authority (DCTA), as part of the department's Unified Planning Work Program (UPWP) budget.

The Information Technology (IT) budget for all of NCTCOG is approximately $1.75 million per year, including costs for all computers and software licenses. NCTCOG's on-site TransCAD lab has 12 high-powered computers. NCTCOG maintains 40 TransCAD licenses at a cost of $30,000 per year for maintenance fees. The IT department also maintains a $200,000 server and a contract for off-site storage in which every model run is filed. The IT department has four staff members, including two staff devoted to GIS. With the zone system anticipated to increase to about 6,000 zones over the next few years, NCTCOG is considering the acquisition of more powerful computers to keep computer application time for model runs to less than a day. NCTCOG is currently testing the performance of computers that cost about $12,000 each.

◼ Primary Challenges and Emerging Issues

NCTCOG considers the existing travel model to have good capabilities for responding to many of the issues of concern in the region. At the same time, it is cognizant of the limitations of the model and does not attempt to use the model to respond to issues that it is not capable of addressing. For example, the model addresses tolling only in the traffic assignment step. NCTCOG is satisfied with results of the process for static pricing analyses but realizes that the NCTCOG travel model (or any current travel model in its opinion) cannot properly model dynamic pricing conditions.

Separate AM and PM assignments allow reversible lanes to be addressed by the model as long as they are constant for an entire time period. HOV lane analyses are incorporated into the model as a travel demand decision through the mode choice model and as a network supply condition through the traffic assignment process.

While peak spreading is a concern for NCTCOG, its primary focus is planning for a network that satisfies peak period traffic demand. Peak spreading is dealt with indirectly in the travel model by assigning minimum values for link times. This approach implies that travelers can always travel through the network on some heavily congested facilities, albeit at very slow speeds. Automatic traffic recorder (ATR) data suggest that NCTCOG's modeling of a 2.5-hour AM peak period and 3.5-hour PM peak period encompasses the peaks of the network, although actual peak flows occur at different times for different parts of the network. Additionally, truck data show that trucks have different peaking patterns and different sensitivities to congestion. Addressing peak spreading issues within peak time periods would require dynamic assignment techniques not currently available within the current NCTCOG model.

NCTCOG does not have a freight model. Rather, it uses a truck model based on locally collected data. So far, the existing truck model has been sufficient for responding to questions asked by decision-makers. There have been no questions to date requiring information about specific commodities or commodity movements. Nevertheless, NCTCOG would eventually like to develop a freight model for the region.

Some sensitivity analysis is performed for different land use scenarios but uncertainty in the forecasts has never been quantified throughout the modeling process. NCTCOG acknowledges that forecasts of traffic volumes for specific roadways and local bus lines may vary substantially from actual volumes. NCTCOG also acknowledges that validation data such as traffic counts have high degrees of variation.

■ Future Plan for Travel Forecasting Model Update

Motivation for the Major Model Update

The motivation for improvements in NCTCOG's travel demand model is driven by an increased need for efficiency and quality control, and by the types of policy questions that NCTCOG is being asked to address using the travel model.

Future Model

NCTCOG is taking a deliberate approach to the development of its future travel model. Three primary model components have been slated for development:

- A land use model that accepts control totals and policies for developments, considers the effects of available transportation modes (e.g., car ownership), is sensitive to accessibility measures from the travel model, and is sensitive to development policies.

- A person-based travel model that features population synthesis (including household and family detail, worker, car ownership); activity/trip generation; time and duration of activity; mode choice and destination choice at the individual traveler level; dynamic traffic assignment (signals, queuing, ITS, toll); transit assignment; trip data at the individual level; the effect of accidents; sensitivity to operational devices; capability of demand management testing; and compatibility with traffic microsimulation for any subarea.

- A commercial travel model with the features: tour-based; goods and services delivery; sensitivity to the effects of hubs and depots at transfer stations; and fleet allocations.

NCTCOG anticipates that the development of a new travel model will take at least five years after the specification and design of the modeling framework. Its timeline includes overlapping periods of three years for collection of survey data, four years for model development, and one year for the development of reporting tools, applications interface procedures, and diagnostic reports.

The data collection phase has started. Current plans are to collect a new household survey in 2009. DART collected an on-board survey in 2007 and the T will collect an on-board survey in 2008. TxDOT collected external origin-destination survey data in 2005. Depending on the results of the 2009 household survey, another airport survey may be performed. Toll road agencies and consultants perform a variety of stated-preference surveys as well as speed and count data collection. Travel-time runs are performed for about 100 arterial corridors of eight to nine miles each. Count data from ATRs are available and TxDOT performs "saturation" traffic counts every five years with the next major effort anticipated in 2009. TxDOT also uses ITS devices to monitor speeds, travel times, and perform traffic counts. NCTCOG and TxDOT expend substantial resources on the regular collection of data for travel model estimation and validation.

MPO Profiles – Seattle, Washington Region

■ Background

The Puget Sound Regional Council (PSRC) is the MPO for the four county Seattle area: King, Pierce, Snohomish, and Kitsap counties. The 2000 regional population was 3.28 million. Total 2000 employment in the region was 1.76 million. The 2030 population for the region is anticipated to grow to about 4.54 million people residing in 1.93 million households. Employment is expected to grow to 2.5 million in 2030.

The U.S. EPA designated the region a maintenance area under the NAAQS of the 1990 CAAA for CO and particulate matter of 10 microns in diameter or smaller (PM_{10}).

■ Current Travel Forecasting Model Practice

Travel Forecasting Model

The PSRC utilizes a trip-based model that was last estimated in 2000 based on 1999 household survey data. The PSRC model includes a traditional cross-classification-based trip production model and a rate-based trip attraction model, a gravity-based trip distribution model, a multinomial logit-based mode choice model, a logit-based time-of-day choice model, equilibrium-based highway assignment procedures, and a multipath transit assignment procedure. The PSRC model forecasts all trips, including those made by both motorized and non-motorized modes. The mode choice model explicitly considers non-motorized travel.

A detailed truck model has been incorporated into the PSRC travel model. The truck model separately generates and distributes light, medium, and heavy duty trucks. The times-of-day of travel for each of the three truck classes are determined based on static diurnal/direction split factors. The resulting truck trips are converted to passenger car equivalents and assigned by class in the traffic assignment process.

PSRC has adopted UrbanSim as its land use modeling tool and is currently validating the model by simulating land use changes from 2000 to 2006 (using 2000 as a base condition).

Travel Forecasting Model's Role in Transportation Planning Process

A Washington State regulation in the 1990s mandated that transportation plans must be based on a "least-cost planning methodology," which PSRC interprets as benefit-cost ratios. A postprocessor to the PSRC model directly outputs benefit-cost ratios for scenarios. The benefit-cost analysis covers about half of the regional measures used to compare projects. Other measures include:

- The consistency of project-influenced growth compared to the approved growth vision;

- Effects on climate change (i.e., greenhouse gases, and CO_2);

- Effects on health (i.e., walk and bike miles traveled); and

- Air quality conformity.

Each project is ranked by multiplying a measure by its assigned weight and comparing its score to other projects. The long-range transportation plan scenario analysis and TIP project ranking use direct outputs from the modeling process. Thus, the PSRC model has a direct impact on project ranking and approval.

The long-range plan is the result of evaluating the regional impacts of four to five alternatives through the State environmental process. The scenarios are populated with project ideas from Washington State DOT (WSDOT), individual counties and cities, Sound Transit, and by PSRC programs aiming for specific strategies such as demand management and pricing. The individual projects are evaluated based on their impact on the entire PSRC system. All analysis is performed based on regional performance data, and the PSRC travel demand model is used wherever applicable. While most projects use the regional PSRC model, some projects use other methods. Sound Transit, for example, has its own direct-demand model that can be used to evaluate transit projects at a much finer detail than the PSRC model.

Results from the PSRC model have demonstrated the practicality of pricing as a reasonable alternative to unsuccessfully trying to build a way out of congestion while at the same time generating revenue. The PSRC model has explicitly included time-of-day choice in the modeling process. Thus, the model considers the impacts of increased or decreased congestion on the time of day travelers choose to travel, while the impact of different tolling schemes is measured through the mode choice model.

Another example in which model output influenced a project was the I-405 corridor. In this case, model output was used to refine the project to yield the best results from available funding sources. This strategy was also used on SR 167 south of I-405 where the programming for construction was phased to widen key areas first based on analysis of results from the regional travel demand model.

PSRC has two policy boards: one for growth and one for transportation. The boards are presented with a general description of model modifications as well as summarized model output of whichever measures of effectiveness are most appropriate for the decision at hand. This is usually a combination of maps and tables summarizing information such as tolling, traffic, freight, travel time savings, VMT, and transit ridership. The detail of results varies based on the topic. For example, a review of the regional transportation plan focused on regional travel times, VMT, and transit ridership, while the review of the tolling study focused on travel time savings, traffic, and transit ridership in specific corridors affected by the tolling, as well as overall regional impacts. Results for various scenarios are presented alongside a baseline scenario.

Decision-makers often use model results to evaluate and present the potential impacts of their decisions. If a board member is interested in using the data presented to them for meetings with constituents, PSRC will summarize information focused on the decision-maker's local jurisdiction.

Support for Travel Forecasting Models

The entire budget for Data Systems and Analysis is $6.5 million every two years, $1.8 million of which is dedicated to model development. In addition to the $900,000 spent annually on model development, approximately $700,000 is spent on data preparation and analysis and $1.3 million is spent on model application. Every 5 to 10 years PSRC conducts a regional household survey, which costs approximately $1 million. Half of the 2006 survey was paid for by WSDOT transit mobility funds, which prompted a subsample focused on transit and pricing. Annual consultant budgets usually range from $200,000 to $300,000 and are used only for specialized work, including activity generator estimation. In the past, PSRC has contracted with University of Washington for UrbanSim development for approximately $300,000 per year. Computer resources are budgeted separately.

The transportation planning department employs 20 people, with 4 or 5 assigned to growth management and 4 or 5 assigned to economic development.

■ Primary Challenges and Emerging Issues

Climate change and pricing have motivated most of PSRC's recent model improvements. Since VMT and speed are the major inputs to most air quality models, PSRC has focused on enhancing the credibility of regional totals and emission sources in order to perform equity analysis and to craft more effective mitigation policies. In the short term, PSRC is making improvements to both freeway and arterial congested speed calculations and estimating activity tours to capture trip chaining. In the long term, PSRC will be estimating a full-scale activity-based model that will yield more credible disaggregate results and possibly incorporate dynamic traffic assignment. Improvements related to pricing include an update of the value-of-time based on survey data, a level-of-service responsive time-of-day model, and more realistic calculations of congested travel times.

■ Future Plan for Travel Forecasting Model Update

Motivation for the Major Model Update

The PSRC board directed PSRC to focus on addressing two issues: pricing and climate change. PSRC has proceeded with making short-term model improvements to address these issues and other increasingly complex policy questions. Short-term solutions to addressing the transportation impact of policy changes range from using existing models

to craft educated hypotheses on the direction or type of change in travel to modifying modeling to provide better information regarding changes in travel. The addition of the time-of-day choice model to the modeling process is a good example of a detailed, short-term solution to tolling and congestion effects on travel. While the mode choice model could be used to estimate the effect of congestion and alternative tolling strategies on travel patterns, the overall modeling process did not take into account the propensity of travelers to change trip timing to account for congestion delays. The addition of the time-of-day choice model explicitly addressed travelers' propensity to change the start times of their travel.

In the long term, PSRC is working towards a fully integrated land use and activity-based model with dynamic operational analysis capability integrated with a next generation air quality model. These long-term changes will continue to respond to questions regarding pricing and climate change. For example, the existing model does not explicitly consider changes in housing or work locations that travelers make over the long-term in response to increasing congestion or tolls. A fully integrated land use and activity-based model will incorporate these changes and the entire process, including dynamic operational analysis capability, will provide for a more internally consistent consideration of policy impacts on travel. It is anticipated that this modeling approach will be able to address most of the current questions facing the PSRC region.

Future Model

Several short-term model improvements have been implemented for the next transportation plan update scheduled for this summer. The two major improvements are the development of a household synthesizer and a tour generator. A workplace location choice model has been implemented within PSRC's UrbanSim application to serve as an anchor to work tour generation. Mode choice model improvements include stratification by walk and drive access and by 10 separate modes, and the addition of urban form measures to pedestrian and bicycle mode choices. In addition, a traffic assignment overhaul is slated to improve validation of observed speeds and increase the accuracy of air quality modeling. Improvements also include the addition of a stock-market analysis-based unreliability factor for freeways and improving the accuracy of delays at arterial intersections to reflect coordinated signals. PSRC also recently evaluated and updated its value-of-time assumptions based on an 18-month Global Positioning System (GPS) study.

In the long term, PSRC plans to implement a full-scale activity-based model and will consider dynamic traffic assignment. It also recognizes the need for a finer grained zone system and plans to expand from 948 TAZs to approximately 4000 TAZs in order to take full advantage of the activity-based model.

PSRC conducts household surveys every 5 to 10 years. The most recent household survey was conducted in 2006 and had a 450 household GPS component. The City of Bellevue conducts workplace surveys. Off-street parking surveys are performed every two years. Three-day traffic counts are carried out along screenlines. Sound Transit is in the process of organizing a new on-board survey and enlisting the support of other operators. Several

special surveys are conducted, including a ferry market origin-destination survey and a port passenger survey. A Commute Trip Reduction Survey collected data on commute modes and household zip codes.

MPO Profiles – Sacramento, California Region

■ Background

The Sacramento Area Council of Governments (SACOG) is the MPO for the six county Sacramento area: El Dorado (except Tahoe basin), Placer (except Tahoe basin), Sacramento, Sutter, Yolo, and Yuba counties. In 2000, the regional population was 1.9 million and employment totaled 920,000. Population for the region is anticipated to grow to about 3.0 million by 2030 with employment forecasted to grow to 1.45 million.

The U.S. EPA designated the region a nonattainment area under the NAAQS of the 1990 CAAA for ozone and PM_{10}. The area also is in maintenance for carbon monoxide (CO).

■ Current Travel Forecasting Model Practice

Travel Forecasting Model

The Sacramento Metropolitan Travel Demand Model, or SACMET, is a four-step model estimated in 1994 based on 1991 household survey data. An update of the auto ownership model was performed in 2000 based on 2000 household survey data. The SACMET model includes a traditional cross-classification-based trip production model and a rate-based trip attraction model; a destination choice model for home-based work trips and gravity-based trip distribution models for other trip purposes; a logit-based mode choice model; a diurnal/direction-split time-of-day model; and equilibrium-based highway assignment procedures. The SACMET model forecasts all trips, and the mode choice model explicitly considers non-motorized travel. Truck trip generation is performed for both two-axle commercial vehicles and three-or-more-axle commercial vehicles.

SACOG has also developed an activity-based travel model, SACSIM, for the region. The model is in its initial testing phase and has been used for some travel analyses. While SACMET represents land use data in a system of 1,503 traffic analysis zones (TAZ) with median size of 300 acres, SACSIM represents land uses at the parcel level. SACSIM represents travel activities as "tours" or series of trips connecting activities a person engages in during the course of a normal day. These cutting-edge features have the potential to capture aspects of land use and transportation interactions, and effects of demographic changes such as aging on travel.

Travel Forecasting Model's Role in Transportation Planning Process

Projects in SACOG's constrained Long-Range Transportation Plan (LRTP) are entered in three phases ranging from design to construction. Each project in the plan has a targeted completion year for construction, which is set to optimize the air quality benefits. Project

prioritization is heavily based on the travel model; hundreds of model runs are performed to accomplish the phasing. As financial resources become increasingly constrained, inclusion of projects in the LRTP has become more reliant on model results. SACOG has worked hard to develop a culture of underpinning planning choices with data and information as opposed to opinions and politics. The constrained LRTP must go through the environmental process. Model results are used not only to develop the plan, but to evaluate impacts such as air quality.

Model results have influenced many decisions in the SACOG area. This is most evident in cases where models yield information that differs from general expectations. For example, model results showed that widening existing bridges across the Sacramento River would be more consistent with Blueprint development (the regional land use plan) than building a new crossing. In another river crossing analysis, model results clearly showed that two new bridges were needed into downtown Sacramento. The clarity of the model results gave SACOG the information necessary to respond to concerns of local officials and secure their commitments for the bridges.

The model also has been used to illustrate how certain projects will be used. For example, the Elk Grove to El Dorado County connector was originally conceived as a typical beltway project. Local opposition to the project was based on the principle that beltways are sprawl-inducing. SACOG demonstrated that modeled travel patterns associated with the project did not exhibit the behavior of a beltway, and was able to gain the support of local citizens as a result. Several other projects, including some light rail extensions and HOV lanes, have been dropped from the LRTP due to poor performance in model runs. At the same time, SACOG has been able to use the model to demonstrate to Caltrans that building HOV lanes near the region's core as opposed to the region's periphery would encourage infill development.

SACSIM model results have been used to help modify development plans. In the case of Placer Vineyards, SACSIM was used to compare the travel patterns of low- and high-density versions of the development. The results showed that regional average trip lengths increased for the less-dense development of Placer Vineyards. This occurred because households that could not be accommodated in the lower-density development plan were reallocated to other vacant parcels throughout the region. Overall, lower development densities resulted in increased travel distances to satisfy the daily needs of the additional households considered in the analysis. In addition, regional transit use decreased for the lower density development of Placer Vineyards due to longer walking distances to transit and lower levels of transit service provided to the additional households.

SACOG educates its board members on how to analyze and use model results, not on the technical aspects of the model. Some board members use the model results such as time of travel, mode choice, VMT, and congested VMT, to discuss issues with their constituents. SACOG has built confidence in the model results by clearly presenting and documenting model validation results. Validation is not used to "prove the model is correct" but to present the level of accuracy associated with the forecasts. Thus, board

members are aware of the levels of accuracy that can be associated with model results when discussing those results with constituents.

SACOG uses its travel models not only to support the development of its LRTP, but to develop its Blueprint land use vision as well. The SACMET model has been used for FTA New Starts analysis, Environmental Impact Statements (EIS), and State Implementation Plan (SIP) development for air quality related to ozone. The model also is used by local jurisdictions for their own analysis purposes.

Support for Travel Forecasting Models

Each year, three person-years of effort are devoted to model development and about two person-years are devoted to developing data inputs for the models. The effort dedicated to developing data inputs for the models should decrease since much of the previous effort had been expended on the development of interim scenarios. Seven transportation planners can run the model; three of the planners focus on transit, three on roadway, and one on pedestrian and bicycle issues.

Consultants play a large role in model development, including the performance of all model estimation work. Consultant budgets for model development, testing, and maintenance of SACSIM total just under $200,000 per year. An additional $90,000 has been allocated to consultants for the development of the PECAS model for small area land use allocation.

■ Primary Challenges and Emerging Issues

Congestion pricing is one of the mitigation measures adopted in the environmental impact report (EIR) for the LRTP. While SACSIM is much more sensitive than SACMET, SACOG realizes that the long-term impacts of congestion pricing to decisions such as household and workplace choice can be addressed only by making land use models sensitive to congestion pricing. For this reason, SACOG is proceeding with PECAS model implementation. In addition, congestion pricing can only be fully analyzed when dynamic traffic assignment is implemented.

SACMET has been used for New Starts applications and performed fairly well through the FTA review. FTA requested the addition of substantial detail to the network in the subarea. SACOG will switch to SACSIM for an upcoming New Starts analysis. It is exploring how the San Francisco County Transportation Authority (SFCTA) used its activity-based tour model in conjunction with SUMMIT. SACOG will need to determine how to apply the SACSIM model in a modified mode with inputs to and outputs from most of the steps fixed, but there will likely not be any requirement for further model changes.

◼ Future Plan for Travel Forecasting Model Update

Motivation for the Major Model Update

SACOG was driven to using an activity-based model for a number of reasons. Due to the critical role VMT plays in the production of greenhouse gases, SACOG recognized the need for an in-depth examination into factors influencing VMT changes. SACOG believes that an activity-based model is the only way to properly address this issue. Trip-based models lose all the detail and true causes of VMT changes, thereby rendering them useless when evaluating possible mitigation policies. Activity-based models can examine who is being affected by what policies and how, and can assign accountability with greater precision. This is particularly important in addressing environmental justice concerns.

Future Model

Since SACSIM is a newly created state-of-the-art travel demand model, no major model updates are planned in the short term. Some minor improvements include reprogramming SACSIM to run in a distributed processing mode to decrease run time, replacing a size variable reduction process with a shadow price process, and transit network refinement. SACOG is also working to estimate a PECAS model for the region that will be able to capture the long-term effects of the transportation system on household and workplace location choice. This is considered to be a very important step in fully analyzing the long-term effects of congestion pricing. On the networks side, SACOG is exploring more efficient assignment algorithms such as origin-based assignment and junction-based modeling.

In the long term, SACOG wants to refine the traffic operations side of SACSIM to be concordant with the demand side. This includes exploring the possibility of dynamic traffic assignment and linkages to microsimulation models. Other long-term, but as yet unfunded, improvements include development of a tour-based goods movement (or commercial vehicle) model, and an update to the vehicle ownership model.

SACOG's last household survey coincided with the 2000 census and the next one will be in 2010. Although it will update its modeling base year to 2008, there is no intent to synchronize this data with the collection of National Household Travel Survey (NHTS) information. SACOG may, however, compare its model results to the data provided by the NHTS for an aggregate model validation.

Summary

Based on the interviews of the five exemplary MPOs, it is evident that travel models and travel model results are used in the transportation planning process in each region. Every studied area maintains a strong modeling staff and allocates substantial resources to the modeling process.

The modeling staffs in the MPOs are cognizant of the questions that they can and cannot answer with the travel models. While traditional trip-based models are somewhat more limited in the questions that can be addressed, state-of-the-art activity-based tour models also face some limitations. Several emerging issues were frequently mentioned as primary challenges:

- Congestion pricing is an issue that can be analyzed at the most basic level with existing traffic assignment processes, especially if a generalized-cost traffic assignment process is used. At the same time, staffs from each of the MPOs realized that issues associated with congestion pricing are complex and cannot be fully answered even with activity-based tour models. Proper analysis of more complex issues associated with congestion pricing might require the use of time-of-day choice models, dynamic traffic assignment or microsimulation, or detailed land use models. Even with these tools, the observed data necessary to determine land use changes resulting from congestion pricing might not be available.

- Managed lanes present many of the same challenges posed by congestion pricing.

- Freight, goods movement, and truck modeling provide a challenge that must be addressed somewhat separately from changes to the passenger travel forecasting process. Although MORPC and SACOG have activity-based tour models, both MPOs recognize the need for improved freight/truck modeling.

Four of the five MPOs still maintain credible trip-based models that have been successfully used in the transportation planning process. Yet three of four MPOs are actively developing activity-based tour models, and the fourth MPO is planning an activity-based model. The philosophy of the five MPOs may be best summarized by the sentiments of the PSRC staff that:

> "…not continuously changing their model to be state-of-the-art leaves them open to criticism that they have not incorporated all the latest available research and technology."

Appendix 1 – Interview Questions

■ **Travel Forecasting Model's Role in Transportation Planning Process**

Travel Forecasting Model's Role in Your Transportation Planning Process Interview Questions

- Describe the Transportation Planning Process.

  – What performance indicators are used in funding allocations?

  – Is the board/committee presented with modeling information, alternative forecasts?

  – Tell me the importance of modeling to the process?

- Describe how projects enter the Long-Range Plan and TIP.

  – Is there a rigorous rating process for projects in the TIP/how are TIP projects selected?

  – Is the process based on modeling?

  – Are models regularly used in EIS's?

  – Are models used with the interchange justification report? How do models evaluate interchanges?

- Where do models enter the process?

  – How do model results influence the final decisions?

  – Provide an example of where modeling information caused a plan modification

  – How do decision-makers use model results?

  – Do the data or model results support the conclusions of the board?

  – Does the MPO have a working relationship with the Board's technical committee?

  – Do models have uses other than the long-range plan?

- Other

  – What land use forecasting methods do you use?
    o Model/what model?
    o GIS/what software?

      o   Land use expert panel?

      o   Simple allocation model?

      o   Other?

– Who are the major players in land use forecasting at regional level?

– Who are the major players in land use allocation at TAZ level?

– What questions do decision-makers ask?

– What is the level of knowledge about models among policy-makers?

– What is the public attitude about the analytical process?

– Does the state DOT request information on model results?

– Is modeling embraced or is it a requirement?

■ Primary Challenges and Emerging Issues

Major Issues Interview Questions

- What major issues are you facing now that your current model cannot address? What methods are you using now to address them? Would these issues lead you to make major improvement to your model (e.g., adopt an activity-based state-of-the-art model)?

- Can current models adequately address emerging issues?

   – Road pricing?

   – Time-specific issues – e.g., parking, telecommuting, reversible lanes, HOV lanes?

   – Improvements in traffic operations?

   – Time dependent changes in speed and volume?

   – Freight policies?

   – Peak spreading and highly congested networks?

   – Goods movement?

   – Freight?

   – Uncertainty in estimates?

   – Dynamic conditions?

   – Land Use scenarios?

◼ Support for Travel Forecasting Models

Management of the Modeling Process Interview Questions

- What resources are allocated to modeling?

- Is there an ongoing data collection program?

- Is something in the work plan related to modeling?

  – Model development budget?
  – Data collection budget?
  – Model application budget?
  – Staffing structures?
    o Total transportation planners?
    o Travel forecasting model developers?
    o Travel forecasting model input data preparers (land use and network)?
    o Travel forecasting result users (those who will distribute the model results or postprocessing the results)?
    o Consultant's role?

- Partnerships

  – What partnerships exist between the agency and:
    o The state DOT?
    o Local governments (including transit agency)?
    o Universities and other research institutions?

- How do other agencies use your model/do other agencies (both public and private) use your model for any applications?

- If yes, what process do you have to reconcile the changes made to the travel model by these agencies?

■ Future Plan for Travel Forecasting Model Update

Motivation for the Major Model Update

- What is the motivation for model updates in the short term?

    - New Starts application?
    - Conformity determination?

- What is the motivation for model updates in the longer term?

    - Traffic operations?
    - Conformity determination?

- Do you think your agency should have more than one model to address different Federal/regional requirements?

    - New Starts?
    - Conformity determination?

Future Model

- What model updates are underway or planned?
- What is the long-term plan for the models?
- Do you have any survey planned?
    - Household?
    - On-board?
    - Workplace?
    - External?
    - Special market?
    - Other?

- Do you have plans to work with other agencies to take advantage of the passive data collection?

    - Collaboration with …?

Appendix 2 – Response to Interview Questions – Atlanta Regional Commission

Interview Date: March 7, 2008

Interview Location: ARC Office, Atlanta, Georgia

Interview Attendees: Guy Rousseau, Charles Krautler, Tom Weyandt, Jane Hayse, Mike Alexander (ARC); Fred Ducca, Robert Ritter (FHWA); Laura McWethy (Cambridge Systematics, Inc.)

MPO Characteristics

Jurisdiction Area: 5,300 square miles

Jurisdiction Population: 4,228,000 (2000)

Number of Counties: 20

Model Characteristics

Model Area:

Modeled Counties: Cherokee, Clayton, Cobb, Coweta, DeKalb, Douglas, Fayette, Forsyth, Fulton, Gwinnett, Henry, Paulding, and Rockdale counties and parts of Barrow, Bartow, Newton, Spaulding, and Walton counties

Modeled Zones:

Modeled Links:

Modeled Nodes:

Modeled Transit Lines:

Interview Discussion: A list of interview questions regarding the role of the travel forecasting models in the region's transportation planning process was sent to interviewees prior to the meeting. The remainder of this document lists the specific questions and then summarizes the responses to those questions. This document is a summary of the interview responses, not a transcript of the interview.

◼ Travel Forecasting Model's Role in Transportation Planning Process

Travel Forecasting Model's Role in Your Transportation Planning Process Interview Questions

- **Describe the Transportation Planning Process.**

  - **What performance indicators are used in funding allocations?**
  - **Is the board/committee presented with modeling information, alternative forecasts?**
  - **Tell me the importance of modeling to the process?**

There are three main performance indicators used in funding. The first criterion is a measure from the travel model. Seventy percent of the criterion is based on congestion relief, with the remaining 30 percent based on other factors. The second criterion is a travel time index, also from the travel model, and the third criterion is a cost/benefit analysis. The cost/benefit analysis is based on the improvement in lost time and cost of fuel by truck and auto classes, which is adjusted for inequity in the rural areas.

The ARC board members are well-informed of the constraints with the air quality mandates, which require modeling results for project selection. The MPO technical and policy committee is comprised of the core members of the ARC board, so they are all familiar with the model and air quality constraints. The board members have confidence in the modeling staff and results, which is attributed to their reliance on the results due to nonconformity issues and the crisis which took place in the 1990s. Efforts are made to introduce the modeling results and the staff to the board, so they are familiar with the modeling process. Sketch modeling time outputs are presented to the board, which demonstrate travel time between two points over a variety of scenarios, so they can see that the modeling results can be brought down to a small level as well, not just a regional picture.

Modeling is an important part of ARC's transportation planning process, as several of the selection criteria depend on the model results. As described above, the air quality mandates require modeling for project selection, and so the model is used extensively.

- **Describe how projects enter the Long-Range Plan and TIP.**

  - **Is there a rigorous rating process for projects in the TIP/how are TIP projects selected?**
  - **Is the process based on modeling?**
  - **Are models regularly used in EIS's?**
  - **Are models used with the interchange justification report? How do models evaluate interchanges?**

The region currently is starting with a deficit of $4.3 billion for the fiscal constraint project budget, so there is a strict process in place for project selection in the transportation planning process. The first thing looked at is any progress that has been made on the project, such as environmental work,

preliminary engineering, etc. If there has been no work done, it is likely that the project will be either dropped or moved into the future.

The next step is to look at how this project measures against others. This project prioritization is done using the regional travel forecasting model, which has three main project selection criteria looked at by the board, as described above. The first criterion is a measure from the travel model. Seventy percent of the criterion is based on congestion relief, with the remaining 30 percent based on other factors. The second criterion is a travel time index, also from the travel model, and the third criterion is a cost/benefit analysis. The cost/benefit analysis is based on the improvement in lost time and cost of fuel by truck and auto classes, which is adjusted for inequity in the rural areas.

The overall transportation planning process relies heavily on modeling, due to air quality standards. One thing to note, though, is that due to time constraints, the initial model run to determine the criteria is typically the only model run done for project selection. While the model is used for prioritization, there is little testing done of the different projects at the project selection phase. The model is used to test different alternatives for corridor studies and when Environmental Impact Statements, Interchange Justification Reports, and Interchange Modification Reports are prepared.

- **Where do models enter the process?**

  - **How do model results influence the final decisions?**
  - **Provide an example of where modeling information caused a plan modification**
  - **How do decision-makers use model results?**
  - **Do the data or model results support the conclusions of the board?**
  - **Does the MPO have a working relationship with the Board's technical committee?**
  - **Do models have uses other than the long-range plan?**

Model results influence the final decisions by providing criteria for rating the projects. These criteria are looked at, along with other non-model factors, as a whole to determine which projects make it into the Regional Transportation Plan (RTP). The entire Envision6 RTP plan development process used model results to rank and prioritize project.

Decision-makers use the project rating criteria when looking at which projects to put into the RTP. Because of the use of the model results in the project selection process, the results support the conclusions of the board.

The MPO works closely with the Board's technical committee and ensures that they understand the model results that they are presented. The model is used for all corridor studies and regional studies so the technical committee may see model results relatively frequently.

- **Other**

  - **What land use forecasting methods do you use?**
    - o **Model/what model?**

- o **GIS/what software?**
- o **Land use expert panel?**
- o **Simple allocation model?**
- o **Other?**
- – **Who are the major players in land use forecasting at regional level?**
- – **Who are the major players in land use allocation at TAZ level?**
- – **What questions do decision-makers ask?**
- – **What is the level of knowledge about models among policy-makers?**
- – **What is the public attitude about the analytical process?**
- – **Does the state DOT request information on model results?**
- – **Is modeling embraced or is it a requirement?**

The land use forecasting process used by ARC are divided into two stages, including regional forecasting, which develops the control totals for the entire region, and small area forecasting, which is the small area allocation of households and jobs. Currently, the regional forecasting model is IPEF (Interactive Population and Econometric Forecasting) model, which uses FORTRAN open source code and the small area land allocation model in use is DRAM/EMPAL. The ARC planning staff is working to upgrade both of their land use forecasting models. The regional forecasting model will be upgraded to a REMI (Regional Economic Models, Incorporated) model, which is an integrated input output and econometric model in wide use across the world for long-range forecasting of larger areas, l. The small area allocation model will be updated to the PECAS model, using Impact Analysis for Planning (IMPLAN) to develop needed technical coefficients. PECAS will also be integrated into the travel model.

The regional forecast process involves a Technical Advisory Group (TAG), at each iteration (year step) of the process, to review assumptions and reasonability of output. This TAG has membership from the local academic and local planning communities, so the review takes into account direct assessment of local forecasts. The TAG is not directly involved in review of the small area forecasts, but (again at each iteration), local planning staff are offered the opportunity to review the distributions as compared to any local forecasts

The area of the model that has raised questions is the validity of the transit component of mode choice. The on-board survey data that was used to estimate the mode choice model was collected in 2002 and it is getting out-dated. A new on-board survey is scheduled for 2008.

The planning staff expressed a concern with stretching the regional model for corridor-specific project selection. There is a need for a corridor-area model to look at congestion relief. This could be either adapted from an off-shelf product or developed in-house. It also would be useful to the planning staff to know what should be the level of resources and funds a large MPO should spend on modeling. Other areas in which FHWA could provide assistance is providing guidelines for presenting and summarizing technical data for policy-makers, as well as visualizing the data. The question the planning staff would most like the models to answer, which they do not, is what is the absolute best project for improving congestion. An example of something that would strive in this direction would be a better measure of evaluating projects against one another.

As stated before, the ARC board members are well-informed of the constraints with the air quality mandates, which require modeling results for project selection. The MPO technical and policy committee is comprised of the core members of the ARC board, so they are all familiar with the model and air quality constraints. The board members have confidence in the modeling staff and results, which is attributed to their reliance on the results due to nonconformity issues and the crisis which took place in the 1990s. Efforts are made to introduce the modeling results and the staff to the board, so they are familiar with the modeling process. Sketch modeling time outputs are presented to the board, which demonstrate travel time between two points over a variety of scenarios, so they can see that the modeling results can be brought down to a small level as well, not just a regional picture.

The public is presented a variety of formats form which to understand the results of the analytic process. This ranges from simple drawings and bulleted points to very detailed reports. This information is provided on the ARC web site, in handouts and through presentations. The presentations can be at meetings, or provided via podcast, vidocast, webinar, or PowerPoint. When the public questions a term or result, they speak or correspond directly with an ARC staff person. The public reacts according to their interest, understanding, and location. For the most part, the public has confidence in the results of the process and understands results implications. When a member of the public challenges a result, the ARC staff person supplies them with background and supplementary material to further inform them until an understanding is hopefully reached.

Modeling is embraced at ARC, primarily because of the air quality nonattainment crisis in the 1990s. This caused a reliance on the model and a culture that relies on the model results.

■ Primary Challenges and Emerging Issues

Major Issues Interview Questions

- **What major issues are you facing now that your current model cannot address? What methods are you using now to address them? Would these issues lead you to make major improvement to your model (e.g., adopt an activity-based state-of-the-art model)?**

- **Can current models adequately address emerging issues?**

  – **Road pricing?**

  – **Time-specific issues – e.g., parking, telecommuting, reversible lanes, HOV lanes?**

  – **Improvements in traffic operations?**

  – **Time dependent changes in speed and volume?**

  – **Freight policies?**

  – **Peak spreading and highly congested networks?**

  – **Goods movement?**

  – **Freight?**

  – **Uncertainty in estimates?**

- **Dynamic conditions?**
- **Land Use scenarios?**

One of the primary challenges that have faced the ARC modeling staff is incorporating managed lanes into the model network. The managed lanes in the network are mandatory truck lanes, but are difficult for the model to enforce, because of the limited access points. This is dealt with by a post-processor spreadsheet, which compares counts to model volumes and assumes that all the trucks are utilizing the mandatory truck lanes. The toll prices also are set using the postprocessor spreadsheet method, which optimizes the travel speed and revenue simultaneously to obtain the best toll price. Another method which could possibly work would be to incorporate toll/non-tolls in the mode choice nests, but this would greatly increase the model run time and requires data which does not exist in the region.

A commonality of many of the challenges and issues facing the ARC modeling staff is the lack of data. In the case of the managed lanes, there is a lack any data on variable tolling in the region, which makes it impossible to incorporate into tolling into the mode choice directly.

The driving force for many of the innovations of the models is the air quality conformity issues that the MPO faces. This also can be problematic, as better models can increase the emissions that are reported, which could lead to nonconformity. One solution to this issue would be to make an emissions budget with one model set, verify it, and then freeze it and move on to the other model set.

Several other emerging issues were discussed in the context of the ARC model and its ability to address them. The only area in which time-specific issues come into play for the ARC model is ramp metering, which currently is a growing strategy in the area. There is no method for incorporating this into the model, and would require a more site-specific analysis of corridors versus a regional model. Telecommuting was tested internally, but because of the limitations of the four-step trip generation, it was difficult to obtain trust-worthy results. An activity or tour-based model would much better answer this question. Freight is another issue that is under scrutiny, and a freight model, looking at commodities rather than trucks, is being developed with the help of a consultant, with the majority of the work to take place in 2009.

Peak spreading is an issue that is dealt with by the incorporation of a time-of-day model. This model has four time periods, which enables the directionality of the peak to be seen, and provides better answers to decision-makers. The TOD model was created using 24-hour traffic count data in 15-minute intervals, along with household travel survey data, to determine time-of-day factors. The time-of-day model can also deal with dynamic conditions better than a daily model. Dynamic traffic assignment is also being looked into to handle dynamic conditions. Ultimately, ARC feels that simulation models are needed to fully address network issues such as these. They have been working with VISSIM/VISUM and were working with TRANSIMS.

The last emerging issue discussed was the issue of uncertainty in estimates. The ARC modeling staff communicates the fact that the model is uncertain to the board, but feels that quantifying the uncertainty is something that the research community should be in charge of, rather than the MPOs.

■ Support for Travel Forecasting Models

Management of the Modeling Process Interview Questions

- **What resources are allocated to modeling?**

- **Is there an ongoing data collection program?**

- **Is something in the work plan related to modeling?**

  – **Model development budget?**

  – **Data collection budget?**

  – **Model application budget?**

  – **Staffing structures?**

    o **Total transportation planners?**

    o **Travel forecasting model developers?**

    o **Travel forecasting model input data preparers (land use and network)?**

    o **Travel forecasting result users (those who will distribute the model results or postprocessing the results)?**

    o **Consultant's role?**

ARC allocated approximately $0.5 million per year for outside consulting modeling work, which is done on a task order basis, and has four staff in the model development group and 3 staff in model applications. Recent and current tasks include estimation of the destination choice model, disaggregation of socioeconomic data, conflagulation of street centerlines (smoothing angular links to more realistically represent the centerlines), freight modeling, and continued efforts on the activity-based model. Ongoing data collection efforts include vehicle classification data, speeds and travel times through the congestion management process and obtaining counts from GDOT. Survey efforts for household travel and transit on-board data do have a significant impact on the ARC budget for model updates.

- **Partnerships**

  – **What partnerships exist between the agency and:**

    o **The state DOT?**

    o **Local governments (including transit agency)?**

    o **Universities and other research institutions?**

- **How do other agencies use your model/do other agencies (both public and private) use your model for any applications?**

- **If yes, what process do you have to reconcile the changes made to the travel model by these agencies?**

The ARC MPO works with the state DOT, local governments, Georgia Regional Transportation Authority (GRTA), and Georgia Technical University. GDOT and the local governments provide input into the modeling process, and there is an informal relationship with the university.

The model can be used by any agency, and is sometimes adapted for a smaller area by an agency. These more detailed networks and zone structures are then added to the model for future use, after review.

■ Future Plan for Travel Forecasting Model Update

Motivation for the Major Model Update

- **What is the motivation for model updates in the short term?**

  - **New Starts application?**
  - **Conformity determination?**

- **What is the motivation for model updates in the longer term?**

  - **Traffic operations?**
  - **Conformity determination?**

- **Do you think your agency should have more than one model to address different Federal/regional requirements?**

  - **New Starts?**
  - **Conformity determination?**

The motivation for model updates in both the short and long term is conformity determination for ARC. While the same model can be used for conformity determination, regional planning and New Starts applications, microscopic and mesoscopic models are needed at the corridor level.

Future Model

- **What model updates are underway or planned?**
- **What is the long-term plan for the models?**
- **Do you have any survey planned?**
  - **Household?**
  - **On-board?**
  - **Workplace?**
  - **External?**
  - **Special market?**
  - **Other?**

The four-step model is the model currently in use, as the activity-based model is still in development. There are no plans to switch over to the activity-based model in the near future, as the ARC planning staff wishes to keep improving the four-step model as much as possible while maintaining the activity-based model development. The household survey data is getting older for the model development use, but it is anticipated that the activity-based model estimation work will

continue with the old data and will be revised once the new household survey data is available after 2010.

A household travel survey is done every 10 years in conjunction with the Census. A transit on-board survey is planned for 2008. An establishment survey was done in the 1990s and it needs to be done again, but is not planned at the moment. The planning staff would like guidance on external trips survey methodology, such as license plate recognition or interception, etc.

- **Do you have plans to work with other agencies to take advantage of the passive data collection?**

    – **Collaboration with …?**

The ARC planning staff feels that the NHTS data is not good for a large MPO like Atlanta, but is rather useful for a small or medium MPO. The timing of the survey was an issue for them, and so they do not use it for anything. CTPP is the data set that is important to them, as long as the aggregation level remains small enough.

- **What help would ARC like from FHWA?**

The ARC planning staff would like to see from FHWA and TMIP things such as standards for practice for surveys, such as standard sample sizes, types of technologies used, and peer discussion and reviews. Additional financial assistance is needed from FHWA in order to collect data via surveys, which then feeds into major model calibration and validation efforts.

Appendix 3 – Response to Interview Questions – Mid-Ohio Regional Planning Commission

Interview Date: March 12, 2008; follow-up conference call on May 12, 2008

Interview Location: MORPC Office; Columbus, Ohio

Interview Attendees: Nick Gill, Zhuojun Jiang (MORPC); Rebekah Anderson (Ohio Department of Transportation); Fred Ducca, Robert Ritter, Noel Mehlo (FHWA); Laura McWethy (Cambridge Systematics, Inc.)

MPO Characteristics

Jurisdiction Area: 1,100 square miles

Jurisdiction Population: 1,334,000 (2000)

Number of Counties: 2 whole and 2 partial

Model Characteristics

Model Area:

Modeled Counties: Franklin and Delaware Counties, the City of Pickerington, Bloom and Violet Townships in Fairfield County, Etna Township and the City of Pataskala in Licking County, and the Newark/Heath urbanized area

Modeled Zones:

Modeled Links:

Modeled Nodes:

Modeled Transit Lines:

Interview Discussion: A list of interview questions regarding the role of the travel forecasting models in the region's transportation planning process was sent to interviewees prior to the meeting. The remainder of this document lists the specific questions and then summarizes the responses to those questions. This document is a summary of the interview responses, not a transcript of the interview.

■ Travel Forecasting Model's Role in Transportation Planning Process

Travel Forecasting Model's Role in Your Transportation Planning Process Interview Questions

- **Describe the Transportation Planning Process.**

    – **What performance indicators are used in funding allocations?**

    – **Is the board/committee presented with modeling information, alternative forecasts?**

    – **Tell me the importance of modeling to the process?**

*The Mid-Ohio Regional Planning Commission (MORPC) has three goals in the Long Range Transportation Plan or TPlan as designated by MORPC: transportation efficiency, multi-modal, and quality of life, all of which have measures associated with them which go towards scoring projects. The measures associated with each of the goals are shown below with quantitative measures shown in **bold**:*

1. *Transportation efficiency:*

    a. ***Average 2030 peak travel delay reduction per person;***

    b. ***Improvement in 2030 level-of-service (LOS) in a corridor;***

    c. ***Improvement in 2015 LOS in a corridor;***

    d. ***Safety measure (number of crashes/crash rate);***

    e. ***Physical condition of facility;***

    f. *TSM usage (efficiency improvement);*

    g. *Maintaining aging infrastructure; and*

    h. ***Percentage of trucks***.

2. *The Multimodal measures:*

    a. ***Pedestrian connections;***

    b. ***Bicycle connections;***

    c. *Travel demand management (TDM) measures; and*

    d. ***Service to intermodal facilities***.

3. *Quality-of-life measures:*

a. *Degree of displacement caused by roadway;*

b. **Environmental justice for transportation disadvantaged;**

c. **Impact on sensitive land;**

d. **Air quality impact (reduction in emissions);**

e. **Change in fuel consumption;**

f. **Storm water increase**; *and*

g. **Non-retail jobs served**.

h. *All of these measures are used to evaluate candidate projects for the transportation plan, but the projects that are included in the Plan are largely based on the priorities of the local communities.*

i. *In accordance with the support provided by the Ohio Department of Transportation (ODOT) for modeling and analytic methods, MORPC uses the travel model extensively in the transportation planning process. The use of the model in the decision making process provides a mechanism to remove politics from the process by keeping a quantitative underpinning.*

Summary model results are presented to the board's technical committee. These summary results include information relating to the congestion management process (CMP) and state of the system information. Detailed model results are used at an earlier stage in the MORPC planning process, primarily in the special studies that are done before the actual selection process for the TPlan. These results are presented to the special committees reviewing or overseeing a study.

- **Describe how projects enter the Long-Range Plan and TIP.**

  – **Is there a rigorous rating process for projects in the TIP/how are TIP projects selected?**

  – **Is the process based on modeling?**

  – **Are models regularly used in EIS's?**

  – **Are models used with the interchange justification report? How do models evaluate interchanges?**

The development of the TPlan starts with the collection of information regarding needs from local communities. Many of these needs are supported by studies conducted for proposed projects although there is no requirement that modeling be used for the special studies. The identification of projects might also come from other sources such as corridor and subarea studies as well as regional studies used to identify transportation system deficiencies. A general criterion for a deficient link is any two lane road with more than 15,000 vehicles per day.

The next step of the process is to determine which potential projects make it into the TPlan. The selection process uses a number of factors:

- *The first consideration is whether or not the project is listed in the TIP and whether the project is past the concept stage. If the project is included in the TIP and is past the concept stage, it is to be included in the TPlan.*

- *The second consideration includes a quantitative evaluation of the projects based on results from the regional travel model and GIS-based factors. This evaluation is done using the measures described in the section above to determine a quantitative score. This score is taken into account with non-model factors such as safety considerations, impact on freight movement, Intelligent Transportation System (ITS) improvements, regional or local security concerns, general community support, and financial support.*

The above process guides the development of a financially constrained TPlan. The role of modeling in the process falls mainly in the project selection stage, rather than weeding out projects for the final plan. The project weeding process is done largely based on the local communities' highest priorities.

The development of the TIP uses a similar process to that used for the development of the TPlan, with a few exceptions. Specifically, local communities submit applications for MORPC controlled funding for projects which they would like included in the TIP. The selection criteria for these projects are essentially identical to those used the TPlan. The local communities have a chance to review the recommendations prior to the completion of the TIP. The exception to the TPlan process used for the TIP development is the inclusion of ODOT funded projects to include in the TIP, which are primarily maintenance activities.

Environmental Impact Statements (EIS) use traffic and ridership numbers which are based on model results. For Interchange Justification Reports, the model is run with and without the new interchange, which would likely change the amount of traffic using adjacent interchanges. For Interchange Modification Studies, a complex reconfiguration may be coded more precisely or make other modifications to the network to better reflect the changes being evaluated. This can lead to some change in the model estimate of traffic using the interchange.

- **Where do models enter the process?**

  - **How do model results influence the final decisions?**

  - **Provide an example of where modeling information caused a plan modification**

  - **How do decision-makers use model results?**

  - **Do the data or model results support the conclusions of the board?**

  - **Does the MPO have a working relationship with the Board's technical committee?**

  - **Do models have uses other than the long-range plan?**

Model results do influence the decisions made for the TPlan. The most recent TPlan process is the first where funding played a major role in the project selection process due to an estimated $22 billion in needed transportation improvements but only $3.5 billion in funding. This funding shortfall caused the selection to be even more quantitative and reasonable model results become more important.

Model results have directly and indirectly contributed to modifications of the TPlan. An example of a direct influence of model results was the removal of light rail transit (LRT) in Columbus from the TPlan. The removal of the LRT was due, primarily, to failure to meet the cost effectiveness indices specified in Federal Transit Administration (FTA) requirements for Section 5309 New Starts funding. The cost effectiveness indices are directly dependent on ridership forecasts resulting from the travel model.

While the quantitative analysis outlined above is a way the TPlan is directly influenced by the model, the model can also have indirect influence on projects included in the plan. An example of the model's indirect influence the TPlan was the removal of a project to widen a two-lane road to a five-lane road in a community. Model results prepared during the preliminary engineering and EIS stage of the project showed that the roadway should be widened to five lanes to handle forecast traffic. However, the road went through a suburb where the community refused to allow the road to be widened to five lanes. Since funding for a road less than the required five lanes determined from the forecast traffic was not authorized, the project has not proceeded and thus was not included in the next TPlan update although it had previously been included in the TPlan. There are no specific instances of a project being removed from the TPlan due to the model results showing that the project is unnecessary. Those decisions are made earlier in the projection identification process.

The data and model results do indeed support the conclusions of the board, as a project generally has had some sort of study, including modeling, performed before it is considered for the TPlan. In this way, almost every project that is under consideration, whether it is included or not, has been justified through modeling. The board's technical committee does not typically examine modeling results, but information produced by the models can be presented with the CMP and state of the system information. It is at the special study level that traffic projections and model information are disseminated.

Modeling has traditionally been used for many aspects for all MPOs in Ohio, as stated above. MOPRC noted that, in particular, they were in the practice of using the model for special studies prior to the planning process, as well as projects such as highway design, where MORPC provides the modeled traffic volumes.

- **Other**

  - **What land use forecasting methods do you use?**
    - o **Model/what model?**
    - o **GIS/what software?**
    - o **Land use expert panel?**
    - o **Simple allocation model?**
    - o **Other?**
  - **Who are the major players in land use forecasting at regional level?**
  - **Who are the major players in land use allocation at TAZ level?**
  - **What questions do decision-makers ask?**

- **What is the level of knowledge about models among policy-makers?**
- **What is the public attitude about the analytical process?**
- **Does the state DOT request information on model results?**
- **Is modeling embraced or is it a requirement?**

Land use forecasting is performed using a GIS-based allocation model developed by MORPC, which allocates land uses to a quarter mile grid. The GIS-based model uses local communities' land use projections as input. Those projections are adjusted to match control totals specified by the State of Ohio. Accessibility is a factor in the GIS-based model, but the primary constraints are the availability of water and sewer. Land uses are further allocated to Transportation Analysis Zones (TAZs) using the GIS with a final review of the allocations by planning staff. Staffs from local communities then review and approve the TAZ-level forecasts prior to final adoption by the MPO.

The decision makers and policy makers typically do not interactively work with the modelers and the model results or ask questions about the models. One exception to this would be for specific controversial cases, but the interaction would be performed by a special group, rather than the board. The public attitude towards the analytical process is positive, as the public thinks there is a need for good data on which to base decisions. This includes traffic forecasts, costs, environmental impacts, and so on.

Modeling is embraced at MORPC, primarily due to the support of ODOT and the long history modeling has in the state.

■ Primary Challenges and Emerging Issues

Major Issues Interview Questions

- **What major issues are you facing now that your current model cannot address? What methods are you using now to address them? Would these issues lead you to make major improvement to your model (e.g., adopt an activity-based state-of-the-art model)?**

The major issue that central Ohio is facing is overall travel growth, as the region continues to grow rapidly. Many of the issues listed in the questions below are not applicable in the MORPC region; MORPC uses the model more for analysis of growth strategies and expansion of the transportation network rather than traffic operations and other congestion management strategies. Recent improvements to the MORPC models were driven primarily by desires to improve transit ridership forecasting procedures.

While the travel model is not currently used for traffic operations and other low cost congestion management strategies, this area of analysis would be of interest to MORPC in the future. One possibility for developing these analysis capabilities would be the integration of simulation-type components for the household trip patterns into the existing activity-based model. There are no plans for this enhancement to the model in the near term.

- **Can current models adequately address emerging issues?**

- Road pricing?

- Time-specific issues – e.g., parking, telecommuting, reversible lanes, HOV lanes?

- Improvements in traffic operations?

- Time dependent changes in speed and volume?

- Freight policies?

- Peak spreading and highly congested networks?

- Goods movement?

- Freight?

- Uncertainty in estimates?

- Dynamic conditions?

- Land Use scenarios?

By law, the Ohio Turnpike is the only tolled road in Ohio. This is not anticipated to change any time soon, so pricing has not been an issue considered by MORPC, although the model has the capability to examine tolls. This capability is incorporated through link attributes in the network, which are then fed back into the tour-based model.

The ability to examine time specific issues has explicitly been built into the tour-based model through the modeling of travel demand for each of 15 hourly periods (from 5:30 am to 11:30 pm). Since the model includes feedback loop into the tour generation phase of the model, trips are allowed to shift out of the peak hour(s). This modeling approach makes it possible to investigate time specific issues such as parking, telecommuting, reversible lanes, High Occupancy Vehicle (HOV) lanes; time dependent issues such as changes in travel speeds and volumes; and peak spreading issues in highly congested networks. The 15 hourly periods are aggregated to four periods for assignment (AM peak, Midday, PM peak, and Night). The tour-based model is currently validated only to average daily traffic (ADT), since insufficient time-of-day specific traffic counts are available for time-of-day model validation. Time-of-day count data are currently being collected so that time-of-day specific validations can be performed for either 2005 or 2010, which would allow MORPC to take advantage of these capabilities. The destination choice model does allow for trips to shift from the peak period to the off-peak period, due to three global iterations of the model system. The peak period has no peak-spreading process, but this can be incorporated in the future. A one hour peak within the peak period is assumed.

As discussed above, MORPC does not currently have a need or requests to model traffic operations although building these capabilities into a future version of the model is being considered. Dynamic traffic assignment is not an issue MORPC has been asked to address. If the region was more static region with respect to growth, traffic operations modeling and dynamic assignment might be more of an issue due to the need to optimize existing facilities. However, since the area is growing, the primary issues being considered relate to increasing capacity and adding new transportation facilities in the region, although special studies can be used to look at a particular corridor or project area.

Columbus is gaining large distribution centers which will impact travel in general. MORPC is interested in modeling goods movement, but feels that this is better handled at the state level, as freight modeling is looked at primarily for traffic volumes rather than special analysis for the

region. Currently the model has a truck component that is based on Quick Response Freight Manual (QRFM) methods. One improvement being considered is the extraction of truck trip tables from the statewide freight model anticipated to be completed by the end of 2008. The statewide freight model will include nine classes of trucks. The increase in large distribution centers in the region will increase the need to model goods movement mode choice. MORPC anticipates that improving the goods movement model for the region will require a major data collection effort. The design of an improved goods movement model and required data to estimate the model have not been thoroughly examined, and would be part of a long-range model improvement.

The land use scenarios are generated using a procedure model, but is reliant on the local communities' forecasts and how they fit into the regional control totals. For special studies, land use scenarios can go outside of the control totals in moderation, and then can be incorporated back into the long range plan.

Uncertainty in forecasts are handled by MORPC by documenting all assumptions, especially on the land use side. Whenever traffic assignment numbers are given, precise numbers are rounded to convey the uncertainties inherent in the numbers.

■ Support for Travel Forecasting Models

Management of the Modeling Process Interview Questions

- **What resources are allocated to modeling?**

- **Is there an ongoing data collection program?**

- **Is something in the work plan related to modeling?**

    – **Model development budget?**

    – **Data collection budget?**

    – **Model application budget?**

    – **Staffing structures?**

        o **Total transportation planners?**

        o **Travel forecasting model developers?**

        o **Travel forecasting model input data preparers (land use and network)?**

        o **Travel forecasting result users (those who will distribute the model results or postprocessing the results)?**

        o **Consultant's role?**

MORPC has about $2 million/year of PL funds, not including special projects. Of this budget, data staffing has about a $400,000-$500,000 budget for 4 full-time staff, and model assistance and maintenance has about $400,000 in its budget for 4 staff. The rest of the budget is divided into short range planning, which includes multi-modal planning, management and operations, and

safety planning, which has a about a $300,000 budget, the TIP budget, including implementation, transportation data, and models, which is about $500,000, and long range planning, including multi-modal planning, public service and involvement and is about $300,000. Major model updates are funded out of special studies. The past two to three years, approximately $60,000 additional has been allocated for the collection of traffic data. The general maintenance and core work is funded out of PL funds. The tour-based model was done using STP funds as a supplement, which was also done for the household travel survey.

MORPC receives support from ODOT in the form of software licenses and maintenance agreements, as well as working on an on-request basis for needs such as surveys.

- **Partnerships**

    - **What partnerships exist between the agency and:**
        o **The state DOT?**
        o **Local governments (including transit agency)?**
        o **Universities and other research institutions?**

- **How do other agencies use your model/do other agencies (both public and private) use your model for any applications?**

- **If yes, what process do you have to reconcile the changes made to the travel model by these agencies?**

MORPC has a close relationship with ODOT with regard to model support. They also have an informal relationship with Ohio State University (OSU) with close ties to the engineering department. The enhancement of MORPC's ties with OSU is an initiative of the Executive Director. MORPC is also closely associated with the Central Ohio Transportation Authority (COTA), the regional transit authority. MORPC performs the modeling required for the development of COTA's long range plan.

Due to its complexity, MORPC maintains tight control over who can run the model. Currently, the model can be run by ODOT and qualified, contracted consultants who can demonstrate a need for the entire model. For transit studies, the complete model has been provided to the (qualified) consultant. For highway studies and National Environmental Protection Act (NEPA) purposes, consultants request data (traffic projections, etc) from ODOT. The tour-based model has not been provided for any highway studies. Design counts are always adjusted from the modeled volumes. ODOT has developed a spreadsheet tool used to develop design volumes from the model results for projects.

Dublin, Ohio, a community within the MPO region, has developed a basic travel model for use in their community and for development of their comprehensive plan. Dublin has provided the data and zone structure to MORPC.

◼ Future Plan for Travel Forecasting Model Update

Motivation for the Major Model Update

- **What is the motivation for model updates in the short term?**

  - **New Starts application?**
  - **Conformity determination?**

- **What is the motivation for model updates in the longer term?**

  - **Traffic operations?**
  - **Conformity determination?**

- **Do you think your agency should have more than one model to address different Federal/regional requirements?**

  - **New Starts?**
  - **Conformity determination?**

The region just recently completed the development of the activity-/tour-based travel model. The motivations for this major update to the travel model have been covered in previous sections. However, the primary reason for updating the previous four-step model was the evaluation of light rail transit options for the region.

MORPC developed the tour-based model primarily to respond to New Starts requirements and to improve transit ridership forecasting procedures. The tour-based model is used exclusively over the previous four-step model, and so there is no need for other models.

Future Model

- **What model updates are underway or planned?**
- **What is the long-term plan for the models?**
- **Do you have any survey planned?**
  - **Household?**
  - **On-board?**
  - **Workplace?**
  - **External?**
  - **Special market?**
  - **Other?**

As described above, there is a desire to improve goods movement modeling for the region and, possibly, add more operations related modeling to the regional model. Several short-term updates to the regional model are planned. A 2005 validation of the model by time-of-day, most likely to the four time periods used for assignment (AM peak, midday, PM peak, and night) is planned. ODOT has requested that all regional travel models include network coding to the intersection level of detail, as the smaller models currently are using junction-level assignment. For long-term model improvements, MORPC would like to migrate the activity-based/tour-based model from Java to Cube scripts. This migration will be performed by segments to evaluate and assess the impacts of differences in run times.

A transit on-board survey is planned for 2008. The results of this survey will be used to update the mode choice equations in the activity-based/tour-based model.

- **Do you have plans to work with other agencies to take advantage of the passive data collection?**

  – **Collaboration with ...?**

ODOT currently has automated traffic data collection in place, as well as a research project using cell phone data to get speed data. MORPC will review the cell phone data but does not presently have plans to use those data. ODOT also has an ongoing work place survey; MORPC will have access to the results and should be able to use the data.

- **What help would MORPC like from FHWA?**

MORPC would be interested in any information regarding freight modeling, both from the data and the actual model perspective. Useful information would include items such as which commodities can be more readily switched to alternative modes, commodity mode shifts and mode use by distance, pricing data, estimated rail system capacity with a comparison to the road system capacity (for freight), information on the intermodal side of freight to compare to the highway, the impact of intermodal facilities on traffic, the impact of intermodal facilities on through trips, etc.

Appendix 4 – Response to Interview Questions – North Central Texas Council of Governments

Interview Date: March 18, 2008

Interview Location: NCTCOG Office, Arlington, Texas

Interview Attendees: Arash Mirzaei, Chad Edwards, Kathy Yu, Behruz Paschai (NCTCOG); Elizabeth Sall (Cambridge Systematics, Inc.)

Phone Call Date: May 15, 2008

Phone Call Attendees: Michael Morris, Arash Mirzaei (NCTCOG); Rob Ritter, Fred Ducca (FHWA); Elizabeth Sall (Cambridge Systematics, Inc.)

MPO Characteristics

Jurisdiction Area: 5,000

Jurisdiction Population: 5,067,000 (2000)

Number of Counties: 10

Model Characteristics

Model Area: 5,000 square miles (will be moving to 10,000 square miles)

Modeled Counties: Will be moving to 13 entire counties

Modeled Zones: 4,874 (will be expanding soon to about 6,000)

Modeled Links: 31,000 (without centroid connectors)

Modeled Nodes: 19,000 (without centroids)

Modeled Transit Lines: 584 (counting each direction)

Interview Discussion: A list of interview questions regarding the role of the travel forecasting models in the region's transportation planning process was sent to interviewees prior to the meeting. The remainder of this document lists the specific questions and then summarizes the responses to those questions. This document is a summary of the interview responses, not a transcript of the interview.

■ Travel Forecasting Model's Role in Transportation Planning Process

Travel Forecasting Model's Role in Your Transportation Planning Process Interview Questions

- Describe the Transportation Planning Process.

  – **What performance indicators are used in funding allocations?**

  – **Is the board/committee presented with modeling information, alternative forecasts?**

  – **Tell me the importance of modeling to the process?**

- Describe how projects enter the Long-Range Plan and TIP.

  – **Is there a rigorous rating process for projects in the Tip/how are TIP projects selected?**

  – **Is the process based on modeling?**

  – **Are models regularly used in EIS's?**

  – **Are models used with the interchange justification report? How do models evaluate interchanges?**

There are two long-range plans developed in Texas: a financially constrained long-range plan as required by Federal law, and a needs-based plan that shows TxDOT the funding shortfalls for transportation. The needs-based plan is very general and uses the units of "freeway lane-miles" to quantify the overall system capacity needed to climb out of a LOS F. NCTCOG has developed an automated process in TransCAD that identifies and places the extra needed capacity. The constrained long-range plan, the most recent is entitled "Mobility 2030," is a very detailed plan that prioritizes projects based on how they support three categories of goals: transportation, quality of life, and financial. Where appropriate, the NCTCOG model is used to evaluate the efficacy of projects or plans in fulfilling these goals. The specific goals of all three categories are listed below as specified by the introduction of Mobility 2030 (Source: Mobility 2030, NCTCOG, page 10).

- *Traditional transportation goals:*

  – *Enhance Mobility and Improve Access for the Movement of People and Goods;*

  – *Reduce Traffic Congestion and Improve Travel Times;*

  – *Develop a Balanced, Efficient, and Dependable Multimodal Transportation System that Reduces Demand for Single Occupant Vehicle Travel;*

  – *Support Management Strategies that Optimize Transportation System Performance through Technology and Innovation;*

  – *Improve the Safety of the Transportation System;*

  – *Provide Stronger, More Direct Linkages Between Project Planning, Funding, and Implementation by Designating a Metropolitan Transportation System;*

- *Support Local, Regional, Statewide, National, and International Intermodal Transportation Systems that Provide Mobility and Accessibility for the Movement of Freight; and*

- *Provide Meaningful Public Involvement Opportunities in the Transportation Plan Development Process.*

- *Quality-of-life goals:*

  - *Promote the Orderly Economic Development of the Region;*

  - *Encourage Balanced Land Use and Transportation Plans and Programs Which Maximize the Use of Transportation Investments;*

  - *Provide Transportation Opportunities to the Traditionally Underserved;*

  - *Encourage the Preservation and Revitalization of Communities and Neighborhoods;*

  - *Support Recreation and Tourism;*

  - *Encourage Transportation Investments that Promote Healthy and Active Lifestyles;*

  - *Avoid, Mitigate, and Enhance the Environmental Impacts of Transportation Improvements;*

  - *Reduce Energy Consumption; and*

  - *Improve Air Quality.*

- *Financial goals:*

  - *Identify and Actively Pursue Adequate, Long-Term, and Stable Sources for the Funding of Transportation Improvements;*

  - *Develop Cost-Effective Transportation Projects, Programs, and Policies Aimed at Reducing the Capital and Operating Costs of the Transportation System;*

  - *Prioritize Transportation Funds to Ensure the Maintenance of the Current and Future Transportation Systems; and*

  - *Preserve Rights-of-Way for Transportation Investments in Advance of Economic Development.*

The transportation planning process begins with a travel forecast for the future year with the current transportation system assumed. The first funding priority is maintenance of the current system. After the future transportation system needs are identified, projects that maximize the current transportation system efficiency are evaluated. These projects include congestion mitigation through transportation system management (TSM) and Travel Demand Management (TDM). Subsequently, additional transportation system needs are addressed as much as possible by rail system enhancements and expansion followed by projects that increase auto occupancy such as HOV and managed lanes. Projects that take care of the remaining single auto occupancy vehicles have the last funding priority.

NCTCOG considers projects for the Transportation Improvement Plan (TIP) based on a pool of projects submitted by local governments in response to a "Call for Projects." The Call for Projects is somewhat dependant on the type of funding available. Often some of the matching funds are tied to certain types of improvements such as local thoroughfares, air quality, etc.

To be entered into the TIP, the one overarching requirement is that they are in the Long-Range Transportation Plan (LRTP). Other rating criteria are dependant on the requirements and goals of the various Federal and state matching money pools (i.e., Congestion Mitigation and Air Quality, or CMAQ). The NCTCOG region is split by two Texas Department of Transportation (TxDOT) districts; therefore, some pools of money available to one side of the region may not be competing for the same pool of state matching money as the other side. Transit funding is allocated to the east or west sides of the region using a formula based on population and vehicle-miles of travel (VMT). Therefore, east side projects compete only with other east side projects for funding and likewise for the west side. Some rating criteria include the level of emissions, the total volume of the roadway, and mobility improvement.

Depending on the size of the project and the model's sensitivity to the rating criteria, the model is used to analyze projects. Most often, however, the qualifications of proposed projects are based on counts. If no counts are available the modeled volume is used. Full model runs are performed for very large projects for which the model should be reasonably sensitive. For traffic operations projects (i.e., a coordinated signal system for a corridor) the model volumes are used as an input to the operational analysis.

The model is used in Environmental Impact Statements (EIS) to help in scenario analysis. Output used for the EIS analyses include volumes, speeds, travel times, and congestion levels. For the environmental justice aspect of the EIS evaluation, the accessibility of various groups to employment is calculated based on travel times for highway and transit and compared across scenarios. An EIS for a roadway or transit project may take a long time and several updates to the mobility plan may occur in the meantime. At the same time, the project will change shape over time as available land is identified or avoidable impacts are uncovered. Therefore it is often necessary to rerun the model analysis several times as the EIS progresses – each time with the current versions of the project and the current mobility plan. The model provides objectivity for contentious projects and often has helped refine scenarios such as how many lanes are necessary.

Model results are used in the evaluation of interchanges. Each interchange ramp is coded directly into the model network from the Microstation engineering diagrams as an individual link.

- **Where do models enter the process?**

  – **How do model results influence the final decisions?**

  – **Provide an example of where modeling information caused a plan modification**

  – **How do decision-makers use model results?**

  – **Do the data or model results support the conclusions of the board?**

  – **Does the MPO have a working relationship with the Board's technical committee?**

  – **Do models have uses other than the long-range plan?**

The model influences the project rating of projects competing to be in the TIP to the extent that the rating criteria can be gleaned from the model. Often the model results have changed projects to show what the build-out for the project should be (i.e., how many lanes, what segment to build first). Decision-makers use model results as a means to support (or refute) contentious projects. The openness of the process and the model along with the continued and proven use of the model give it credibility.

Elected officials comprise NCTCOG's policy committee, the Regional Transportation Council (RTC), which is similar to a Transportation Advisory Committee (TAC). The RTC is comprised of representatives from each county as well as representatives from towns and cities. Each city is represented by 1 member per 200,000 residents (in some cases several clusters of cities that are smaller than 200,000 are represented by a shared representative). Other voting members include each transit agency, highway department, North Texas Tollways, and the DFW airport. The RTC has a technical subcommittee – the Surface Transportation Technical Committee (STTC) that is made up of over 50 transportation professionals in the region. Each member of the RTC must have a STTC participant. They are often transportation department directors from cities, counties, and transit agencies. The RTC has a separate technical subcommittee pertaining to goods movement. In order to facilitate cooperation of freight movement in the region, NCTCOG has invited the major players in the private freight industries (all Class I railroads as well as intermodal shippers) to be members of this subcommittee.

The STTC can request changes to the Mobility Plan and make recommendations to the RTC. The Mobility Plan is brought to the RTC over time and in pieces such as the roadway component and then the transit component. The technical issues are not discussed in detail at the RTC meetings but they may provide guidance in addressing certain types of criteria such as air quality. The RTC makes fewer changes to the Mobility Plan than the STTC. Often the weighting of the criteria to get into the plan are examined and negotiated to allow certain projects to move up to be included in the plan. The weighting and ranking of the projects must support the final approved Mobility Plan. The model results always support the conclusions of the RTC regarding the Mobility Plan through the rating and weighting criteria used to rank projects included in the plan. The MPO has a working relationship with the STTC, the regions technical committee, along with many other committees.

The model is used in various other activities other than development of the Mobility Plan, including environmental documents, air quality conformity, transit new starts, public-private partnerships on toll roads, TIP prioritization, corridor studies, and development impact analysis. Land use decisions generally result from negotiations but the model may be used to evaluate the impacts of various land use plans as well.

- **Other**

  - **What land use forecasting methods do you use?**
    - o **Model/what model?**
    - o **GIS/what software?**
    - o **Land use expert panel?**
    - o **Simple allocation model?**
    - o **Other?**

- **Who are the major players in land use forecasting at regional level?**

- **Who are the major players in land use allocation at TAZ level?**

- **What questions do decision-makers ask?**

- **What is the level of knowledge about models among policy-makers?**

- **What is the public attitude about the analytical process?**

- **Does the state DOT request information on model results?**

- **Is modeling embraced or is it a requirement?**

NCTCOG uses DRAM/EMPAL as their general land use model. The base-year land use forecasts are tied to a sophisticated building permit database that includes geographic referencing. The files for each local jurisdiction are sent to them for review and comment.

Some of the primary questions that decision-makers ask NCTCOG are in reference to congestion pricing and toll roads. Specifically they are interested in different user class tolls by type of car or type of occupancy. They also are increasingly interested in the effect of land use on transportation and the effects of transit-oriented developments. For example, does building a giant road to a small community increase the population because of the increased accessibility to employment or decrease the population because people move out? Decision-makers also are interested in robust cost-benefit analysis for specific projects.

Policy-makers have varying levels of interest in the technical aspects of the model. In cases where policy-makers are especially interested, such as toll roads, NCTCOG presents classes for them to learn about how the model works. NCTCOG has, at times, used consultants to help explain answers to difficult policy-maker questions. Overall, the policy-makers are good at making regional decisions and stay away from only looking out for the good of their sole local community. Because of the long history of its use in the planning process and the openness of the process, model results are held in high regard. Additionally, NCTCOG does not put itself in the position of using the model to answer questions it is not designed to answer. Occasionally consultants produce conflicting model results to those obtained NCTCOG. However, the disputes are often a results of the validity of the input data (i.e., alternative versus "official" land use forecasts) and not the technical underpinnings on the model itself.

TxDOT uses the NCTCOG model for their own projects, mostly EISs.

Modeling is embraced for the TIP as an objective tool for project prioritization. However, since the area is in nonattainment for air quality. As a result, there are additional analyses and uses of the model results.

■ Primary Challenges and Emerging Issues

Major Issues Interview Questions

- **What major issues are you facing now that your current model cannot address? What methods are you using now to address them? Would these issues lead you to**

make major improvement to your model (e.g., adopt an activity-based state-of-the-art model)?

- **Can current models adequately address emerging issues?**

  - **Road pricing?**
  - **Time-specific issues – e.g., parking, telecommuting, reversible lanes, HOV lanes?**
  - **Improvements in traffic operations?**
  - **Time dependent changes in speed and volume?**
  - **Freight policies?**
  - **Peak spreading and highly congested networks?**
  - **Goods movement?**
  - **Freight?**
  - **Uncertainty in estimates?**
  - **Dynamic conditions?**
  - **Land Use scenarios?**

The model addresses tolling only in the traffic assignment step. NCTCOG is satisfied with results of the process for static pricing analyses. However, dynamic pricing conditions cannot be adequately modeled. The model does not address parking.

Telecommuting is only addressed in the sense that the home-based work trip generation rates estimated using the household survey data were affected.

Reversible lanes can be addressed by the model as long as they are constant for an entire time period. Separate AM and PM assignments allow this to be feasible. HOV lanes are in the model as a part of the mode choice decision.

Air quality emissions are separated into 26 time periods a day based on the AM, OP, and PM outputs. Texas Commission on Environmental Quality (TCEQ) performs detailed air quality modeling. Inputs for the detailed air quality modeling include travel model results factored to represent different days of the week based on automatic traffic recorder (ATR) data. The ATR data are stratified by county, day-of-week, time-of-day, and area type.

At the moment NCTCOG only has a link-based delay in the assignment process. A host of post processing tools are used to model improvement in traffic operations in order to give the TCEQ the information it needs to evaluate the impacts of operational strategies on air quality. There are no functions in the model that allow transit priority but in the future they may use separate parameters in the VDF for buses.

Time-dependent changes in speeds can be modeled if the changes are constant for an entire time period. Peak spreading is dealt with tangentially by assigning minimum values for link times. The ATR data suggest, however, that NCTCOG's modeling of a 2.5-hour AM peak period and 3.5-hour PM peak period encompass the peaks of the network. Actual peak flows occur at different times for different parts of the network. To account for this, NCTCOG does not provide all of the available

capacity for the period in the assignment process. Additionally truck data show that trucks have a different peaking patterns and sensitivities to congestion. While peak spreading is a concern for NCTCOG, their primary focus is on having a good network. Dynamic assignment within a time period cannot be addressed in the current NCTCOG model.

NCTCOG does not have a freight model, but they do have a truck model. So far, the existing truck model has been sufficient for responding to questions. At present, there are no policy-makers requesting information about specific commodities or commodity movements. However, NCTCOG would eventually like to move to a freight model rather than just a truck model.

The model is used to create a log-sum-based accessibility measure that is converted to in-vehicle travel time and fed into the DRAM/EMPAL land use model. These accessibilities are created for both the base and base-plus-five-year networks and are used to calibrate the land use model.

Some sensitivity analysis is performed for different land use scenarios but the uncertainty in the model forecasts is never quantified all the way through the modeling process. However, it is generally acknowledged that the validity of results for specific links and local bus lines is very loose considering there are 12,000 links and hundreds of bus lines over a very widespread area. NCTCOG also acknowledges that the validation data have high degrees of variation, particularly for collectors.

■ Support for Travel Forecasting Models

Management of the Modeling Process Interview Questions

- **What resources are allocated to modeling?**

- **Is there an ongoing data collection program?**

- **Is something in the work plan related to modeling?**

  - **Model development budget?**
  - **Data collection budget?**
  - **Model application budget?**
  - **Staffing structures?**
    - o **Total transportation planners?**
    - o **Travel forecasting model developers?**
    - o **Travel forecasting model input data preparers (land use and network)?**
    - o **Travel forecasting result users (those who will distribute the model results or postprocessing the results)?**
    - o **Consultant's role?**

The total five-year model development budget is $7 million, $5 million of which goes towards data collection. Approximately 50 to 60 percent of the planning department staff time is devoted to applying the model, or about $800,000 a year. TransCAD training costs are included in that budget but training costs are kept down by having Caliper hold on-site training. Sometimes the department's revenue is increased by acting like a consultant to some CDAs. However, most of the model runs for other agencies such as the Dallas Area Rapid Transit Authority (DART), the Tarrant County Transit Authority (the T), or the Denton County Transit Authority (DCTA) are included as a part of the department's Unified Planning Work Program (UPWP) budget. If the UPWP funds budgeted for a specific fiscal year are not expended they can be carried over to the next fiscal year. However, work is coordinated between cities and counties to match UPWP model application budgets match needs on an annual basis.

The Information Technology (IT) budget for all of NCTCOG is approximately $1.75 million per year for all computers and software licenses. NCTCOG's on-site TransCAD lab has 12 high-powered computers. NCTCOG has 40 TransCAD licenses that cost $30,000 per year (for maintenance fees). The IT department also maintains a $200,000 server and a contract for off-site storage where every model run is stored. The IT department has four staff members, including two staff devoted to GIS. The high-end lab computers are recycled as personal desktops for each office. With the anticipated zone system increase to about 6,000 zones over the next few years, NCTCOG is considering acquisition of more powerful computers in order to keep computer application time for a model run to less than a day. NCTCOG currently is testing the performance of computers that cost about $12,000.

Six NCTCOG staff is dedicated to model development and maintenance. Four staff are dedicated to network coding although six to eight have the capability. Two NCTCOG employees are responsible for preparing the land use inputs into the model. Approximately 25 people in the planning department have the capability to apply the travel model and some have the ability to modify the implementation code. Consultants are used for all data collection efforts and training efforts to enhance the technical capability of the model development staff. NCTCOG has found that the keys to retaining skilled model estimator and model programmer staff in a public agency are providing meaningful model estimation and programming tasks and removing their salaries from the constraints imposed by Planning Department pay scales. Each member of the six-person model development staff has a Master's degree or Ph.D. and programming skills. Creating a work environment that results in low staff turn-over allows for timely completion of projects, efficient model applications, and provides time to work on cutting-edge projects.

- **Partnerships**

    - **What partnerships exist between the agency and:**
        o **The state DOT?**
        o **Local governments (including transit agency)?**
        o **Universities and other research institutions?**

- **How do other agencies use your model/do other agencies (both public and private) use your model for any applications?**

- **If yes, what process do you have to reconcile the changes made to the travel model by these agencies?**

TxDOT has a smaller role in model development and oversight for NCTCOG compared to other MPOs in the State due to some hard fought battles and strong internal agency support and dedication. NCTCOG fills a consultant role to TxDOT if they need a model run for studies such as an EIS or MIS. Support to local transit agencies Dart, T, and DCTA is included in the UPWP and also local cities receive technical assistance from NCTCOG staff. Assistance to consultants is provided at no charge provided they are working for a local agency. However, NCTCOG staff time is charged if the consultant is working for a CDA. These requests are most often processed by the Transportation Planning group. The model development group gets involved only if changes are required to the modeling process or output summaries.

NCTCOG has a strong partnership with University of Texas at Austin (UT-Austin), particularly from Dr. Kockelman regarding land use models and Dr. Bhat regarding activity-based models. In total, $170,000 per year has been allocated to model research at UT-Austin and another $170,000 per year has been allocated to land use research. The work scope and tasks are coordinated with the long-range plan.

The model source code it tightly controlled; only the six staff members in the model development department of NCTCOG are allowed to make changes to the source code. However, NCTCOG fully documents their model so anyone with the technical modeling skills could recreate the model and modify it to suit their needs. When model modifications are requested, they are assessed and, if appropriate, processed by the model development department.

At the present time, there are no subcounty or city models competing with the NCTCOG model. Some special projects require model modifications that, in effect, produce project-specific models. For example, the FHWA Integrated Corridor Management research project required the development of a focused model for subarea analysis.

◼ Future Plan for Travel Forecasting Model Update

Motivation for the Major Model Update

- **What is the motivation for model updates in the short term?**

  – **New Starts application?**

  – **Conformity determination?**

- **What is the motivation for model updates in the longer term?**

  – **Traffic operations?**

  – **Conformity determination?**

- **Do you think your agency should have more than one model to address different Federal/regional requirements?**

  – **New Starts?**

  – **Conformity determination?**

Motivations for improvements in NCTCOGs model are driven either by an increased need for efficiency and quality control and by the types of policy questions that are being asked. It is NCTCOG's opinion that model improvements should be led by what is being asked from the model, not vise-versa.

Future Model

- **What model updates are underway or planned?**

- **What is the long-term plan for the models?**

- **Do you have any survey planned?**

  - **Household?**

  - **On-board?**

  - **Workplace?**

  - **External?**

  - **Special market?**

  - **Other?**

- **Do you have plans to work with other agencies to take advantage of the passive data collection?**

  - **Collaboration with …?**

NCTCOG's last household survey was performed in 1996. Household surveys have generally been collected about every 10 years; current plans are to collect a new household survey in 2009. DART collected an on-board survey in 2007 and the T will collect an on-board survey in 2008. TxDOT collected an external origin-destination survey in 2005. External surveys are typically collected about every 10 years. A workplace survey was last performed in 1994 so a new workplace survey may be warranted. Depending on the results of the 2009 household survey, another airport survey may be performed. The last airport survey was performed in 2001. Toll road agencies and consultants perform a variety of stated-preference surveys and speed and count data collection. Travel time runs are performed for about 100 arterial corridors of eight to nine miles each. Count data from ATRs are available and TxDOT performs "saturation" traffic counts every five years. The last major TxDOT traffic count effort was in 2004. TxDOT also uses ITS devices to monitor speeds, travel times, and perform traffic counts.

- **What help would NCTCOG like from FHWA?**

NCTCOG believes that FHWA should continue to help advance analytical tools as they currently are doing. NCTCOG is a big believer in technology transfer and supports FHWAs work on this. Additional things that NCTCOG believes FHWA can help with include issuing quality control manuals on travel modeling and data collection methods, development of English-speaking travel modelers, and a travel model professional certification program. NCTCOG also feels as though some of the FHWA requirements are redundant and/or meaningless (i.e., air quality analysis is required at the system and project level).

In order to demonstrate funding shortfalls, NCTCOG suggests that needs-based planning would be an appropriate requirement for the next legislation. NCTCOG also believes that University Transportation Centers should be held accountable and to high standards that are comparable with the level of funding they are receiving.

Appendix 5 – Response to Interview Questions
Puget Sound Regional Council

Interview Date: March 24, 2008

Interview Location: PSRC Office, Seattle, Washington

Interview Attendees: Maren Outwater, Chris Johnson, Larry Blain, Charlie Howard
                          (PSRC); Rob Ritter, Fred Ducca (FHWA); Elizabeth Sall
                          (Cambridge Systematics, Inc.)

MPO Characteristics

Jurisdiction Area: 6,400 square miles

Jurisdiction Population: 3,275,857 (2000)

Number of Counties: 4

Model Characteristics

Model Area:

Modeled Counties: King, Pierce, Snohomish, and Kitsap Counties

Modeled Zones:

Modeled Links:

Modeled Nodes:

Modeled Transit Lines:

Interview Discussion: A list of interview questions regarding the role of the travel
                          forecasting models in the region's transportation planning
                          process was sent to interviewees prior to the meeting. The
                          remainder of this document lists the specific questions and then
                          summarizes the responses to those questions. This document is a
                          summary of the interview responses, not a transcript of the
                          interview.

■ Travel Forecasting Model's Role in Transportation Planning Process

Travel Forecasting Model's Role in Your Transportation Planning Process Interview Questions

- **Describe the Transportation Planning Process.**

    – **What performance indicators are used in funding allocations?**

    – **Is the board/committee presented with modeling information, alternative forecasts?**

    – **Tell me the importance of modeling to the process?**

A Washington State regulation in the 1990s mandated that the transportation plan must be based on a "least-cost planning methodology", which PSRC interprets as benefit cost ratios. A post-processor to the PSRC model directly outputs benefit cost ratios for scenarios. Benefit cost analysis covers about half of the regional measures used to compare projects (i.e. travel time and reliability savings, capital, operations, and maintenance costs, accident costs, and equity). Other measures, include:

- *Consistency of project-influenced growth compared to the approved growth vision;*

- *Effect on the environment (i.e. green house gases, CO2, air quality conformity (PSRC been in AQ maintenance))*

- *Effect on quality of life, including safety, health, and security (i.e. walk and bike miles traveled or redundancy of the system)*

- *Economic prosperity (i.e. will the transportation system improve our competitiveness as a region)*

Each project is ranked by multiplying a measure by its assigned weight and comparing its score to other project.

PSRC has two policy boards: one for growth and one for transportation. The boards are presented with a general description of model modifications as well as summarized model output of whichever measures of effectiveness are most appropriate for the decision at hand. This is usually a combination of maps and tables summarizing things such as tolling, traffic, freight, travel time savings, VMT, or transit ridership. The detail of results varies based on the topic. Results for various scenarios are presented alongside a baseline scenario.

The PSRC model is an integral part of PSRC's project ranking process. The benefit cost post-processor is a direct output of the PSRC model and the other measures listed above are outputs from the travel model or are based on travel or land use model outputs.

- **Describe how projects enter the Long-Range Plan and TIP.**

  – **Is there a rigorous rating process for projects in the Tip/how are TIP projects selected?**

  – **Is the process based on modeling?**

  – **Are models regularly used in EIS's?**

  – **Are models used with the interchange justification report?   How do models evaluate interchanges?**

The first step for project construction is to be included in the long range transportation plan. Projects progress from being unprogrammed parts of the plan (needed, but with no identified funding) to programmed. There are two types of programmed projects: candidate and approved. Candidate projects have a sponsor identified and approved projects have an identified funding source and completed environmental work. Only approved projects are eligible to be included in the TIP for construction. However, the TIP can include studies for projects that have not yet been approved.

The long-range plan is the result of evaluating the regional impacts of 4-5 alternatives through the state environmental process. The scenarios are populated with project ideas from Washington State DOT, individual counties and cities, Sound Transit, and by PSRC programs aiming for specific strategies such as demand management and pricing. The individual projects are evaluated based on their impact on the entire PSRC system. All the analysis is done based on regional performance data and the PSRC travel demand model is used wherever applicable. While most projects use the regional PSRC model, some projects, like transit, use other methods. Sound Transit, for example, has its own direct-demand model that can be used to evaluate transit projects with better route-level accuracy than the PSRC model.

Not only is the PSRC model used in project-level EIS's, but the entire transportation plan must pass through an EIS process as mandated by Washington State.

Interchanges in the PSRC region are justified by Washington State DOT or the supporting local jurisdiction using traffic microsimulation models. However, these traffic microsimulation models are often fed data and information from the PSRC regional demand model.

- **Where do models enter the process?**

  – **How do model results influence the final decisions?**

  – **Provide an example of where modeling information caused a plan modification**

  – **How do decision-makers use model results?**

  – **Do the data or model results support the conclusions of the board?**

  – **Does the MPO have a working relationship with the Board's technical committee?**

  – **Do models have uses other than the long-range plan?**

The long-range transportation plan scenario analysis and TIP project ranking use direct outputs form the modeling process. Therefore, the PSRC model has a direct impact on project ranking and approval.

Results from the PSRC model have demonstrated the practicality of pricing as a reasonable alternative to unsuccessfully trying to build their way out of congestion while at the same time generative revenue. Another example where model output influenced a project was the 405 corridor. In this case, model output was used to refine the project to get the biggest "bang for the buck" for the available funds. This strategy also was used on a widening project on 167 south of 405 where the programming for construction was phased to widen key areas first – all the analysis done using the regional travel demand model.

Decision-makers often use model results to evaluate the potential impacts of their decisions. If a board member is interested in the data presented to them, PSRC will often repackage it for them in a form that is more geographically focused to the decision-maker's local jurisdiction in order to present the information to their constituents.

PSRC only has authority to rank and select projects that use Federal funds, (such as STP, CMAQ, some FTA) which comprises only 6 percent of the total value of the TIP. PSRC only has veto-authority over Federal interstate maintenance projects. The state also has the authority to rank and select projects as well as SOUND Transit with their local sales tax. However, these projects must all still be in the long-range transportation plan. In some cases, some projects will receive funding without being in the plan. This most often occurs in the case of congressional earmarks. In some cases a plan amendment has been adopted in order to allow these projects to move forward. However, PSRC would not likely approve a project (such as a circumferential freeway) to be in the plan if it was inconsistent with the regional goals and vision.

PSRC has one technical committee that deals with all data issues as well as modeling. There are two subcommittees related to modeling: one on land use and one on travel modeling. The MPO hosts the meetings of the technical committee but it is self-run. There is a two-way working relationship between PSRC and the technical committees. Some feedback from the technical committees is used for model development and sometimes PSRC asks for suggestions for improvements or feedback on the potential usefulness of proposed improvements.

While PSRC's model is not used in transit service planning or FTA New Starts Analysis, it is used for things other than the long-range plan. In addition to other nationally required analysis such as air quality conformity, it is used to satisfy state requirements such as environmental impact analysis of the long-range plan and other major investments. PSRC also uses its model extensively in land use policy development.

- **Other**

  - **What land use forecasting methods do you use?**
    - ○ **Model/what model?**
    - ○ **GIS/what software?**
    - ○ **Land use expert panel?**
    - ○ **Simple allocation model?**

- o **Other?**
  - **Who are the major players in land use forecasting at regional level?**
  - **Who are the major players in land use allocation at TAZ level?**
  - **What questions do decision-makers ask?**
  - **What is the level of knowledge about models among policy-makers?**
  - **What is the public attitude about the analytical process?**
  - **Does the state DOT request information on model results?**
  - **Is modeling embraced or is it a requirement?**

PSRC uses the Puget Sound Economic Forecaster (PSEF) to develop annual regional control totals for land use. PSEF uses national and international economic data as inputs. In the past, the PSEF control totals fed a DRAM\EMPAL model. This year PSRC will begin using their UrbanSim model, which has been in development phase for four years, 1.5 years of which was gathering data. The PSRC application of UrbanSim is parcel-based and works in one-year increments, with travel model integration at five-year increments. The parcel output can be aggregated up to the TAZ level. In the near future, UrbanSim will be linked to an ESRI GeoDatabase. In terms of the resources that UrbanSim required, PSRC found the estimation process relatively easy and automated once the initial data collection was done. Aside from the initial data collection, they do not feel that UrbanSim requires more data than the travel model. They also acknowledged that they were the guinea pigs for UrbanSim and that it would be faster and easier for anybody else to implement. There is a users group of MPOs that use UrbanSim so that the lessons learned at PSRC are transmitted to others.

PSRC uses their land use model to test the transportation plan to see if the transportation plan supports the agreed upon land use vision policy. The land use vision policy has an up-front agreement for cooperation – local jurisdiction's comprehensive plans must be certified by PSRC, forcing the local plans to be consistent with the regional vision. Under law (The Growth Management Act), local jurisdictions must make local zoning laws consistent with their comprehensive plans.

PSRC's investment in land use modeling was driven by the questions being asked by decision-makers as well as in response to state laws. Land use in the Puget Sound region is viewed as much a part of the solution as any transportation aspect. They need to be able to demonstrate to officials that the proposed policies to arrive at the "Vision" land use actually produce the vision land use in an efficient manner.

Most of the recent and planned model improvements have been in response to questions decision-makers ask and policies they implement. These include questions regarding climate change and alternatives to traditional capacity increases such as efficiencies gained through land use changes and pricing.

The level of knowledge of the policy-makers is higher in this region than average. Policy-makers are aware that they don't know the technical workings of the model. However, they trust the technical committees. Presentations to policy-makers are developed such that the technical underpinnings are there but presented so the policy-makers understand. They have a healthy respect for the

technical work and have a reasonable understanding because of the time they take to ask questions. The direct knowledge and involvement of decision-makers and the public with the model was not discussed in detail. However, they acknowledged that their decision-makers were understanding of continued improvements providing a continuum of results. Their take on this was that a stagnant model that is not continuously improved with state-of-the-art practices is susceptible to attack. Since they base all of their decision on model output, they want the model to be continuously improved.

PSRC enjoys a very vibrant public. The public attitude is fairly respectful and very involved. For the recently adopted VISION plan for growth management they had approximately 2000 comments from the public – all of which were responded to.

Washington State DOT are actively engaged in running the PSRC model and share their model results with PSRC just as often as PSRC shares results with them. The State and PSRC have a strong working relationship and work on some projects collaboratively.

Modeling (both land use and transportation) is embraced as the key analytical tool to justify investments.

■ Primary Challenges and Emerging Issues

Major Issues Interview Questions

- **What major issues are you facing now that your current model cannot address? What methods are you using now to address them? Would these issues lead you to make major improvement to your model (e.g., adopt an activity-based state-of-the-art model)?**

PSRC has adopted many short-term solutions to answering increasingly complex policy questions. In the long-term, PSRC is working towards a fully integrated land use and activity-based model with dynamic operational analysis capability and next generation air quality model that will be able to address most of their questions. The board directed PSRC to focus on addressing two issues: pricing and climate change and PSRC has proceeded with making short-term model improvements to address these issues. Please see the section on motivation for model improvement for a more detailed discussion.

- **Can current models adequately address emerging issues?**

  - **Road pricing?**

The new activity-based model will be able to address road pricing in a more comprehensive manner, including changes to trip chaining in response to pricing policies. At present, PSRC has a time-of-day model that is sensitive to peak spreading, which was funded by WSDOT and has a multi-user class assignment for four income groups to allow for variations in the value of time. PSRC feels like it does a good job addressing pricing compared to the rest of the country.

- **Time-specific issues – e.g., parking, telecommuting, reversible lanes, HOV lanes?**

PSRC has a time-of-day model that is sensitive to speak spreading.

There are five time periods in the model so anything that varies across but not within these time periods can be captured in the model, including reversible lanes and HOV lanes.

Telecommuting will be addressed in two manners. Regular telecommuting will be treated as a workplace location in the workplace location model. Occasional or semiregular telecommuting will be addressed in the activity generator.

Parking cost is stratified by trip purpose (work and non-work) but is based on simple relationships and is a place for needed improvement in the PSRC model.

- **Improvements in traffic operations?**

The PSRC model can handle some, but not all, increases in capacity due to operational strategies. Eventually, PSRC plans to address most of these issues through dynamic traffic assignment. In the interim, they improved their static assignment be introducing some variables for reliability on freeways and increasing the accuracy of signalized delay on arterials.

- **Time dependent changes in speed and volume?**

This can be addressed across the five time periods that have traffic assignments.

- **Freight policies?**

- **Peak spreading and highly congested networks?**

Peak spreading is addressed by the time-of-day choice model that models the shoulder peaks as well as half-hour time segments in the peaks.

PSRC believes that they are not correctly addressing highly congested networks and that DTA is the real solution to this issue. In the interim, the activity generator is responsive to levels-of-service and staying at home should the network be overly congested will be an option in the model.

- **Goods movement?**

- **Freight?**

PSRC has plans to overhaul their goods movement model after a statewide commodity flow survey to be completed next year (2009).

Presently, PSRC uses a hybrid approach to modeling freight. Goods movement into, out, and through the PSRC region is modeled by commodity from TRANSEARCH data. This is supplemented by a local truck model that includes special generators such as ports, which enter the model as static numbers of trucks based on information the port gives. The port is concerned about land side capacity. The benefit cost analysis post processor is set up to evaluate freight separately. PSRC also evaluates port-associated emissions based on truck VMT.

- **Uncertainty in estimates?**

PSRC focuses on comparative analysis instead of absolute baseline forecasts, thus dampening the importance of absolute accuracy in magnitudes. Although they do not produce a range of answers,

they may start doing this when the activity model is implemented (since it is a simulation). However, they feel that ranges don't provide much more information since the focus is always on the high numbers.

Another method that PSRC employs to defray the focus of absolute numbers is by making the forecast year more ambiguous when discussing forecasts with the public. They emphasize the variability in the timing of when you get to these conditions instead of the actual year that these numbers will occur.

– **Dynamic conditions?**

These are addressed in the time-specific issues.

– **Land Use scenarios?**

A baseline land use scenario is developed based on a "do nothing" alternative. Subsequently, a series of land use policies are tested to come up with a VISION land use. The VISION land use is not hard coded, but is dynamic and responsive to the policies and the transportation system. Thus, the land use scenario changes every time the transportation system changes.

PSRC is about to start using their UrbanSim model, which provides credibility to their land use policies and helps evaluate the impact of various transportation plans versus the VISION plan.

See the land use forecasting section for more details.

■ Support for Travel Forecasting Models

Management of the Modeling Process Interview Questions

- **What resources are allocated to modeling?**

- **Is there an ongoing data collection program?**

- **Is something in the work plan related to modeling?**

    – **Model development budget?**
    – **Data collection budget?**
    – **Model application budget?**
    – **Staffing structures?**
        o **Total transportation planners?**
        o **Travel forecasting model developers?**
        o **Travel forecasting model input data preparers (land use and network)?**
        o **Travel forecasting result users (those who will distribute the model results or post-processing the results)?**
        o **Consultant's role?**

The entire budget for Data Systems and Analysis is $6.5 million every two years, $1.8 million of which is dedicated to model development. This is represented by 22 technical staff. Annually, in addition to $900,000 spent of model development, approximately $700,000 is spent on data preparation and analysis and $1.3 million on model application. Every 5 to 10 years PSRC conducts a household survey, which costs approximately $1 million. Half of the 2006 survey was paid for by the state DOT transit mobility funds, thus a subsample focused on transit and pricing. Annual consultant budgets usually range from $200,000 to $300,000 and are used only for specialized work, including activity generator estimation. In the past, PSRC has contracted with University of Washington to do UrbanSim development for approximately $300,000 a year. Computer resources are a separate part of the budget.

With the exception of hiring a staff that will be able to estimate discrete choice models and review the activity model work done by consultants, PSRC things thinks that after an initial learning phase the resources required for advanced models will be the same. Most of the cost of moving to an activity-based model already was paid for by implementing UrbanSim. UrbanSim is run by two people full-time and two other staff spend about 20 percent of their time on it. However, they feel that moving to dynamic traffic assignment would require a lot more resources both in terms of staff requirements but also computing resources.

The transportation planning department has 21 technical staff, growth management has an additional 6 staff and economic development has 5 staff.

- **Partnerships**

  – **What partnerships exist between the agency and:**
    o **The state DOT?**
    o **Local governments (including transit agency)?**
    o **Universities and other research institutions?**

- **How do other agencies use your model/do other agencies (both public and private) use your model for any applications?**

- **If yes, what process do you have to reconcile the changes made to the travel model by these agencies?**

Many local agencies and consultants as well as the Washington State DOT all have copies of the PSRC model. Local agencies often add detail to the model and have the ability to make other changes to the model if they wanted. The City of Seattle refined the trip generation rates for Seattle using the Seattle survey records from the PSRC surveys. The City of Bellevue used the PSRC survey to develop its own Trip Generation and Trip Distribution parameters. There is no formal requirement or process for PSRC to formally review the changes; however most local agencies present what they have done in the collaborative exchange facilitated by regular user group meetings. The Model Users Group (MUG) consists of both public and private model users, is hosted by PSRC, and meets every month. The Land Use Technical Advisory Committee (LUTAC) consists of public agency staff and is hosted by PSRC on a semi-regular basis. PSRC as a group decides what changes to implement. PSRC started a versioning process last year and plan to release a new version every year, with mid-year updates released as necessary.

SOUND Transit, however, has their own, separate direct demand model. The SOUND Transit model pivots off of existing ridership data; however, they rely on the mode choice coefficients developed by PSRC. SOUND Transit has used their model for New Starts and they will continue to have their own separate model due to the relatively shorter timeframe they are interested in (usually a six-year plan). While the two models will not be consolidated, an effort is underway to better align the two models moving forward.

Washington State DOT is a strong partner and is activity engaged in contributing both with money and ideas. However, there is no statewide model to integrate with.

The University of Washington has partnered with PSRC on isolated research projects. In addition, Paul Waddell, a professor at the Evans School and head of the Center for Urban Simulation and Policy Analysis (CUSPA) is an associate member of the regional council. PSRC benefits from a lot of his work and is still the test bed for a lot of his development work.

■ Future Plan for Travel Forecasting Model Update

Motivation for the Major Model Update

- **What is the motivation for model updates in the short term?**

  - **New Starts application?**

  - **Conformity determination?**

- **What is the motivation for model updates in the longer term?**

  - **Traffic operations?**

  - **Conformity determination?**

- **Do you think your agency should have more than one model to address different Federal/regional requirements?**

  - **New Starts?**

  - **Conformity determination?**

Climate change and pricing motivate most of PSRC's model improvements. Since VMT and speed are the major inputs to most air quality models, PSRC has focused on giving these further credibility both in terms of regional totals as well as where the emissions are coming from in order to craft more effective mitigation policies and do equity analysis. In the short term, PSRC is making improvements to both freeway and arterial congested speed calculations and estimating activity tours to capture trip chaining. In the long term, they are estimating a full-scale activity-based model that will output more credible disaggregate results and possibly doing dynamic traffic assignment. Improvements related to pricing include an update of the values of time based on survey data, a LOS-responsive time-of-day model, and more realistic calculations of congested travel times.

It is PSRC's view, that not continuously changing their model to be state-of-the-art, leaves them open to criticism that they have not incorporated all the latest available research and technology.

PSRC does not think that it needs more than one model for long-range planning, however, a separate model, run by SOUND Transit, does all the New Starts forecasting and short-range transit planning.

Future Model

- **What model updates are underway or planned?**

- **What is the long-term plan for the models?**

- **Do you have any survey planned?**

    - **Household?**

    - **On-board?**

    - **Workplace?**

    - **External?**

    - **Special market?**

    - **Other?**

- **Do you have plans to work with other agencies to take advantage of the passive data collection?**

    - **Collaboration with ...?**

Several short-term model improvements have been implemented for the next transportation plan update that will occur this summer. The two major improvements are a household synthesizer, a tour generator. A workplace location choice model has been implemented within PSRC's UrbanSim application. This serves as an anchor to the work tour generation. Other improvements include a mode choice model stratified by walk and drive access and then stratified by 10 separate modes, the addition of urban form measures to the pedestrian and bicycle part of the mode choice model, and a traffic assignment overhaul. The purpose of the traffic assignment improvements was to improve validation to observed speeds, thus increasing the accuracy of the air quality modeling. These improvements included the addition of a stock-market analysis-based unreliability factor for freeways that has its greatest effect at 50 mph and improving the accuracy of the delay at arterial intersections in order to have the capability to reflect coordinated signals. PSRC also recently evaluated and updated their values of time assumptions based on an 18-month GPS study survey (Traffic Choices Study).

In the long term, PSRC plans to implement a full-scale activity-based model and will consider dynamic traffic assignment when the software gets there is improved. They also realize their need for a finer grained zone system and plan to expand from 948 to approximately 2000-4,000 zones in order to take full advantage of the activity-based model.

PSRC conducts household surveys every 5-10 years. The most recent household survey was conducted in 2006 and had a 220 household GPS component and an additional stated preference component with 916 households. Employment surveys are conducted biannually to supplement employment security commission data. The City of Bellevue conducts workplace surveys. Off-street parking surveys are also done every two years. Three-day traffic counts are done along screenlines. Sound transit is in the process of organizing a new on-board survey and is trying to get other operators to do it at the same time. Several special surveys are conducted including a ferry market OD survey and a port passenger survey. A Commute Trip Reduction Survey collected data on commute mode and the household's zip code. Washington DOT conducts several one-time surveys. In the past this has been for things like bike trips. They also fund major OD surveys on through trips and along interstate corridors. National data such as NHTS is not a need, but PSRC uses it because it is there.

- **What help would PSRC like from FHWA?**

PSRC feels that targeted research is quite helpful. Some examples of research that would be helpful to them include the value of time for freight, impacts from changes in auto operating costs.

The Federal government can be a helpful facilitator of information sharing. AMPO and ASHTO have been calling for an "inventory of knowledge" and are asking each participating MPO for $5,000 to $10,000 to start it. PSRC feels that pooled studies can be good but taking money out of an existing budget is hard when there are no specific and immediate results. PSRC finds peer reviews useful for both validation and reassurance as well as ideas for areas of improvement. A group of MPOS meet informally every other month and share progress on activity-based models with no consultants or academics. PSRC feels that the same sort of thing can be done at a national level and that the ongoing regularly scheduled nature is what makes them useful. PSRC finds some specific conferences useful, including the TRB Innovations in Travel Modeling and Planning Applications conferences and the upcoming Land Use forecasting conference put together by Oregon DOT. They also think the TMIP webinars are useful and well-received.

PSRC would like to see FHWA lobby congress and educate decision-makers about the importance of models given the trillions of dollars of projects that are decided upon because of them.

Appendix 6 – Response to Interview Questions Sacramento Area Council of Governments

Interview Date: March 25, 2008

Interview Location: SACOG Office, Sacramento, California

Interview Attendees: Gordon Gerry, Bruce Griesenbeck, Kacey Lizon, Mike McKeever, Matthew Carpenter, Pete Hathaway (SACOG); Rob Ritter, Fred Ducca (FHWA); Elizabeth Sall (Cambridge Systematics, Inc.)

MPO Characteristics

Jurisdiction Area: 6,188 square miles

Jurisdiction Population: 1,896,000 (2000)

Number of Counties: 4 entire counties; parts of 2 other counties

Model Characteristics

Model Area: 6,188 square miles

Modeled Counties: El Dorado (except Tahoe basin), Placer (except Tahoe basin), Sacramento, Sutter, Yolo, and Yuba

Modeled Zones: 1502

Modeled Links: 27,500

Modeled Nodes: 12,600

Modeled Transit Lines: 180 (in 2005)

Interview Discussion: A list of interview questions regarding the role of the travel forecasting models in the region's transportation planning process was sent to interviewees prior to the meeting. The remainder of this document lists the specific questions and then summarizes the responses to those questions. This document is a summary of the interview responses, not a transcript of the interview.

■ Travel Forecasting Model's Role in Transportation Planning Process

Travel Forecasting Model's Role in Your Transportation Planning Process Interview Questions

- **Describe the Transportation Planning Process.**

    - **What performance indicators are used in funding allocations?**
    - **Is the board/committee presented with modeling information, alternative forecasts?**
    - **Tell me the importance of modeling to the process?**

Projects submitted to SACOG for TIP funding are evaluated based on:

- *Readiness (has it gone through engineering, environmental, etc.);*

- *Accordance with the LRTP;*

- *Previous record of agency investment (whether SACOG has invested money in that agency lately; and*

- *How it relates to other projects (are there any synergistic effects).*

- **Describe how projects enter the Long-Range Plan and TIP.**

    - **Is there a rigorous rating process for projects in the TIP/how are TIP projects selected?**
    - **Is the process based on modeling?**
    - **Are models regularly used in EIS's?**
    - **Are models used with the interchange justification report? How do models evaluate interchanges?**

Projects in SACOG's constrained Long-Range Transportation Plan (LRTP) are entered as three phases ranging from design to construction. Each project in the plan has a targeted completion year for construction which is optimized based on the air quality benefits. The start date for consideration for TIP programming is mostly determined by working backwards from the targeted completion date through the time needed to complete the phases. While local agencies submit projects they want Federal and state money for, they do not submit any projects that will be completed with developer money. Submitted projects are evaluated based on readiness (has it gone through engineering, environmental, etc.), whether it is in accordance with the LRTP, whether SACOG has invested money in that agency lately, and how it relates to other projects that SACOG is considering (are there any synergistic effects).

During the most recent MTP development[2], project evaluations were heavily based on the travel model - hundreds of model runs are done to accomplish the phasing. The model was used internally by SACOG staff to evaluate various packages of projects in eight different planning corridors in the SACOG region. An abbreviated version of the model was also adapted for use in a series of intensive public workshops on the MTP. In these public workshops, selected tables were equipped with laptops and, using a trained coder/facilitator at each table, the table's consensus alternative was run and evaluated using the abbreviated version of SACMET.

Since the MTP was adopted, the SACMET is used very little for internal evaluations of projects. Instead, SACOG's activity based travel model, SACSIM, has been used to test alternate land use scenarios, fuel price changes, and other non-project aspects of the region's land use and transportation system.

As money becomes shorter there has been more reliance on the models to explain why certain projects were not included in the plan. Beginning with the Blueprint Plan, SACOG has continued to work hard developing a culture of putting data and information behind planning choices (as opposed to feelings and politics). This, in their opinions, has been the key to surviving a political dichotomy. Because so much weight is put on the model results, they invest in making sure they are credible. While modeling can often affect the sequence of projects in the plan, it does not offer a level of precision that could counter any of the local agency's microsimulation work for the operational-oriented projects. For example, the model is not designed to forecast turn queues, delays, and congestion.

The constrained LRTP must go through the environmental process, and the model was used to not only develop the plan, but to evaluate impacts such as air quality.

- **Where do models enter the process?**

  - **How do model results influence the final decisions?**
  - **Provide an example of where modeling information caused a plan modification**
  - **How do decision-makers use model results?**
  - **Do the data or model results support the conclusions of the board?**
  - **Does the MPO have a working relationship with the Board's technical committee?**
  - **Do models have uses other than the long-range plan?**

Models have influenced many decisions in the SACOG area. An instance where this is most evident is when the model comes to conclusions that differ from general expectations. For example, the model determined that widening existing bridges across the Sacramento River would be more consistent with Blueprint development than building a new crossing in a more rural part of the region. In another river crossing case, the model provided results to show strong benefits that two

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[2] SACOG adopted an updated MTP in March 2008, after a nearly two year policy analysis, technical evaluation, and public participation process.

new bridges could provide in providing access into and out of downtown Sacramento, as well as putting some bounds of reasonable-ness on some of the negative aspects of the new crossings. The information drawn from modeling results gave the SACOG board members sufficient information to retain the new crossings into downtown Sacramento in the recently-adopted MTP, and move the projects toward more detailed planning and evaluation.

The model has also been used to show how certain projects will be used. For example, the Elk Grove to El Dorado County connector was originally conceived as a typical beltway project. Local opposition to the project was founded on the general principle that beltways are sprawl-inducing. Again, the more recent travel model results provided SACOG Board members with information on how travel patterns in the corridor would likely change based on more recently adopted land use patterns, and was able to show that travel demand in this sector of the region could be addressed with a grid pattern of arterials, plus more modest improvements in the historic connector corridor, rather than a single high capacity road. Several other projects dropped out of the plan due to poor performance, relative to cost, in the model including some light rail extensions and some HOV lanes. SACOG demonstrated with the model to Caltrans that building HOV lanes near the core as opposed to the periphery would encourage infill development. Modeling results have also helped in generating public discussion and debate about development plans in some Greenfield areas. In the case of Placer Vineyards, SACSIM was to trace the travel patterns of a less-dense, less well-mixed, proposed alternative compared to a more-dense alternative, and were able to show that total vehicle miles traveled increased, and transit use decreased by households that had to locate somewhere else (because of the lower density).

SACOG consistently provides model output which relate to regionwide performance: i.e. time of travel, mode split, VMT, congested VMT, etc. , and not the technical aspects of the model. Some board members use the model output to discuss issues with their constituents.

SACOG uses their travel model not only to develop their long range transportation plan , but to develop their blueprint land use vision as well. In addition, the model is used for FTA New Starts analysis, EISs, and ozone SIP development for the air quality plan. The model is also used by local jurisdictions for their own analysis purposes.

- **Other**

  – **What land use forecasting methods do you use?**
    o **Model/what model?**
    o **GIS/what software?**
    o **Land use expert panel?**
    o **Simple allocation model?**
    o **Other?**
  – **Who are the major players in land use forecasting at regional level?**
  – **Who are the major players in land use allocation at TAZ level?**
  – **What questions do decision-makers ask?**
  – **What is the level of knowledge about models among policy-makers?**

– **What is the public attitude about the analytical process?**

– **Does the state DOT request information on model results?**

– **Is modeling embraced or is it a requirement?**

SACOG relies on regional economic and demographic growth forecasts from the Center for Continuing Study of the California Economy. During the Blueprint Study SACOG extensively used a parcel-level I-PLACE³S scenario development tool plus a MEPLAN model. SACOG is in the process of developing a parcel-level PECAS model that will be able to evaluate the long-term impacts of congestion pricing as well as identify situations where the Blueprint Plan is in danger of becoming "derailed".

SACOG has an inventory of current parcel data from local sources (the tax assessor, General Plans, field surveys, etc.) as well as I-PLACE³S parcel/pseudo parcel data sets for the entire region broken up by I-PLACE³S place type. Data that is included are number and type of unit and the parcel size.

Transportation plans are developed to support the Blueprint plan, not visa versa.

The SACOG board has been very interested in the effect of land use changes on the transportation system operations and the possibilities of making land use changes in lieu of increasing infrastructure.

In general SACOG's board supports the model and enjoys the goodwill of the public due to the Blueprint process. Board members that attack the model are the exception to the rule however there are a few who are suspicious of all models and another handful that don't like the model when it gives results that they don't like. SACOG educates the board on what the model output means so they can effectively compare scenarios. Some board members take this information and use the model output to discuss outcomes with their constituents. When SACOG went to the board to discuss the need for an activity-based model, additional education was also needed. SACOG had to discuss with the board how the 4-step, zone-based model was not capable of evaluating land use changes in lieu of transportation projects.

The blueprint and LRTP process allowed the public to use a simplified version of the model to evaluate their own ideas. This was more of a public-education exercise than an efficient means to develop a plan; nonetheless it instilled a high amount of credibility with SACOG. While SACOG feels they have earned the public trust, they are cognizant that they will have to periodically reprove themselves.

In addition to public trust, SACOG is one of the few planning organizations in California to have the trust of the Attorney General's office. The California Attorney General Jerry Brown has not intervened in SACOG's plans as he has with other agencies just before they were adopted (i.e. SANDAG and the Central Valley). The California Air Resources Board calls SACOG for information and for modeling runs. SACOG works with Caltrans to evaluate their projects with the model (i.e. the HOV lanes).

The model and modeling process is definitely embraced by the SACOG region as a critical analytical tool.

■ Primary Challenges and Emerging Issues

Major Issues Interview Questions

- **What major issues are you facing now that your current model cannot address? What methods are you using now to address them? Would these issues lead you to make major improvement to your model (e.g., adopt an activity-based state-of-the-art model)?**

A Congestion pricing study is one of the mitigation measures adopted in the EIR for the MTP. While SACSIM is much more sensitive that SACMET, SACOG realizes that the long-term impacts of congestion pricing to things such as household and workplace choice will only be addressed if they use a land use model that is sensitive to it. Therefore they are proceeding with PECAS model implementation. In addition, congestion pricing can only be fully analyzed when dynamic traffic assignment is implemented.

SACOG was driven to using an activity-based model for a number of reasons. SACOG recognizes the need for an in-depth examination into what influences VMT given the critical role it plays in calculating green house gasses and carbon emissions and feels that an activity-based model is the only way to really get at this issue. Trip-based models lose all the detail and true causes of VMT thereby rendering them useless when evaluating possible mitigation policies. Activity models can examine who (important for environmental justice) is being affected by what policies and how – and can assign accountability with greater precision. SACOG also had used a post processor to the 4-step model to examine some of the effects of smart growth - however the SACOG staff concluded that if all of these things were wholly contained within the modeling process, it would provide a better analytical model.

- **Can current models adequately address emerging issues?**

  - **Road pricing?**

SACOG feels that the effects of congestion pricing can only be fully addressed with an economic land use model (PECAS), which they are implementing now, and with dynamic traffic assignment, which they are considering for the future.

  - **Time-specific issues – e.g., parking, telecommuting, reversible lanes, HOV lanes?**

SACSIM is built in 30-minute time slots so applying time-specific issues across those slots is doable. However, there are only four time periods for traffic assignment (they are considering moving to eight) so the model can only capture operational differences between those chunks of time.

Parking policies are another place where SACSIM will do a better job than SACMET due to the parcel-level data and tour-based approach. However they are not being properly analyzed in SACMET.

SACSIM has people working at home on a given day. However there is not a lever in the model to implement a policy that would influence this.

- **Improvements in traffic operations?**

SACOG is interested in mesoscopic assignments and dynamic traffic assignment. They also are interested in origin-based assignment and junction-based assignment as a stepping stone to getting better results. They are going to add more detail to the networks so that the network detail is more in-line with their parcel-based land use. However, at the moment they have link-delay-based static traffic assignments.

- **Time dependent changes in speed and volume?**

Changes between but within the four time periods currently assigned can be made. In the future, there will be eight time periods.

- **Freight policies?**
- **Peak spreading and highly congested networks?**

SACSIM addresses some peak spreading during the time of travel choice and duration choices. However, there doesn't appear to be a large sensitivity to it. Congestion is a variable in the travel time choice and a skim is done of the "amount of congestion experienced" for each of the four level-of-service time periods.

- **Goods movement?**
- **Freight?**

Freight and goods movement is not modeled at all right now outside of truck trips. However with the implementation of PECAS this is being looked at.

SACOG implemented a rudimentary three-step commercial vehicle model that uses MTC's commercial vehicle trip generation rates, friction factors from the QRFM (calibrated to locally observed data). The trucks are not weighted in the assignment process yet and there are not truck climbing lanes coded in.

- **Uncertainty in estimates?**

The seeds are frozen on the simulation runs. All other uncertainties are not really addressed at all. SACOG pointed out that with activity models the number of known unknowns increases but the number of unknown unknowns decreases.

- **Dynamic conditions?**

PECAS will make the land use forecast dynamic but the assignment process doesn't address dynamic conditions at all in its current state.

- **Land Use scenarios?**

SACOG is at the forefront of integrating the evaluation of their land use scenarios with transportation planning using their blueprint planning process, I-PLACE[3]S, parcel-based SACSIM, and now the development of the PECAS model. SACOG views models as learning devices to understand policies. They hope that PECAS will help them identify where their plan will "come off the tracks" the soonest so they know what the key policies will be.

■ Support for Travel Forecasting Models

Management of the Modeling Process Interview Questions

- **What resources are allocated to modeling?**

- **Is there an ongoing data collection program?**

- **Is something in the work plan related to modeling?**

  - **Model development budget?**
  - **Data collection budget?**
  - **Model application budget?**
  - **Staffing structures?**
    - o **Total transportation planners?**
    - o **Travel forecasting model developers?**
    - o **Travel forecasting model input data preparers (land use and network)?**
    - o **Travel forecasting result users (those who will distribute the model results or postprocessing the results)?**
    - o **Consultant's role?**

There are four person-years devoted to model development and applications. There are two transportation analysts who can run the model, and four staff persons run the land use modeling. About two person-years have been devoted to developing data inputs. However, this will likely decrease because a lot of interim scenarios were being developed during the recent MTP development.

Aside from budget to do the household survey, $50,000 of budget has been added to do a monitoring program of counts across the screenlines.

Consultants play a large role in model development, doing all the model estimation work. Consultants do just under $200,000 of work a year for model development, testing, and maintenance of SACSIM. They also are spending $90,000 to consultants for the PECAS model development. Additional funds will be needed to complete the model estimation and calibration. Local jurisdictions' consultants get files for SACMET from SACOG.

- **Partnerships**

  - **What partnerships exist between the agency and:**
    - o **The state DOT?**
    - o **Local governments (including transit agency)?**
    - o **Universities and other research institutions?**

Caltrans has given SACOG several hundred thousand dollars from their discretionary funds to use for model development. To date, this has been a one-way interaction of funds and not a collaborative process.

There are no formal university partnerships. However, due to the parcel-based system and activity-based model many universities are coming to SACOG with research projects related to both the travel model and the land use model. Thus far, these projects have been one-sided efforts as SACOG does not resources to devote to them. SACOG welcomes the prospect of being a test bed for innovative models.

- **How do other agencies use your model/do other agencies (both public and private) use your model for any applications?**

- **If yes, what process do you have to reconcile the changes made to the travel model by these agencies?**

Most local jurisdictions do not have anybody who understands travel modeling. Rather, there are a handful of consultants who run SACOG's models for the local jurisdictions. Occasionally SACOG will do a model run in-house to give consultants and local jurisdictions answers to some basic questions. SACMET has a wide distribution across local jurisdictions and consultants, but SACSIM is presently given out to just a select few consultants. However, a future training session and publication of a users guide will allow more consultants to use SACSIM. The SACMET users group has not been recently active. SACOG expects the distribution of SACSIM will spring the users group back to life.

Often the only changes that consultants make are refinements to the base-year network. SACOG asks that they report back any egregious errors and source the changes to themselves rather than SACOG. However, there are not any other methodologies competing with SACOG's models.

■ Future Plan for Travel Forecasting Model Update

Motivation for the Major Model Update

- **What is the motivation for model updates in the short term?**

  – **New Starts application?**
  – **Conformity determination?**

- **What is the motivation for model updates in the longer term?**

  – **Traffic operations?**
  – **Conformity determination?**

- **Do you think your agency should have more than one model to address different Federal/regional requirements?**

  – **New Starts?**

– **Conformity determination?**

Adapted/refined versions of SACMET have been used by the Sacramento Regional Transit District for New Starts application and did fairly well through the FTA review. FTA requested a lot of work on the network side – a lot of detail was added to the network subarea. SACOG expects that the SRTD will be using SACSIM to do upcoming New Starts analysis. They are exploring how SFCTA used their tour model in conjunction with SUMMIT and will running the model in a modified mode with most of the steps frozen but there will likely not be any requirement for further model changes .

Future Model

- **What model updates are underway or planned?**

- **What is the long-term plan for the models?**

- **Do you have any survey planned?**

    – **Household?**

    – **On-board?**

    – **Workplace?**

    – **External?**

    – **Special market?**

    – **Other?**

- **Do you have plans to work with other agencies to take advantage of the passive data collection?**

    – **Collaboration with ...?**

Since SACSIM is a newly-created state of the art travel demand model, no major model updates are planned in the short term. Some minor improvements include re-programming SACSIM to run in a distributed computer system to decrease run time, a size variable reduction process in the logit based models being replaced by a shadow price process, and transit network refinement. Alongside these, SACOG is working to estimate a PECAS model for the region that will be able to capture the long term effects of the transportation system on household and workplace location choice. They consider this a very important step to be able to fully analyze the long-term effects of congestion pricing. On the networks side, they are exploring more efficient assignment algorithms such as origin-based assignment, and junction-based modeling. In the long term, SACOG wants to refine the traffic operations side of their model to be concordant with the demand side. This includes exploring the possibility of dynamic traffic assignment and linkages to microsimulation models. Other long term unfunded improvements include a tour-based goods movement (or commercial vehicle) model, and an update to the vehicle ownership model – and important input to emissions modeling.

SACOG's last household survey coincided with the 2000 census and the next one will be in 2010. Although they are going to update their modeling base year to 2008 this was not done with any

intent to be in sync with NHTS; however they may compare their results to it in aggregate. SACOG gathers a lot of data from other sources rather than collecting it themselves. For example, they use InfoUSA's employment data and local area's traffic counts. In an effort to have consistent counts along their screenlines, they allocated $50,000 of their budget to a screenline monitoring program.

- **What help would SACOG like from FHWA?**

SACOG encourages FHWA to set up an incentive program to give small pools of money to MPOs that mean certain model and practice standards to explore new ideas. SACOG, for instance, would like FHWA to help them develop a form-based code that would ease the implementation of their blueprint plan. Such a project is an example of how transportation and land use planning can be integrated. FHWA is encouraged to more explicitly recognize this integrated process in their planning regulations.

SACOG believes that establishing a floor, rather than a ceiling for good modeling practice would be a more effective strategy as establishing a "bar" could stifle innovation as opposed to sparking it.

SACOG encourages FHWA to influence the next transportation reauthorization bill to discuss requirements for data and modeling upgrades. Additionally, the bill should reward the most effective use of the total system capacity, which would require more efficient land use. They pointed out that there are a lot of technical tools and examples that FHWA could give congress detailing methods to link land use and transportation without threatening local governments.

SACOG views any peer to peer connecting as positive but requested that it be executing in geographically proximate places so that modelers of certain states be part of a cohesive team. SACOG agrees that some of the targeted TRB conferences are helpful such as the Innovations in Travel Modeling Conference to be held in Portland this June, and the Planning Applications Conference.

SACOG would like to see improvements to the Highway Performance Monitoring System (HPMS), as it is often the only thing for most regions to use to predict VMT, thus carbon and green house gas emissions. They believe that FHWA should work with the EPA regarding conformity requirements would lessen the immediate burden on some agencies who may be scared away from adopting a new model system.