Metropolitan Washington Council of Governments
National Capital Region Transportation Planning Board

Review of Current Use of Activity-Based Modeling

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Executive Summary

Activity-based models have been hailed as the next major advance in travel demand forecasting, with many claiming that the resulting models provide a framework and paradigm that will permit more accurate forecasts than the so-called traditional four-step, trip-based models, and will provide the ability to analyze a wider range of transportation and land-use policies. This memo summarizes our review of the state of the art and practice in activity-based models.

While a few agencies have implemented and are using activity-based models to conduct work program activities, there is limited information on the results of these initial applications of the model. VHB was unable to find detailed documentation of the use of the activity-based models for project planning studies. A number of large MPOs have added elements of advanced modeling practice (e.g., strategic work trips, tour-based modeling) into their existing trip-based models, have structured data collection so that information suitable for building activity-based models is available, and have in their long-term model development plans expressed an intent to explore and to likely transition to a fully-implemented activity-based model. Agency staff with who we have discussed travel modeling and discussions on both the Travel Model Improvement Program (TMIP) listserv and a Yahoo! listserv for a coalition of MPOs interested in activity-based models indicate that MPOs are moving forward slowly, as they still have many concerns about the need for a complete activity-based model and its application to typical MPO work program elements, such as air quality / conformity analysis, corridor and project planning studies, and transit studies.

This memo suggests that now is not the right time for TPB to begin full-scale adoption of an activity-based model – the technique is not yet widely accepted, and there are still numerous issues to be resolved before activity-based modeling is "ready for prime time" in the Washington region. However, there are steps that TPB can and should take now to ensure that proper consideration can be given to activity-based models several years in the future.

The best activity that can be undertaken to keep pace with advanced model development is to ensure that current data collection efforts include data that will allow transition to a tour or activity-based framework. With the data in place, TPB will have the flexibility to continue advanced model development at the pace it sees fit, including elements of activity-based models, while maintaining the high standards of the existing trip-based model for continuing support of work program activities.

Following the completion of the home interview survey, there are several options for TPB to begin an incremental approach to moving toward an activity-based model. The logical first step would be to convert the trip results of the home interview survey into tours. While it is possible to have a tour-based model that is not activity-based, an activity-based model must be tour-based.

To pursue any facet of the incremental approach, TPB may wish to consider formalizing a closer relationship with area universities to begin research into the development and application of an

activity-based model for the Washington region.[1] Such relationships have proven beneficial to MPOs like NCTCOG in advancing modeling work in their metropolitan area.

Another option is for TPB to participate in (and if necessary lead) a joint program with other MPOs that will keep abreast of the current status of activity-based models. This joint project could document the success or failure of activity-based model development and application efforts by the early adopters of activity-based models. This same mechanism could be used to perform further research into how an activity-based model can be cost-effectively developed and applied by TPB and other MPOs. This joint program could guide the direction of any incremental approach to advanced model development.

Advanced Travel Demand Models: Is It Truly An Activity-Based Model?

The terms "activity-based model" and "tour-based model" are sometimes incorrectly used interchangeably. Activity-based models (ABMs) by definition use the tour (rather than the trip) as the basic unit of travel and are therefore also tour-based models; however, not all tour-based models are activity-based. Adding to the confusion is the use of "journey-based" as a substitute for tour-based. The primary difference between the two constructs is that *true* activity-based models begin with the inclusion of a full daily activity pattern (DAP) for each member of a synthetic household prior to tour generation and carry the DAP through the entire model chain to trip assignment.[2] The use of the daily activity pattern and corresponding activity scheduler prior to tour generation allows the model to simulate intra-household interactions in travel, provides more explicit and detailed time-of-day modeling, and avoids illogical destination or mode choices. Figures 1 through 3 illustrate the workflow of the Columbus, Ohio activity-based model.[3]

[1] TPB's university partners must be representative of the National Capital Region, and have the expertise to contribute to a usable activity based model for the entire modeled area.
[2] In tour-based and activity-based models tours are converted back to trips for network assignment.
[3] Anderson, et al., (2003)

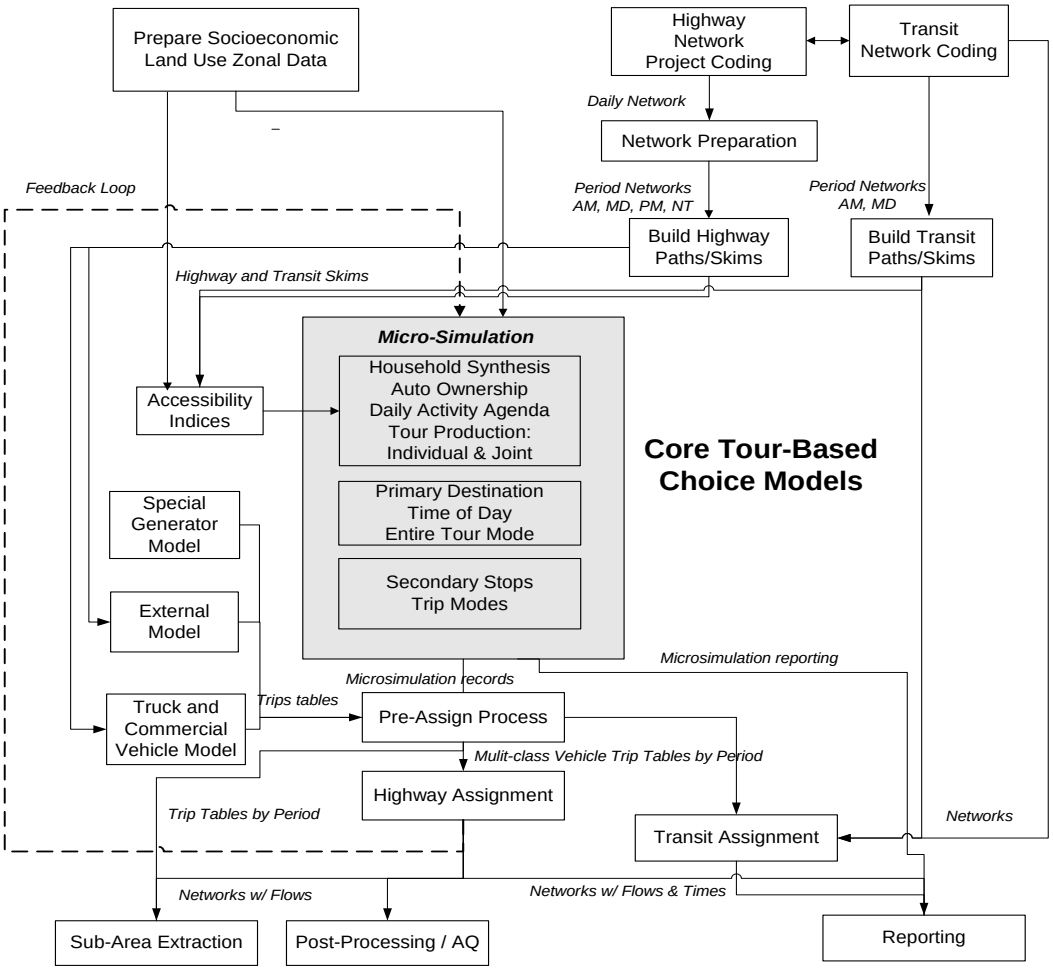

Figure 1: MORPC Tour-Based/Microsimulation Models – General Applications Flow

MPOs and Other U.S. Agencies Currently Using or Developing Advanced Models

As of the publication of this memo, there are three (3) models that may be characterized as ABMs in use by public agencies in the United States:

- New York, New York (New York Metropolitan Transportation Council – NYMTC)
- Columbus, Ohio (Mid-Ohio Regional Planning Commission – MORPC)
- San Francisco, California (San Francisco County Transportation Authority – SFCTA)

In New York and Columbus, the models were developed as part of the MPO work program and are now being run by the MPO to support activities such as conformity analysis and corridor studies for both highway and transit projects. SFCTA's model covers internal San Francisco

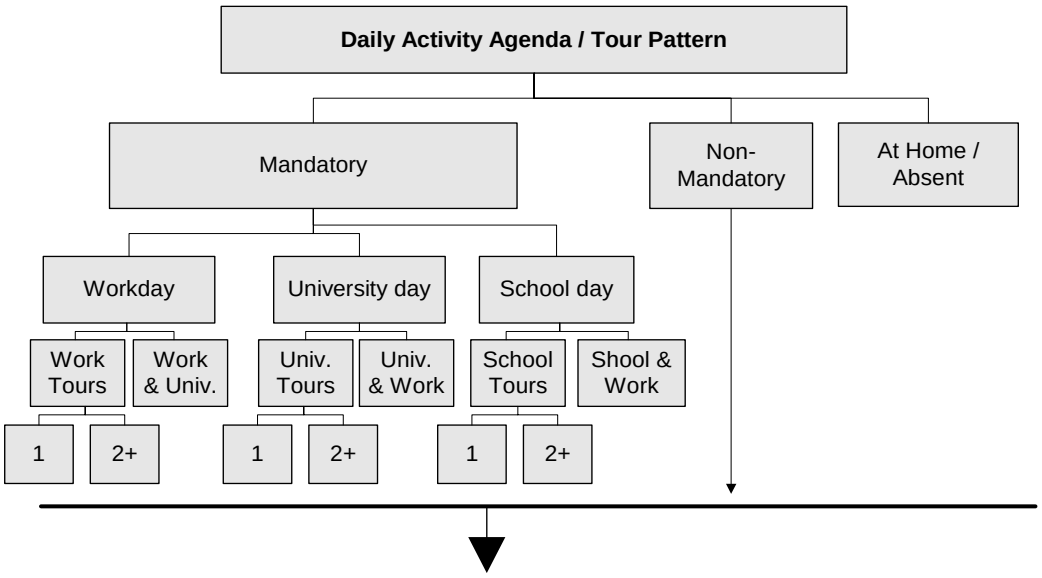

Figure 2: MORPC Classification of Daily Activity Patterns

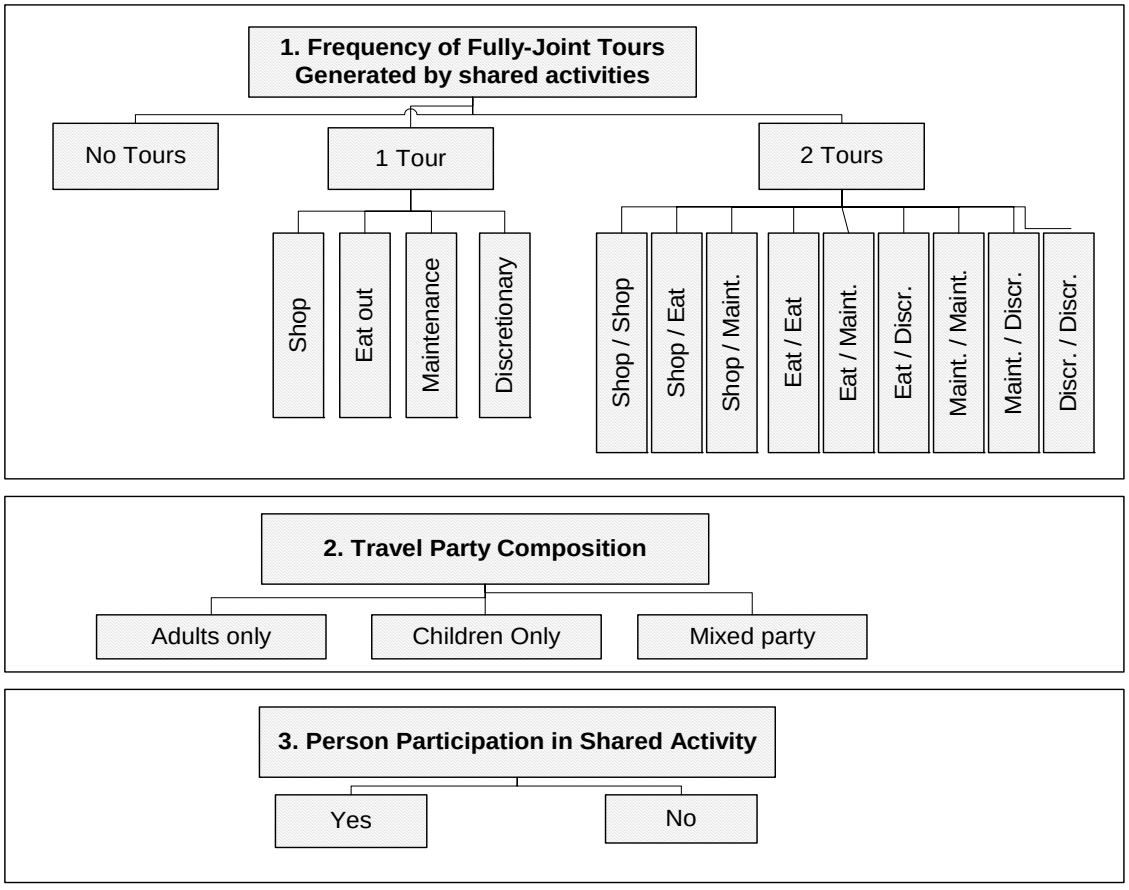

Figure 3: MORPC Joint Travel in the Modeling Hierarchy

County[4] travel only; regional modeling and external-internal trips to San Francisco are handled by the Metropolitan Transportation Commission (MTC) traditional four-step model. All three models received *significant* consultant support for model development, testing, calibration and validation, and are receiving additional consultant support for the next round of model improvements.[5]

In Portland, Oregon, METRO has not actively used its activity-based model since the late 1990s, having found the results not entirely satisfactory; however, at that time, results from the activity-based model were used to support re-estimation of the trip-based model, and that four-step model set (which is among the most robust trip-based models in the county) is the current MPO production model. Near-term model development efforts will primarily be focused on improving the trip-based model – such as upgrading the mode choice model structure from multinomial logit (MNL) to nested logit (NL). Use of an NL structure will assist in a transition back to an improved activity-based model should METRO choose that option further in the future. In addition, METRO's next household travel survey, currently expected around 2008, could include information regarding daily activity patterns to support an improved activity-based model. Separate research and testing of the TRANSIMS activity-based model continues in the Portland area.[6]

Several other MPOs are either in various stages of development of an advanced model by adding advanced model chain elements to their existing trip-based models, or have plans (some formal, some less formal) to move toward a tour-based or activity-based model. These MPOs include:

- Atlanta, Georgia (Atlanta Regional Commission – ARC)

ARC is in its third year of work program activity toward developing an advanced model set for the Atlanta region, allocating approximately $100,000 per year to support these activities. ARC has recently implemented a population synthesizer but currently the synthetic population is applied back into their trip-based model.[7] ARC has not definitively committed to fully implementing an activity-based model but is adding advanced model elements to its system, such as the population synthesizer, while maintaining a parallel track of improvements to its existing trip-based model. That trip-based model will be calibrated and validated for an expanded 20-county modeling region very soon.

- Sacramento, California (Sacramento Area Council of Governments – SACOG)

SACOG's most recent travel survey conducted in the year 2000 also included an activity survey. Model design for an activity-based model occurred during 2001. Model development is near completion, and SACOG expects to adopt their activity-based model as the MPO production

[4] The City and County of San Francisco are coincident. San Francisco's land area is approximately 47 square miles, making it smaller than Washington D.C.; however, its 2005 estimated population is nearly 800,000, making it denser than Washington.
[5] Consultant support for each model is as follows: NYMTC – PBConsult; SFCTA – Cambridge Systematics and Parsons Brinckerhoff; MORPC – PBConsult and AECOM Consult. Caliper Corporation is currently providing support for the NYMTC code optimization in TransCAD.
[6] See Gliebe (2006).
[7] Consultant support for ARC was provided by John Bowman

model and use it to support development of their updated regional Long Range Plan starting next month.[8] SACOG has been separately developing a series of sophisticated land-use models and a GIS-based scenario tester integrated with their trip-based models, and the long-term plans are to integrate these with the activity-based model set.

- Dallas, Texas (North Central Texas Council of Governments – NCTCOG)

NCTCOG is not developing its own advanced model at this time but is coordinating closely with the development of an activity-based model at the University of Texas in Austin (see section below).

- Denver, Colorado (Denver Regional Council of Governments – DRCOG)

DRCOG plans to have an activity-based model developed within two years, and has recently completed work on model design. The DRCOG activity-based model will be an enhanced version of the approach used for the SFCTA activity-based model.[9] Model development is now under way. DRCOG also plans to integrate their activity-based model with the UrbanSIM land use model.[10] The DRCOG integrated activity-based model will exist in an object-oriented environment and on a relational database platform to improve the ability to quickly make updates and improvements to the system.

- Seattle, Washington (Puget Sound Regional Council – PSRC)

PSRC does not have any formalized plans to develop an advanced model, but an activity-based model is the logical outcome of the agency's models development and improvement plan from 2001. PSRC's upcoming (this year) household survey will be designed to capture information about daily activity patterns to provide base data for use in the construction of an activity-based model. PSRC uses UrbanSIM for its land use model and plans to integrate that functionality into its advanced travel demand model.

- San Francisco, California (Metropolitan Transportation Commission – MTC)

MTC is in the early stages of a $250,000 consultant contract to conduct the first phase of a model specification and training study that will lead to development of an advanced model set. An additional $250,000 was planned for the current fiscal year for model development and improvement activities. MTC plans to work with SFCTA staff to conduct an analysis and comparison of results from the SFCTA activity-based model with MTC's existing trip-based model.

- Phoenix, Arizona (Maricopa Association of Governments – MAG)

MAG expects to begin development of an activity-based model in 1-2 years.

[8] Consultant support for SACOG was provided by DKS Associates with Mark Bradley and John Bowman.
[9] Consultant support to DRCOG provided by Cambridge Systematics, Mark Bradley, and John Bowman. See Sabina and Rossi (2006).
[10] UrbanSIM is an open-source land use model developed by researchers at the University of Washington.

- El Paso, Texas (El Paso Metropolitan Planning Organization)

The El Paso MPO has begun converting its trip-based model into a tour-based framework as a first step toward building a full advanced model set. The El Paso MPO plans to conduct travel surveys in 2007, so they are beginning consideration of updating their instrument to capture information on daily activity patterns.

- Santa Barbara, California (Santa Barbara County Association of Governments – SBCAG)

SBCAG and the University of California, Santa Barbara (UCSB) have begun the initial stages of cooperative and coordinated research into activity-based modeling in the MPO region. Kostas Goulias at UCSB is an active researcher in activity-based modeling.

- St Louis, Missouri (East-West Gateway Council of Governments)

East-West Gateway has a next-generation model specifications document from 2003 that outlines future development of a tour-based model. Recent activities have been directed toward improvements to the regional trip-based model, so no formal work on developing an advanced model has occurred to date.

Other U.S. Activity-Based Models

There are also activity-based models used as university research tools, such as the Comprehensive Econometric Microsimulator for Daily Activity-Travel Patterns (CEMDAP) from the University of Texas and the Florida Activity Mobility Simulator (FAMOS) from the University of South Florida in Tampa. CEMDAP is noteworthy because it has been applied to the NCTCOG modeling region, and is currently being used for a direct comparison with NCTCOG's trip-based model.[11] The results of that comparison are not yet available. Several MPOs who have expressed an interest in moving toward an advanced model system have also advocated the use of UrbanSIM, which includes a household and employment synthesizer, to create an integrated land use / transportation model for their region.

The majority of MPOs are like TPB in that they have an interest in advanced model constructs. However, they are proceeding cautiously and observing the state of the art, the evolving state of the practice, and watching in particular the experience of the MPO first-adopters of the advanced models. This will allow them to learn from others whether the results make sense, are implemented in a cost-effective manner, and are able to support the MPO work program and adequately respond to the transportation questions being posed by MPO board members and member jurisdictions / agencies.

[11] NCTCOG is not funding the CEMDAP research; it is 100% funded by the Texas Department of Transportation (TxDOT)

Experience with Activity-Based Models outside the United States

Based on a literature review, modeling efforts outside of the United States have not led to the implementation of *purely* activity-based models in any large metropolitan area. While several of the more recent metropolitan and national models in Europe do not strictly adhere to the traditional four-step trip-based forecasting method, none of them are *truly* activity-based. The Stockholm Model System uses separate models to forecast tours with different purposes. The Netherlands National Model is a tour-based model that incorporates activity choices by splitting tours into more activity categories than in a traditional model. The ALBATROSS system, also developed in the Netherlands, is an activity-based model that simulates in which activities residents will participate and forecasts their travel needs based on these schedules.[12] As this system has not yet been fully implemented by the Dutch government, its success is still unmeasured.

The metropolitan transportation agency in Jerusalem, Israel, is preparing to issue an RFP for a multi-year program to convert its trip-based model into an activity-based model. Australia has two advanced models. The Transport and Environmental Strategic Impact Simulator (TRESIS), is an activity-based model developed by the University of Sydney and applied for research purposes in the five largest metropolitan areas: Sydney, Melbourne, Brisbane, Perth, and Adelaide. The Land Use, Travel Demand, Microsimulation Model (LUTDMM), a joint project of the New South Wales state government and the University of South Australia in Adelaide, also an activity-based model, has been tested in a small area in northern Adelaide. Not enough is known about the planning requirements and functions in Australia to know how applicable these models would be to the U.S. experience, but the projects and initial results seem promising.[13] No other information about advanced models either being applied or under development in areas outside the United States was found in the literature review.

Application of Activity-Based Models in the United States

The three active U.S. activity-based models (San Francisco, Columbus, and New York City) have been used to support the full spectrum of MPO planning activities – air quality conformity analysis, transit and highway studies, including FTA New Starts analysis, and others. But while the models have been applied to a wide variety of projects, the total number of applications is still quite limited -- approximately 10-20 projects – not a significant base from which to draw conclusions about the usability of the models. Obtaining objective information about the effectiveness of the models proved difficult. However, it was possible to discuss the activity-based models with MPO staff and other public agency staff with project planning experience using the models.

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[12] ALBATROSS is one element of the current activity-based model systems developed by the Dutch and Belgian governments and research universities -- built to show improvements over the previously-developed PATRICIA, the nested logit models used as benchmark data, and RAMBLAS, an early simulation system. To ALBATROSS the developers have now added AURORA, a new model that incorporates an activity *rescheduler*. An extended version of AURORA called FEATHERS (Forecasting Evolutionary Activity-Travel of Households and their Environmental Repercussions, and a GPS/PDA-based application for collecting activity diary data, PARROTS (PDA System for Activity Registration and Recording Of Travel Scheduling) will be developed for and applied in the Flanders region of Belgium. See Arentze, et al. (2006).

[13] See Xu (2005) and Stopher (2005).

- NYMTC Model

NYMTC reports that the New York Best Practices Model (NYBPM)[14] has been used since 2002 to support air quality conformity analysis and a series of single-mode and multimodal transportation studies, including:

  - Southern Brooklyn Transportation Improvement Study
  - Gowanus Expressway (I-278) Study
  - Tappan Zee Bridge / I-287 Corridor Study
  - Bruckner Expressway (I-278) / Sheridan Expressway (I-895) Study
  - Bronx Arterial Needs Major Investment Study (MIS)
  - Kosciuszko Bridge Study
  - Goethals Bridge Modernization Environmental Impact Study (EIS)

It appears from a review of several of the documents from the above studies that the full NYBPM model chain was not always applied – sometimes it was just the detailed assignment module. This may be due to the relative instability of the model at the time the studies were conducted –some parties may have been pushing to apply the NYBPM before it was truly ready to serve as a production model.

Regardless, a representative from the New York Metropolitan Transportation Authority (MTA) who worked on the Tappan Zee Bridge / I-287 Alternatives Analysis[15] did not report any major problems with the application of the NYBPM in the study. The NYSDOT project manager for the Kosciuszko Bridge[16] study initially reported that the study team's experience with the NYBPM was "frustrating," but further questioning revealed that the problems the team encountered were primarily with coding errors in the model network, a problem hardly unique to activity-based models. Once the network was fully quality-checked, the project manager stated that they were very satisfied with the model results, that they seemed intuitive, and that the level of detail provided was improved over previous models, down to the level of lane changes.

- SFCTA Model

The SFCTA model has been used to provide forecasts for two major transit projects – the New Central Subway light rail transit (LRT) project, and the Geary Corridor Study, which is considering multiple transit options.[17] The Geary study is currently in Alternatives Analysis, and different scenarios are being tested. The Central Subway study has progressed to the point where the SFCTA model was used with FTA's Summit program to calculate user benefits for consideration in a New Starts application. While some adjustments to the model were required to prepare the outputs for use as inputs to Summit,[18] both SFCTA staff and a transit planner from

[14] This is NYMTC's preferred name for their current model.
[15] This is a multimodal study jointly conducted by MTA / Metro-North Railroad, the New York State Department of Transportation (NYSDOT), and the New York State Thruway Authority.
[16] A study of a 1.1 mile section of the Brooklyn-Queens Expressway (I-278) in New York City. The Kosciuszko Bridge connects Brooklyn and Queens.
[17] The choice of transit technology in the Geary corridor, either LRT or bus rapid transit (BRT) is a hot button issue in San Francisco
[18] See Freedman, et al (2006) for a detailed discussion of these issues.

the San Francisco Municipal Transportation Authority[19] who worked on the New Starts application for the Central Subway project also reported satisfaction with the results of the SFCTA model, including the interaction with Summit.

The SFCTA model has also been used for equity analysis and environmental justice analysis of transportation projects[20], as well as mobility and accessibility measures and transit service measures, such as vehicle utilization (crowding). While the SFCTA model employs a disaggregate approach to tour generation, tour destination choice, and tour mode choice, it still employs an aggregate network assignment.[21] This greatly lowers the accuracy of model assignments below the corridor level, and since many of the above measures are most useful at the street level or lower, SFCTA commonly re-assigns the model results using Synchro or VISUM to produce the fine-grained measures required for their studies.

- MORPC Model

MORPC reports that they use their activity-based model for air quality / conformity analysis, transit alternative analysis, and for highway major investment studies. Information was available on the use of the model for a New Starts analysis, the North Corridor Transit Project (NCTP) AA/DEIS, a study of a 13-mile corridor. As with the SFCTA model, the MORPC model required some "tweaking" for use with FTA's Summit program to calculate user benefits (UBs),[22] but once those issues were resolved the resulting UBs were generally reasonable. A consultant using the MORPC model for the UB calculation did report some frustration with long model run-times and the size of model data files when having to make minor corrections, but still deemed the UB results to be good.[23]

Benefits of Activity-Based Models: Fully Realized?

In concept, there are benefits to be realized through the use of tour-based and activity-based models. The concepts of the tour as the primary unit of travel and of the constraints on traveler behavior imposed by a daily activity pattern are arguably closer to the "reality" of travelers' behavior than the paradigm of the four-step models. The initial applications of the activity-based models in the United States show that activity-based models can be implemented in the framework of the metropolitan transportation planning process. These applications, coupled with the accrued benefits and satisfaction to date of the three activity-based models in use and the promise of the ability to respond to policy questions not easily treated in four-step models,

[19] MUNI, the primary transit operator in San Francisco and the project sponsor (applicant) for FTA New Starts funding.
[20] See Castiglione, et al (2006) for a detailed discussion of this application.
[21] This was done due to resource limitations during the initial development of the model; SFCTA has expressed an interest in moving toward microsimulation / disaggregate assignment in the future.
[22] Most of the issues revolve around FTA's requirement to use a fixed trip table across all alternatives to calculate UBs and the incompatibility of this method with activity-based models. See Vovsha (2006) for a detailed discussion of how this was resolved for the MORPC model in the NCTP study. Proponents of activity-based models have argued that FTA needs to change its requirements to allow variable trip tables when calculating UBs. FTA has (unofficially) considered such changes and conducted research as to how they might be implemented, but currently has no plans to change its methodology.
[23] See Schmitt (2006).

has been enough for a few other MPOs to actively pursue adoption of activity-based models of their own. However, review of literature and of recent work in activity-based modeling shows that the touted benefits have not yet been fully realized, and probably will not be fully realized for some time. Furthermore, there has not been an evaluation of how well existing activity-based models support the needs of MPOs.

Concerns

The use of activity-based models by three out of hundreds of MPOs does not indicate state of the practice; it indicates "bleeding-edge" state of the art and a highly advanced proof of concept that is just starting to gain acceptance in those three metropolitan areas. There are still many concerns about the new models in general and their applicability that have yet to be meaningfully addressed:

- Model Response

No comprehensive comparison tests between a "traditional" model and an activity-based model for the same metropolitan area or project have been performed to date. Modelers understand the sensitivity and responses to different travel scenarios resulting from trip-based models. It is not yet known how those responses compare with those provided by activity-based models.

- Data

Typically, for model estimation / calibration / validation, activity-based models require a larger amount of data and at a finer level of detail than traditional trip-based models, due in part to the disaggregate nature of activity-based models that employ microsimulation. Agencies validating activity-based models, in addition to relying on their own collected dataset such as home interview surveys and activity diaries, are also relying on the Census data, including the Public Use Microdata Sample (PUMS). There is a concern that the Census Bureau will eliminate PUMS for the 2010 census due to confidentiality issues. Other data sources such as the long form responses and the CTPP are to be sharply reduced as they are being replaced by the American Community Survey (ACS), which combines more frequent sampling with a smaller sample size and fewer questions. The decreased availability of Census data products is a cause for concern for all modeling efforts, but it is a greater concern for agencies adopting activity-based models due to the increased data requirements and dependence on census data, especially for the population synthesis elements. A very extensive validation effort is planned for the DRCOG activity-based model, and this along with the recent validation for the SACOG activity-based model should be reviewed by TPB to see both what data are used and what actions are considered for adjusting to data availability problems.

- Hardware and Run-Time

The current TPB model (Version 2.1D #50) takes 15-17 hours to run on a single 3.0GHz computer running 32-bit Windows 2000. By contrast, the MORPC activity-based model runs on a 3-5 machine cluster (one master, 3-4 slaves). This includes at least one multiple-CPU machine running 64-bit Windows and utilizing parallel processing and distributed computing. Run times

range from 20-48 hours for a metropolitan area much smaller than that served by TPB.[24] NYMTC initially reported model run-times as long as one week using the NYBPM, although now reported run-times have been reduced to about 80 hours. Both agencies are working to improve run times, but even getting to these levels has required major investments in computing power. In adopting an activity-based model, TPB would need to work with member agencies to address expectations of quick turnaround of model results for a given project, and commit funding for hardware upgrades.[25]

- Software and Code

While some model chain elements of the existing activity-based models are built using existing model platforms (TP+/Cube, TransCAD), large sections of these models are being executed using large blocks of C++ or Java code outside the modeling software, and some of the programming code is already being revisited to provide code optimization in an effort to improve model run-time performance. Some models are also being run under open-source environments such as the Linux operating system. TPB has recently invested considerable time and money converting much of the remaining FORTRAN code in the Version 2.1D model into TP+ scripts to provide model integration and consistency. The need to "outsource" model chain elements to procedures outside the main modeling platform is in some ways an evolutionary step backwards and likely something TPB may not wish to revisit.

- Model Ownership

The vast majority of TPB's model applications and models development work is currently performed by TPB staff, with occasional consultant support for certain tasks. As noted previously, the development and application of an activity-based model is a multi-year, often multi-million dollar project with massive consultant participation. While it is unreasonable to expect such an undertaking to be feasible without consultant support, it may not be in TPB's best interest to be too dependent on one or more consultants to maintain, improve, or run their models. There is a danger that TPB could lose control of their modeling process if they are dependent on a consultant. The ongoing use of consultants at MORPC and NYMTC to tweak the models and perform programming code fixes likely makes this a real possibility.[26]

[24] The MORPC region is approximately 2,300 square miles, roughly one-third of the TPB region. MORPC model run-times are dependent on the horizon year of the model run and which of the three clusters (two at MORPC, one at COTA, the Central Ohio Transit Authority) is used for the model run. See Anderson, et al. (2006)..

[25] SFCTA reports current model run-times of 12 hours and SACOG reports run-times of around 9 hours. Both models have benefited from code optimization, but it is important to note that they are also applied to smaller areas (geographically and demographically) than the TPB modeling region.

[26] SFCTA noted that since the initial release of their activity-based model, most model development has been performed internally by SFCTA staff. In some ways SFCTA, with its model focused on a single jurisdiction and internal model development, is in the same position that the Montgomery County Department of Park and Planning (M-NCPPC) was in ten years ago; TPB should watch with interest how modeling in the Bay Area evolves as MTC develops their activity-based model – will SFCTA continue its own models development program like the Prince George's Planning Department (M-NCPPC), or focus on applications and let the MPO (MTC) take the lead on models development like Montgomery Park and Planning did with TPB?

- Institutional Issues

TPB must consider the following question: will "the model" be more trusted by non-modelers if/when the switch is made to an activity-based model, or will the time spent educating and gaining the trust of decision-makers in the current modeling process revert to distrust and a renewed perception of the model as a "black box" when the decision-makers are presented with a new process that is not fully understood and doesn't produce the results they are accustomed to receiving?

TPB's forecasting activities are more closely scrutinized than most MPOs, as evidenced by the recent TRB model review and responsive actions. While the level of scrutiny has served to advance the state of model development in the Washington region, it has also consumed significant staff and fiscal resources. Moving to an activity-based model would likely require a significant increase in available funding to support additional staff and training to introduce new skill-sets (programming and model techniques) into the TPB knowledge base, provide consultant support, and would introduce another level of scrutiny to TPB's activities, since the model would be radically changed.

While more review of TPB's models development program would likely lead to a more widely-accepted process by member jurisdictions and regional decision-makers, TPB must weigh the question of resources, both time and staff. TPB technical staff must be able to do their work without constantly being under the regional microscope, and must be able to focus their efforts on actual model development rather than responding to critiques. Meanwhile, while an activity-based model is under development, TPB staff should still be able to apply and improve its existing trip-based model to support work program activities, which would result in staff supporting two models simultaneously for several years.

Conclusions

The 2002 report of the Florida Statewide Model Task Force considered the merits of trip-based vs. activity-based models and concluded that "…the panel felt that these approaches [activity-based models] may not yet be ready for full-scale adoption in Florida….However, the panel felt that the state should…be mindful of data collection opportunities that may help pave the way for developing and implementing such models in a more long-term model enhancement program."[27] Likewise, the 2004 draft documentation of the Charlotte-area regional model states the following:

> This model estimates *trips*, i.e., individual trip segments between each stop. This is the conventional definition of travel that has been in common use in the past 40 years. At the start of this project, consideration was given to using a newly emerging definition of travel: *tours* (or *journeys*). A tour is generally defined as the round trip of a person's travel throughout the day, such that almost all tours start and end at the person's home. Although this definition more closely mirrors the way in which travel is commonly made, the state of the art in tour-based modeling in 2004 was judged to be insufficiently well developed to permit its use

[27] Page 18.

> in the Metrolina model at this time. Within about 5-7 years, however, tour-based modeling is expected to become more common and at that time (shortly after the 2010 Census), it should be feasible to update this model using that definition of travel.[28]

While the Florida report refers to activity-based models and the Charlotte report refers to only tour-based (and not activity-based) models, a conclusion similar to the general theme of both reports as it pertains to advanced, non-trip-based model structures can be reached in 2006 for TPB: now is not the right time for TPB to begin full-scale adoption of an activity-based model – the technique is not yet widely accepted, and there are still numerous issues to be resolved before activity-based modeling is "ready for prime time" in the Washington region. However, there are steps that TPB can and should take now to ensure that proper consideration can be given to activity-based models several years in the future.

The best activity that can be undertaken to keep pace with advanced model development is to ensure that current data collection efforts include data that will allow transition to a tour or activity-based framework. TPB's current plans for the upcoming home interview survey include an activity diary. It is crucial that this part of the home interview survey remain in place if activity-based models are to be an option for TPB over the next decade or longer. Even if it is five years or more before activity-based models are in wide enough use and well enough accepted that TPB should consider developing an activity-based model, the data collected in this survey will be used for that effort. The upcoming home interview survey will likely be the source of data for model estimation, calibration, and validation of any future activity-based model. If activity-based models do prove successful, waiting for the next survey after 2006 to be conducted to capture daily activity pattern data may place TPB behind its peer agencies in terms of its ability to provide the best practices in modeling. With the data in place, TPB will have the flexibility to continue advanced model development at the pace it sees fit, including elements of activity-based models, while maintaining the high standards of the existing trip-based model for continuing support of work program activities.

Following the completion of the home interview survey, there are several options for TPB to begin an incremental approach to moving toward an activity-based model. The logical first step would be to convert the trip results of the home interview survey into tours. While it is possible to have a tour-based model that is not activity-based, an activity-based model must be tour-based. Following the creation of the tour dataset, TPB could begin designing and estimating a tour generation model. Another option would be for TPB to develop a detailed network assignment procedure similar to those used in the NYMTC and MORPC models. And another option would be to develop a population synthesizer module first; this is the approach being followed by ARC in Atlanta.

To pursue any facet of the incremental approach, TPB may wish to consider formalizing a closer relationship with area universities to begin research into the development and application of an

[28] Section 4-1.

activity-based model for the Washington region.[29] Such relationships have proven beneficial to MPOs like NCTCOG in advancing modeling work in their metropolitan area.

Another option is for TPB to participate in (and if necessary lead) a joint program with other MPOs that will keep abreast of the current status of activity-based models. This joint project could document the success or failure of activity-based model development and application efforts by the early adopters of activity-based models. This same mechanism could be used to perform further research into how an activity-based model can be cost-effectively developed and applied by TPB and other MPOs. Such an effort could be jointly funded by MPOs throughout the country and be led by the Association of Metropolitan Planning Organizations (AMPO), the U.S. Department of Transportation, or another organization that serves MPOs. TPB already participates in both the TMIP listserv and the activity-based model coalition listserv, and such an effort has been discussed periodically in these forums. This joint program could guide the direction of any incremental approach to advanced model development.

[29] TPB's university partners must be representative of the National Capital Region, and have the expertise to contribute to a usable activity based model for the entire modeled area.

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