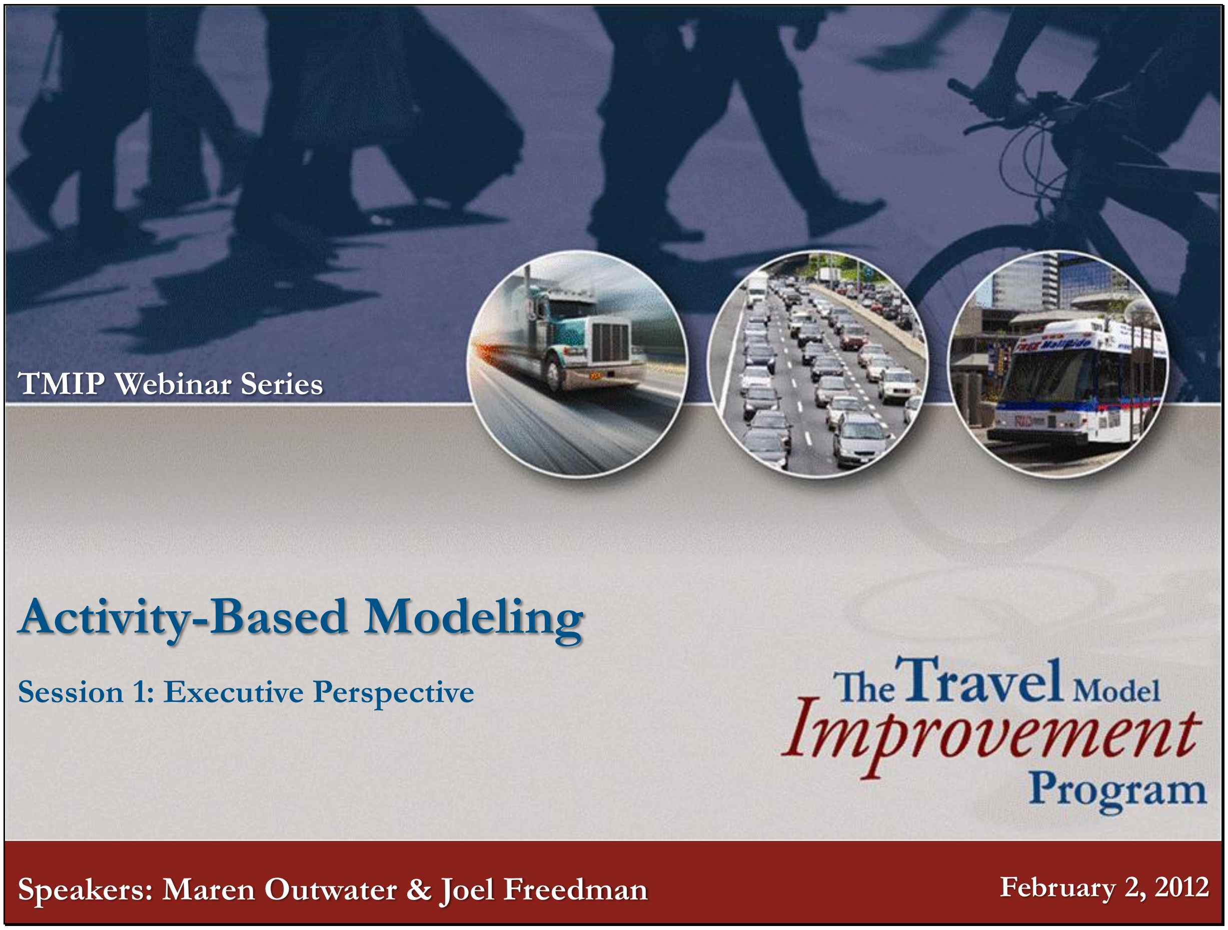
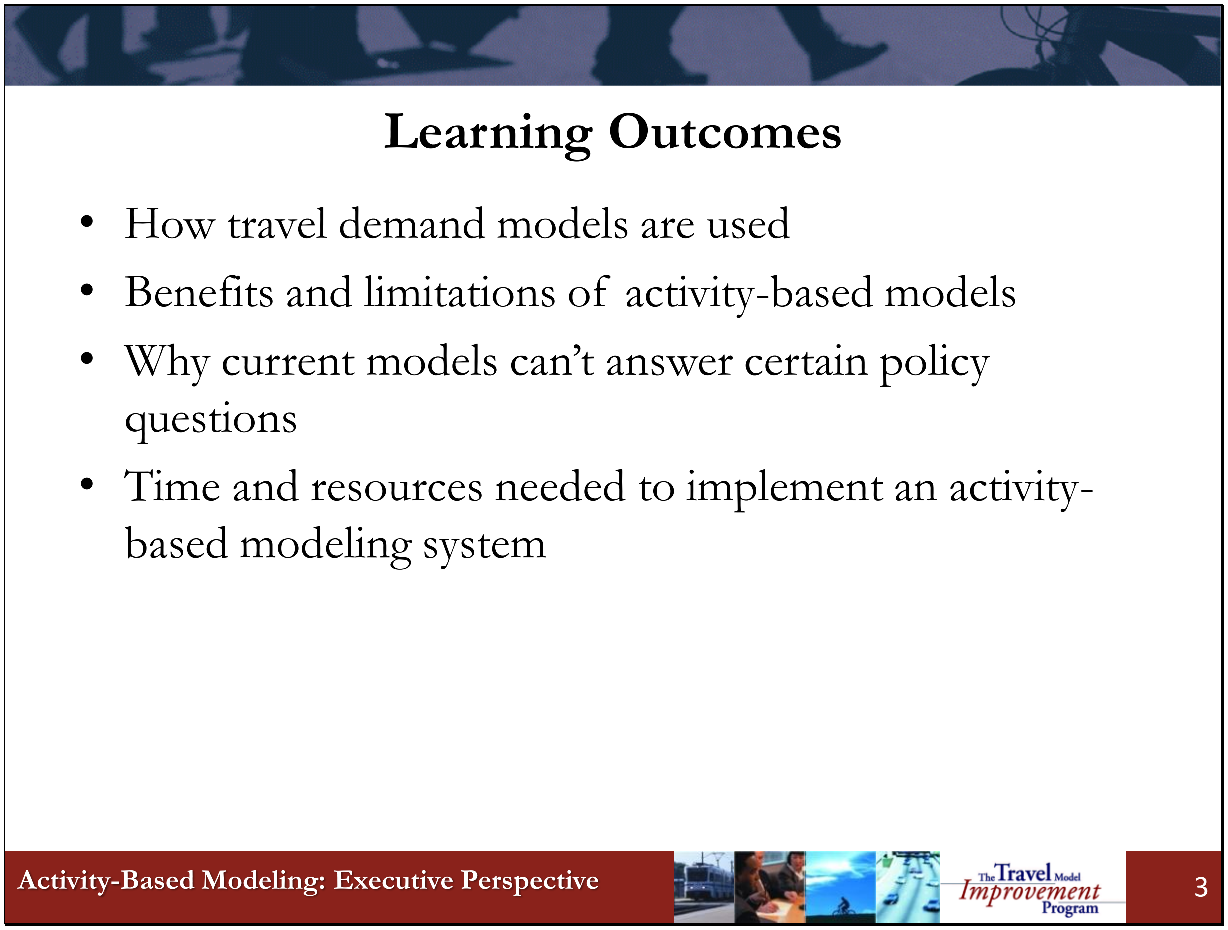


This is the first of twelve activity-based modeling webinars that we will conduct over the next nine months. This session is designed as a high-level view of activity-based models, designed for executives. The next two sessions are designed for modeling managers. The remaining nine sessions are technical in nature and are designed for modeling staff.

Resource Systems Group and Parsons Brinckerhoff have developed these webinars collaboratively, and we will be presenting each webinar together.

- Maren Outwater and Joel Freedman are co-presenters. They were also primarily responsible for preparing the material presented in this session.
- Stephen Lawe is the session moderator.
- Content development was also provided by John Gliebe, Peter Vovsha, and Rosella Picado.
- Bhargava Sana and Brian Grady were responsible for media production, including setting up and managing the webinar presentation.



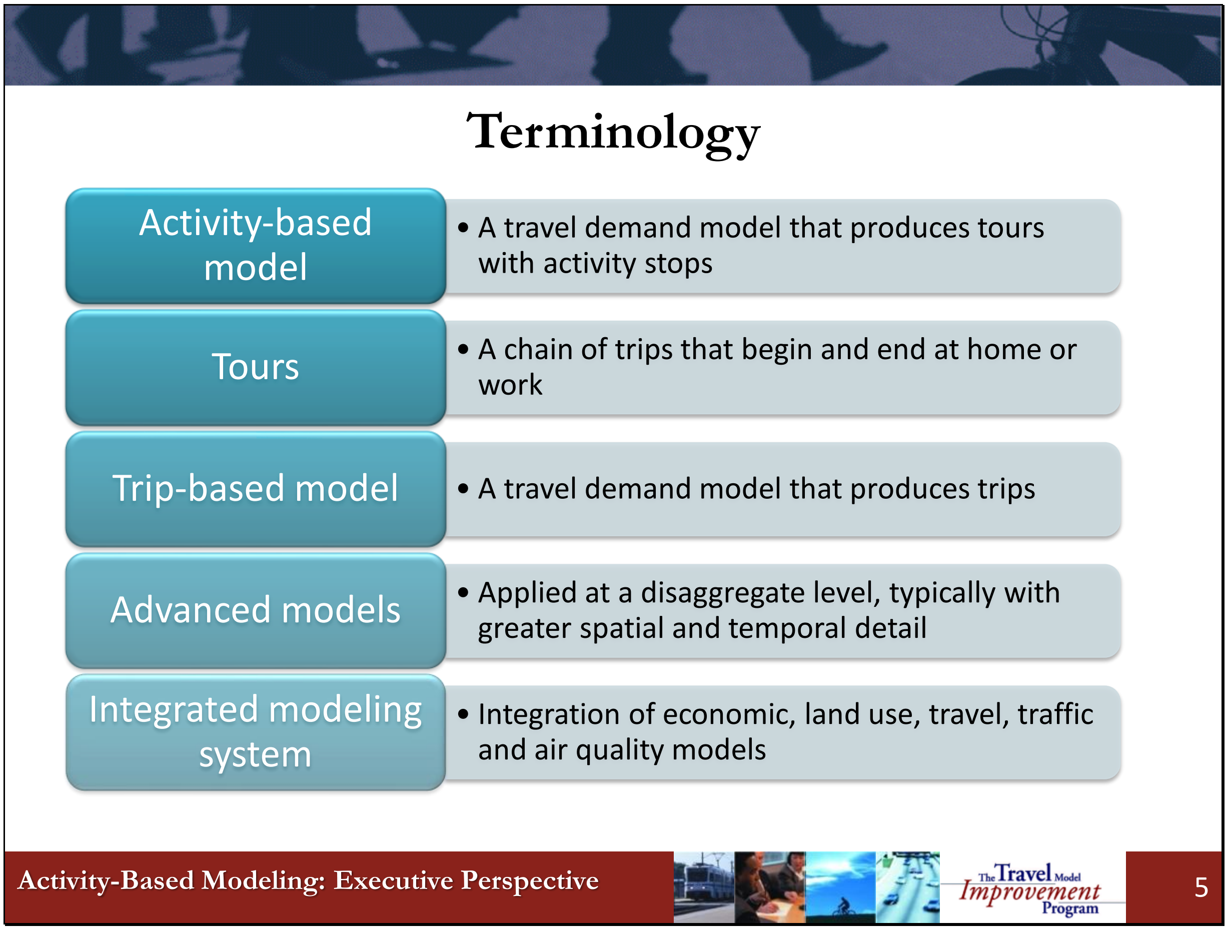
At the end of this presentation, you should understand the following executive viewpoints on:

- Why travel demand models are used in planning;
- What activity-based models can do well and what some of the limitations and challenges in using these models are;
- What policy questions are better answered with activity-based models; and
- The staff, software and hardware resources needed to implement an activity-based model.

Outline

- Overview of activity-based models and their use
- Practical advantages of activity-based models
- Limitations of activity-based models
- Policy evaluations that benefit from activity-based models
- Staff and resource requirements

(Maren Outwater) I will cover an overview of activity-based models, including providing some specific practical advantages of their use. In addition, I will cover some of the challenges and limitations of using activity-based models to provide a balanced perspective (activity-based modeling is certainly not appropriate for every agency or every purpose). Then, Joel will cover examples of policy evaluations where activity-based models have an advantage over traditional methods. Lastly, Joel will discuss the staff and resource requirements of activity-based models.



For discussion purposes, we'd like to define the following terms:

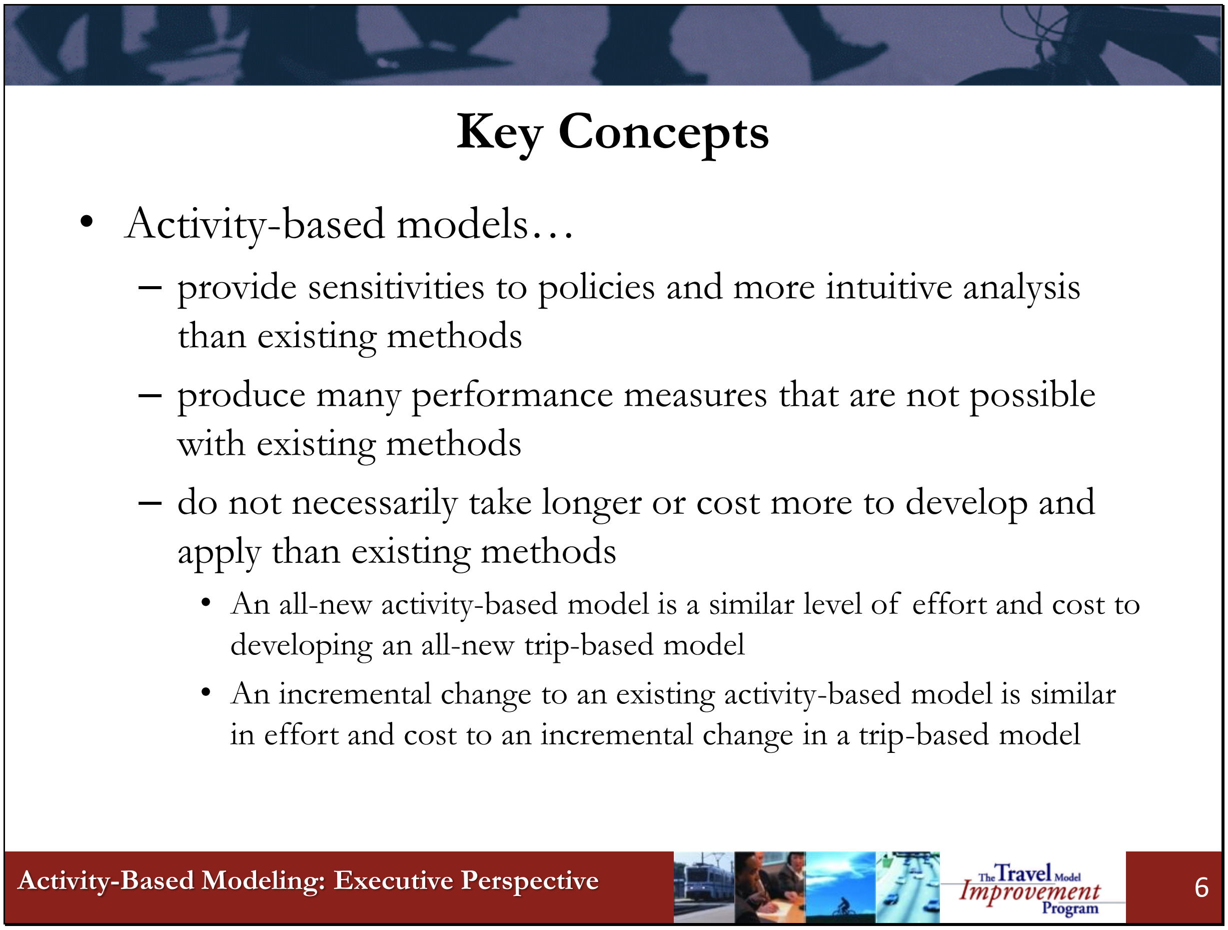
Activity-based model is a travel demand model that produces tours with activity stops, also called a tour-based travel model

Tours refers to a chain of trips that begin and end at home or work; these trips are linked so that travelers, destinations, modes and times are all consistent in the context of the tour

Trip-based model is a travel demand model that produces trips, also called a 4-step planning model

Advanced models includes activity-based models, dynamic traffic assignment, land use, economic and air quality models that are applied at a disaggregate level, typically with greater spatial and temporal detail than traditional models

Integrated modeling system involves integrating economic, land use, travel, traffic and air quality models to provide sensitivity to a broader array of variables. We will not be discussing integrated modeling systems today, but wanted to provide the context for how activity-based models are typically used in planning.



One of the most important reasons to move to an activity-based model is to provide sensitivities to policies that are not possible using existing methods. Pricing policies have been pushing many MPOs into activity-based models because prior models did not have sensitivity to price on demand, destination or route choice. Another strong benefit is that many performance measures that are important for decision-making are now possible. For example, traveler benefits accruing to different populations can be provided to assess the equity of transportation investments.

Now that the first wave of activity-based models have been developed, the time and cost of developing a new model does not necessarily take longer or cost more. It is difficult, of course, to make an “apples-to-apples” comparison of these costs, but some agencies have developed activity-based models with the same timeframe and costs as a trip-based model.

Why use models in planning?

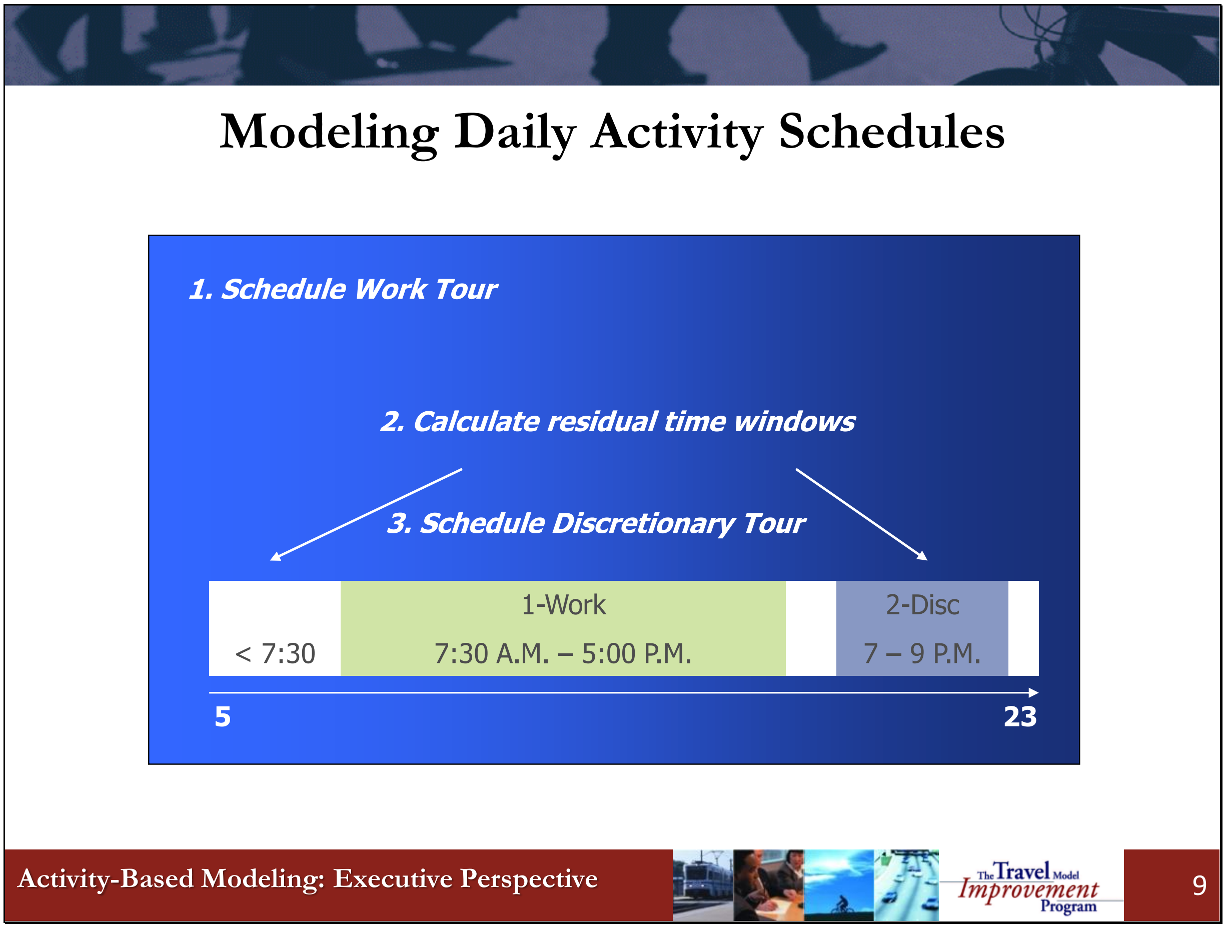
- Objective assessments of transportation investments
- Demonstrate advantages and disadvantages of alternatives
- Forecasts depend on modeling assumptions, which should be systematic and transparent
- Assess a range of outcomes based on changes in assumptions
- Evaluate potential impacts of transportation policies

Travel demand models have been used in planning to provide information for decision makers. They do not represent a decision, but allow objectivity in the evaluation of alternatives and the potential impacts of transportation policies. They can also provide insight on the specific benefits or limitations of an alternative. Models are also quite useful to better understand the impacts that various futures, such as changes in gas prices, will have on travel demand. The forecast assumptions used in travel demand models should be transparent and evaluated through sensitivity tests to better understand the uncertainty of forecasted input assumptions.

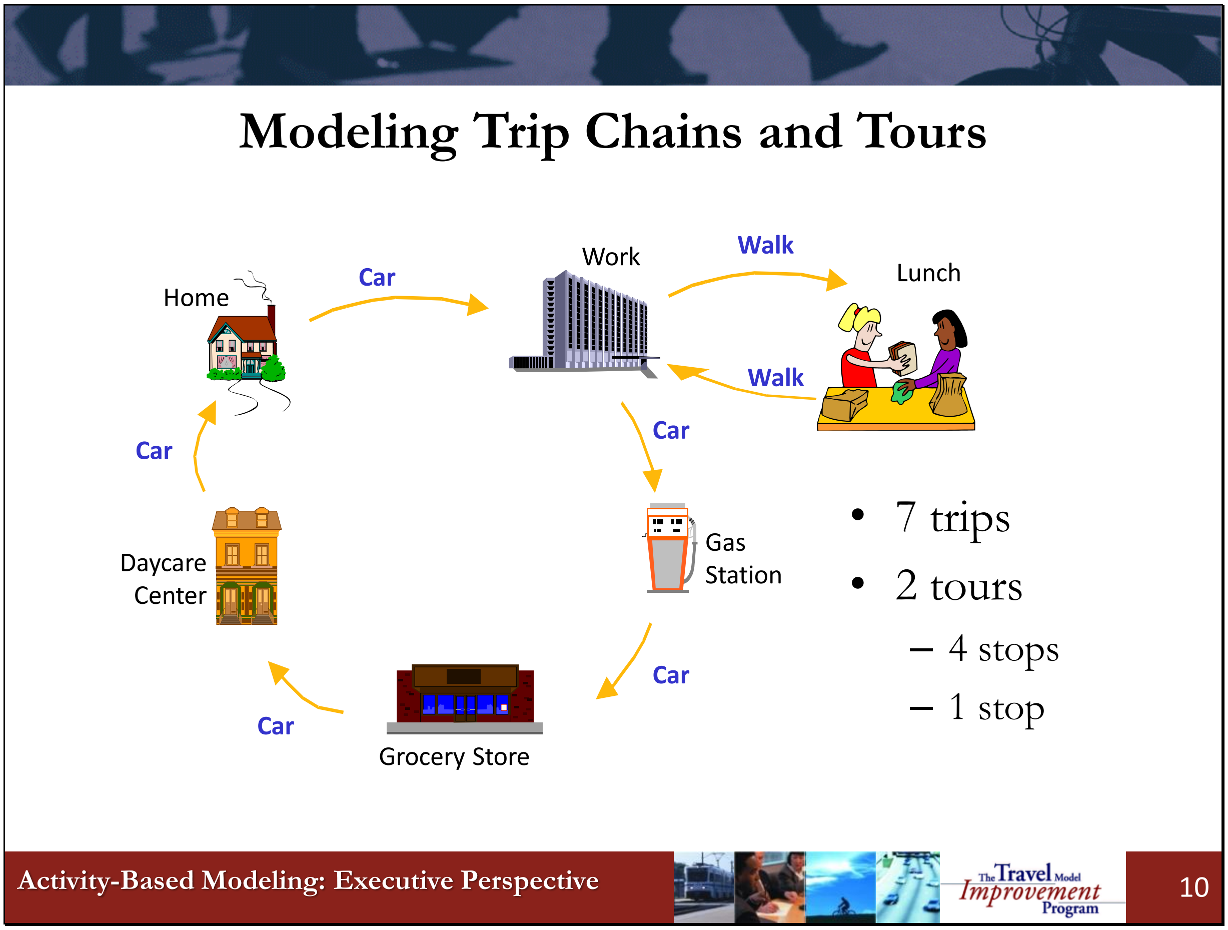
What is an activity-based travel model?

- Travel is a derived demand – it results from the need of people to engage in activities outside the home
- Activity-based travel models are based on behavioral decision-making theory
  - whether to travel
  - where to travel to
  - when to travel
  - how to travel
- This makes them better suited to address policies that affect how people make travel decisions than trip-based models

Activity-based models are more intuitively correct than traditional models because they closely follow an individual's decision-making process, whether to make a trip outside the home (or engage in activities at home), where this activity will take place, and when and how to get there. Results of activity-based models tend to be more intuitive than trip-based models also. This is because the modeled relationships underlying in the outcome behavior are more intuitive.



One concept in activity-based models is to model the full daily activity pattern and set schedules to fit these activities and the travel associated with them into a single day. Typically mandatory activities, such as work, are scheduled first and discretionary activities, such as shopping or eating out, are scheduled into remaining time periods.

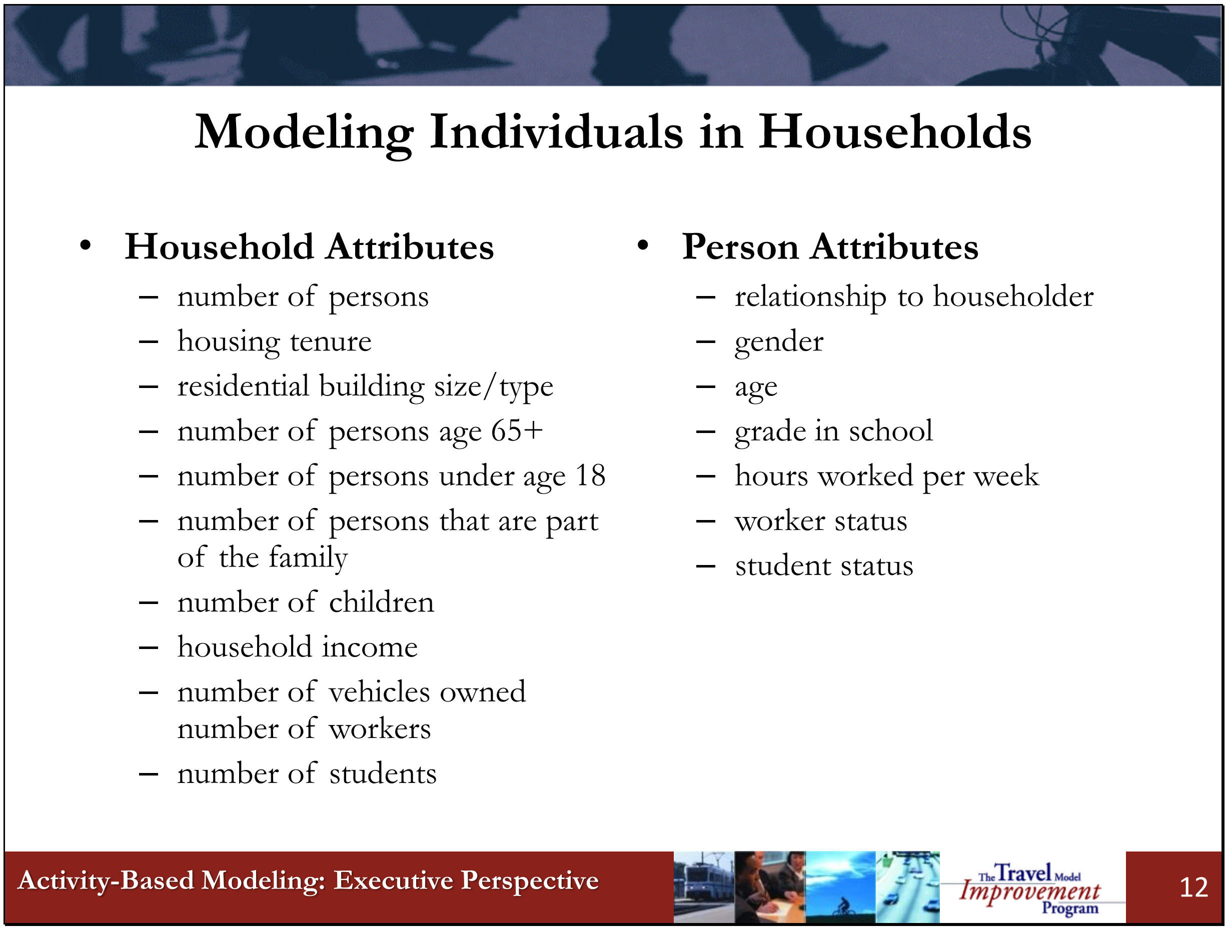


Another concept is that trips are part of a larger tour that may accomplish one or more activities and that all trips on a tour should be linked. For example, if you take your car in the morning to work, then you must use your car for running errands on the way home. You may also go out to lunch during the day, which represents another tour. Changes in this system may prompt you to go home before running errands, which means more trips and possibly different destinations, modes, or timing for these trips.

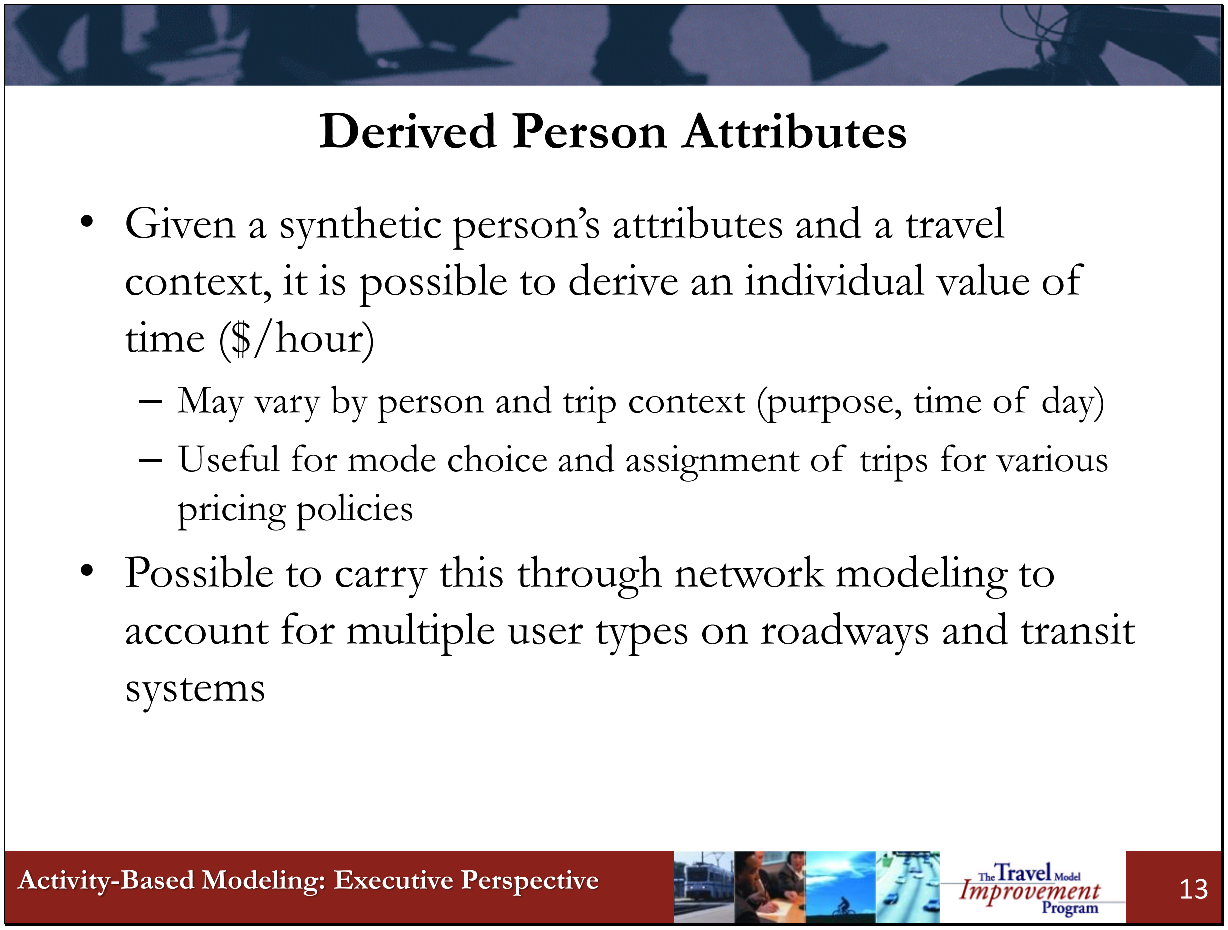
Why use an activity-based model?

- Connects travel throughout the day, similar to how decisions are made
- Is sensitive to cost, time, demographics, and policies
- Allows for greater spatial and temporal detail
- Allows greater household/person attribute detail.
- Tracks individual's travel behavior (not averages)

Activity-based models are consistent in their representation of travel behavior, which produces more consistent responses to changes in the transportation system. So, a change to the transportation system will affect whether someone will make a trip, where they make that trip, how and when in the same way. Trip-based models do not have the same level of consistency throughout the process. The other important aspect about activity-based models is that there are significantly more details and resolution on travelers, space and time, which provides more information on transportation impacts for decision-making.



For example, activity-based models can take advantage of additional household and person attributes that are available in trip-based models in a more limited fashion. These include household attributes and person attributes, which are listed on this slide. Activity-based models utilize these attributes by synthesizing a population based upon Census data records.

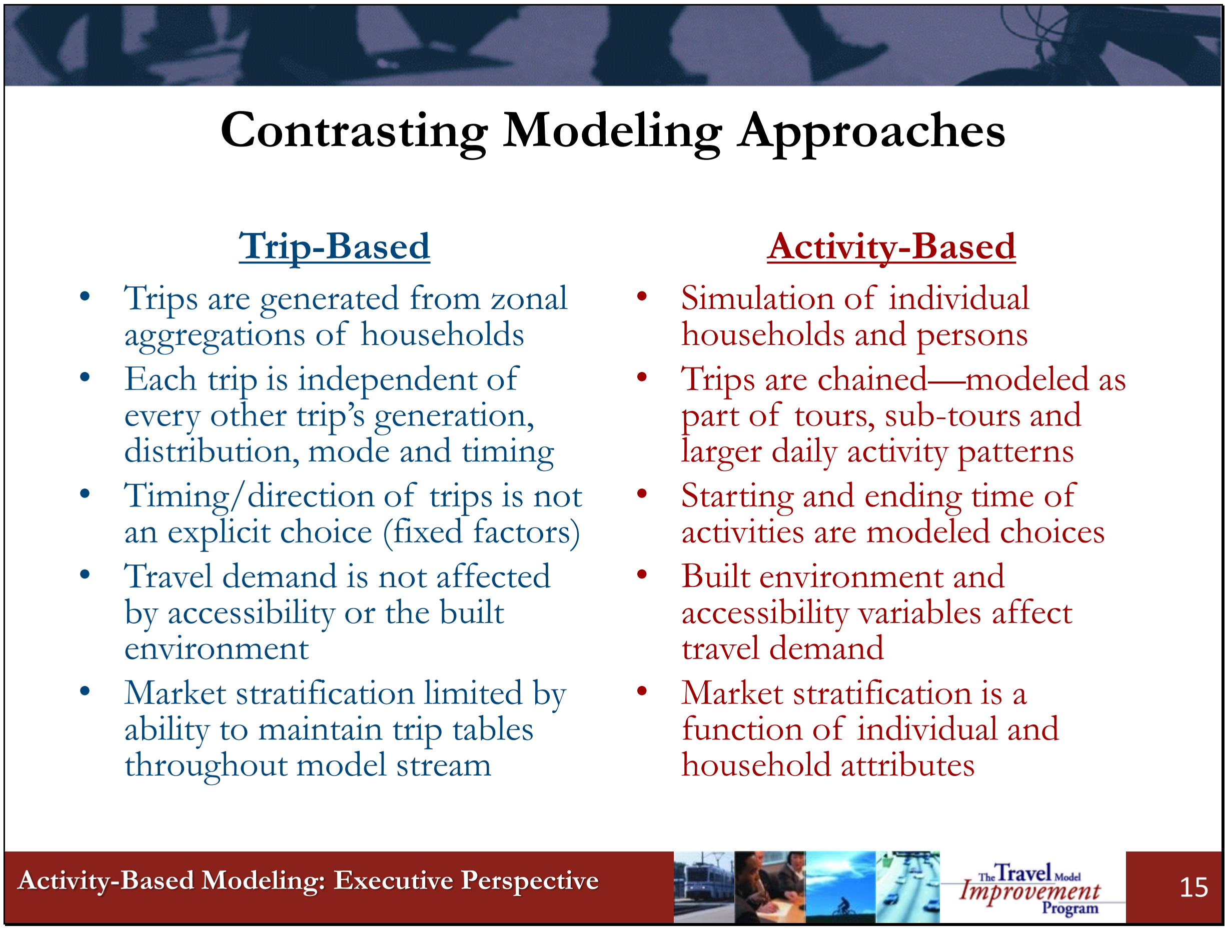


Attributes can also be derived based upon several explicit attributes listed on the previous slide. One example of an important derived person attribute is that of value of time, which can be estimated for each person and may also vary by trip purpose or time of day. This additional detail is necessary to evaluate pricing policies such as HOT lanes, cordon pricing, or tolls by time of day.

Activity Purposes

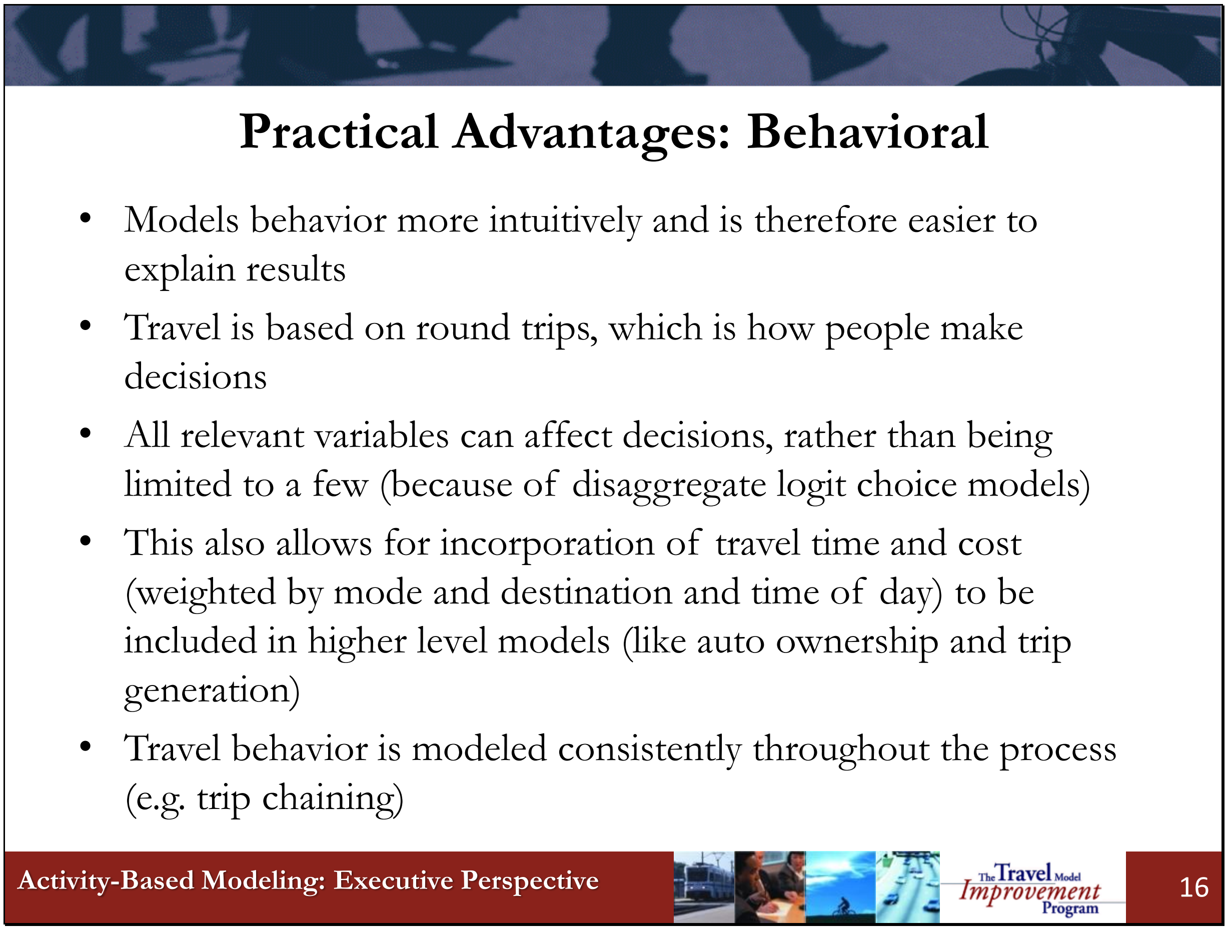
- Work
- School/College
- Personal Business (e.g., Medical)
- Shopping
- Meals
- Social/Recreational
- Escort Passenger(s)
- Joint Participation
- Home (any activity which takes place within the home)

Activity-based models typically have many more purposes than trip-based models so that these can be associated with specific land uses. Often college trips are separated from grade-school trips, in order to send the right trips, by mode and time-of-day, to the right destination. Escorting passengers and joint participation in travel provide the means to track the interactions of persons in a household so that decisions that affect this joint travel are connected. Eating meals is often modeled as a separate trip purpose from other discretionary travel.



Many of you have employed trip-based (or 4-step) travel demand forecasting models for planning purposes at your agencies. I am going to talk about some of the benefits and limitations of activity-based models in a minute, but wanted to start with a simple comparison of the approaches.

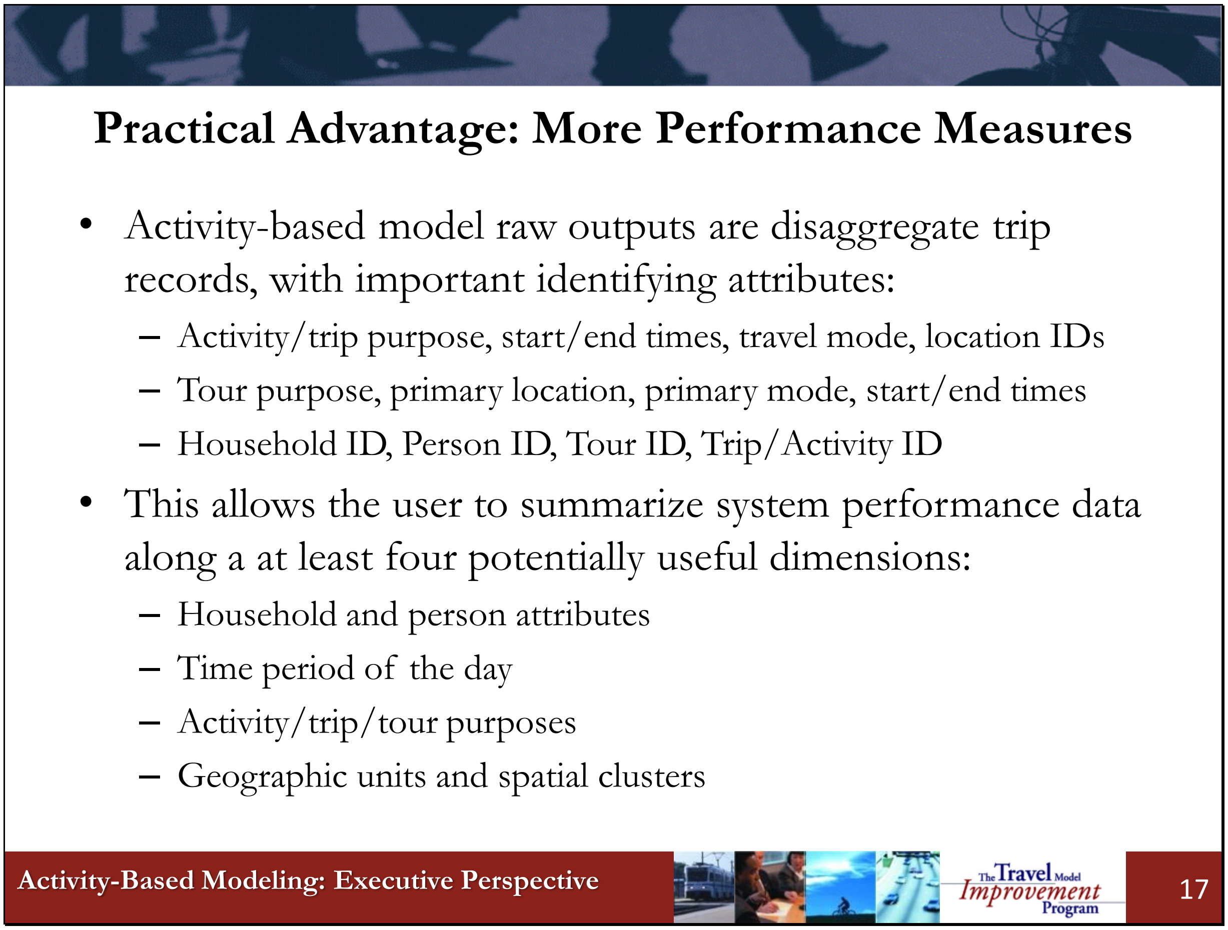
- Most activity-based models simulate individual travel, whereas most trip-based models generate aggregate zonal estimates of travel;
- Most activity-based models model trip timing as a choice, whereas most trip-based models use fixed factors for trip timing;
- Most activity-based models show how accessibility and the built environment affect travel demand, whereas most trip-based models do not; and
- Trip-based models have limited market segmentation capabilities, whereas activity-based models do not.



One of the best features of activity-based models is that travel choices are based on round trips and daily activity patterns. For example:

- If I need to stay late at work and there is no bus home at that hour, I will not choose to ride transit to work regardless of how good the service is.
- If I decide to run errands near work at lunchtime, then I won't need to stop on the way home.
- If I am telecommuting to work or school, then I won't need to travel at all.
- If there are new tolls on the system, I may choose to shop somewhere closer to home or on-line.

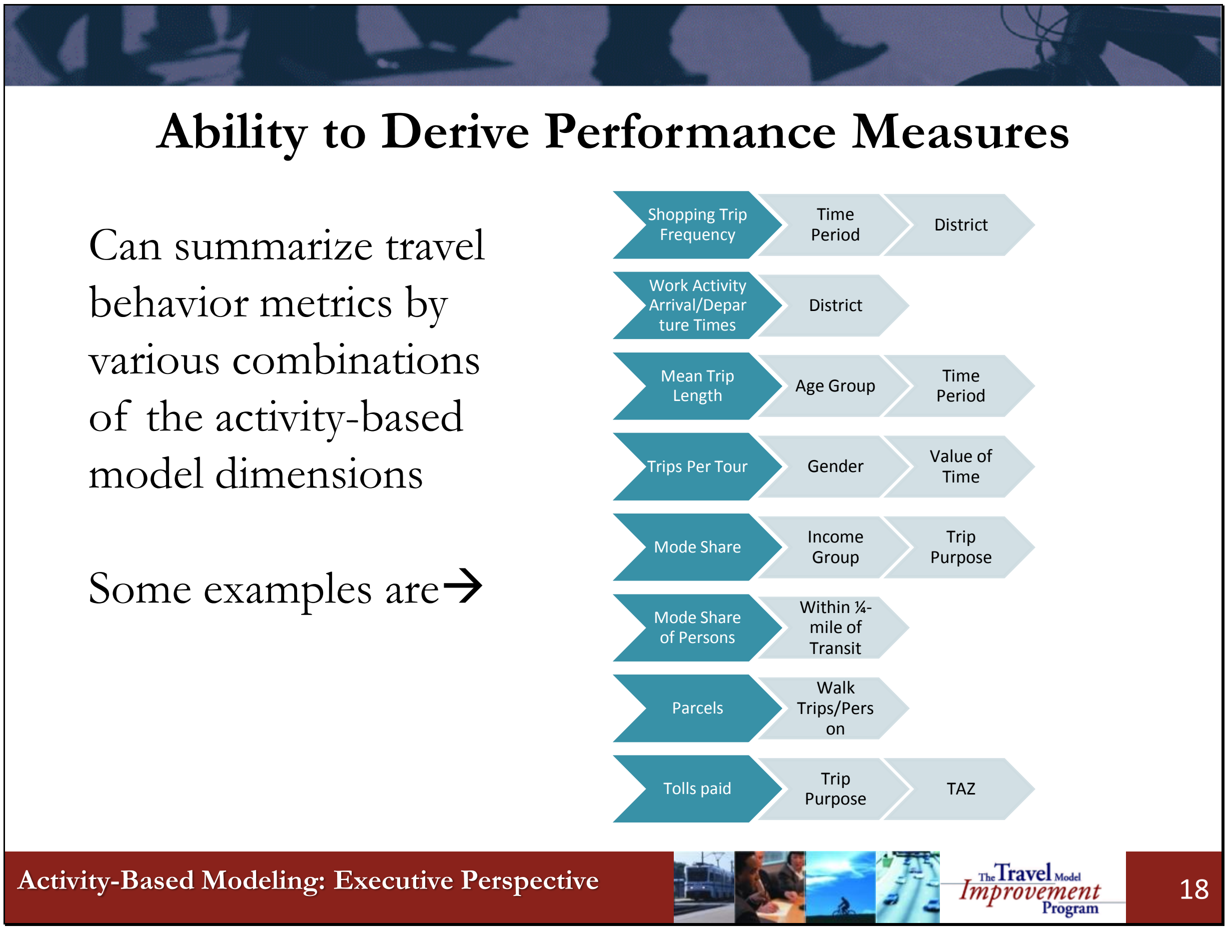
All of these factors are modeled consistently by the behavioral processes in an activity-based model.



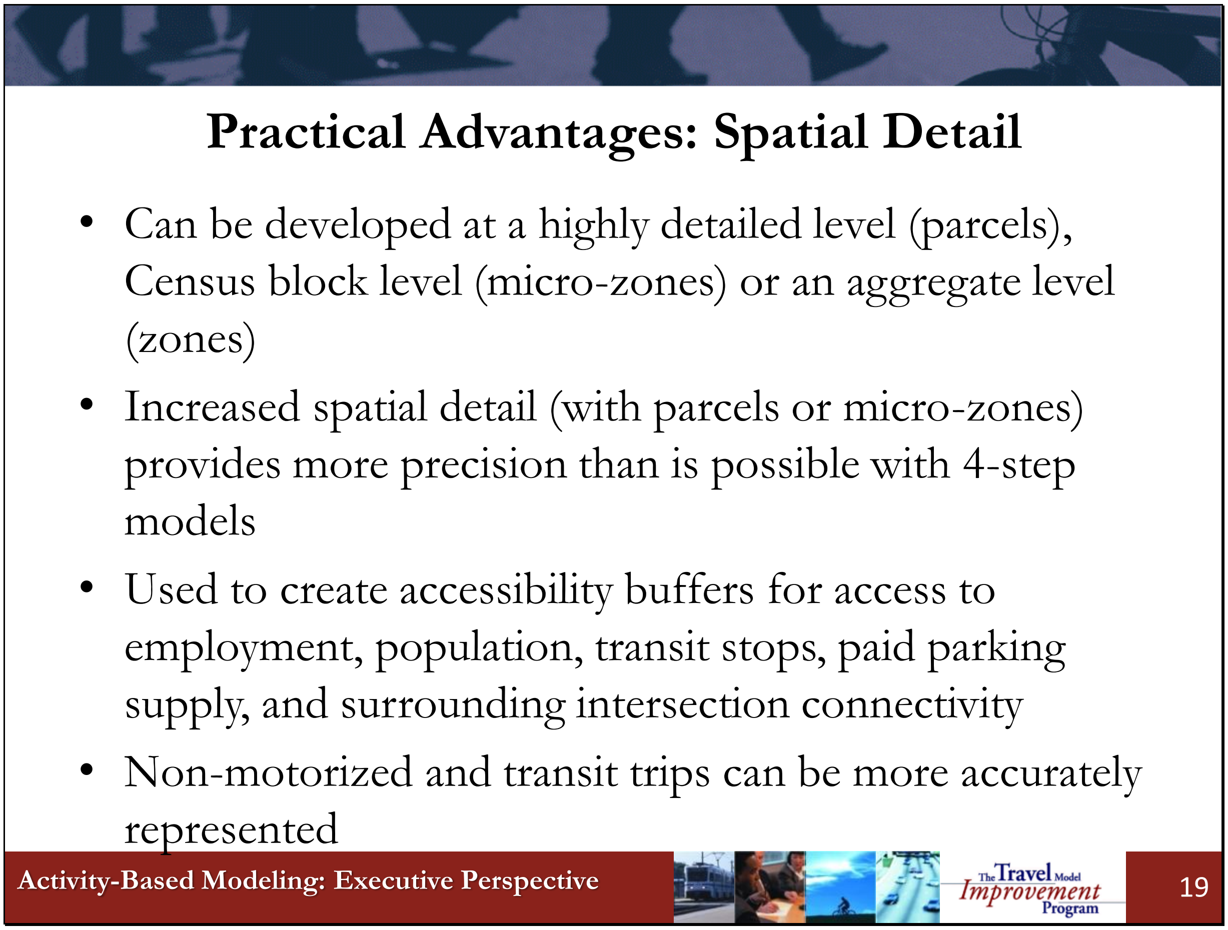
Another important advantage is that the additional detail in the models provides many more measures of performance for decision-makers. For example:

- Travelers benefits can be attributed to different populations, such as low income groups, to evaluate the equity of specific alternatives;
- VMT or emissions outputs can be attributed to households to understand who is causing these impacts and where they live;
- Congestion can be evaluated by half-hour time periods to understand the impact of pricing policies or capacity investments on delay; and
- Traveler benefits can be attributed to clusters of employment that are important for economic development.

Current trip-based models are not equipped to handle any of the above measures.



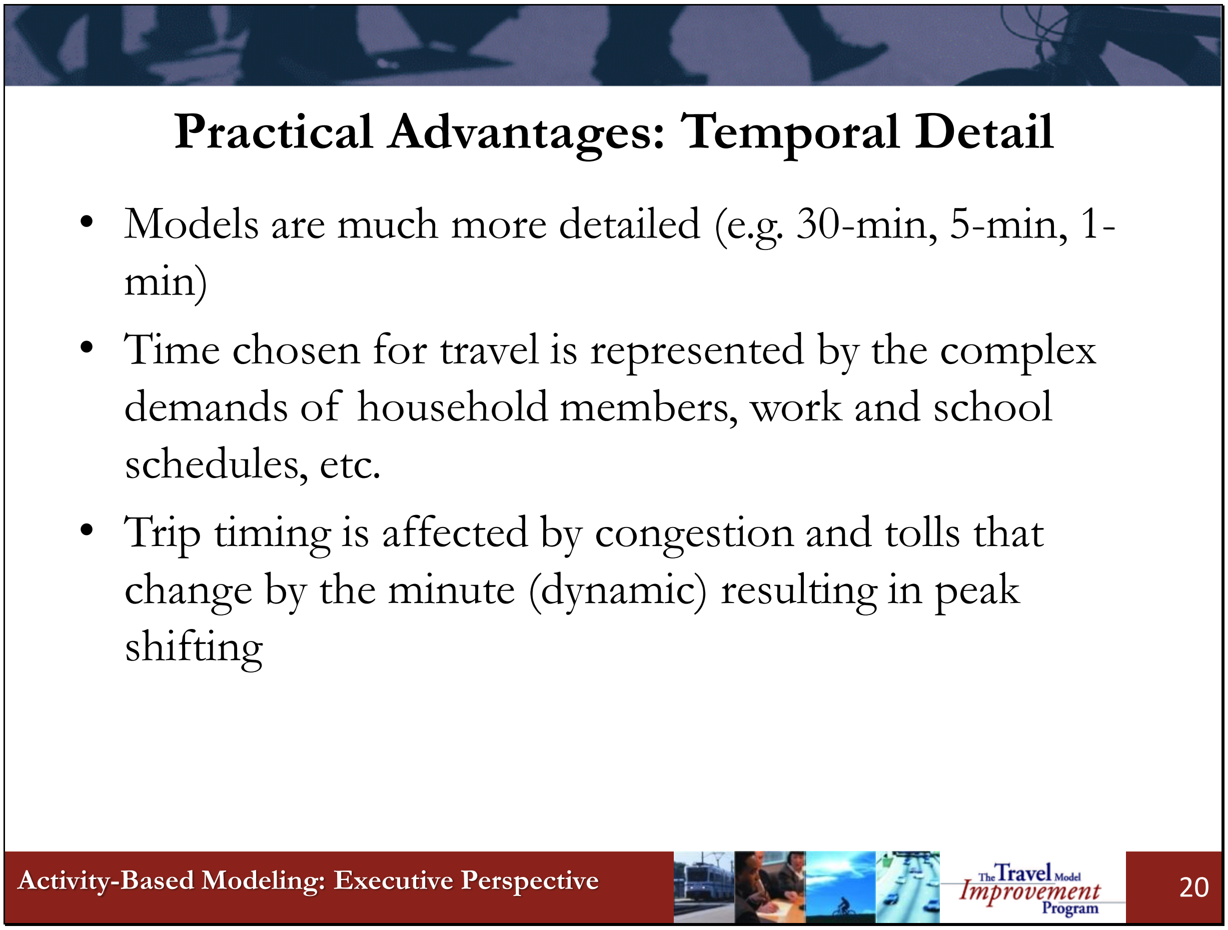
There are many more examples of performance measures that are possible because activity-based models are based in individuals, which can be summarized across any number of traveler or trip characteristics. These measures include time spent in various activities, frequency of travel for various purposes, and person-type summaries of model outputs.



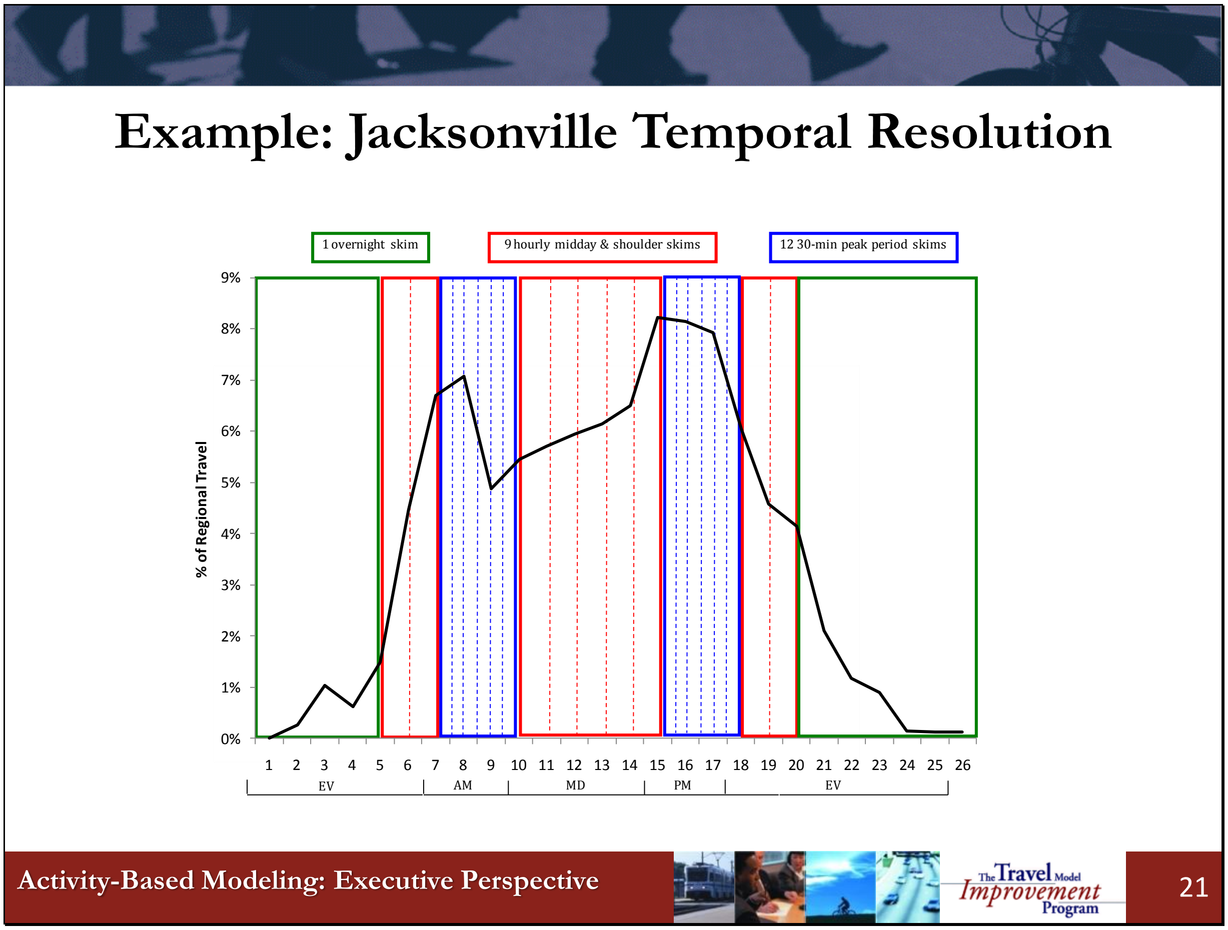
Spatial detail in activity-based models has been developed at the parcel level, the micro-zone level, or the traditional analysis zone (TAZ) level. The increased detail of parcels and micro-zones offers more precision, more information for reporting, and more intuitive results. For example:

- Shopping activities would primarily be located on retail parcels
- Each job will be filled by a single worker in that industry

The built environment can be represented by buffers of population and employment within a certain distance of transit stops or parking and by network or urban densities. For example, transit oriented development can be specifically represented. Non-motorized travel (walk and bike) and walking to transit also can be explicitly modeled with this additional spatial detail.



Activity-based models are typically much more detailed temporally as well. Often time is measured in 30 minute time intervals, if not smaller. This provides benefits for evaluation of operational strategies at the regional level as well as traffic operations at a local level. With this additional level of detail, analysis of dynamic pricing strategies is possible.



Here is an example of additional temporal resolution in the Jacksonville model. The variations within a traditional broader time period are significant and may produce misleading results when an average volume or delay is calculated.

Practical Advantages: Micro-simulating Demand

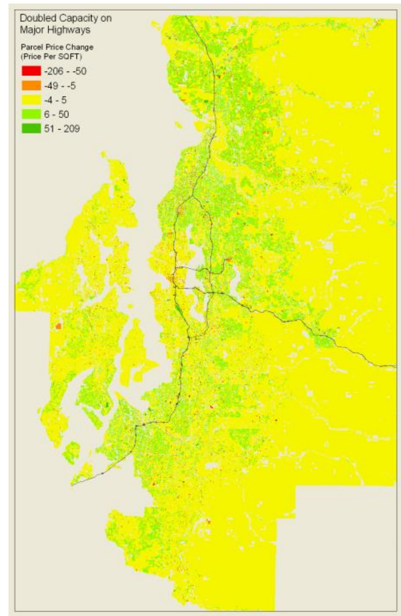
- Results are disaggregate and can be combined along many dimensions for analysis
- Monte Carlo simulation approach can be used with large samples
- Results show a range of possible outcomes or random variation can be fixed to produce a single outcome

Monte Carlo simulation is a computerized mathematical technique that allows people to account for risk in quantitative analysis and decision making.

When we synthesize population for the activity-based model, we draw samples of households with the representative characteristics from the Census. This is one example of a Monte Carlo simulation approach that is used throughout activity-based models to simulate an individual characteristic within a known distribution. The simulation can produce different results each time because of the random draws, but the random draws can also be fixed to produce the same outcome each time. The range of outcomes can be used to reflect the uncertainty in models of this type.

Practical Advantage: Visualization of Results

- There are many new types of measures that can be reported
- Detailed spatial or temporal data can be visualized quickly
- Aggregated results can be reported across many different dimensions

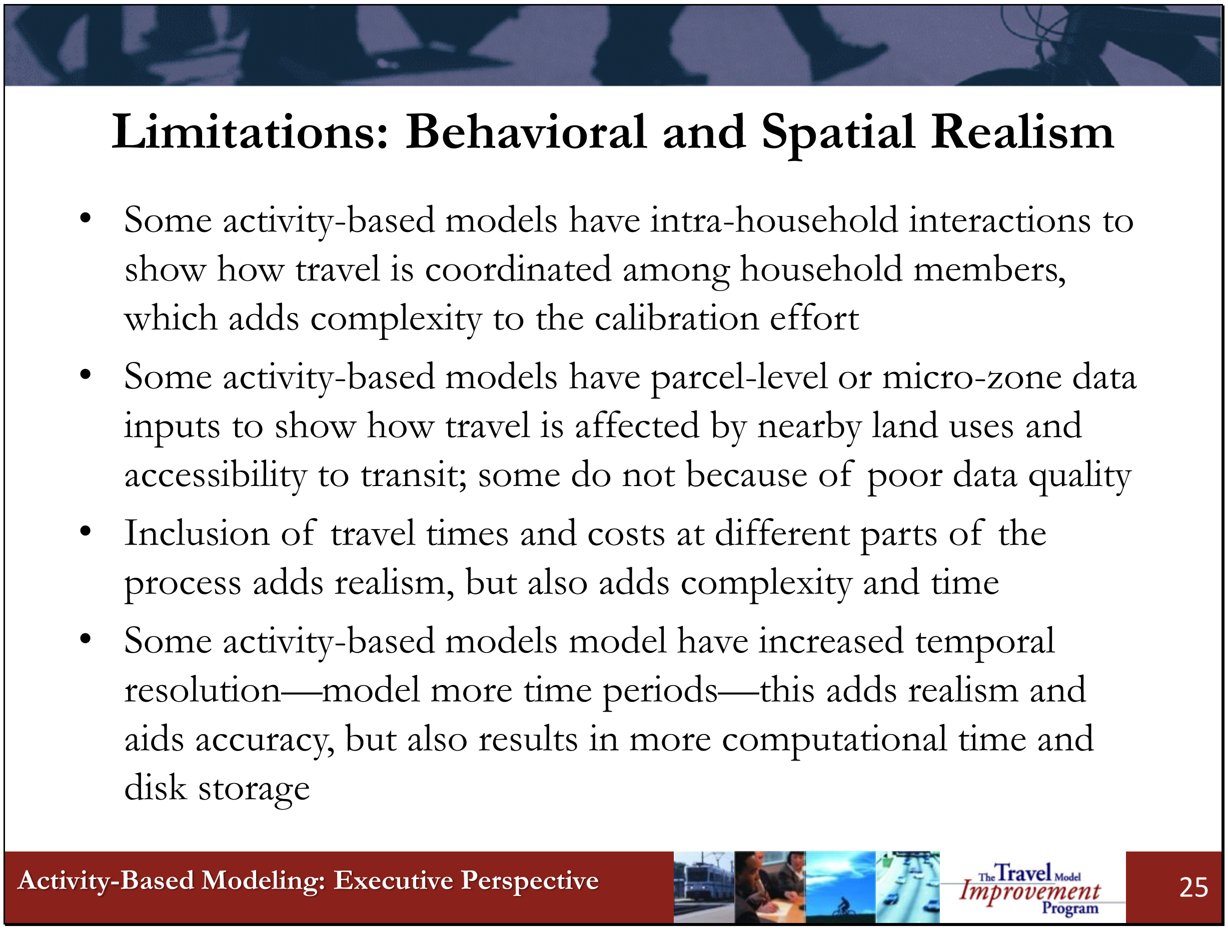


The visualization of results in activity-based models is possible because of the additional spatial and temporal detail and market segmentation that are contained in the models. For example, this plot of change in real estate prices for each parcel in the Seattle region (1.2 million) shows a positive change in price due to expanded highway capacity.

Limitations: Computational Challenges

- Tradeoffs between
  - Model features
  - Optimized software
  - Hardware
  - Run time
- New, unconventional software platforms

One of the bigger challenges for activity-based models in the past has been the development of new software platforms, which are now more stable than they were in the beginning. The computational challenge for these software platforms has been the tradeoff between modeling features, optimization of the programs, more expensive hardware and run times. Each agency may identify one or more of these as objectives and must tradeoff the others in order to achieve the objective. For example, if I want to limit run time, then I will need some combination of fewer model features, more optimized programs, and more expensive hardware.



While more complexity is possible, it is not always desirable, and it should be tailored to the region's needs. Tradeoffs for behavioral and spatial realism are inevitable. It is also important to note that activity-based models can be developed in phases to add detail over time.

Advantage and Limitation: Data

Traditional data that is generally applicable:

- Household travel survey data
- Highway and transit networks and zone systems
- On-board surveys

Other data desired includes:

- Parking supply and cost
- Built environment
- Pedestrian/bike

Data can be limited to existing sources, but advantages of the activity-based models will be dependent on level of detail, quality and completeness of the data

The Travel Model Improvement Program

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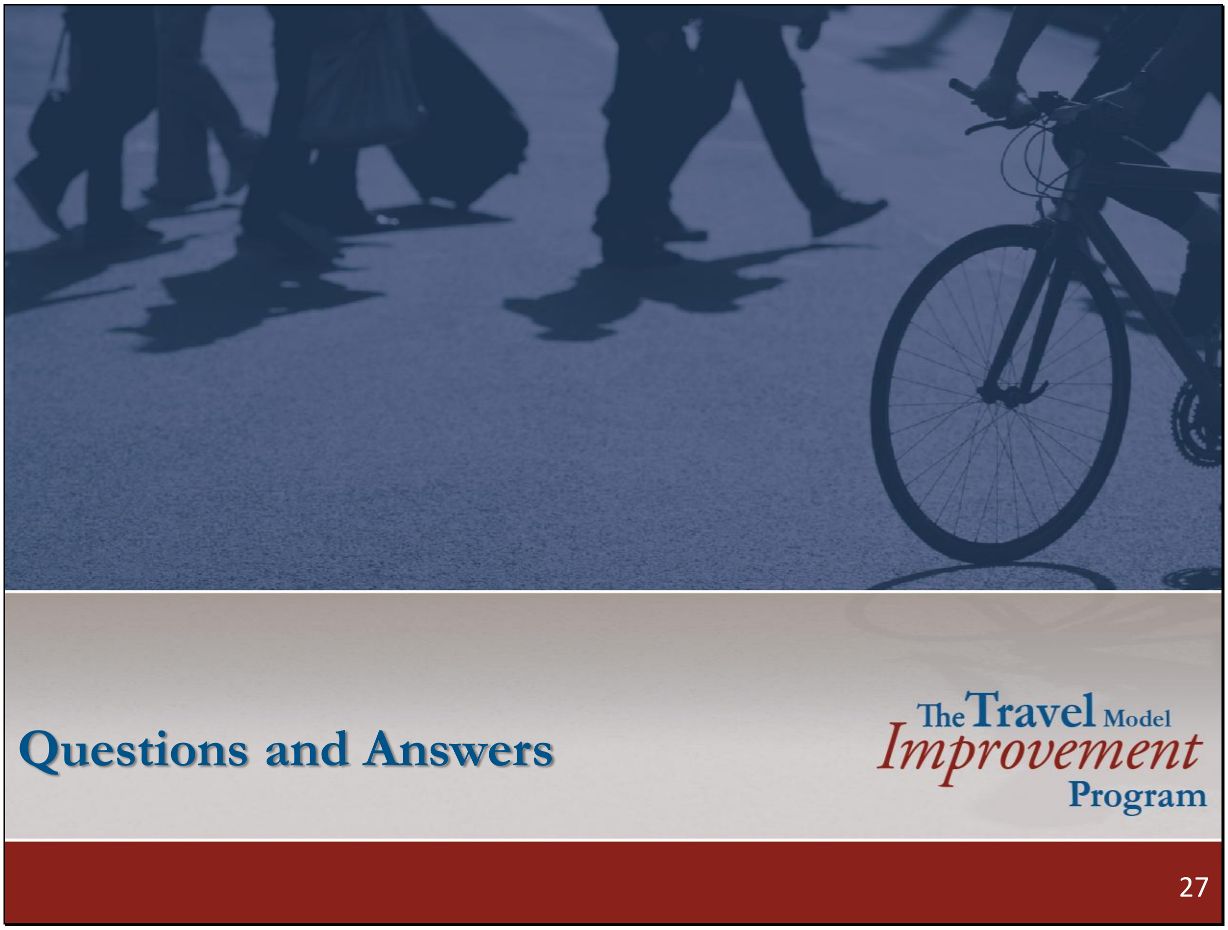
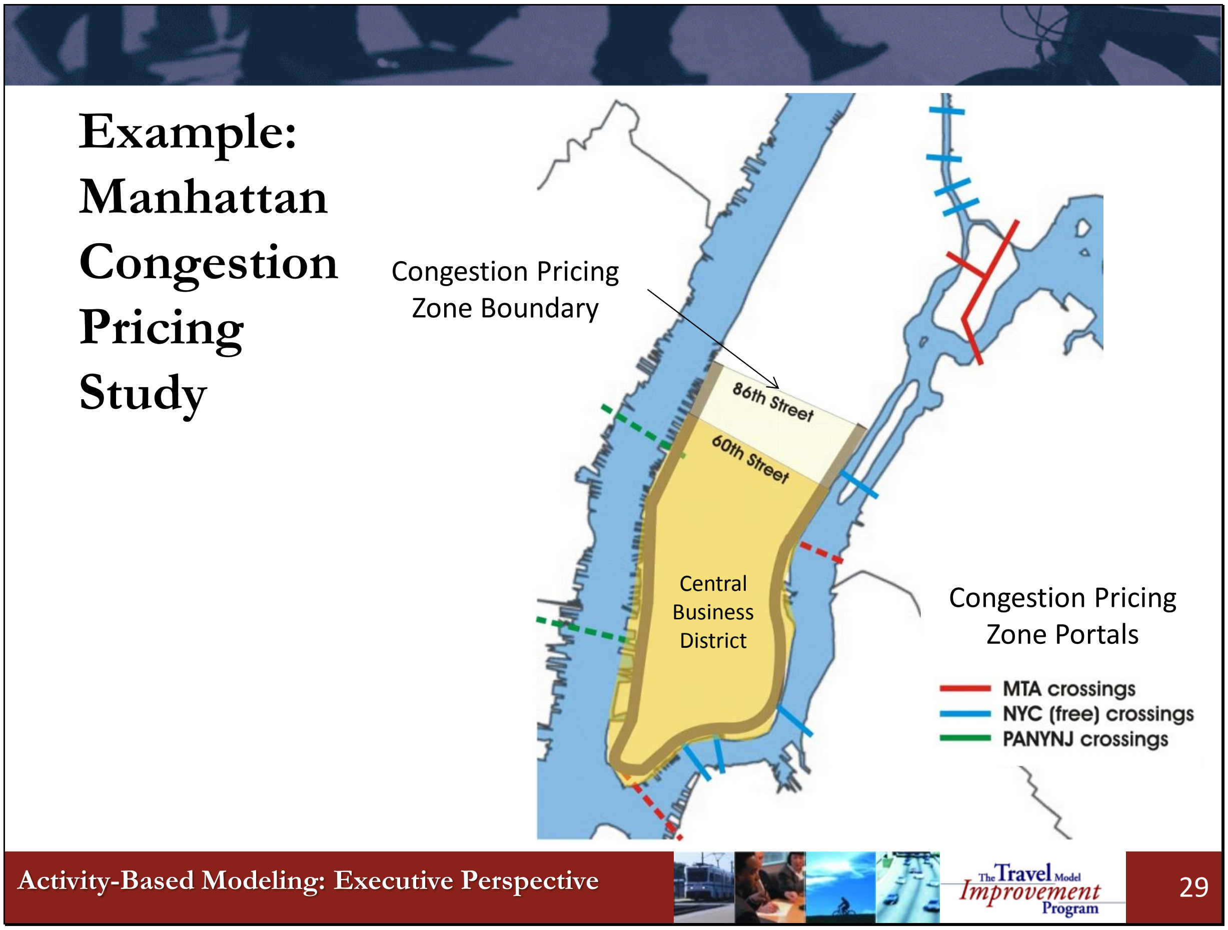
Activity-based models offer an advantage in that many new types of data can be utilized and the models can take advantage of more detailed data. Activity-based models also can be implemented with primarily traditional data sources, but this will limit its advantages so incremental improvements should include enhancements to the data. Activity-based models use traditional data in more rigorous ways, so the quality and completeness of these data are more important (and also easier to check and correct).


Questions and Answers
The Travel Model Improvement Program
27

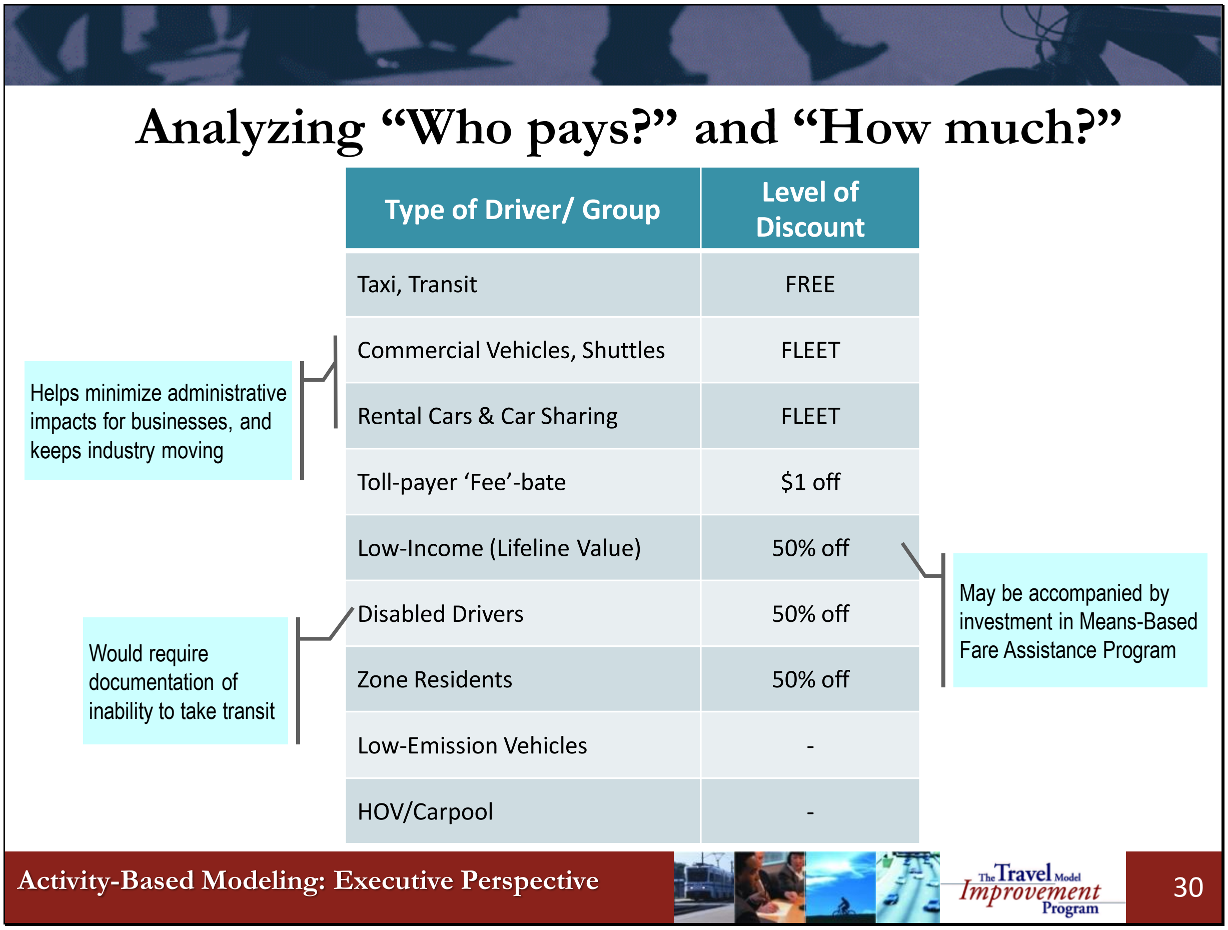
Policy Evaluation: Pricing

- Ability to represent time-cost tradeoffs on multiple, relevant travel choices:
  - Daily/trip choices: route, time of day, mode, location, vehicle occupancy, pay toll/avoid toll, parking
  - Long-term choices: work and school location, vehicle ownership, transit pass holding
- Affected by income, household structure and mobility resources

Many MPOs that have invested in the development of an activity-based model are motivated by the need to model pricing policies such as toll lanes, high-occupancy toll lanes, parking pricing, and/or congestion pricing schemes. Activity-based models are able to represent multiple dimensions of travel choices that are affected by pricing policies, such as route choice, time-of-day, mode choice, location choice, and parking location choice. Longer-term decisions such as work and school location choice, vehicle ownership, and transit pass-holding can also be affected, and those affects can be modeled. Appropriate sensitivities can be represented in the model by income, household structure, and mobility resources such as auto ownership.



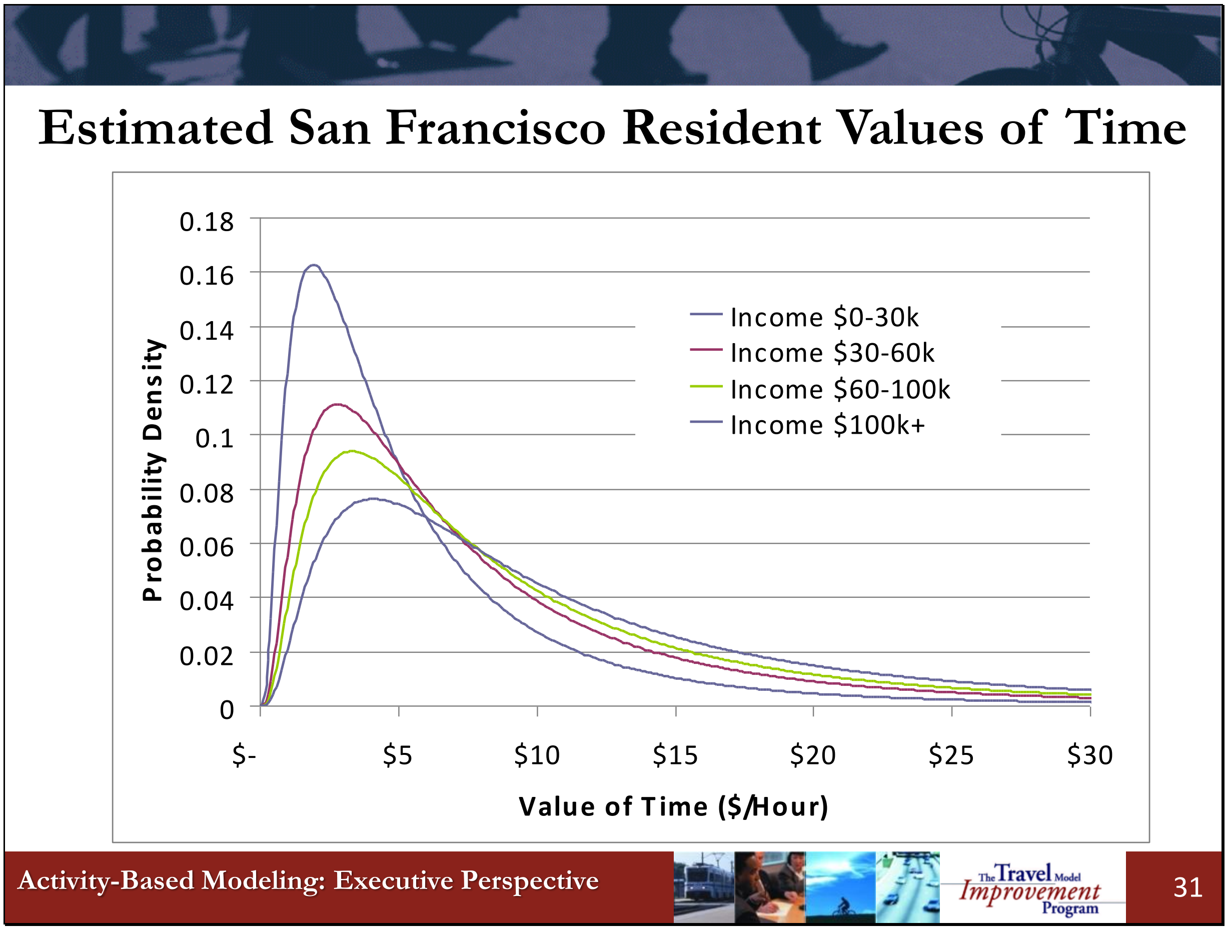
One of the first activity-based model applications for a major pricing project in the United States was the application of the New York Metropolitan Region (NYMTC) activity-based models to a congestion pricing policy for Manhattan. The application tested a number of congestion pricing schemes, including a cordon pricing scheme, where all auto trips crossing the zone boundaries indicated on the slide were charged a fee.



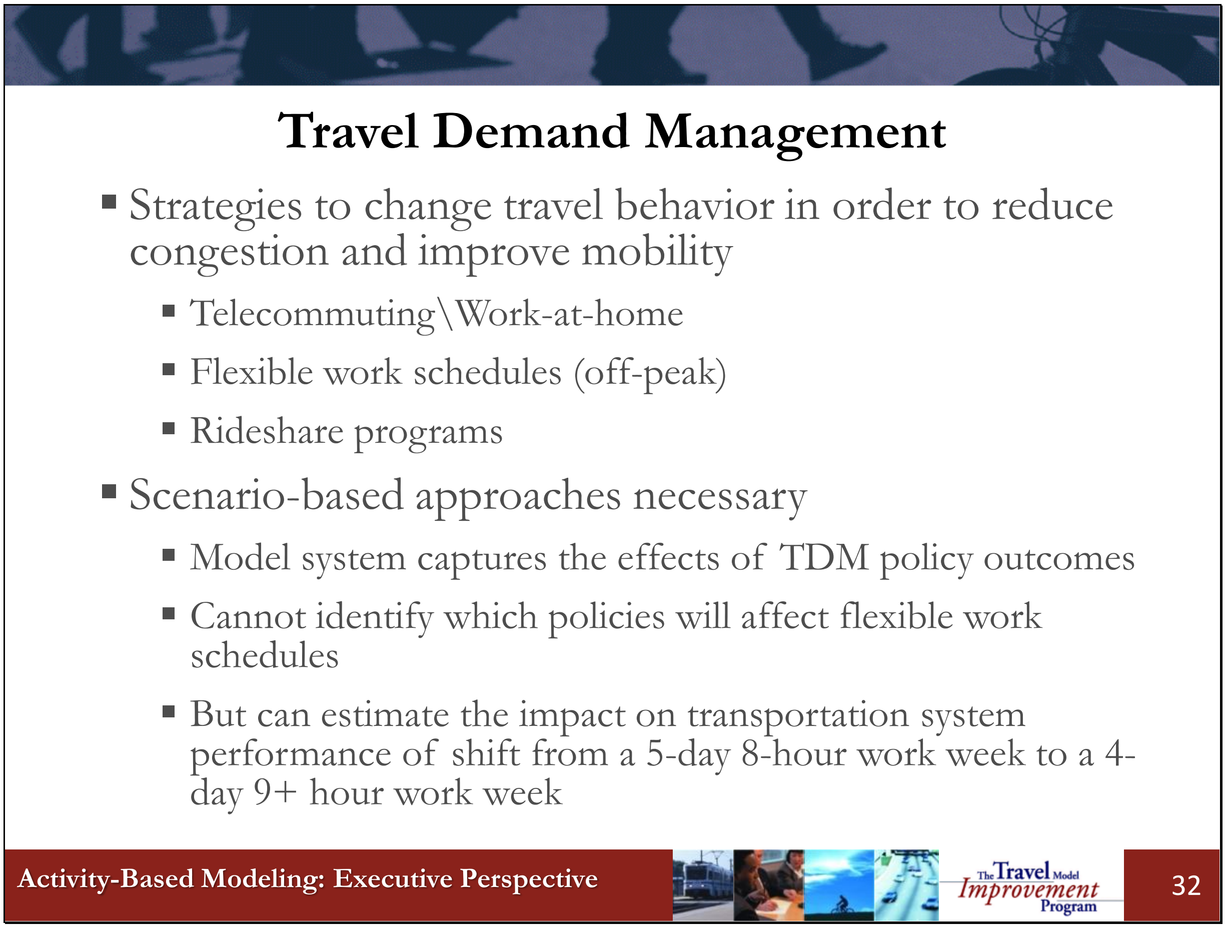
Analyzing “Who pays?” and “How much?”

Type of Driver/ Group	Level of Discount
Taxi, Transit	FREE
Commercial Vehicles, Shuttles	FLEET
Rental Cars & Car Sharing	FLEET
Toll-payer ‘Fee’-bate	$1 off
Low-Income (Lifeline Value)	50% off
Disabled Drivers	50% off
Zone Residents	50% off
Low-Emission Vehicles	-
HOV/Carpool	-

Another congestion pricing application involved the San Francisco County Transportation Authority (SFCTA) activity-based model. This shows an example of one of the toll policies explored in the study. The complexity of the policy, in terms of the types of discounts offered to different user groups, is difficult to represent efficiently with a trip-based model.



A key assumption in any road pricing study is travelers' value of time, which determines the tolls that travelers are willing to pay to achieve certain travel time savings. We know from many surveys and studies that values of time are situational and that they vary greatly, from person to person and even for any given person, depending of the situation. The SFCTA model represents this value of time variability explicitly, and doing so helps to obtain a more logical response to tolls from the model.



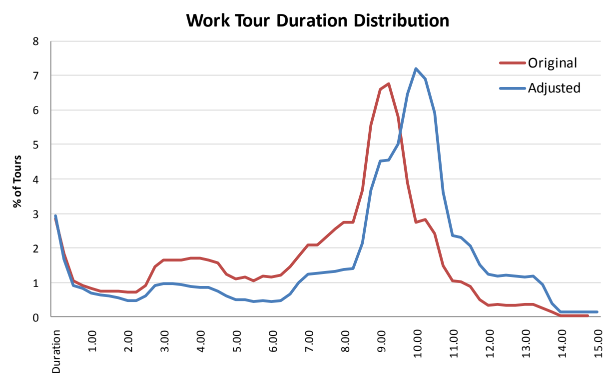
Travel demand management schemes are another policy application that activity-based models are particularly well-suited for. Travel demand management strategies seek to change travel behavior in order to reduce congestion and improve mobility, and include strategies such as telecommuting, flexible work schedules, and rideshare programs. Though it is difficult for any model to predict participation in such programs, it is possible to use a scenario-based approach in order to model the program’s effects on transport demand, congestion, and air quality. A scenario-based approach involves making assumptions about participation rates (or borrowing rates from other existing programs) and adjusting model demand to match those assumptions. The model is then run to determine the impacts of those assumptions.

TDM Analysis: Burlington, VT

- "Flexible Schedule" scenario
- Asserted assumptions about:
  - Fewer individual work activities
  - Longer individual work durations
  - Aggregate work durations constant
- Target: Fulltime Workers

Tours by Purpose (Fulltime Workers)

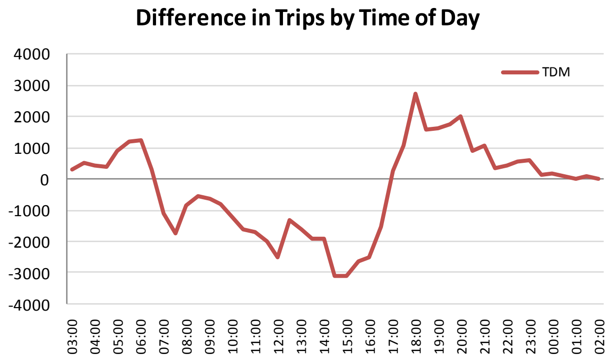
	Original	Adjusted	Adj/Orig
Work	94,408	78,472	0.83
School	115	140	1.22
Escort	8,070	9,023	1.12
Pers Bus	13,519	16,848	1.25
Shop	10,531	12,938	1.23
Meal	3,817	3,842	1.01
Soc/Rec	13,076	14,360	1.10
Workbased	27,949	23,211	0.83
Total	171,485	158,834	0.93



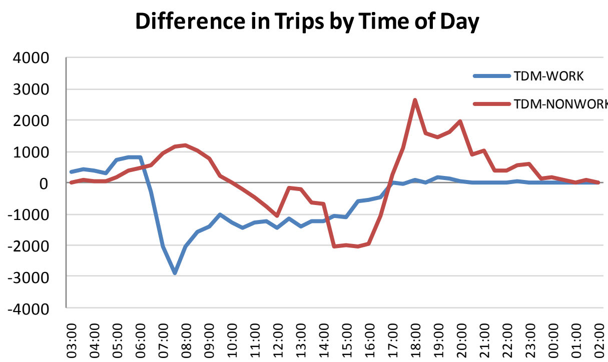
For example, a flexible schedule scenario was run using the Burlington, Vermont activity-based model. The scenario assumed that there would be approximately 20% fewer work and work-based tours as a result, but with longer work tour durations. The tour generation and time-of-day choice models were adjusted according to these assumptions, and the model was run to determine the impacts on other dimensions of travel.

TDM: Demand Impacts

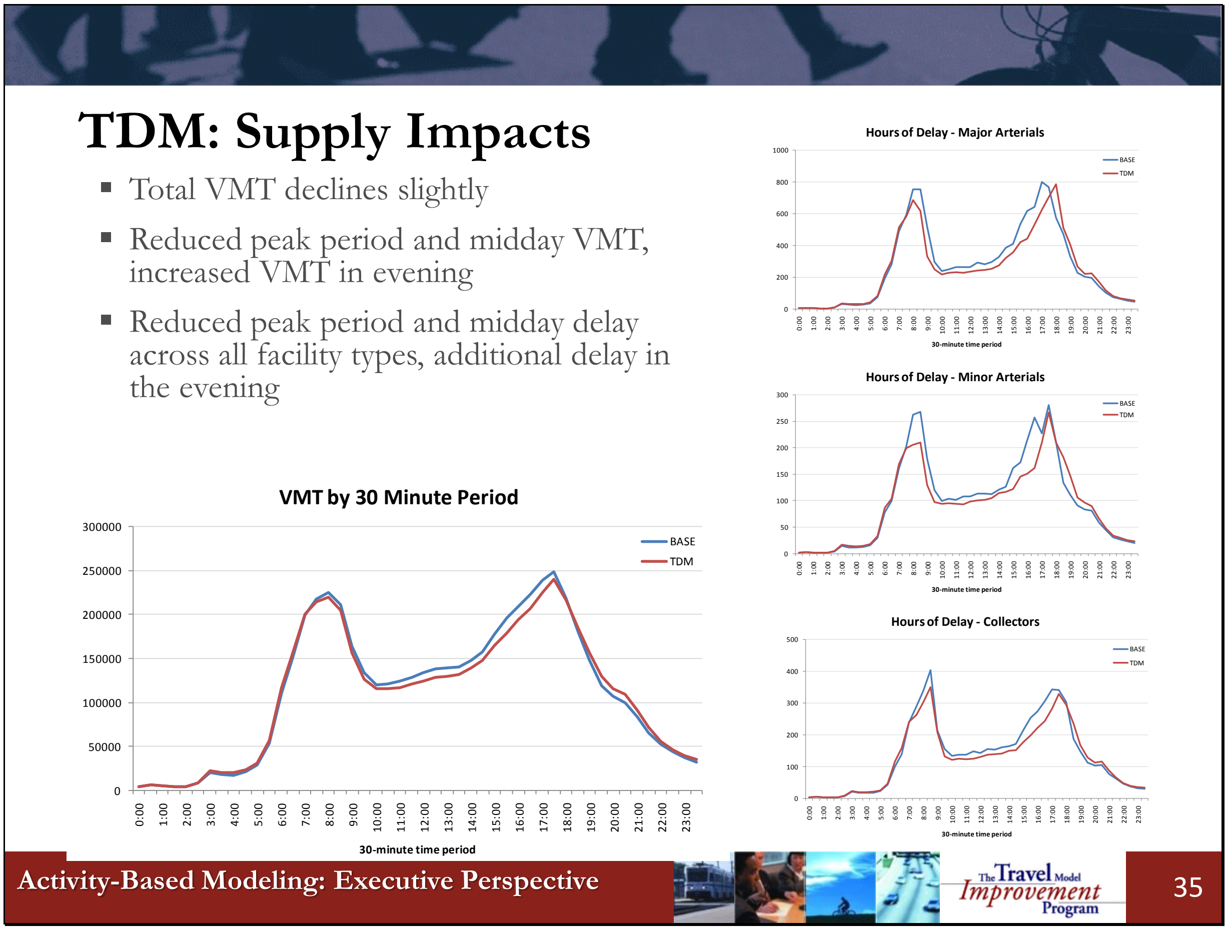
- ~4% Reduction in overall trips
- Reduced peak period and midday travel
- More early AM travel and evening travel



- Fewer, and earlier, work trips
- More nonwork trips in morning and evening with fewer in midday



The results shows a 4% overall reduction in trips, with reduced peak period and midday travel, but more early AM and evening travel (due to the longer work hours). There were also more non-work trips in the morning and the evening, as workers seek to fulfill travel needs (such as shopping and escorting) at other times in the day.

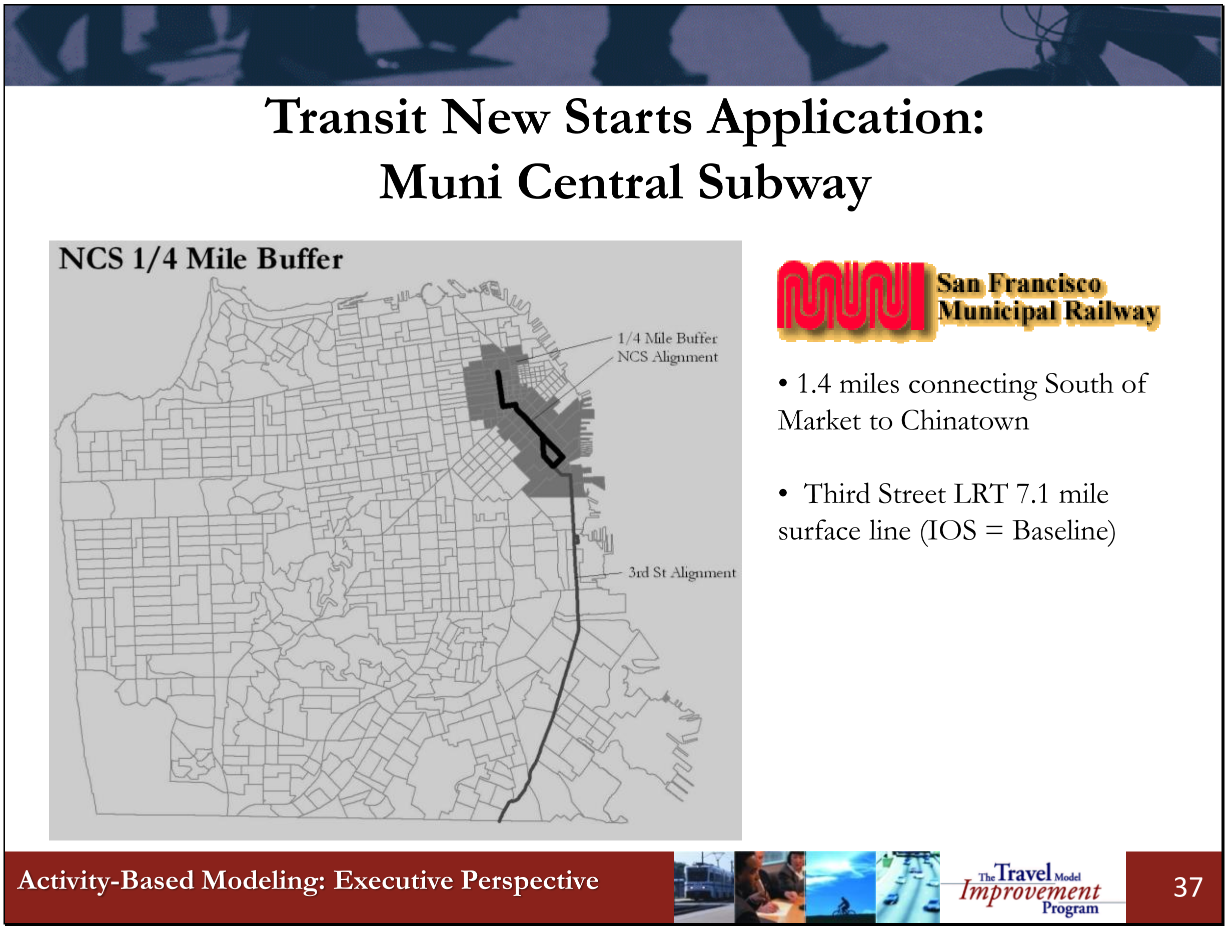


Only slight declines were observed in vehicle-miles of travel (VMT), with slight increases in the evening.

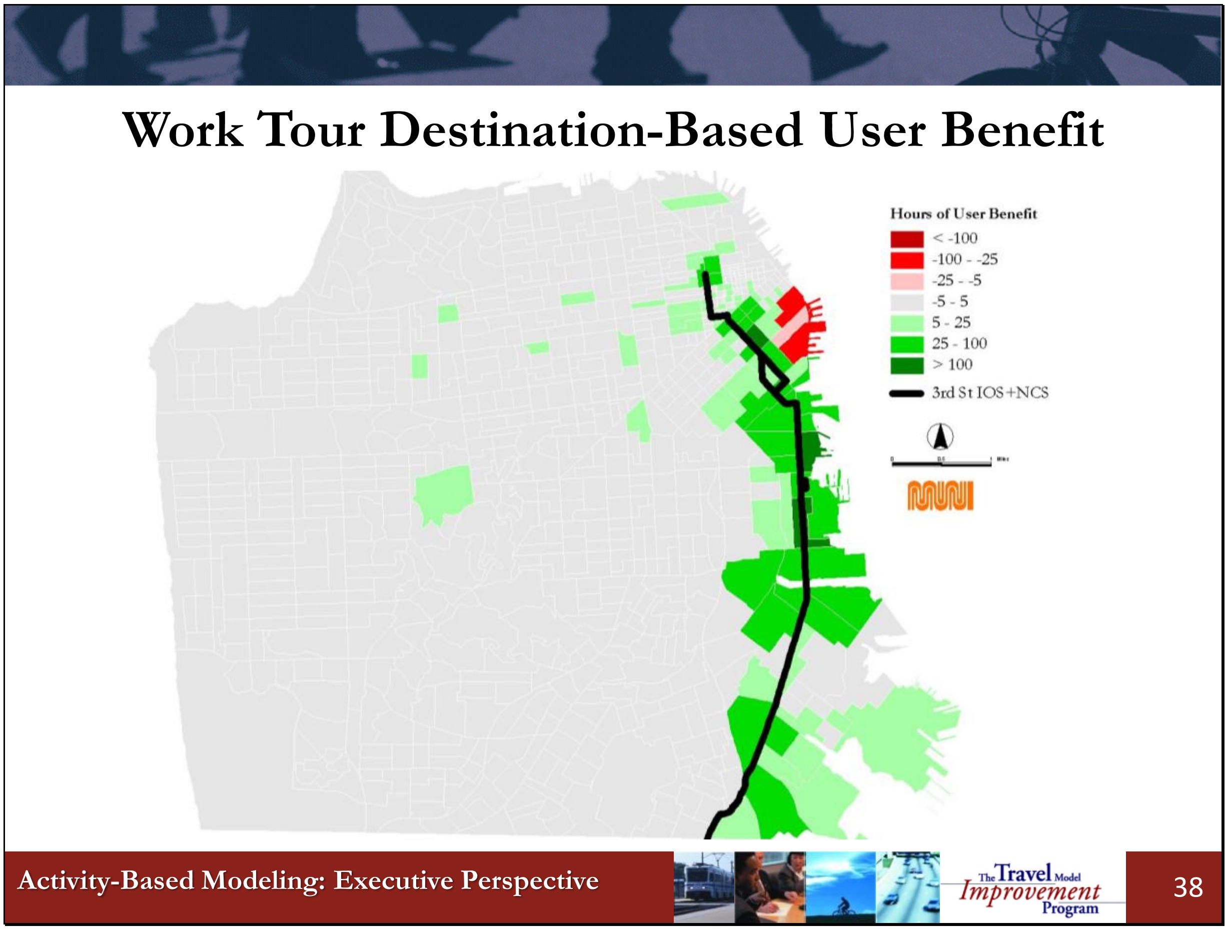
Policies: Transit

- Destination and mode choices for round trips (tours) affect destination and mode choices for individual trips
- Tour-level destination and mode choices consider both outbound and return availability, travel times and costs
- Added detail from home to the transit stop and from the stop to the destination and for local walk and bike travel has improved accuracy
- Transit fare passes and driver's licenses can be explicitly represented
- Built environments affect station area ridership

Activity-based models have also been successfully used for major transit applications, including New Starts forecasting. Activity-based models offer a number of advantages over trip-based models for transit analysis. Because activity-based models consider round-trip levels-of-service, PM peak and evening transit service can affect transit demand throughout the day. Transit fare policies can be better modeled by explicitly modeling transit fare pass ownership at a person-level instead of a trip level. Increased spatial accuracy between the origin\destination and the transit stop results in a more realistic representation of access and egress time.



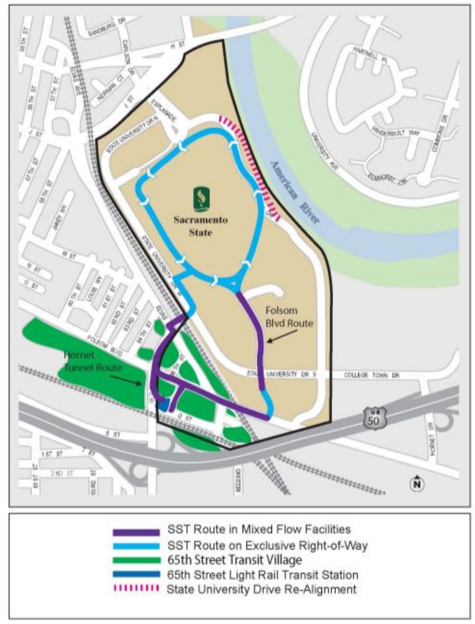
The New Central Subway was the first New Starts project in the United States to be evaluated with an activity-based model. This project involved the evaluation of a 1.4-mile long underground extension to the Third Street light-rail line in San Francisco, connecting the South of Market area to Chinatown.



This map shows User Benefits provided by the Central Subway compared to a baseline alternative, specifically for work tours by destination zone. The green zones are “winners”; that is, zones that see an overall improvement in mobility due to the subway. The red zones are “losers”; zones that see an overall decrease in mobility due to the subway. In this particular alternative, there are losses in mobility along the existing Embarcadero light-rail line, due to re-routing of trains to the Central Subway corridor, causing an increase in headway and wait time.

Another (non-New Starts) Transit Application: Sacramento State BRT Project

- Activity-based model used to simulate campus arrivals and departures by ½ hour time periods
- Parking lots fill up -> park further from destination
- Choice of BRT or walk from lot to destination



Activity-Based Modeling: Executive Perspective

The Travel Model Improvement Program

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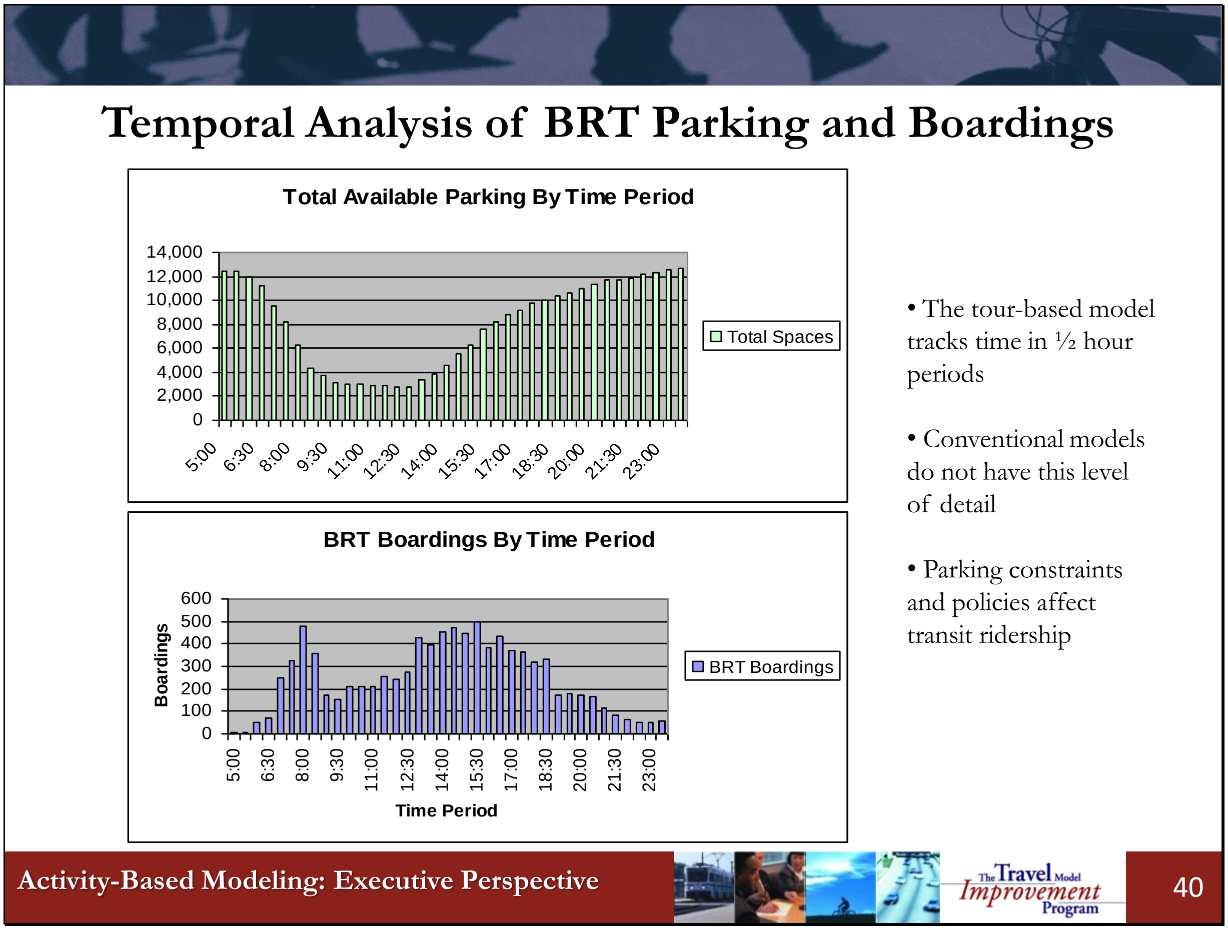
The Sacramento Area Council of Governments (SACOG) activity-based model was used to feed a simulation model developed for Sacramento State University in order to measure demand for a bus-rapid transit (BRT) project. The activity-based model produces travel demand in 30-minute intervals. The simulation model disaggregated demand to and from Sacramento State University to a more refined zone system. Trips driving to and from campus were allocated to one of the parking lots on campus, and their choice of mode (walk versus transit) between their campus destination and the parking lot was explicitly modeled.



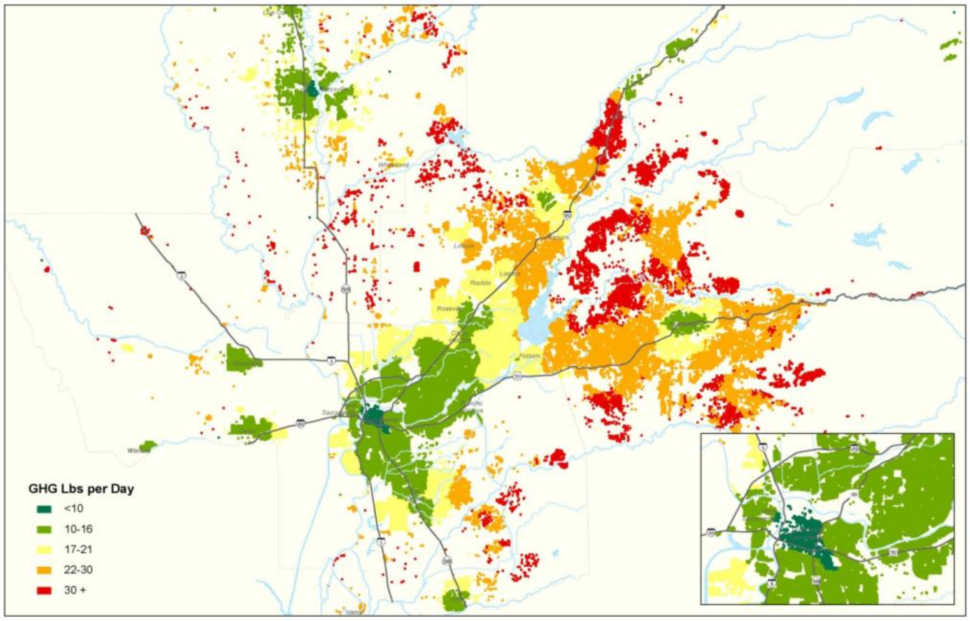
The results of the Sacramento State campus area application are shown. The top chart shows how parking spaces are utilized throughout the day. As parking lots in more desirable locations fill up, students and faculty must park further from their on-campus destination. As that occurs, BRT boardings (shown below) increase. BRT boardings are due to the timing of on-campus arrivals and departures and the use of the BRT line as an intra-campus distribution system (as well as demand from the nearby light-rail station which the BRT line also serves). Various parking configurations were tested with the model.

Policies: Environment and Climate Change

- Disaggregate data on travel provides more accurate estimates of emissions
- Trip chaining provides better data on starts/stops
- Compact Urban Form and Transit Oriented Development represented more completely through greater level of detail
- Pricing and TDM are important policies for GHG reduction
- Vehicle ownership (type, age) affects emissions

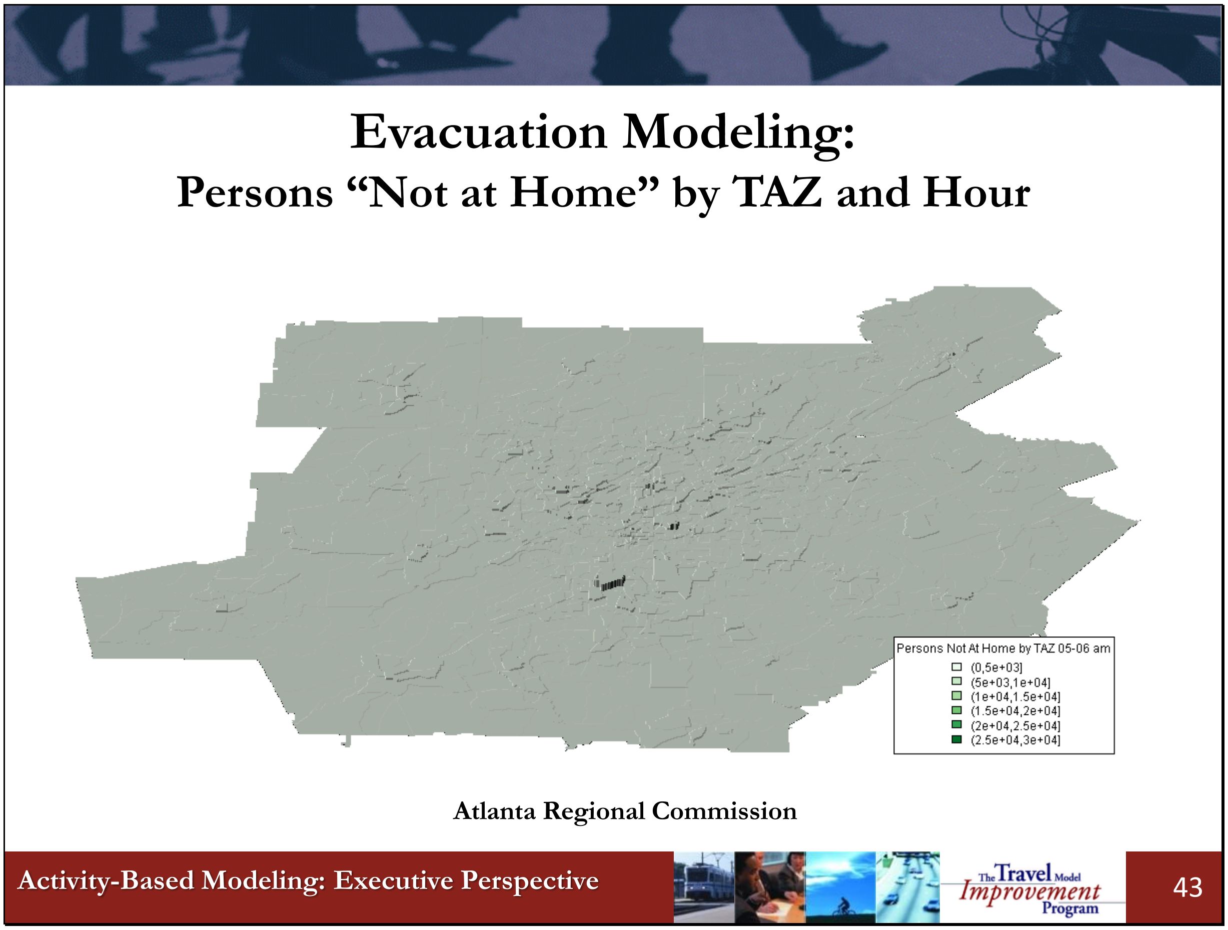
Activity-based models have been used to test policies involving the environment and climate change. One useful aspect of activity-based models is that vehicle-miles of travel and emissions calculations can be traced back to the household, since non-home-based trips are modeled as part of tours. This makes it easier to describe the effects of land-use policy on emissions.

Combined with Emissions Modeling

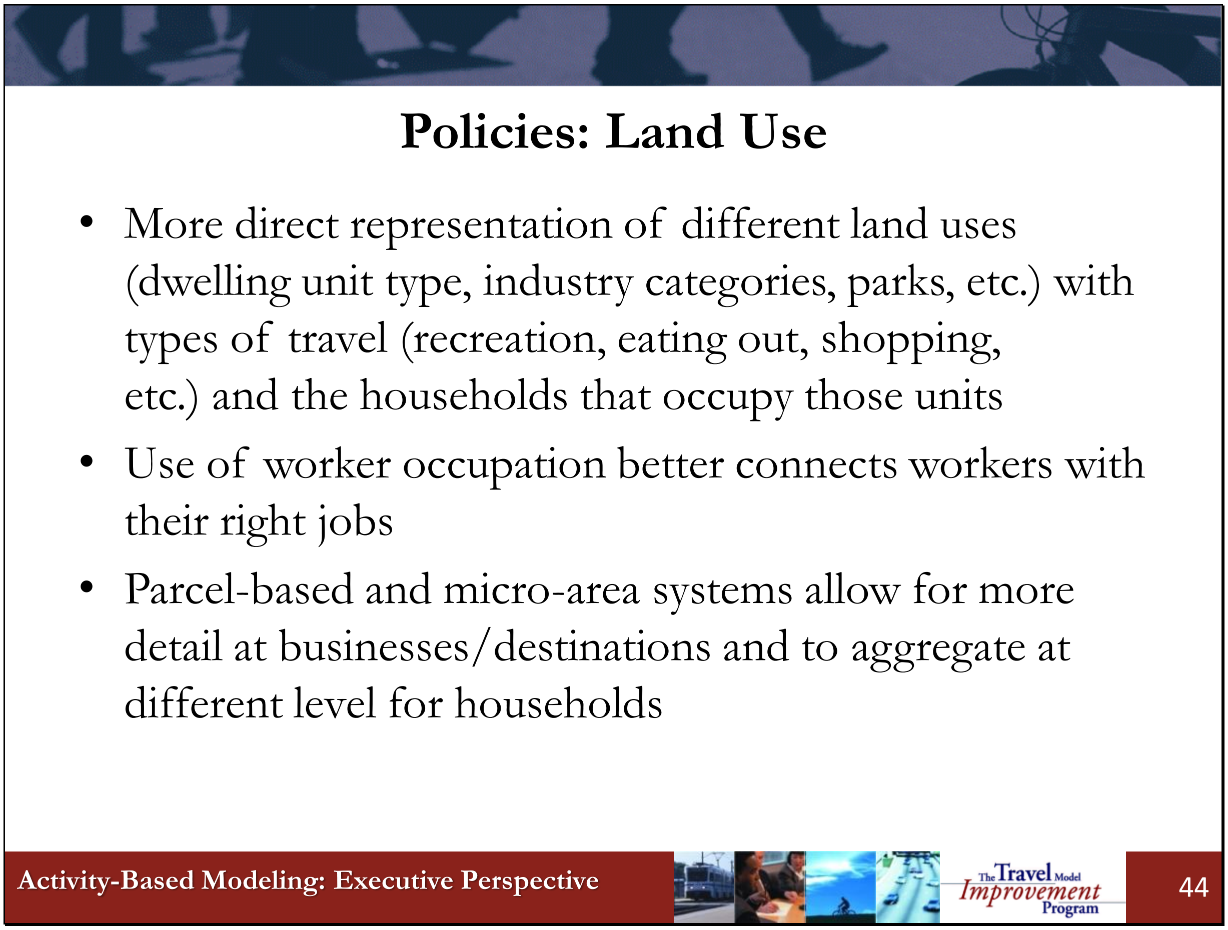


GHG estimates by residence parcel -- Sacramento Area Council of Governments

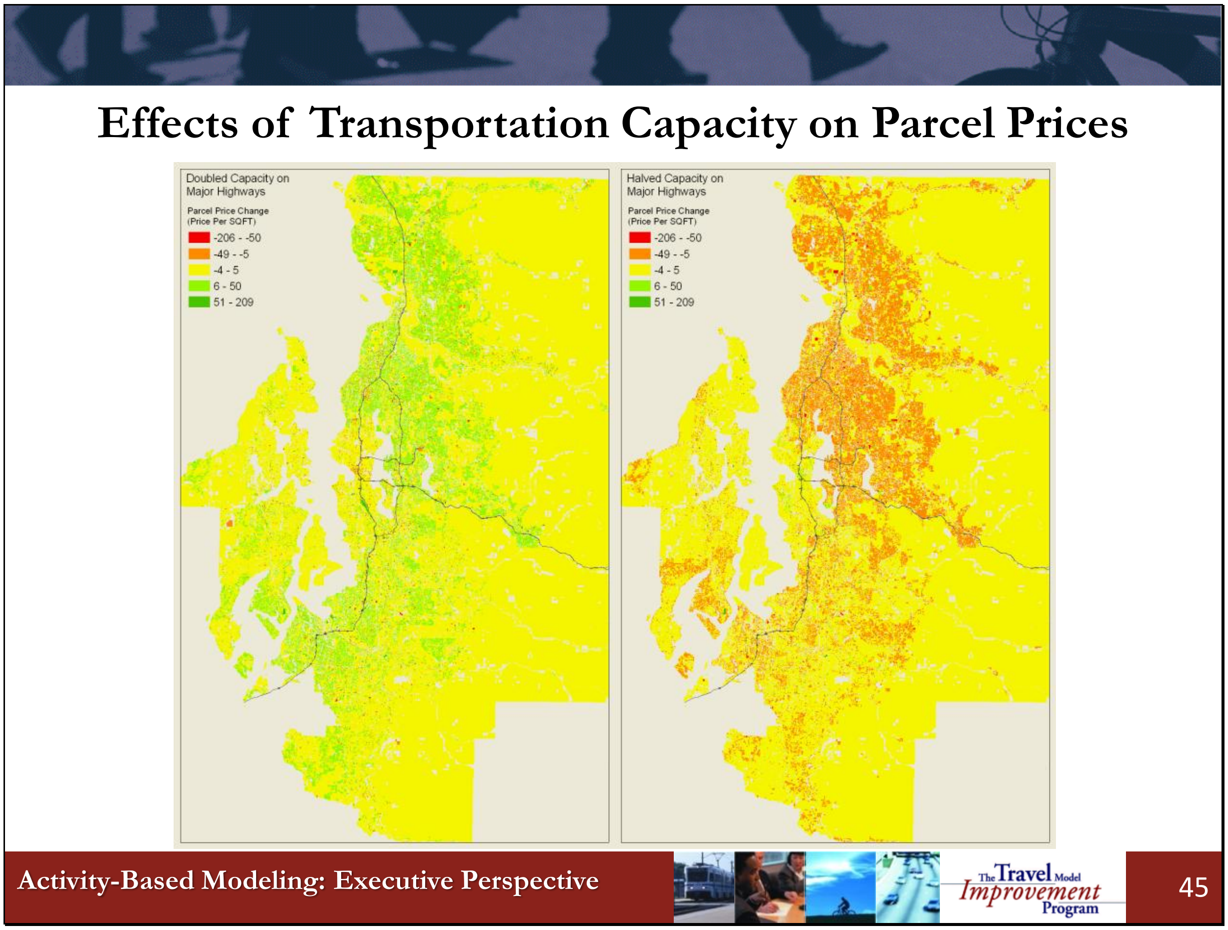
Here is a plot that shows greenhouse gas emissions by residential parcel, from the SACOG activity-based model. Households residing in more urbanized areas generate relatively less greenhouse gas emissions than households living in more rural areas, due to relatively smaller household sizes, shorter trip lengths, and increased use of non-motorized and transit modes.



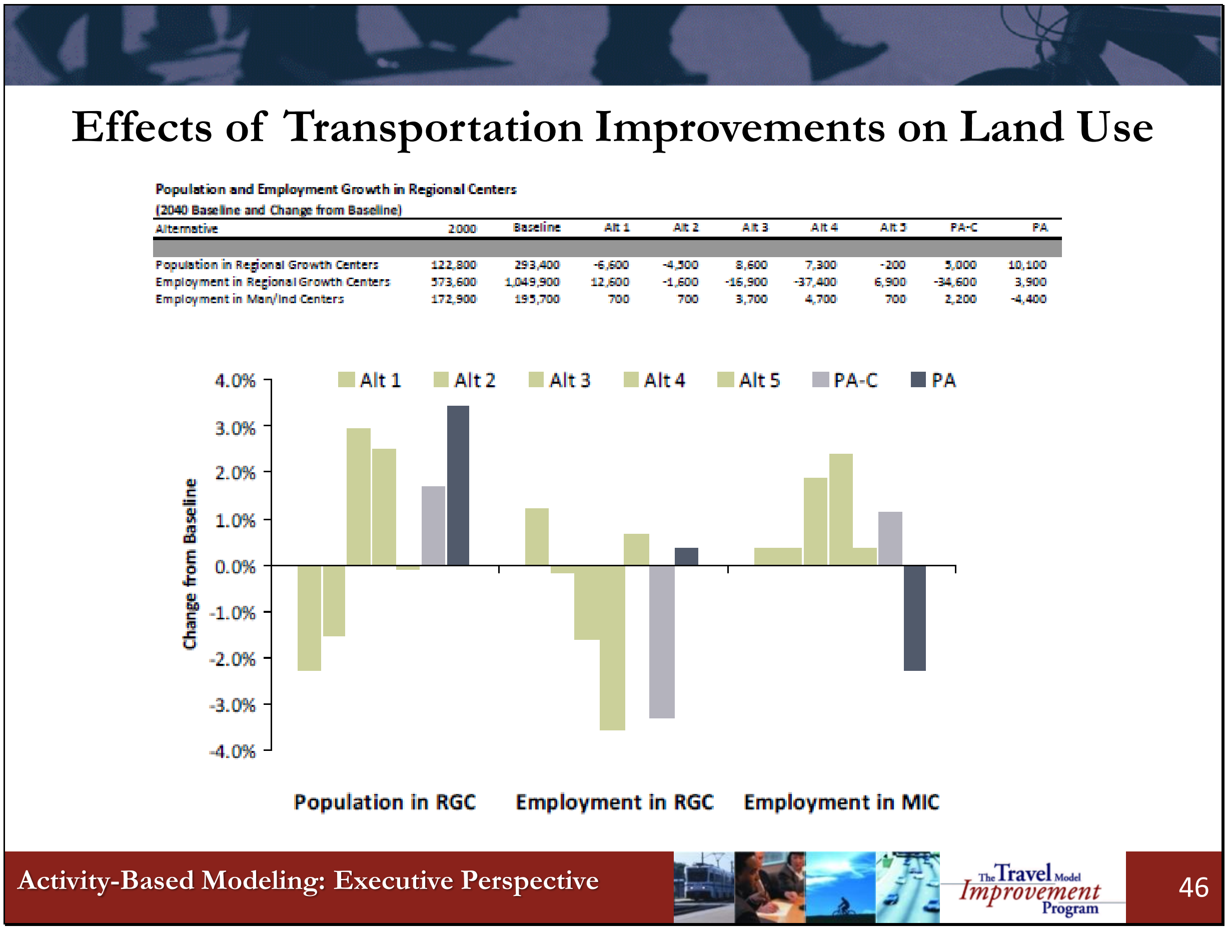
Activity-based models can be used to perform evacuation modeling. This animation shows the height of each zone based upon the number of persons in that zone who do not live in the zone, by hour of the day. These are persons who are traveling for work, shopping, and other out-of-home activities, which is possible because the activity-based model tracks how people are spending their time throughout the day. This provides an opportunity to model evacuation plans; the simulation can be stopped for a specific time period and the behavior of each person can be modeled based upon supplementary survey data.



There are a number of advantages that activity-based models offer to better address land-use policy. Activity-based models often use a finer spatial system than the zone, so they are able to provide a more realistic representation of density, mixed-use land-use, and other pedestrian environment variables.



The Puget Sound Regional Council (PSRC) model was a hybrid model where the land use and activity pattern generator were micro-simulated. These micro-simulation model steps were then integrated with a trip-based destination and mode choice model. These examples come from the activity-based part of the model. These graphs show the results from a sensitivity test where core urban highway capacity was doubled (i.e. the same networks as the baseline with a doubling of the lane capacities for the core urban highway facilities (I-5, I-405, I-90, and SR-520) for the first graph and halved for the second graph). The changes in the parcel prices, along with changes in the accessibility, filter down through the land use, workplace location choice, and activity generation models to produce shifts in VMT (8% increase for double capacity; 10% decrease for half capacity). Some of these shifts come from more trips and some from longer trip lengths.



Alternative	2000	Baseline	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	PA-C	PA
Population in Regional Growth Centers	122,800	293,400	-6,600	-4,500	8,600	7,300	-200	5,000	10,100
Employment in Regional Growth Centers	573,600	1,049,900	12,600	-1,600	-16,900	-37,400	6,900	-34,600	3,900
Employment in Man/Ind Centers	172,900	195,700	700	700	3,700	4,700	700	2,200	-4,400

This slide shows the changes in population and employment at regional centers in the Puget Sound Region (Seattle). These are centers for their transportation plan where they have targeted new growth. Alternatives that support increases in growth in these centers are considered to be better than alternatives that do not support this growth. MICs are Manufacturing and Industrial Centers.

The alternatives are combinations of projects with increasing levels of pricing in each (Alt. 1 has minimal pricing; Alt. 5 is full network system tolling). Alt. 2 has more highway projects than the others, and Alt. 5 has more transit. The shifts in land use were modest for the alternatives, as expected.

Policies: Induced (Latent) Demand

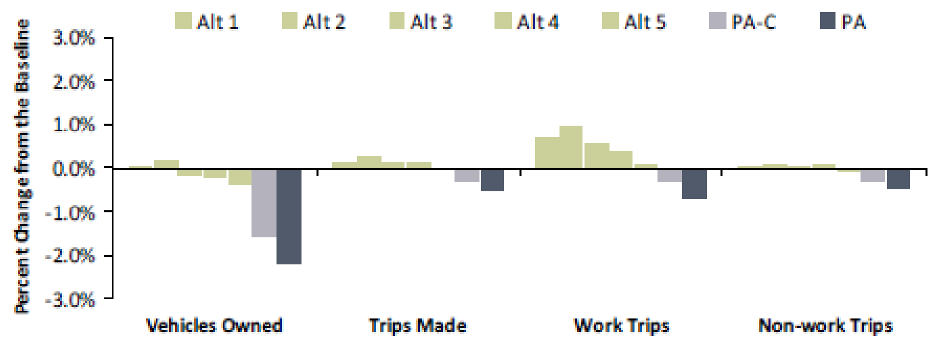
- Additional travel demand resulting from a transportation investment is directly represented
- Additional travel demand resulting from a change in growth patterns due to a new transportation investment can be represented if the model is integrated with a land use forecasting model
- Induced demand may be tempered by changes in performance after the investment is in place (improved speeds on a facility induces more travel in that corridor, which lowers the speed) – these interrelationships are important to capture induced demand

Activity-based models represent the effects of transport policy on induced demand through their inclusion of accessibility variables on tour- and stop-generation components.

Effects of Transportation Investments on Demand

Total Daily Travel (Vehicles Owned and Daily Person Trips Made by Households)

Scenario	2006 Base Year	2040 Baseline	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	PA-C	PA
Vehicles Owned	2,587,000	3,841,000	3,842,000	3,847,000	3,836,000	3,833,000	3,826,000	3,759,000	3,759,000
Change from 2006		48%	49%	49%	48%	48%	48%	45%	45%
Work Trips Made	2,169,000	3,161,000	3,183,000	3,191,000	3,178,000	3,174,000	3,162,000	3,130,000	3,130,000
Change from 2006		46%	47%	47%	47%	46%	46%	44%	44%
Non-Work Trips Made	11,563,000	15,990,000	15,993,000	16,000,000	15,993,000	15,996,000	15,984,000	15,919,000	15,919,000
Change from 2006		38%	38%	38%	38%	38%	38%	38%	38%



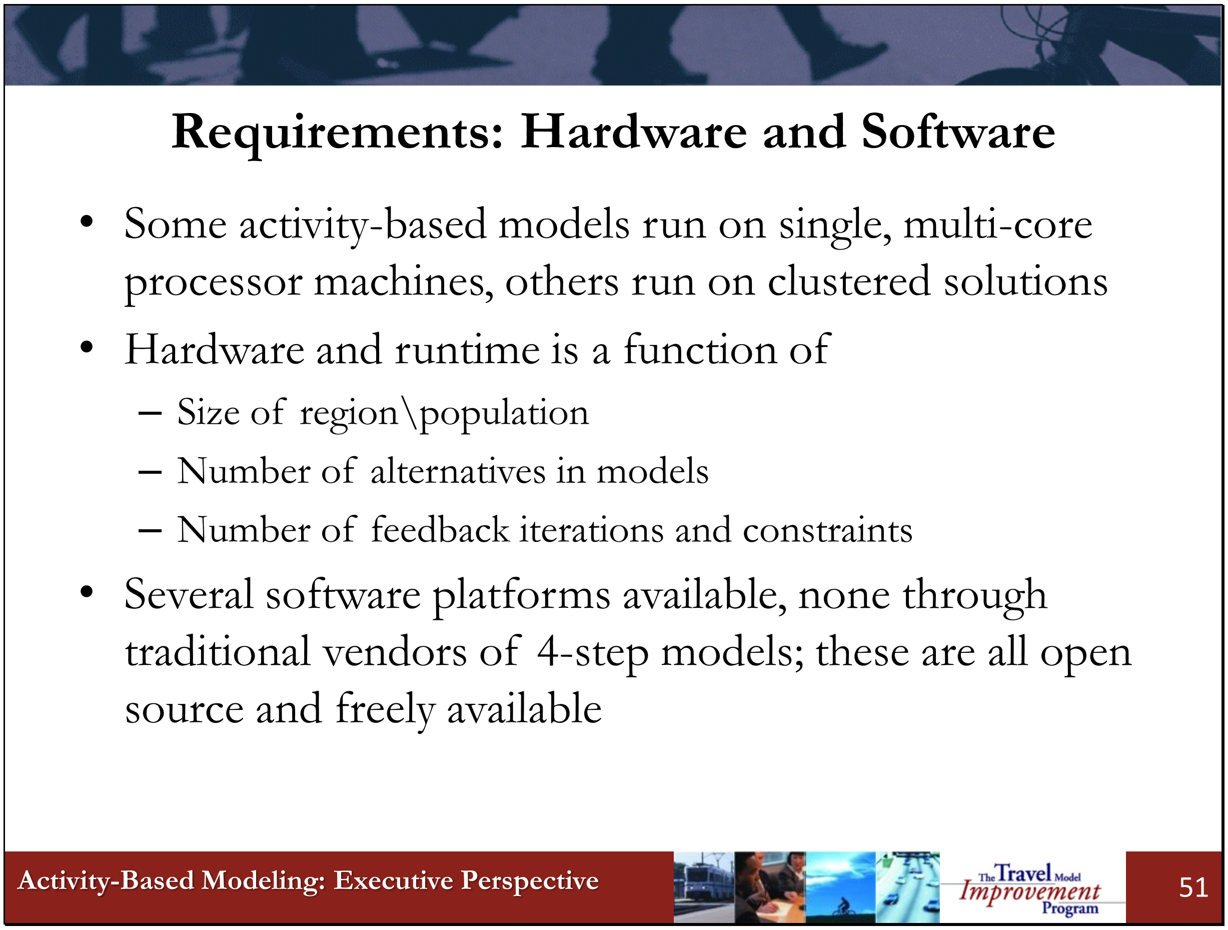
These graphs show how the effects of transportation improvements on the land use changes that we just saw also have an impact on induced demand. The activity-based demand model showed changes to vehicles owned and number of trips made, differentiated by work and non-work activity types.

Requirements: Staff Resources

- Need to understand discrete choice models
- Need to learn activity-based models modeling process
- May require more custom scripting and light programming
- Helpful to understand database or statistical queries (in addition to working with matrices)
- Will require time to maintain and prepare scenario databases, if parcels or micro-zones represent land use
- Network coding – potentially more time-of-day networks to code (PM in addition to AM)

There are a number of staff training issues to consider if an agency is contemplating adopting an activity-based model. Many of the model components have theoretical roots in choice behavior theory, so knowledge of discrete choice modeling is essential. In addition, the model system application may require more custom scripting and programming than trip-based models. These skills are necessary in order to maintain and enhance the system, but may not be necessary to run the models. Since activity-based models produce databases containing the travel choices of the synthetic population, it is important to have familiarity with statistical and/or database software. There are also implications for the development of input data and the maintenance and coding of networks, depending upon the details of how the system represents space and time.

Consultant assistance is often required for activity-based model development. Model development contracts are generally in the same range as contracts for advanced trip-based models, though contracts can be valued more depending upon the amount of innovation desired or warranted. Most development schedules are similar to what one might expect for a four-step model development contract, depending on whether one is starting from scratch or modifying an existing model. There are a number of alternatives that can be considered for consultant assistance, ranging from borrowing existing structures\software to developing models from scratch. Most models do require some estimation and all new implementations require calibration to local conditions.

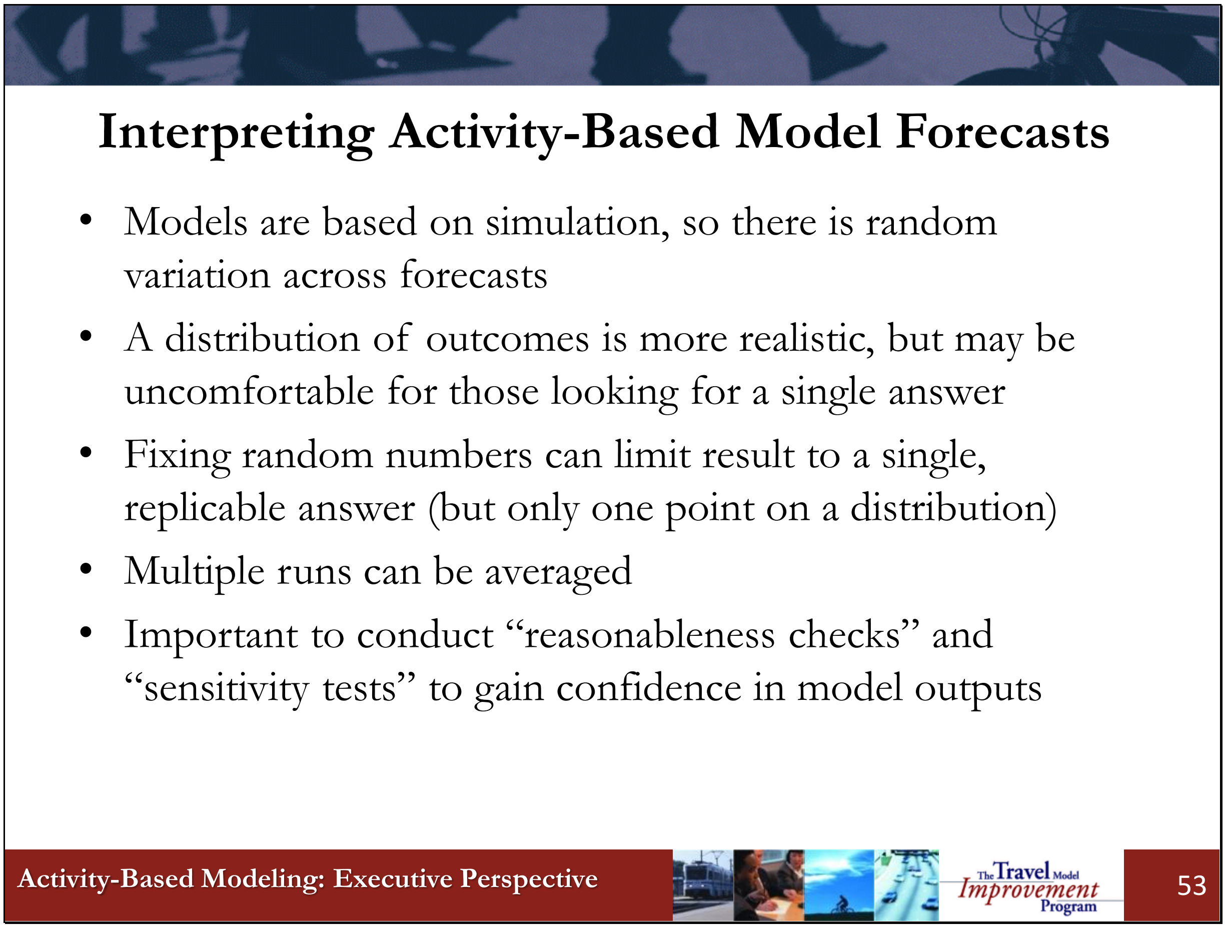


Model run times depend on several factors, the most important of which is the number of agents in the model. Models for larger regions, such as the San Francisco Bay or Atlanta regions typically distribute computational burden across multiple computers because the simulations are for millions of people. Other issues that may require more computing power include the number of alternatives in various models, extent of shadow pricing and feedback loops, type of sampling used for models with large numbers of alternatives, number of time periods and modes skimmed, and efficiency of program code. Another option for sharing resources is cloud computing, but documentation is limited (less extensive than for off-the-shelf software) and support must be negotiated.

Extensions: Travel Markets

- At their core, activity-based models cover daily person travel generated by households (similar to existing methods)
- May need separate models for other special markets
  - Visitors
  - Airports
  - Universities
  - Commercial travel
  - Internal\External and through-travel
  - Other long-distance travel
  - Special events
- An integrated land use model would be needed to model impacts of travel activity and accessibility on urban development and land values

Just as with four-step models, special market models may be required in addition to the core resident activity-based model. These markets might include visitors, airports, internal-external travel, and other markets. These models can either be adopted from existing trip-based methods, or developed specifically to be consistent with the activity-based model. Tour-based treatments for many of these markets were recently developed specifically for the San Diego activity-based model system.



Activity-based models rely upon random number sequences to determine results. Therefore there is random variation within and across forecasts. In such cases, it is useful to analyze a distribution of results; particularly for model outputs in which a limited number of decision-makers are affected (such as a local street volume, or ridership on a low volume transit route). Such distributions are useful in order to communicate the uncertainty associated with particular outputs. An alternative would be to fix random number seeds in order to ensure consistent results across model runs, though it should be recognized that such methods result in only one realization or outcome from a distribution and could be misleading. A better approach is to average multiple runs. In all cases, it is important to conduct reasonableness checks and sensitivity checks on models in order to ensure that models react reasonably to changes to inputs and are ready to be used for forecasting policies of interest.

We recommend developing a data collection and model development plan prior to embarking on an activity-based model development project. This helps plan for funding and keeps the overall project on track. Some initial decisions to be made are the extent of new data collection and whether to develop the model all at once or in phases through a number of years. One should plan on thorough calibration, validation, sensitivity testing, training and documentation. Understand that certain new features may involve some risk, at least to schedule, as research and development takes time. In addition, it is helpful to have an activity-based model lead or “champion” at the agency to keep staff briefed on model development and application activities and to secure funding.

Further Research

- Advancements in modeling decisions across multiple dimensions (destination, mode, tours, trips, schedules)
- Testing models with information technology policy parameters
- Integration with dynamic traffic assignment models
- Transferability of activity-based models
- Visualizing and communicating model outputs for decision making

There are many advancements being made in activity-based modeling, some of which are listed on this slide. They include advancements in discrete choice models related to modeling many alternatives and multiple dimensions simultaneously, integration with dynamic traffic assignment models, the transferability of activity-based models, and software and techniques to mine and visualize the data produced by activity-based models.

Questions and Answers

The Travel Model Improvement Program

2012 Activity-Based Modeling Webinar Series

Session	Date
Executive and Management Sessions	
Executive Perspective	February 2
Institutional Topics for Managers	February 23
Technical Issues for Managers	March 15
Technical Sessions	
Activity-Based Model Framework	March 22
Population Synthesis and Household Evolution	April 5
Accessibility and Treatment of Space	April 26
Long-Term and Medium Term Mobility Models	May 17
Activity Pattern Generation	June 7
Scheduling and Time of Day Choice	June 28
Tour and Trip Mode, Intermediate Stop Location	July 19
Network Integration	August 9
Forecasting, Performance Measures and Software	August 30

Thank you for joining us this week. The next webinar will be held in three weeks, and will cover institutional topics for managers.