Activity-Based Modeling
Session 1: Executive Perspective

Speakers: Maren Outwater & Joel Freedman

February 2, 2012
Acknowledgments

This presentation was prepared through the collaborative efforts of Resource Systems Group, Inc. and Parsons Brinckerhoff.
Learning Outcomes

• How travel demand models are used
• Benefits and limitations of activity-based models
• Why current models can’t answer certain policy questions
• Time and resources needed to implement an activity-based modeling system
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
**Terminology**

<table>
<thead>
<tr>
<th><strong>Activity-based model</strong></th>
<th>• A travel demand model that produces tours with activity stops</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Tours</strong></td>
<td>• A chain of trips that begin and end at home or work</td>
</tr>
<tr>
<td><strong>Trip-based model</strong></td>
<td>• A travel demand model that produces trips</td>
</tr>
<tr>
<td><strong>Advanced models</strong></td>
<td>• Applied at a disaggregate level, typically with greater spatial and temporal detail</td>
</tr>
<tr>
<td><strong>Integrated modeling system</strong></td>
<td>• Integration of economic, land use, travel, traffic and air quality models</td>
</tr>
</tbody>
</table>
Key Concepts

• Activity-based models…
  – provide sensitivities to policies and more intuitive analysis than existing methods
  – produce many performance measures that are not possible with existing methods
  – do not necessarily take longer or cost more to develop and apply than existing methods
    • An all-new activity-based model is a similar level of effort and cost to developing an all-new trip-based model
    • An incremental change to an existing activity-based model is similar in effort and cost to an incremental change in 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
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
Modeling Daily Activity Schedules

1. Schedule Work Tour

2. Calculate residual time windows

3. Schedule Discretionary Tour

<table>
<thead>
<tr>
<th></th>
<th>1-Work</th>
<th>2-Disc</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 7:30</td>
<td>7:30 A.M. – 5:00 P.M.</td>
<td>7 – 9 P.M.</td>
</tr>
<tr>
<td>5</td>
<td>23</td>
<td></td>
</tr>
</tbody>
</table>
Modeling Trip Chains and Tours

- 7 trips
  - 4 stops
  - 1 stop
- 2 tours

Activity-Based Modeling: Executive Perspective
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)
Modeling Individuals in Households

• Household Attributes
  - number of persons
  - housing tenure
  - residential building size/type
  - number of persons age 65+
  - number of persons under age 18
  - number of persons that are part of the family
  - number of children
  - household income
  - number of vehicles owned
  - number of workers
  - number of students

• Person Attributes
  - relationship to householder
  - gender
  - age
  - grade in school
  - hours worked per week
  - worker status
  - student status
Derived Person Attributes

• Given a synthetic person’s attributes and a travel context, it is possible to derive an individual value of time ($/hour)
  – May vary by person and trip context (purpose, time of day)
  – Useful for mode choice and assignment of trips for various pricing policies

• Possible to carry this through network modeling to account for multiple user types on roadways and transit systems
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)
Contrasting Modeling Approaches

**Trip-Based**
- Trips are generated from zonal aggregations of households
- Each trip is independent of every other trip’s generation, distribution, mode and timing
- Timing/direction of trips is not an explicit choice (fixed factors)
- Travel demand is not affected by accessibility or the built environment
- Market stratification limited by ability to maintain trip tables throughout model stream

**Activity-Based**
- Simulation of individual households and persons
- Trips are chained—modeled as part of tours, sub-tours and larger daily activity patterns
- Starting and ending time of activities are modeled choices
- Built environment and accessibility variables affect travel demand
- Market stratification is a function of individual and household attributes
Practical Advantages: Behavioral

- Models behavior more intuitively and is therefore easier to explain results
- Travel is based on round trips, which is how people make decisions
- All relevant variables can affect decisions, rather than being limited to a few (because of disaggregate logit choice models)
- This also allows for incorporation of travel time and cost (weighted by mode and destination and time of day) to be included in higher level models (like auto ownership and trip generation)
- Travel behavior is modeled consistently throughout the process (e.g. trip chaining)
Practical Advantage: More Performance Measures

• Activity-based model raw outputs are disaggregate trip records, with important identifying attributes:
  – Activity/trip purpose, start/end times, travel mode, location IDs
  – Tour purpose, primary location, primary mode, start/end times
  – Household ID, Person ID, Tour ID, Trip/Activity ID

• This allows the user to summarize system performance data along at least four potentially useful dimensions:
  – Household and person attributes
  – Time period of the day
  – Activity/trip/tour purposes
  – Geographic units and spatial clusters
Ability to Derive Performance Measures

Can summarize travel behavior metrics by various combinations of the activity-based model dimensions

Some examples are→
Practical Advantages: Spatial Detail

• Can be developed at a highly detailed level (parcels), Census block level (micro-zones) or an aggregate level (zones)
• Increased spatial detail (with parcels or micro-zones) provides more precision than is possible with 4-step models
• Used to create accessibility buffers for access to employment, population, transit stops, paid parking supply, and surrounding intersection connectivity
• Non-motorized and transit trips can be more accurately represented
Practical Advantages: Temporal Detail

• Models are much more detailed (e.g. 30-min, 5-min, 1-min)

• Time chosen for travel is represented by the complex demands of household members, work and school schedules, etc.

• Trip timing is affected by congestion and tolls that change by the minute (dynamic) resulting in peak shifting
Example: Jacksonville Temporal Resolution

Activity-Based Modeling: Executive Perspective
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.
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
Limitations: Computational Challenges

• Tradeoffs between
  – Model features
  – Optimized software
  – Hardware
  – Run time

• New, unconventional software platforms
Limitations: Behavioral and Spatial Realism

• Some activity-based models have intra-household interactions to show how travel is coordinated among household members, which adds complexity to the calibration effort.

• Some activity-based models have parcel-level or micro-zone data inputs to show how travel is affected by nearby land uses and accessibility to transit; some do not because of poor data quality.

• Inclusion of travel times and costs at different parts of the process adds realism, but also adds complexity and time.

• Some activity-based models model have increased temporal resolution—model more time periods—this adds realism and aids accuracy, but also results in more computational time and disk storage.
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.
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
Example: Manhattan Congestion Pricing Study

Congestion Pricing Zone Boundary

Central Business District

Congestion Pricing Zone Portals
## Analyzing “Who pays?” and “How much?”

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

- Helps minimize administrative impacts for businesses, and keeps industry moving
- Would require documentation of inability to take transit
- May be accompanied by investment in Means-Based Fare Assistance Program

Activity-Based Modeling: Executive Perspective
Estimated San Francisco Resident Values of Time
Travel Demand Management

- Strategies to change travel behavior in order to reduce congestion and improve mobility
  - Telecommuting/Work-at-home
  - Flexible work schedules (off-peak)
  - Rideshare programs

- Scenario-based approaches necessary
  - Model system captures the effects of TDM policy outcomes
  - Cannot identify which policies will affect flexible work schedules
  - But can estimate the impact on transportation system performance of shift from a 5-day 8-hour work week to a 4-day 9+ hour work week
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

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

Work Tour Duration Distribution

- Original vs. Adjusted Durations
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
TDM: Supply Impacts

- Total VMT declines slightly
- Reduced peak period and midday VMT, increased VMT in evening
- Reduced peak period and midday delay across all facility types, additional delay in the evening

VMT by 30 Minute Period

Hours of Delay - Major Arterials

Hours of Delay - Minor Arterials

Hours of Delay - Collectors
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.
Transit New Starts Application: Muni Central Subway

- 1.4 miles connecting South of Market to Chinatown
- Third Street LRT 7.1 mile surface line (IOS = Baseline)
Work Tour Destination-Based User Benefit

Hours of User Benefit
- < -100
- -100 - -25
- -25 - -5
- -5 - 5
- 5 - 25
- 25 - 100
- > 100

3rd St IOS + NCS
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
Temporal Analysis of BRT Parking and Boardings

- The tour-based model tracks time in ½ hour periods
- Conventional models do not have this level of detail
- Parking constraints and policies affect transit ridership

### Total Available Parking By Time Period

<table>
<thead>
<tr>
<th>Time Period</th>
<th>Total Spaces</th>
</tr>
</thead>
<tbody>
<tr>
<td>5:00</td>
<td>14,000</td>
</tr>
<tr>
<td>6:30</td>
<td>12,000</td>
</tr>
<tr>
<td>8:00</td>
<td>10,000</td>
</tr>
<tr>
<td>9:30</td>
<td>8,000</td>
</tr>
<tr>
<td>11:00</td>
<td>6,000</td>
</tr>
<tr>
<td>12:30</td>
<td>4,000</td>
</tr>
<tr>
<td>14:00</td>
<td>2,000</td>
</tr>
<tr>
<td>15:30</td>
<td>0</td>
</tr>
<tr>
<td>17:00</td>
<td>0</td>
</tr>
<tr>
<td>18:30</td>
<td>0</td>
</tr>
<tr>
<td>20:00</td>
<td>0</td>
</tr>
<tr>
<td>21:30</td>
<td>0</td>
</tr>
<tr>
<td>23:00</td>
<td>0</td>
</tr>
</tbody>
</table>

### BRT Boardings By Time Period

<table>
<thead>
<tr>
<th>Time Period</th>
<th>Boardings</th>
</tr>
</thead>
<tbody>
<tr>
<td>5:00</td>
<td>600</td>
</tr>
<tr>
<td>6:30</td>
<td>500</td>
</tr>
<tr>
<td>8:00</td>
<td>400</td>
</tr>
<tr>
<td>9:30</td>
<td>300</td>
</tr>
<tr>
<td>11:00</td>
<td>200</td>
</tr>
<tr>
<td>12:30</td>
<td>100</td>
</tr>
<tr>
<td>14:00</td>
<td>0</td>
</tr>
<tr>
<td>15:30</td>
<td>0</td>
</tr>
<tr>
<td>17:00</td>
<td>0</td>
</tr>
<tr>
<td>18:30</td>
<td>0</td>
</tr>
<tr>
<td>20:00</td>
<td>0</td>
</tr>
<tr>
<td>21:30</td>
<td>0</td>
</tr>
<tr>
<td>23:00</td>
<td>0</td>
</tr>
</tbody>
</table>
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
Combined with Emissions Modeling

GHG estimates by residence parcel -- Sacramento Area Council of Governments
Evacuation Modeling:
Persons “Not at Home” by TAZ and Hour

Atlanta Regional Commission
Policies: Land Use

• More direct representation of different land uses (dwelling unit type, industry categories, parks, etc.) with types of travel (recreation, eating out, shopping, etc.) and the households that occupy those units.

• Use of worker occupation better connects workers with their right jobs.

• Parcel-based and micro-area systems allow for more detail at businesses/destinations and to aggregate at different level for households.
Effects of Transportation Capacity on Parcel Prices

Doubled Capacity on Major Highways
Parcel Price Change (Price Per SQFT)
-206 - 50
-49 - 5
-4 - 5
6 - 50
51 - 209

Halved Capacity on Major Highways
Parcel Price Change (Price Per SQFT)
-206 - 50
-49 - 5
-4 - 5
6 - 50
51 - 209
Effects of Transportation Improvements on Land Use

Population and Employment Growth in Regional Centers
(2040 Baseline and Change from Baseline)

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

Diagrams showing changes in population and employment between different alternatives and the baseline.
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.
### Total Daily Travel (Vehicles Owned and Daily Person Trips Made by Households)

<table>
<thead>
<tr>
<th>Scenario</th>
<th>2006 Base Year</th>
<th>2040 Baseline</th>
<th>Alt 1</th>
<th>Alt 2</th>
<th>Alt 3</th>
<th>Alt 4</th>
<th>Alt 5</th>
<th>PA-C</th>
<th>PA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicles Owned</td>
<td>2,587,000</td>
<td>3,841,000</td>
<td>3,842,000</td>
<td>3,847,000</td>
<td>3,835,000</td>
<td>3,833,000</td>
<td>3,828,000</td>
<td>3,759,000</td>
<td>3,759,000</td>
</tr>
<tr>
<td>Change from 2006</td>
<td>48%</td>
<td>49%</td>
<td>49%</td>
<td>49%</td>
<td>48%</td>
<td>48%</td>
<td>48%</td>
<td>45%</td>
<td>45%</td>
</tr>
<tr>
<td>Work Trips Made</td>
<td>2,169,000</td>
<td>3,161,000</td>
<td>3,183,000</td>
<td>3,191,000</td>
<td>3,178,000</td>
<td>3,174,000</td>
<td>3,162,000</td>
<td>3,130,000</td>
<td>3,130,000</td>
</tr>
<tr>
<td>Change from 2006</td>
<td>46%</td>
<td>47%</td>
<td>47%</td>
<td>47%</td>
<td>47%</td>
<td>46%</td>
<td>46%</td>
<td>44%</td>
<td>44%</td>
</tr>
<tr>
<td>Non-Work Trips Made</td>
<td>11,563,000</td>
<td>15,990,000</td>
<td>15,993,000</td>
<td>16,000,000</td>
<td>15,993,000</td>
<td>15,996,000</td>
<td>15,984,000</td>
<td>15,919,000</td>
<td>15,919,000</td>
</tr>
<tr>
<td>Change from 2006</td>
<td>38%</td>
<td>38%</td>
<td>38%</td>
<td>38%</td>
<td>38%</td>
<td>38%</td>
<td>38%</td>
<td>38%</td>
<td>38%</td>
</tr>
</tbody>
</table>

#### Percent Change from the Baseline

- **Vehicles Owned**
- **Trips Made**
- **Work Trips**
- **Non-work Trips**
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)
Requirements: Consultant Resources

• Often desired for activity-based model development, but not application.
• Most recent development contracts the same cost range as 4-step model development contracts (although initial contracts were higher due to learning curves).
• Most recent contracts the same schedule as 4-step models (schedule largely driven by data availability and funding resources at agency).
• May need to retain consultants for making major model changes and code maintenance.
Requirements: Hardware and Software

• Some activity-based models run on single, multi-core processor machines, others run on clustered solutions.
• Hardware and runtime is a function of:
  – Size of region\population
  – Number of alternatives in models
  – Number of feedback iterations and constraints
• Several software platforms available, none through traditional vendors of 4-step models; these are all open source and freely available.
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
Interpreting Activity-Based Model Forecasts

• Models are based on simulation, so there is random variation across forecasts
• A distribution of outcomes is more realistic, but may be uncomfortable for those looking for a single answer
• Fixing random numbers can limit result to a single, replicable answer (but only one point on a distribution)
• Multiple runs can be averaged
• Important to conduct “reasonableness checks” and “sensitivity tests” to gain confidence in model outputs
Some Lessons Learned

• Develop a data collection and model development plan
  – Need more, better data?
  – Develop all at once or phase over a few years?
  – Thorough calibration, validation, sensitivity testing, documentation required

• Know the risks
  – Transfer existing model, adapt and incrementally improve, or develop from scratch?

• Train staff

• Identify a champion
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
Questions and Answers
# 2012 Activity-Based Modeling Webinar Series

## Executive and Management Sessions

<table>
<thead>
<tr>
<th>Session</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Executive Perspective</td>
<td>February 2</td>
</tr>
<tr>
<td>Institutional Topics for Managers</td>
<td>February 23</td>
</tr>
<tr>
<td>Technical Issues for Managers</td>
<td>March 15</td>
</tr>
</tbody>
</table>

## Technical Sessions

<table>
<thead>
<tr>
<th>Session</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Activity-Based Model Framework</td>
<td>March 22</td>
</tr>
<tr>
<td>Population Synthesis and Household Evolution</td>
<td>April 5</td>
</tr>
<tr>
<td>Accessibility and Treatment of Space</td>
<td>April 26</td>
</tr>
<tr>
<td>Long-Term and Medium Term Mobility Models</td>
<td>May 17</td>
</tr>
<tr>
<td>Activity Pattern Generation</td>
<td>June 7</td>
</tr>
<tr>
<td>Scheduling and Time of Day Choice</td>
<td>June 28</td>
</tr>
<tr>
<td>Tour and Trip Mode, Intermediate Stop Location</td>
<td>July 19</td>
</tr>
<tr>
<td>Network Integration</td>
<td>August 9</td>
</tr>
<tr>
<td>Forecasting, Performance Measures and Software</td>
<td>August 30</td>
</tr>
</tbody>
</table>