NCHRP 25-38, Input Guidelines for MOVES

Project Summary

presented to
AMPO Air Quality Work Group

presented by
Rich Denbow

April 27-28, 2015
Objectives and Products

**Objective**

» Produce guidelines for transportation practitioners on methods, procedures, and datasets needed to develop and obtain transportation-related regional- and project-level inputs for using MOVES

**Products**

» Resource document on developing MOVES inputs
» Sample data & examples
» Tools for processing data
» Final report documenting research approach
MOVES Inputs Covered in Resource Document

Volume 1 – Regional-Level Inputs
- Age distribution
- Source (vehicle) type population
- VMT by vehicle class
- Temporal adjustments
- Road type distribution
- Ramp fraction
- Average speed distribution
- Meteorology
- Inspection and maintenance programs
- Fuel formulation and supply

Volume 2 – Project-Level Inputs
- Age distribution
- Link source types
- Link characteristics:
  - traffic volumes
  - length and grade
  - average speed
- Operating mode distributions and drive schedules
- Off-network data
Activities

Completed:

» Literature review and survey of practitioners (75 respondents – thank you!!!)
» Sensitivity analysis on MOVES inputs
» Resource materials for each MOVES input
» Examples
» Tools

Panel review

Final report & resource materials
**Sensitivity Analysis**

**Objective:** complement other efforts, expand to more inputs

<table>
<thead>
<tr>
<th>Type of Input</th>
<th>Input</th>
<th>EPA</th>
<th>Volpe/FHWA</th>
<th>NCHRP 25-38 CS/ERG</th>
<th>ERG/CRC</th>
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</thead>
<tbody>
<tr>
<td>Fleet-Based Inputs</td>
<td>Age distribution by vehicle class</td>
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<tr>
<td></td>
<td>Source (vehicle) type population</td>
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<tr>
<td>Activity-Based Inputs</td>
<td>VMT by vehicle class</td>
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<td></td>
<td>Temporal adjustments</td>
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<td></td>
<td>Road type distribution</td>
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<tr>
<td></td>
<td>Ramp fraction</td>
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<tr>
<td></td>
<td>Average speed distribution</td>
<td></td>
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<td></td>
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<tr>
<td>Other Inputs</td>
<td>Meteorology data (temp, humidity)</td>
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<td></td>
<td>IM Program</td>
<td></td>
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<td></td>
<td>Fuel formulation and supply</td>
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</tbody>
</table>
Sensitivity Analysis Results – Road Grade

Effects of Road Grade on Emissions – Urban Unrestricted Access Roads

-6% -4% -2% 2% 4% 6%

VOC CO NOx CO2 PM10
# Summary of MOVES Inputs Falling in Different Sensitivity Ranges

<table>
<thead>
<tr>
<th>MOVES Input</th>
<th>VOC</th>
<th>NOx</th>
<th>PM</th>
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</thead>
<tbody>
<tr>
<td>Temperature</td>
<td>Very Substantial</td>
<td>Very Substantial</td>
<td>Very Substantial</td>
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<tr>
<td>Humidity</td>
<td>Modest</td>
<td>Substantial</td>
<td>Modest</td>
</tr>
<tr>
<td>Speed</td>
<td>Very Substantial</td>
<td>Very Substantial</td>
<td>Very Substantial</td>
</tr>
<tr>
<td>Age</td>
<td>Very Substantial</td>
<td>Substantial</td>
<td>Substantial</td>
</tr>
<tr>
<td>VMT</td>
<td>Substantial</td>
<td>Very Substantial</td>
<td>Very Substantial</td>
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<tr>
<td>Population</td>
<td>Substantial</td>
<td>Substantial</td>
<td>Substantial</td>
</tr>
<tr>
<td>Ramp Fraction</td>
<td>Modest</td>
<td>Modest</td>
<td>Substantial</td>
</tr>
<tr>
<td>Source Type Detail for Road Type Dist</td>
<td>Modest</td>
<td>Modest</td>
<td>Moderate</td>
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<tr>
<td>Source Type Detail for Speed Dist</td>
<td>Modest</td>
<td>Modest</td>
<td>Moderate</td>
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<tr>
<td>Month VMT Fraction</td>
<td>Modest</td>
<td>Modest</td>
<td>Modest</td>
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<tr>
<td>Hour VMT Fraction</td>
<td>Modest</td>
<td>Modest</td>
<td>Modest</td>
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## Collect and Analyze Data and Develop Sample Datasets

<table>
<thead>
<tr>
<th>Dataset/Source</th>
<th>Contents</th>
<th>Inputs Supported</th>
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</thead>
<tbody>
<tr>
<td>VTRIS</td>
<td>Classified traffic counts (reporting states)</td>
<td>Temporal distributions (hr and day) VMT (fractions)</td>
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<tr>
<td>Highway Statistics</td>
<td>VMT estimates from traffic counts (all states and UZA)</td>
<td>Road type distributions VMT (fractions)</td>
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<tr>
<td>ITS</td>
<td>Metro ITS volume and speed data</td>
<td>Speed distributions Temporal distributions (all)</td>
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<td>Private Vendor Speed</td>
<td>Speed from in-vehicle devices</td>
<td>Speed distributions</td>
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<tr>
<td>Speed Data</td>
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<tr>
<td>GPS Travel Surveys</td>
<td>GPS-supported household travel surveys – vehicle traces</td>
<td>Speed distributions</td>
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<tr>
<td>Travel Demand</td>
<td>Current and forecast volumes and speeds</td>
<td>VMT Road type distributions Speed distributions</td>
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<td>Forecasting Models</td>
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<tr>
<td>MCMIS</td>
<td>Commercial vehicle fleets</td>
<td>Source type population Age distribution</td>
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</tbody>
</table>
Speed Data and Estimation Methods

- Compared a variety of speed data sources and estimation methods
  - Models, ITS detectors, NAVTEQ/INRIX, GPS surveys

### Average Speed – Jacksonville Freeways

<table>
<thead>
<tr>
<th>Time of Day</th>
<th>TDFM</th>
<th>TDFM - Postproc.</th>
<th>ITS</th>
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</thead>
<tbody>
<tr>
<td>Overnight</td>
<td>60.0</td>
<td>50.0</td>
<td>40.0</td>
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<tr>
<td>AM Peak</td>
<td>50.0</td>
<td>40.0</td>
<td>30.0</td>
</tr>
<tr>
<td>Midday</td>
<td>50.0</td>
<td>40.0</td>
<td>30.0</td>
</tr>
<tr>
<td>PM Peak</td>
<td>50.0</td>
<td>40.0</td>
<td>30.0</td>
</tr>
</tbody>
</table>

### Average Speed - Atlanta Freeways

<table>
<thead>
<tr>
<th>Time of Day</th>
<th>TDFM - #1</th>
<th>TDFM - #2</th>
<th>ITS</th>
<th>GPS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overnight</td>
<td>70.0</td>
<td>60.0</td>
<td>50.0</td>
<td>40.0</td>
</tr>
<tr>
<td>AM Peak</td>
<td>60.0</td>
<td>50.0</td>
<td>40.0</td>
<td>30.0</td>
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<tr>
<td>Midday</td>
<td>70.0</td>
<td>60.0</td>
<td>50.0</td>
<td>40.0</td>
</tr>
<tr>
<td>PM Peak</td>
<td>70.0</td>
<td>60.0</td>
<td>50.0</td>
<td>40.0</td>
</tr>
</tbody>
</table>
Off-Network Examples & Data Sources

- **Port Terminal**
  - Drayage truck study (EPA/ERG)
  - Port entry/exit data
  - Portable activity monitors

- **Municipal Parking Lot**
  - Passenger vehicle starts
  - Parking lot accumulation study

- **Truck Rest Stop**
  - Heavy-Duty Extended idle
  - Truck Idling study (M. Baker)
Tools

- MOVES Operating Mode Data Import Tool
- MOVES Meteorology Data Import Tool
Tools (continued)

- MOVES Highway Statistics Analysis
- MOVES VTRIS Analysis Tool
Examples

- **Example #1**: Regional Analysis with Limited Data
- **Example #2**: Regional Analysis with More Extensive Data
- **Example #3 – Project-Level Analysis**
- These are included in the Guidebook
Example Topics Covered in Resource Documents

- Analysis of temporal (hour, day) distributions by source type in 27 states based on FHWA Vehicle Travel Information System (VTRIS) data from traffic counters

- State-level road type distributions by source type based on Highway Statistics data

- Methods for combining registration and VMT data for source type populations inputs

- Supplementing reg. data with license plate surveys to account for out-of-area vehicles in age distribution

- Examples of drive-cycle inputs for project-level analysis
Additional Research and Data Needs

Data Collection

- Classified traffic data collection for VMT-based inputs
- Speed data and traffic networks
- Heavy-duty vehicle fleets and activity
- Off-network data

Research and Methodology Development

- Speed data by source type
- Speed prediction methods
- Traffic classification methods
- Truck short- versus long-haul populations
- Expanded use of fleet-based telematics data to measure heavy-duty vehicle activity
Thank You!