SANDAG

Transportation Modeling Forum

December 12, 2018
Forum Agenda

External Model Assumptions

Analyzing Observed VMT

Series 14 Preview
External Model Assumptions

Mike Calandra
Mike.Calandra@sandag.org

Rick Curry
Rick.Curry@sandag.org
Table of Contents

- Population Forecasts
- General Plans
- Circulation Elements
- Freight Forecasts
- Airport Forecasts
- Auto Operating Costs
The California Department of Finance produces an annual statewide population forecast

- Regional Housing Needs Assessment (RHNA)
- MPO’s are mandated to be within ±3%
- **AB 1086** (2017) updates the mandate to be within ±1.5%

<table>
<thead>
<tr>
<th>Growth Forecast</th>
<th>DoF Source</th>
<th>DoF 2050 POP Forecast</th>
<th>SANDAG 2050 POP forecast</th>
<th>Percent Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Series 13</td>
<td>2014</td>
<td>3,989,654</td>
<td>4,068,759</td>
<td>2.0%</td>
</tr>
<tr>
<td>Series 14</td>
<td>2018</td>
<td>3,953,511</td>
<td>4,011,150</td>
<td>1.5%</td>
</tr>
</tbody>
</table>
The region’s General Plans (Land Use) have changed significantly over time

- A broad planning and policy guideline for future development within all jurisdictions
- Recommended to be updated every 15-20 years
- Used by SANDAG to define regionwide Housing Capacity as an input into the Growth Forecasts

<table>
<thead>
<tr>
<th>Growth Forecast</th>
<th>General Plan Year</th>
<th>Regionwide Dwelling Unit Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Series 12</td>
<td>2008</td>
<td>435,885</td>
</tr>
<tr>
<td>Series 13</td>
<td>2012</td>
<td>395,042</td>
</tr>
<tr>
<td>Series 14</td>
<td>2016</td>
<td>381,984</td>
</tr>
</tbody>
</table>
The region’s Circulation Element (network) has changed significantly over time.

- Historical
  - SR-125
  - I-805
  - SR-54
  - SA-680
The region’s Circulation Element (network) has changed significantly over time

Recent

- Rancho Del Oro
- Regents Rd Bridge
- Fenton Pkwy
- Alta Rd
Freight Analysis Forecast (FAF)

Produced by:
- Bureau of Transportation Statistics
- Federal Highways Administration

Version 4 estimates tonnage and value by:
- Regions of origin and destination
- Commodity type
- Mode

Data are available for:
- 2012 – 2016
- 2020 to 2045 in 5-year intervals

https://faf.ornl.gov/fafweb/
The Truck Model uses the FAF Forecast for Truck Flows into and out of the San Diego Region.

I = Internal
E = External
Airport Forecasts

- Weekday Annual Enplanement Forecasts
  - San Diego International Airport (SAN)
  - Cross Border Express (CBX) for Tijuana International Airport (TIJ)
Auto Operating Costs (AOC)

- AOC is the Average Driving Cost Per Mile
  - Function of:
    - Fuel costs
      - US Energy Information Administration (EIA) for gas
      - CA Energy Commission (CEC) for Diesel, Electric, Hydrogen, PHEV/Gas, & PHEV/Electric
    - Fuel efficiency
      - CA Air Resources Board (CARB)
    - Maintenance costs
      - American Automobile Association (AAA)
  - Converted to ABM Cost Year ($2010)
  - ABM AOC Elasticity
    - 10% increase in AOC results in a 1% decrease in VMT
Historical Fuel Costs

- National & CA: US EIA
- San Diego: Oil Price Information Service (OPIS)
Fuel Efficiency

Miles per Gallon for SB375 Vehicle Classes
Maintenance Costs - AAA

- Maintenance
- Repair
- Tires
AOC by Regional Plan

AOC by Sustainable Communities Strategy

- 1st SCS (SR12)
- 2nd SCS (SR13)
- 3rd SCS (SR14)

Year
- 2015
- 2020
- 2025
- 2030
- 2035
- 2040
- 2045
- 2050
- 2055

AOC (Cents per Mile, $2010)
Analyzing Observed VMT

Mike Calandra
Mike.Calandra@sandag.org

Joaquin Ortega
Joaquin.Ortega@sandag.org
Analyzing Observed VMT

VMT Defined

1. **Vehicle Miles of Travel**
2. A metric used in transportation planning, design, policy-making and revenue estimation
3. Measures the amount of travel for all vehicles in a geographic area over a period of time

A straightforward calculation:

\[
\text{Roadway Centerline Length} \times \text{Observed Traffic Count} = \text{VMT}
\]
VMT Calculation Considerations

- Travel behavior patterns
- Demographic characteristics
- Land use
  - Mix of uses
  - Road (intersection) density
- Accessibilities
  - Employment within a travel shed
VMT Calculation Considerations

- Economic conditions
- Out-of-pocket costs
  - Fuel tax
- Weather and seasons

- Methods of Observation
- Methods of Analysis
Methods of Observation

- **Short Counts**
  - Pneumatic tube counts
  - Manual counts

- **Continuous Counts**
  - Loop detectors
  - Radar / Microwave / Laser

- **Others**
  - Travel Surveys
  - Fuel sales
  - Auto registration
Observation Method Limitations

- **Short Counts**
  - Cost prohibitive
    - Time: sample size
    - Space: distance between count locations

- **Continuous Counts**
  - Device calibration & mechanical failure

- **Others**
  - Sample size & inaccurate responses
  - Seasonal variations
  - Odometer calibration, rollover & tampering
Regulatory Environment

- **AB 32**
  - Reduce Green House Gas (GHG) emissions

- **SB 375**
  - Set regional targets for GHG reduction

- **SB 743**
  - VMT replaces LOS as an “impact” for EIRs
    - VMT per Capita & VMT per Employee

- **Climate Action Plans**
  - Reduction in VMT equates to reduction in GHG
    - Disaggregated VMT by jurisdiction
VMT Data Sources

- HPMS
  - Short count collection submitted by jurisdictions
- ARB EMFAC Software
  - Fuel sales data & BAR smog data
- Third party
  - INRIX & HERE
- PeMS
  - Continuous collection for State Routes
Caltrans HPMS

- Annual Public Road Data publication
  - 2001-2016 Annual average daily VMT inventory
  - VMT for all facility types
  - VMT by jurisdiction
  - Data library for all CA counties
Caltrans HPMS

CALTRANS HPMS
AVERAGE DAILY VMT
SAN DIEGO REGION

ARB EMFAC Software

- Three versions released since 2011
  - Annual average daily VMT inventory
  - Estimates & future forecasts for VMT
  - By vehicle type
  - Fuel sales & BAR smog check data
  - Data library for all CA counties/MPOs
  - [https://www.arb.ca.gov/emfac/](https://www.arb.ca.gov/emfac/)
ARB EMFAC Software

- EMFAC estimates for past years vary by version

San Diego County estimated average weekday VMT - All roads

<table>
<thead>
<tr>
<th>EMFAC VERSION</th>
<th>v2011</th>
<th>v2014</th>
<th>v2017</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000 VMT</td>
<td>72,291,135</td>
<td>71,507,511</td>
<td>77,607,593</td>
</tr>
<tr>
<td>2005 VMT</td>
<td>77,498,458</td>
<td>77,583,134</td>
<td>84,454,198</td>
</tr>
<tr>
<td>2010 VMT</td>
<td>82,630,299</td>
<td>73,443,967</td>
<td>81,717,627</td>
</tr>
</tbody>
</table>
ARB EMFAC Software

ARB EMFAC AVERAGE DAILY VMT SAN DIEGO REGION

v2011
v2014
v2017
INRIX/TAMU Data

- 2015 Urban Mobility Report
  - 1982-2014 Annual average daily VMT inventory
  - FHWA Seasonally Adjusted VMT
  - INRIX proprietary methodology
  - Data library for 101 US metro areas
  - [https://mobility.tamu.edu/ums/](https://mobility.tamu.edu/ums/)
INRIX/TAMU Data

INRIX TAMU UMR
AVERAGE DAILY VMT
SAN DIEGO FREEWAYS

30 M  35 M  40 M  45 M  50 M  55 M
PeMS VMT Data

- Galaxy of San Diego VMT
  - All State freeways & highways with loop detectors
    - Samples filtered for San Diego County
    - Samples filtered for >85% detector health
  - All weekdays - holidays excluded
  - January 1, 2003 - June 30, 2018
  - Average daily variation ± 5%
  - [http://pems.dot.ca.gov/](http://pems.dot.ca.gov/)
Galaxy of San Diego VMT

San Diego County: 2003 - 2018 Weekday Freeway VMT

Annual Average: 29.1 M 30.6 M 33.5 M 35.2 M 37.1 M 36.0 M 33.8 M 34.0 M 33.4 M 35.4 M 37.1 M 38.1 M 40.4 M 40.5 M 42.2 M 41.8 M

Standard Deviation: ± 5.1% ± 5.8% ± 4.9% ± 3.7% ± 6.3% ± 5.8% ± 4.3% ± 4.9% ± 3.8% ± 6.7% ± 4.4% ± 4.6% ± 4.2% ± 3.9% ± 4.1% ± 4.1%
Observed Outliers

- Heavy Winter Storms
- San Diego Comic Con
- Cedar & Paradise Fires
- Witch Fire
Observed Outliers

San Diego Comic Con

Doubling of Local Unemployment Rate

Holiday week

Heavy Winter Storms
Observed Outliers

- San Diego Comic Con
- Heavy Winter Storms
- 2016 Presidential Election
VMT Analysis Conclusions

ANNUAL DAILY VMT ESTIMATES FOR ALL ROADS

- EMFAC v2011
- EMFAC v2017
- Caltrans HPMS

ANNUAL DAILY VMT ESTIMATES FOR FREEWAYS

- Urban Mobility Scorecard
- Caltrans PeMS
VMT Analysis Conclusions

Further Steps

- Educate stakeholders on the variety of VMT sources and estimation methods
- Methods will improve with advances in telemetry technology
- Accessibly to data, metadata, and documentation

- Statewide collaboration to create a consistent VMT estimation methodology or data library for regulatory analysis and compliance!
VMT Analysis Conclusions

- Fifteen years of observed VMT data
  - State Routes
    - Freeways and highways with loop detection
      - Covers about 46% of the system
      - Provides enough data points for statistical analysis
  - Arterials
    - Arterials with short (hose) counts
      - Covers about 5% of the system
      - Do not provide enough data points for statistical analysis
VMT Analysis Conclusions

- Fifteen years of observed VMT data
  - Weekday VMT fluctuates daily by \( \pm 5\% \)
    - Methods of observation and analysis
    - Weather, special events, natural disasters and holidays amplify weekday variation
    - Correlates with economic conditions

- Third-party data is helpful for VMT estimation

- VMT is an estimation, not an empirical calculation!
Series 14 Preview

Ziying Ouyang
Ziying.Ouyang@sandag.org

Rick Curry
Rick.Curry@sandag.org
Series 14 Preview

- ABM2
- EMME Conversion
- Regional Plan
A Suite of Travel Models

- Core model
  - San Diego resident model

- Special market models:
  - Airport passenger models: (San Diego International Airport (SAN) and Tijuana International Airport (TIJ))
  - Visitor model
  - Cross border model
  - Tour-based commercial travel model (CTM)
  - External models
  - Truck model
**Differences between ABM1 and ABM2**

<table>
<thead>
<tr>
<th>Category</th>
<th>ABM1</th>
<th>ABM2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base Year</td>
<td>2012</td>
<td>2016</td>
</tr>
<tr>
<td>Household Travel Survey</td>
<td>2006</td>
<td>2016/2017</td>
</tr>
<tr>
<td>Transit On-Bound Survey</td>
<td>2009</td>
<td>2015</td>
</tr>
<tr>
<td>Airport Model</td>
<td>SAN</td>
<td>SAN and TIJ</td>
</tr>
<tr>
<td>Commercial Travel</td>
<td>Trip-Based</td>
<td>Tour-Based</td>
</tr>
<tr>
<td>Travel Time Reliability</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Escort Model</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Truck Model</td>
<td>FAF3</td>
<td>FAF4</td>
</tr>
<tr>
<td>Assignment/Skimming</td>
<td>TransCAD</td>
<td>EMME</td>
</tr>
</tbody>
</table>
EMME Conversion

Model overview – new

Network files

Bike/walk models

Import network

Traffic assignment

Transit assignment

iter>3?

Data export

Data loader

Emme Modeller tool

CT-RAMP SDRM

CT-RAMP SMM

Emme database

logsums*.csv

skims OMX

skims demand

Commercial veh.

Truck

External-internal (USA-SD)

External-external

Build trip tables

demand OMX
EMME Conversion

Project Structure
- emme_project folder with Emme data
Regional Plan Process

- Data Collection
- Analysis
- Forecast
- Alternatives
- Evaluation

2015 → 2019
## SB 375 Regional Plan
### Climate Targets

<table>
<thead>
<tr>
<th></th>
<th>2020</th>
<th>2035</th>
</tr>
</thead>
<tbody>
<tr>
<td>Targets through</td>
<td></td>
<td></td>
</tr>
<tr>
<td>September 30, 2018</td>
<td>-7%</td>
<td>-13%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Targets beginning</td>
<td></td>
<td></td>
</tr>
<tr>
<td>October 1, 2018</td>
<td>-15%</td>
<td>-19%</td>
</tr>
</tbody>
</table>
## Limitations of the Model

### Understanding

<table>
<thead>
<tr>
<th>Aware</th>
<th>Understand</th>
<th>Don’t Understand</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>In the Model</strong></td>
<td><strong>Off Model</strong></td>
</tr>
<tr>
<td></td>
<td>Traffic</td>
<td>Connected vehicles</td>
</tr>
<tr>
<td></td>
<td>Transit / bike</td>
<td>Automated vehicles</td>
</tr>
<tr>
<td></td>
<td>Demographics</td>
<td>Mobility as a Service</td>
</tr>
<tr>
<td></td>
<td>Existing land use</td>
<td>Electric vehicle charging stations</td>
</tr>
<tr>
<td>Unaware</td>
<td><strong>Not Modeled</strong></td>
<td><strong>Unmodelable</strong></td>
</tr>
<tr>
<td></td>
<td>Safety</td>
<td>Technology we don’t know about</td>
</tr>
<tr>
<td></td>
<td>Personal preference</td>
<td>Events we don’t know about</td>
</tr>
<tr>
<td></td>
<td>Restricted choices</td>
<td></td>
</tr>
</tbody>
</table>
Dials

Technology
- Connected and automated vehicles (On)
- Smart signals (On)
- ATDM reliability (On)
- Electric Vehicle charging stations (Off)
- Managed Lanes/High Occupancy toll rates (On)
- Mileage based user fee (On)
- Parking rates (On)
- Transit fares (On)

Economic (Cost)
- HOV/Managed Lane occupancy (On)
- Community based transportation plan (Off)
- Vanpool (Off)
- Bikeshare (Off)
- Microtransit (Off)
- Pooled rides (Off)
Model Run Timeframes

Network Details
- Master network concept
- Quality control

Policy Dials
- Attributes and parameters updated
- Quality control

Model Run
- Dual processor - 28 cores each and 256GB RAM

Performance Measures
- Air quality
- Social equity
- Model metrics
- Off-model calculators

Quality Assurance

3-5 Days

1-2 Days

3-4 Days

3-5 Days

1-2 Days
Forum Agenda

External Model Assumptions

Analyzing Observed VMT

Series 14 Preview

Next Transportation Model Forum:

June 13, 2019