TRANSPORTATION MODELING FORUM

December 9, 2020
Forum Agenda

• Welcome, Introductions and Announcements
• Social Equity Analysis and Regional Planning
• RTP Modeling Retrospective
• Growth Forecast Lifecycle Policy
• ABM2+ Subarea Enhancements
Welcome, Introductions and Announcements

• Welcome to SANDAG Jielin Sun!!

• Welcome back to SANDAG Susan Xu!!

• New Model Website – coming soon
  – Update of SANDAG Regional Models website expected December/January
  – New wiki pages for ABM2+
    • https://github.com/SANDAG/ABM/wiki

• Other Announcements?
RIP Bill McFarlane

• William “Bill” McFarlane, 1951 – 2020
• Passed away on November 17, 2020
• Career
  – Longtime SANDAG transportation modeling manager
  – Architect and developer of one of the most advanced 4-step models in the nation
  – Integration of GIS and transportation modeling
  – Use of microzones and transit access points for detailed representation of transit accessibility and non-motorized travel

We stand on his shoulders and carry on his legacy
Social Equity Analysis in the Regional Plan

Jane Clough, Ph.D. , Ziying Ouyang
Transportation Model Forum – December 9, 2020
Tribal Lands and Local Jurisdictions in the San Diego Region
April 2018

Military Facilities
Cleveland National Forest

Sources: County of San Diego Assessor’s Mapping Division, San Diego Geographic Information Source (SanGIS), SANDAG
Three challenges

Reduce congestion
Improve social equity
Meet state and federal mandates – to be faster, fairer, and cleaner
San Diego Region Household Income Distribution, 2016

- Less than $30,000: 35.0%
- $30,000 to $44,999: 20.0%
- $45,000 to $59,999: 15.0%
- $60,000 to $74,999: 10.0%
- $75,000 to $99,999: 7.0%
- $100,000 or more: 5.0%
San Diego Region Age and Sex Composition, 2016 and 2050
Social Equity Focus Populations
Data-Driven Planning
Where people live and work
Trips to and from employment centers are the most predictable
7% low-income residents have access to fast and frequent transit service.
The median transit travel time is **51 minutes** – double the travel time for people who drive to work.
10% of the region’s population has a disability.
13% of our population will be age 75 or older in 2050
## Social Equity Analysis in the Regional Plan

<table>
<thead>
<tr>
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<tbody>
<tr>
<td><strong>Process</strong></td>
<td>- Formal Stakeholders Working Group</td>
<td>- 14 CBOs as Community Based Consultants</td>
<td>- 12 CBOs from EJ Communities per Calenviroscreen</td>
</tr>
<tr>
<td></td>
<td>- CBOs part of SWG</td>
<td>- Social Equity Peer Group</td>
<td>- CBO Working Group</td>
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<td></td>
<td>- EJ Subcommittee</td>
<td>- Education/Outreach/ Advocacy</td>
<td>- CBO Network for education/outreach/advocacy</td>
</tr>
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<td></td>
<td>- CBO grants (8)</td>
<td>- From PIP thru 3 months after plan (3 yrs)</td>
<td>- Resourced throughout approval of RP</td>
</tr>
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<td>- 6 months into process thru Plan adoption</td>
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<tr>
<td><strong>Analysis</strong></td>
<td>- Travel Demand Model (4-Step)</td>
<td>- ABM/PECAS</td>
<td>- ABM2+</td>
</tr>
<tr>
<td></td>
<td>- Unit of Analysis: TAZ analysis</td>
<td>- Unit of Analysis: Traveler/HH</td>
<td>- Unit of Analysis: Traveler/HH</td>
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<tr>
<td></td>
<td>- Indexes for Communities of Concern</td>
<td>- Demographic that can be forecast only</td>
<td>- Demographic that can be forecast only</td>
</tr>
<tr>
<td></td>
<td>- Basic comparison of Performance Measures</td>
<td>- Social Equity Calculation based on the 80/20 rule</td>
<td>- Social Equity Calculation based on the 80/20 rule</td>
</tr>
<tr>
<td></td>
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<td></td>
<td>- AB805 Pollution Reduction Strategies for EJ Communities</td>
</tr>
</tbody>
</table>
### Evolving Definitions: Communities of Concern

<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>Minorities – TAZ w/ 65%</td>
<td>All Minorities</td>
<td>All Minorities</td>
</tr>
<tr>
<td>Low –Income</td>
<td>Low-Income – 200% of Federal Poverty Level</td>
<td>Low-Income – 200% of Federal Poverty Level</td>
</tr>
<tr>
<td>• Income</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Severe overcrowding</td>
<td></td>
<td></td>
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<tr>
<td>• Poverty</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low Mobility</td>
<td>Seniors – 75+</td>
<td>Seniors – 75+</td>
</tr>
<tr>
<td>No car households</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disabled</td>
<td></td>
<td></td>
</tr>
<tr>
<td>75 +</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low Civic Engagement</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Educational attainment</td>
<td></td>
<td></td>
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<tr>
<td>• Linguistic Isolation</td>
<td></td>
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</tr>
</tbody>
</table>

**Source:**
- 2050 RTP (2011)
- San Diego Forward (2015)
- San Diego Forward (2021)
Geographic Communities per CalEnviroScreen 3.0 (AB805)
CalEnviroScreen 3.0 Indicators

**Exposure:**
- contact with pollutants

**Environmental Effects:**
- Adverse environmental conditions caused by pollution

**Sensitive Populations:**
- Biological traits that may magnify the effects of pollution exposures

**Socioeconomic Factors:**
- Community characteristics that result in increased vulnerability to pollution
CalEnviroScreen 3.0 Formula

**CalEnviroScreen Formula**

Pollution Burden

- Average of Exposures and Environmental Effects*

Population Characteristics

- Average of Sensitive Populations and Socioeconomic Factors

CalEnviroScreen Score

*The Environmental Effects component is weighted one-half when combined with the Exposures component.*
Identifying Disadvantaged Communities
CBO Partner Network
Human-Centered Design

By listening to residents throughout the region, we can plan for improvements that address their unique needs.
CBO Partners
Voices from Environmental Justice Communities
Tribal input in the 2021 Regional Plan
5 Big Moves

Inter-reliant strategies that work as one and enhance each other
## Social Equity Performance Measures

<table>
<thead>
<tr>
<th>Equity Area</th>
<th>Measure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Economy</td>
<td>Access to opportunities via transit (employment centers and higher education)</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Enviro. and Quality of Life</td>
<td>Access to basic needs (retail, parks, and medical)</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Mobility and Safety</td>
<td>People within ½ mile of transit (by transit tier)</td>
</tr>
</tbody>
</table>
Technical Aspects of Performance Measures

- Streamlined process
- Disaggregated simulation model to simulate an individual travel pattern
- Regional or sub regional measures
- ABM2+ outputs stored in SQL database
- SQL stored procedures/python scripts to summarize performance measures
- Python script to write out measures to an Excel template with multiple tabs for measures for a series of years and scenarios
Social Equity Analysis in the Regional Plan

Questions?
RTP Modeling Retrospective

Joaquin Ortega
Neeco Beltran
Introduction/Project Intent

• Regional Transportation Plans Have Been a Requirement for Decades
  – Plans are completed at the moment in time with the best available information, analysis, and tools
  – Plans are approved by decision makers in that time period

• Project Intents/Goals
  – To compare the differences between forecasted traffic volumes and measured traffic volumes
  – To assess the causes of differences between forecasted traffic volumes and measured traffic volumes
Forecast Data Collection

• There are 7 historic RTP hard copy documents in the SANDAG transportation library. These historic RTP documents contain maps with forecasted screen line volumes.
• Forecasted screen line volumes are for years that have already passed
• Manual interpretation of the exact location based on the placement of the label point.
• If the label point was in an area where it could be ascribed to multiple locations, it was excluded.
• Sampling Results

<table>
<thead>
<tr>
<th>RTP YEAR</th>
<th>FORECAST YEAR</th>
<th>SAMPLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>1976</td>
<td>1995</td>
<td>23</td>
</tr>
<tr>
<td>1980</td>
<td>2000</td>
<td>37</td>
</tr>
<tr>
<td>1984</td>
<td>1995</td>
<td>34</td>
</tr>
<tr>
<td>1984</td>
<td>2005</td>
<td>37</td>
</tr>
<tr>
<td>1986</td>
<td>1995</td>
<td>36</td>
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<td>1986</td>
<td>2005</td>
<td>41</td>
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<tr>
<td>1989</td>
<td>2000</td>
<td>42</td>
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<tr>
<td>1989</td>
<td>2010</td>
<td>46</td>
</tr>
<tr>
<td>1997</td>
<td>2010</td>
<td>48</td>
</tr>
<tr>
<td>2000</td>
<td>2010</td>
<td>43</td>
</tr>
</tbody>
</table>

Note: All location sampling was done prior to any processing of empirical count data.
Historic Count Data Acquisition

• Data Source: SANDAG ADT Link count spreadsheet
  – Caltrans Adjusted 5 day counts
  – Date range for fwy ADT Link 5 day counts 1980-2012 (Starting in 2013 all counts now gathered from PeMS)
• Two methods for processing empirical counts
  – Absolute Count: The single count that matches the forecast year
  – Average Count: 2 years prior to the forecast year + the forecast year + 2 years after the forecast year (5 year average)
• Highway network ground truth status
  – Planned highway projects sometimes were not on the ground in the year specified by some past plans.
  – Classify each sample with a Network Status Flag
Historic Count Data Acquisition

-1 = The highway facility did not exist on the ground in the forecast year.

0 = The highway facility existed in the forecast year but the planned improvement did not.

Network Status = -1
SR-125 was never completed past its current terminus at SR-52

Network Status = 0
I-5 was complete as a freeway but no HOV facility was constructed in this section of the corridor.
Historic Count Data Acquisition

• 1 = The highway facility exists as planned or improved in the forecast year
• 2 = The highway facility existed but it is unclear if improvements were planned for the forecast year

Network Status = 1
SR-54 was completed as a freeway in this section in the late 1990’s

Network Status = 2
I-805 was complete as a freeway by 1980 but it is unclear if any improvements were noted by 2000
Preliminary Results

Validation Plot (Analysis Set)

R-squared: 0.7469
# Preliminary Results

## Results by Network Status (Analysis Set)

<table>
<thead>
<tr>
<th>Range</th>
<th>0</th>
<th>1</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>-10% to 10%</td>
<td>36.11%</td>
<td>25.00%</td>
<td>35.24%</td>
</tr>
<tr>
<td>-20% to 20%</td>
<td>52.78%</td>
<td>57.14%</td>
<td>58.15%</td>
</tr>
<tr>
<td>-30% to 30%</td>
<td>61.11%</td>
<td>80.95%</td>
<td>81.06%</td>
</tr>
<tr>
<td>Outside of +/- 30%</td>
<td>100.00%</td>
<td>100.00%</td>
<td>100.00%</td>
</tr>
</tbody>
</table>

## Results by Plan Year (Analysis Set)

<table>
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</tr>
</thead>
<tbody>
<tr>
<td>-10% to 10%</td>
<td>0.00%</td>
<td>16.13%</td>
<td>14.29%</td>
<td>19.72%</td>
<td>42.50%</td>
<td>60.00%</td>
<td>64.10%</td>
</tr>
<tr>
<td>-20% to 20%</td>
<td>16.67%</td>
<td>19.35%</td>
<td>41.27%</td>
<td>59.15%</td>
<td>70.00%</td>
<td>80.00%</td>
<td>76.92%</td>
</tr>
<tr>
<td>-30% to 30%</td>
<td>33.33%</td>
<td>38.71%</td>
<td>76.19%</td>
<td>90.14%</td>
<td>83.75%</td>
<td>93.33%</td>
<td>89.74%</td>
</tr>
<tr>
<td>Outside of +/- 30%</td>
<td>100.00%</td>
<td>100.00%</td>
<td>100.00%</td>
<td>100.00%</td>
<td>100.00%</td>
<td>100.00%</td>
<td>100.00%</td>
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</tbody>
</table>
Preliminary Results

- Mean Absolute Percentage Error (MAPE):
  \[ \frac{1}{n} \sum_{i=1}^{n} \left| \frac{\text{Actual}_i - \text{Forecast}_i}{\text{Actual}_i} \right| \]

- Mean Absolute Percentage Error Advantages
  - Easy to interpret
  - Unit-free
  - Accounts for large spread between units, specifically between positive and negative values
  - Drawback: Doesn’t tell if overcounting or undercounting

- Mean Percentage Error (MPE):
  \[ \frac{1}{n} \sum_{i=1}^{n} \frac{\text{Actual}_i - \text{Forecast}_i}{\text{Actual}_i} \]
Preliminary Results

Mean Absolute Percentage Error (Average Count) by Plan Year

Mean Absolute Percentage Error (Average Count) by Network Status
Next Steps

• Evaluating other modes of transportation
  – Recall: this analysis only measures freeway screenline volumes
  – Public transit forecasts and other metrics can help contextualize inaccuracies in freeway/highway traffic forecasts

• Assessing the causes of model forecast inaccuracy
  – Model Inputs
    a) Population forecasts
    b) Economic forecasts
    c) Land use forecasts
  – Exogenous variables not captured by the model
    a) Sudden economic changes: recessions, fuel cost changes
    b) Societal changes: labor force participation rate for women
Questions
Growth Forecast Lifecycle Policy

• SANDAG Service Bureau governance, including use of growth forecasts and models, is defined in Board Policy #12

• Where can you find SANDAG’s board policies?

• And specifically Board Policy #12?
Growth Forecast Lifecycle Policy

Key Recent Dates and Changes

• May 2017
  – Board Policy #12 amended (formally modified February 2018)
  – Lifecycle policy formally adopted for Service Bureau and informally adopted for SANDAG projects
• December 2017
  – Executive Committee establishes project priorities when SANDAG has more projects than available staff
    • First priority: The Regional Plan and other agency priorities
    • Second priority: Member and other government agency project requests
    • Third priority: Private-sector development project requests
Growth Forecast Lifecycle Policy

Key Recent Dates and Changes

• February 2019
  – SANDAG Board approves a bigger and bolder transportation vision with planned adoption as the 2021 Regional Plan
  – SANDAG starts work on ABM2+

• October 2019
  – Emergency adoption of 2019 Federal RTP
  – ABM2 with Growth Forecast series 14 (version 17)

• Jan 2020
  – Board Policy #12 temporarily amended
  – SANDAG Executive Committee approved a temporary waiver of the enforcement of the requirement that all new projects use the current version of the model
What was the result when the 2019 Federal RTP was adopted (Nov 2019) and Board Policy #12 was amended (Feb 2020)?

<table>
<thead>
<tr>
<th>Status</th>
<th>Regional Growth Forecast</th>
<th>Travel Demand Model Platform</th>
<th>Use in Service Bureau Modeling Jobs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Retired</td>
<td>Series 12</td>
<td>4-Step Model</td>
<td>No longer used for modeling projects</td>
</tr>
<tr>
<td>Prior Model</td>
<td>Series 13</td>
<td>ABM1</td>
<td>For continuation of work that started in ABM1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><em>New work that requires land use modifications</em></td>
</tr>
<tr>
<td>Current Model</td>
<td>Series 14 (version 17)</td>
<td>ABM2</td>
<td>New work for regional data extraction and network scenarios</td>
</tr>
</tbody>
</table>
### Growth Forecast Lifecycle Policy

**What will be the result when the 2021 RP is adopted in November 2021?**

<table>
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<td>ABM1</td>
<td>No longer used for modeling projects</td>
</tr>
<tr>
<td>Prior Model</td>
<td>Series 14 (version 17)</td>
<td>ABM2</td>
<td>For continuation of work that had started in ABM2</td>
</tr>
<tr>
<td><em>Current Model</em></td>
<td>Series 14 (version 38,39)</td>
<td>ABM2+</td>
<td>All new modeling projects</td>
</tr>
</tbody>
</table>
ABM2+ Subarea Enhancements: Project Goals

• Implement land use overrides by MGRA in ABM2+
  – Update synthetic population for the study area
  – Update the employment density table
  – Implement new land use unit types
• Allow for use of flexible Traffic Analysis Zone (TAZ) layers
• QA/QC and subarea report automation
• Define reporting thresholds
ABM2+ Subarea Enhancements: Scope of Work

• Task Descriptions
  – Task 1: Project Management
  – Task 2: Employment Density Update
  – Task 3: Review Existing Process and Produce a Model Enhancements Plan
  – Task 4: Model Enhancements
  – Task 5: Trip Data Report and Threshold Definition
  – Task 6: Application Tests
  – Task 7: Final Report and Workshop
  – Task 8: As-Needed Support

• Scope put to bid in summer 2020
• RSG selected as the consultant in fall of 2020
• October 22, 2020 kickoff meeting
ABM2+ Subarea Enhancements: Project Management

• Project Management Plan
  – Communications
  – Key staff
  – Budget and invoicing
  – Project schedule and deliverables

• Bi-weekly project meetings and minutes
  – Set time and day
  – Setup confluence project page

• Monthly progress reports
ABM2+ Subarea Enhancements: Employment Density Update

• Update non-residential employment density table
  1. Agriculture and mining
  2. Construction
  3. Manufacturing
  4. Wholesale trade
  5. Retail trade
  6. Transportation and warehousing, and utilities
  7. Information, finance and real estate
  8. Professional and business services
  9. Education and health services
  10. Leisure and hospitality
  11. Other services
  12. Government
  13. Self-employed and domestic workers (employees per square foot)

• Update non-residential unit type support
  1. Outdoor and recreational land uses (Employees per Acre)
  2. Group Quarters (Employees per Bed)
  3. Other potential unit types:

<table>
<thead>
<tr>
<th>LAND USE CATEGORY</th>
<th>UNIT TYPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gas Stations</td>
<td>Pumps</td>
</tr>
<tr>
<td>Car Washes</td>
<td>Stalls</td>
</tr>
<tr>
<td>Casinos</td>
<td>Slots &amp; Gaming Tables</td>
</tr>
<tr>
<td>Campgrounds</td>
<td>Campsites</td>
</tr>
<tr>
<td>Marinas</td>
<td>Berths</td>
</tr>
<tr>
<td>Movie Theaters</td>
<td>Seats &amp; Screens</td>
</tr>
<tr>
<td>Sports Activities</td>
<td>Courts</td>
</tr>
<tr>
<td>Bowling Alleys</td>
<td>Lanes</td>
</tr>
<tr>
<td>Golf Courses</td>
<td>Holes</td>
</tr>
<tr>
<td>Parking Lots &amp; Garages</td>
<td>Spaces</td>
</tr>
</tbody>
</table>
ABM2+ Subarea Enhancements: Model Enhancement Plan

• Review and document existing process
  – Requirements
  – Use cases
  – Issues and opportunities for improvement

• Develop model enhancement plan
  – Data pipeline and management system
  – Review duplication in inputs
  – Incorporate employment density updates
  – Update the population synthesizer for the study area
  – Apply population over/under-sampling for subareas
  – Develop automated QA/QC reports
ABM2+ Subarea Enhancements: Model Enhancement

Feature

• Traffic Analysis Zone splitting
  – Lost in translation from the 4-Step model to ABM1
  – Internal TAZ and network building process remains unchanged
    • Modify local TAZ layer using MGRA boundaries
    • Change / add zone connectors to accommodate new TAZ(s)
    • Run script to refresh lookup tables that include TAZ
    • Build updated Hwycov, Trcov and bike network layers

  – Improves subarea model calibration accuracy
  – Important when analyzing infill development
  – Boosts confidence of analysis in supporting documents
  – Increases client satisfaction
ABM2+ Subarea Enhancements: Model Enhancement Feature

- Traffic Analysis Zone splitting challenge

One TAZ & Four MGRAs include 100+ MF dwelling units & 5700+ industrial and office employees

The property owner wants to develop a vacant parcel

How do we provide accurate distribution and VMT analysis for only the proposed hotel?
ABM2+ Subarea Enhancements: TAZ Split

- Regional Network
- Subarea Network
ABM2+ Subarea Enhancements: Model Enhancement Feature

• Intelligent Sampling
  – Over-sampling the population in the subarea at a rate over one
  – Reducing the sample rate with respect to increased distance from the subarea
  – Reduce Monte Carlo variation
  – Reduce model run times
ABM2+ Subarea Enhancements: Model Enhancements

- Implement each improvement as a data pipeline step
- Deliver a clear user interface for application workflow
- Identify existing procedures that can be streamlined or optimized
- Manage work items with JIRA Issue Tracker
- Deliver code in GitHub repository
- Document subregional applications in ABM Wiki
ABM2+ Subarea Enhancements: Trip Data Reports and Threshold Definitions

• Trip data reports
  – Person and Vehicle trips from the 2016 base year
    • Parsed by Land Use Code
    • Parsed by Unit Type
    • Regionwide and parsed by Major Statistical Area (MSA)

• Threshold definitions
  – Population and employment activity thresholds and confidence levels for subarea reporting
ABM2+ Subarea Enhancements: Application Tests

• Develop a testing plan to define application tests
  – Define 12 land use scenarios
• Run 12 Application Tests
  – SANDAG to provide inputs
  – RSG to evaluate model outputs and document
• Update modeling procedures if needed
ABM2+ Subarea Enhancements: Final Report and Workshop

• Executive summary
• Objectives and limitations of the project
• Methodology of enhanced features and technical approach
• Application test results, including analysis and insights as well as runtime performance
• Conclusions on the strengths and limitations of the enhancements
• User guide appendix, including data dictionaries for input and output files, guidance on applying the enhanced model, and standard reports and thresholds

• As needed support
ABM2+ Subarea Enhancements: Project Schedule

- Aligned with the expected Board of Director’s adoption of the 2021 Regional Plan
Forum Agenda Recap

• Welcome, Introductions and Announcements
• Social Equity Analysis and Regional Planning
• RTP Modeling Retrospective
• Growth Forecast Lifecycle Policy
• ABM2+ Subarea Enhancements

Next Transportation Model Forum: June 9, 2021