Modeling at the Crossroads: Practices and Challenges for Applying MPO TDMs to Caltrans Projects

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Round Peg, Square Hole

Models are not built for project-level analysis

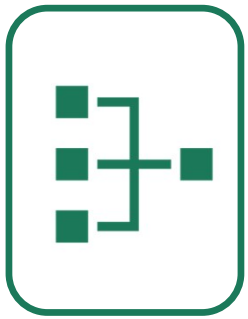
- MPOs develop models chiefly for regional system planning (RTP/SCS)
- States develop separate models chiefly for high-level policy and planning

Are regional travel demand models (TDMs) appropriate for Caltrans project-level applications?

Regulatory Requirement

Survey & Interview

Model Review



Project Review

Findings & Recommendations

Regulatory Requirements & Guidance Review

Federal

RTP

- Does not require development or maintenance of TDMs but mandate use of suitable tool

Clean Air Act

- **Regional air quality conformity analysis must be based on a network-based travel mode – Special cases**
- Expects adherence to federal guidance – FHWA & FTA

NCHRP Guidance

- Report 765 – Model should meet calibration and validation standards at the highest spatial and temporal resolution

FHWA Guidance

- Travel Model Improvement program (TMIP) – Model should be statically and dynamically validated at the scale of application

California

SB 375

- Compliance is dependent on TDMs to forecast regional GHG emissions.

CEQA Guidance

- Does not specify modeling methods but requires technical adequacy based on substantial evidence and "best efforts."
- Common practice is to follow guidance from agencies (e.g., FHWA/TMIP, Caltrans), TRB, and ITE

CTC Guidance

- Technical guidance - 2024 RTP Guidelines for MPOs and RTPAs (CTC) recommends static and dynamic validation of TDMs

CARB Guidance

- Reviews and critiques TDMs used for SCS analysis
- Does not include review of use of TDMs for project-level analysis.

Caltrans Guidance

- Forecasting guidance - Transportation Analysis Framework (TAF) and Transportation Analysis under CEQA (TAC) recommends compliance with FHWA/TMIP noted above

Survey

A survey was distributed via email to **44** MPOs and RTPAs evaluating the capabilities and limitations of travel demand models (TDMs) for use in evaluation of transportation project across the state.

The survey was designed using Microsoft Forms and circulated via emails.

Survey yielded **24** responses (**55%** response rate).

Among respondents, **12** out of **15** MPOs and **6** out of **9** RTPAs have travel demand models.

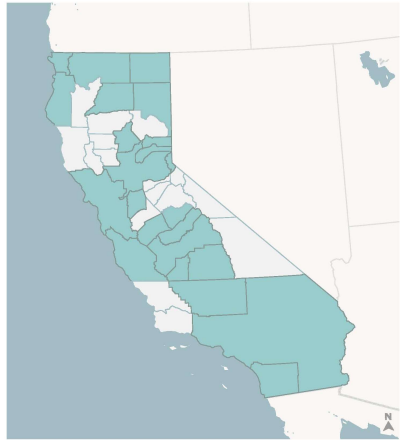


Figure 1. Responded to Survey

Follow Up Interviews

- Conducted with 14 MPOs/RTPAs to supplement the statewide survey
- One-hour virtual conversations enabled two-way dialogue and deeper insights
- Aimed to clarify responses and explore practices, challenges, and priorities
- Understand concerns regarding model applications

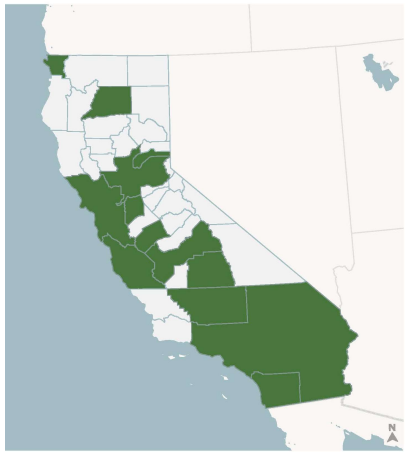
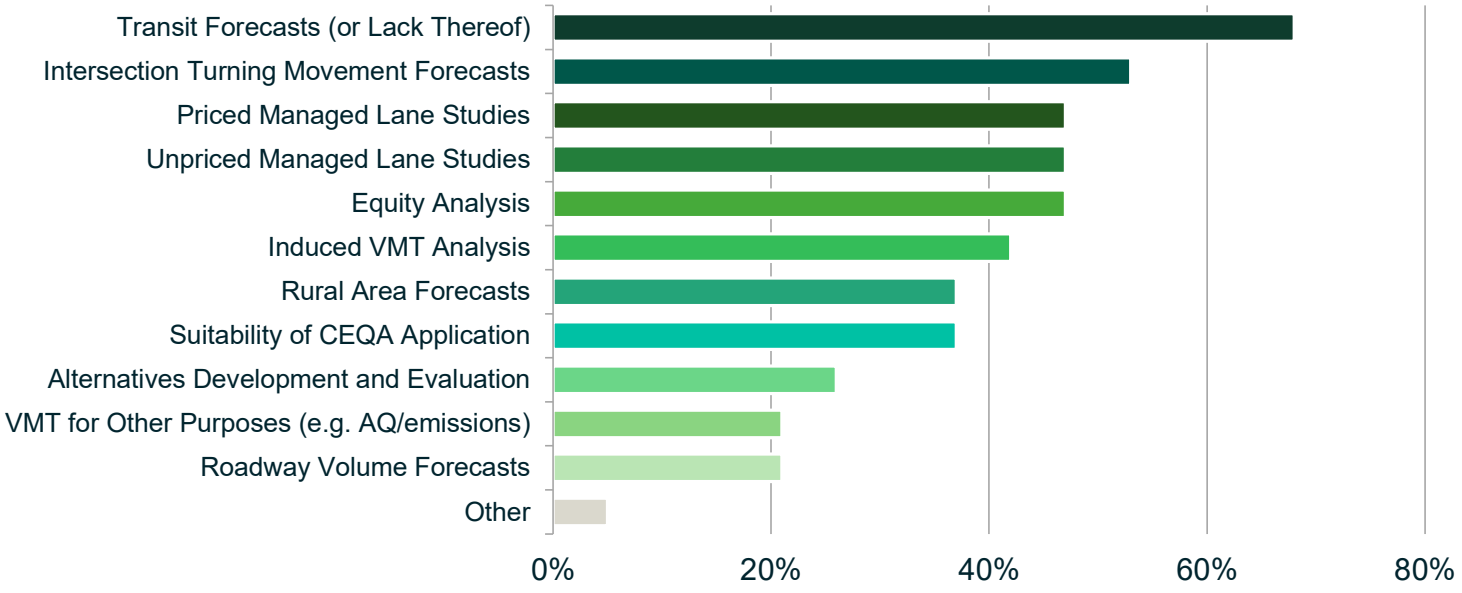


Figure 2. Agencies Interviewed

Concerns

Do you have concerns about the suitability of your agency's model for reasonably generating any of the following metrics for project level application?



Model Review

- Review six regional travel demand models covering urban and rural geographies relevant to Caltrans projects
- Understand each model's structure, capabilities, and limitations for project-level applications
- Assessment Metrics:
  - Model Documentation
  - Model Year Alignment
  - Model Performance against Available Guidance
  - Modeling Detail
  - Sub-modules
- Finding Categories

N/A (Metric Not Applicable for this model)	**Yes** (Model includes/passes assessment metric)	**Incomplete** (Model includes/ passes some components of the assessment metric)	**No** (Model does not include/pass assessment metric)

Assessment Checklist

Assessment Criteria		Description	Priority	Assessment Findings					
				ABM 1	ABM 2	ABM 3	TBM 1	TBM 2	ABM 4
Model Documentation									
Complete Model Documentation is available	Model Development Report	Model provides a development report that includes methodology, validation reports, and model performance. For CEQA and planning use, this report helps ensure transparency, replicability, and appropriate use of the model.	High	Yes	Yes	Yes	Yes	Yes	Yes
	Model Installation Guide	A publicly accessible model installation guide ensures that users can run the model and replicate results. This should include software, versions, and computing environment requirement as well as proper guidance on how to install them.	Moderate	Yes	Yes	No	No	Yes	Yes
	Model User Guide	A model user guide provides guidance on how to apply the model including how to update necessary modeling components. A well-documented user guide would provide guidance on all aspects of the model including how to edit land uses, demographics/socioeconomics, population synthesis, special generator, external workers, commercial vehicle trips, etc.	High	Incomplete	Incomplete	Incomplete	No	Incomplete	Incomplete
	Guidance on project-level application	A model user guide on project-level application provides guidance on sub-area calibration/validation, how to change model inputs and parameters, and how to prepare and evaluate model outputs.	High	No	No	No	No	Incomplete	No
	Data Dictionary	Provides clarity on the data variables, definitions, and relationships used in the TDM, which aids users in accurately interpreting the data, ensuring consistent application, and enhancing the overall reliability of analyses and outcomes.	High	Yes	Yes	Yes	Yes	Yes	Yes

Continued

Model Review

Key Findings

- Documentations lack consistency, transparency, and user guidance.
- Model base years are outdated and don't reflect post-COVID trends.
- Calibration and validation are limited especially at the project scale; Land use and demographic sensitivity tests are often insufficient
- Models show low sensitivity to recent travel behavior changes.
- Induced vehicle travel effects are not fully modeled.
- Time-of-day shifts and DTAs are not common
- Tolling effects may overestimate demand
- Freight, visitor, airport, and external worker travel components are often incomplete.
- ABMs offer detailed insights for regional policy related to resident travel but are less sensitive to the other demand components while also being complex, resource-intensive, variable between runs, and having long run times that hinder project-level use.

Project Application Review

Transparency

Project documentation lacks transparency.

Source model details and project-specific modifications are often unclear.

Input parameters for project-level updates are not well documented.

Analysis Year

Model base or forecast years do not match analysis/opening year.

Interpolation may overstate congestion relief.

Extrapolation of growth past RTP/SCS horizon year could misallocate or over-estimate growth.

Growth factoring may be speculative under CEQA.

Few projects explain any of the above.

Purpose Alignment

Source models are validated and calibrated for regional use only.

Model version is not suitable for the project "purpose and need statement".

Source models are not validated for peak-hour volumes or person throughput for different modes.

Model Noise (ABM)

ABMs introduce random variation ("noise").

This variability is rarely tested or addressed by using multiple model runs.

It can lead to unreliable forecasts.

Model randomness can obscure true impacts.

Key Challenges and Limitations

- Model & Project Purpose Misalignment
- Insufficient Documentation
- Lack of Dynamic Traffic Assignment (DTA)
- VMT Truncation at Regional Boundaries
- Error Propagation in Operations Analysis
- Missing Sub-Area Validation
- Analysis Year Misalignment
- Stochasticity Without Averaging
- Inadequate Validation for Project Metrics
- Induced Travel Underrepresented
- Limited Integration of Post-Pandemic Trends
- Outdated Representation of Emerging Travel Trends
- Inflexible and Unvalidated Sub-Models
- Limited MPO Support and Weak Legal Framework

Recommendations: Issues & Near-Term Actions

- **Guidance & Oversight**
  - Coordinate with MPO staff on project use of regional models
  - Coordinate with District staff & consultants for oversight
- **Transparency**
  - Provide guidance & checklists for model adaptation
  - Apply project validation checklists rigorously
- **Model–Project Misalignment**
  - Coordinate MPO & District staff to align project needs with modeling
  - Identify validation needs for project-level analysis
- **ABM Complexity & Cost**
  - Coordinate with MPOs on managing ABM stochasticity
  - Explore automation of ABM input prep (e.g., SACOG tools)
- **Estimating Induced VMT**
  - Coordinate on Caltrans "hybrid" approach (regional models + NCST calculator)

Recommendations: Issues & Middle to Long-Term Actions

- **Guidance & Oversight**
  - Launch technical assistance program to address funding/staffing gaps for MPO engagement
  - Launch technical assistance program to provide training/resources for District project staff
  - Update RTP & CTC guidelines on documentation/validation
- **Transparency**
  - Fund MPOs for better model validation
  - Promote DTA use in congested urban areas
- **Model–Project Misalignment**
  - Coordinate MPO & District staff to align project needs with modeling
- **ABM Complexity & Cost**
  - Develop simpler project-level modeling tools
  - Support district-level project-focused models
- **Estimating Induced VMT**
  - Update NCST calculator to address context sensitivity

Questions?

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