Review of Travel Demand Models Across California for Caltrans Projects Analysis

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Caltrans

Fehr & Peers

Project Objective and Approach

Are regional travel demand models appropriate for use in project-level applications?

- Review regulatory framework for the use of travel demand models (TDMs) by:
  - Examining requirements for TDMs used in regional planning
  - Examining requirements for TDMs used in project-level applications
- Assess the suitability of regional TDMs for project-level applications by:
  - Conducting a statewide survey of MPOs and RTPAs to document current modeling practices
  - Holding follow-up interviews with 14 agencies to explore challenges, needs, and priorities
  - Performing a detailed review of six regional models using a structured technical checklist
- Evaluate how TDMs are applied in practice by:
  - Reviewing the models used in four recent Caltrans projects
  - Assessing how models performed and how well they aligned with project needs
- Identify key limitations
- Provide recommendations to improve modeling practices, project-level guidance, and coordination with MPOs and RTPAs

Regulatory Requirement

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
- Mandates adherence to federal guidance – FHWA & FTA

NCHRP Guidance

- Report 765 - Evaluate and describe currently used methods, data sources, and procedures for producing travel forecasts for highway project-level analysis

FHWA Guidance

- Travel Model Improvement program (TMIP) - Model validation for project-level analysis

California

SB 375

- Mandates TDM use for regional GHG forecasting.

CEQA Guidance

- Doesn't specify modeling methods but require technical adequacy based on substantial evidence and "best efforts."
- Common practice is to follow guidance from agencies (e.g., FHWA, Caltrans), TRB, and ITE

CTC Guidance

- Encourages use of Travel Model for RTP/SCS
- Technical guidance - 2024 RTP Guidelines for MPOs and RTPAs (CTC).

CARB Guidance

- Reviews and critiques TDMs
- 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)

Surveys and Interviews

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.

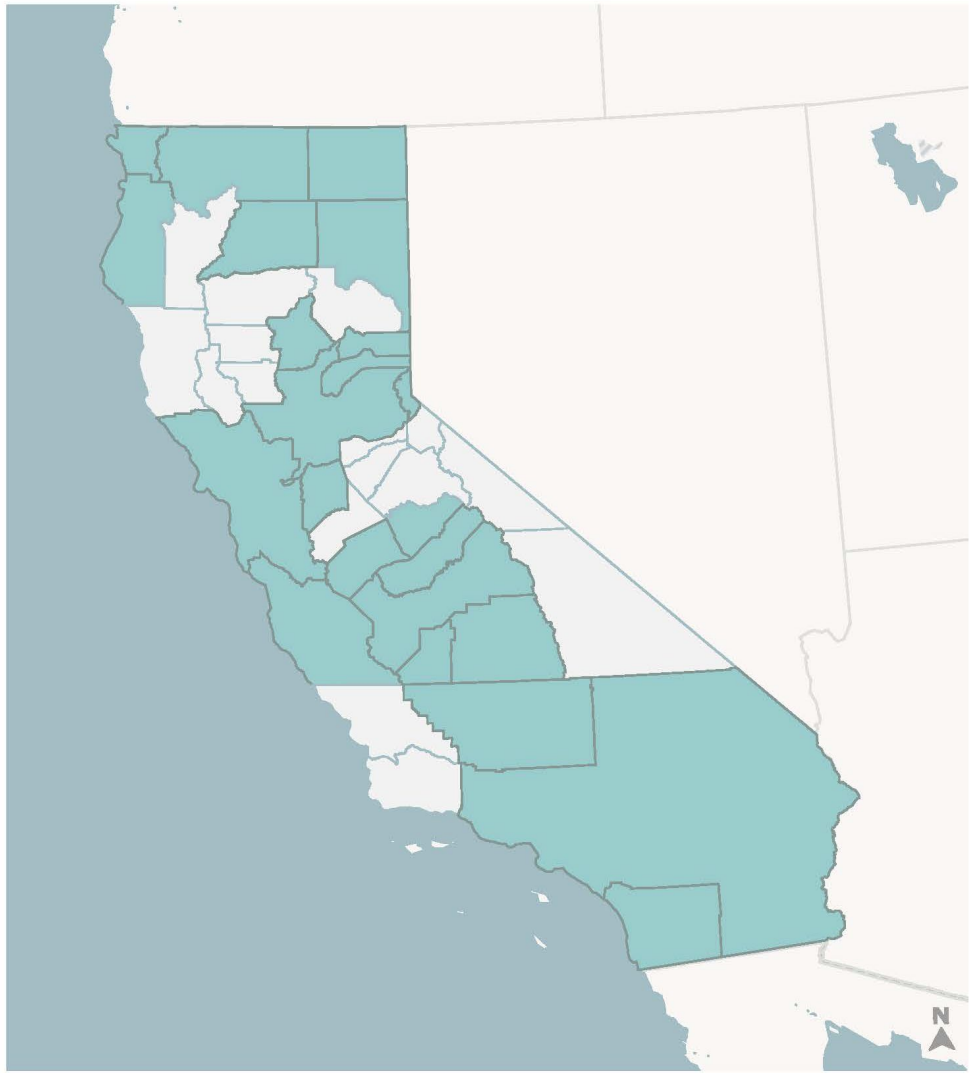
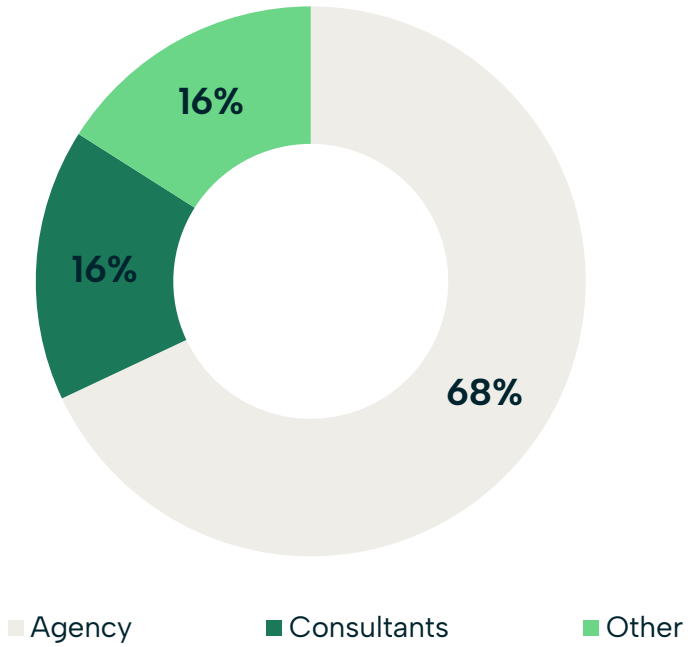


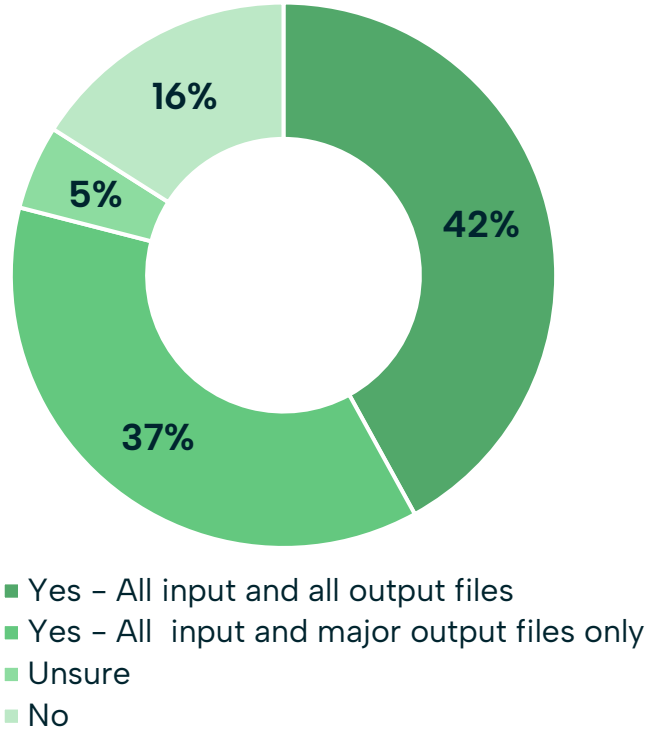
Figure 1. Responded to Survey

Model Management

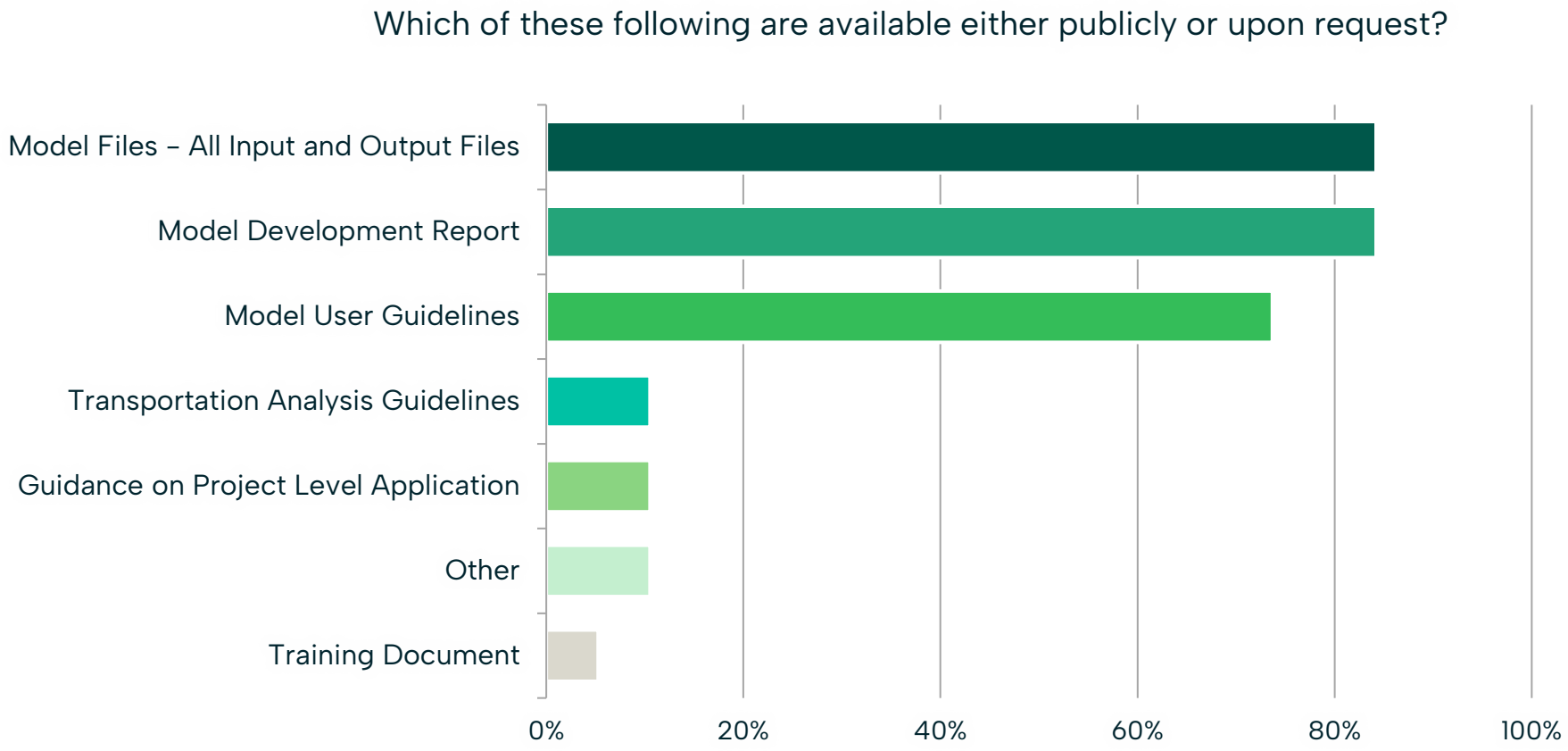
Who manages the model files and documentations?



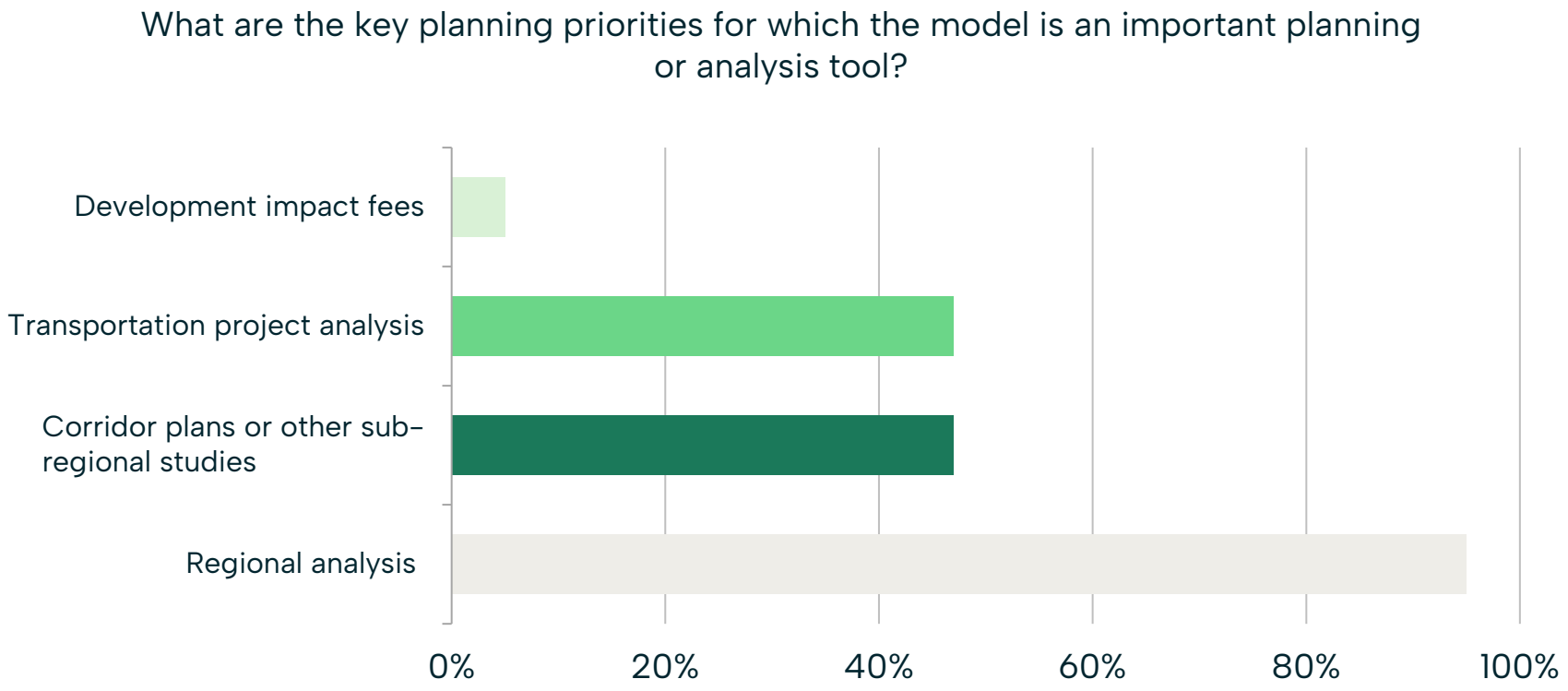
Do you provide your agency's model to other agencies or their consultants, for analysis of their programs or projects?



Model Documentation

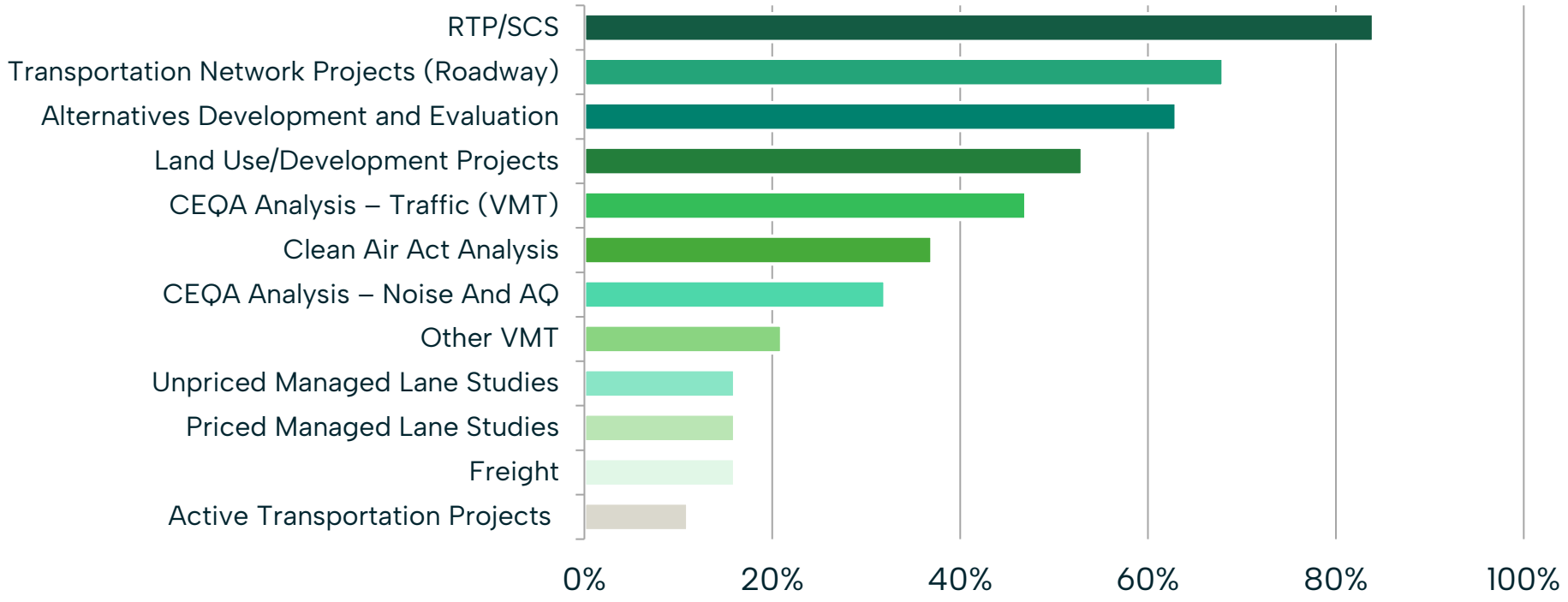


Model Application



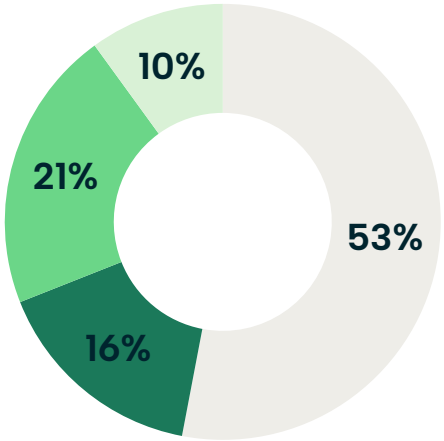
Model Application

Is the “Off-the-shelf” model (the model version managed by the MPO/RTPA without modification) adequate for application of any of the following project type?



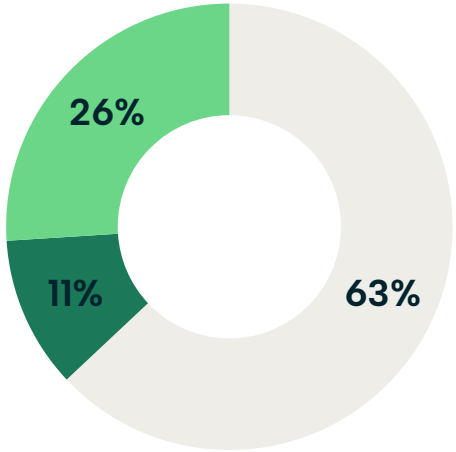
Model Validation/Calibration

When was the model last calibrated and validated?



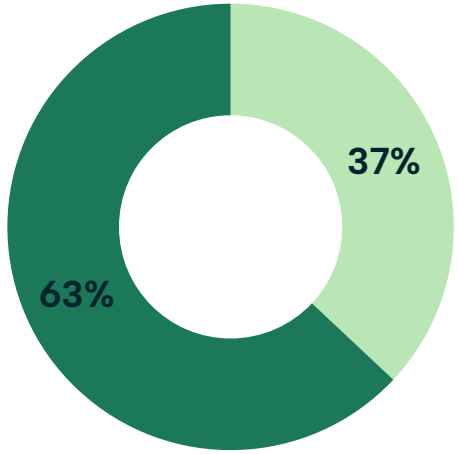
Within the last two years (post-pandemic)
Unsure
Three to five years ago

Were any dynamic validation or sensitivity tests performed?



Yes
No
Unsure

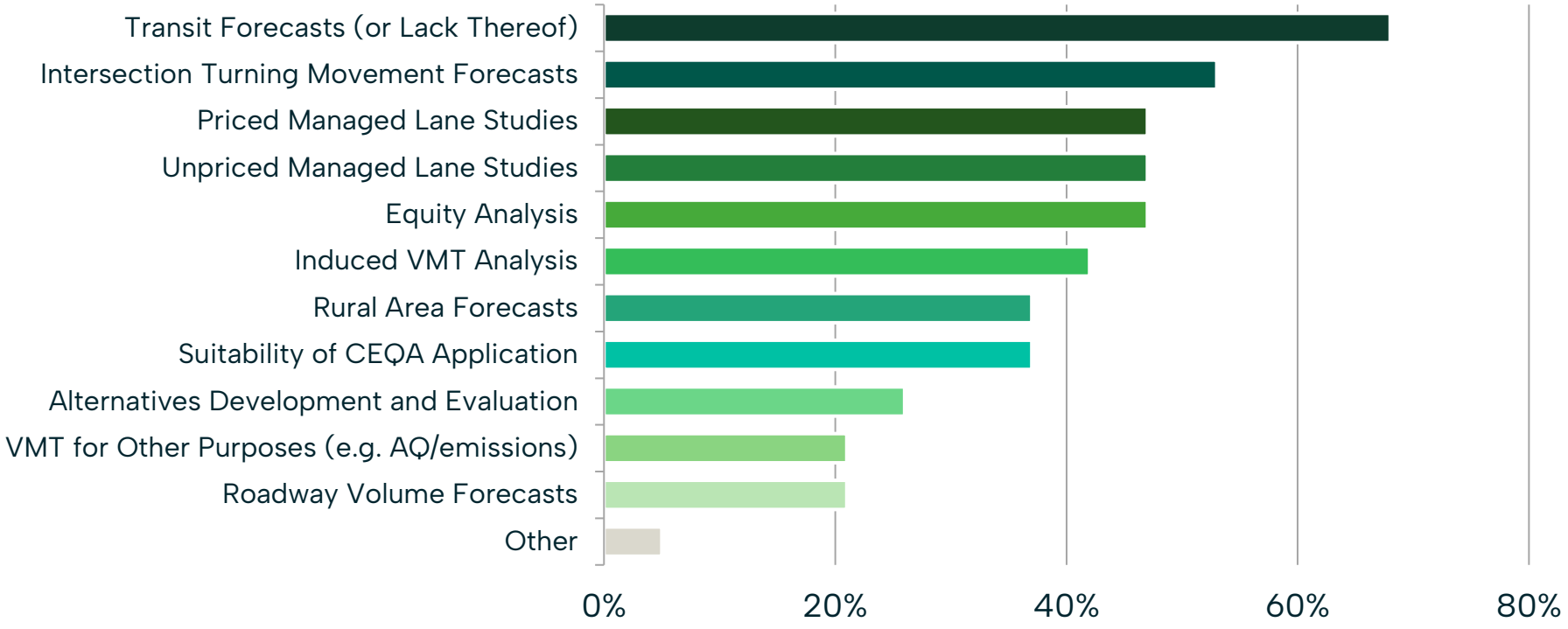
Does your model include any post pandemic adjustments?



Yes
No

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?



Follow Up Interviews

Design & Purpose

- 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

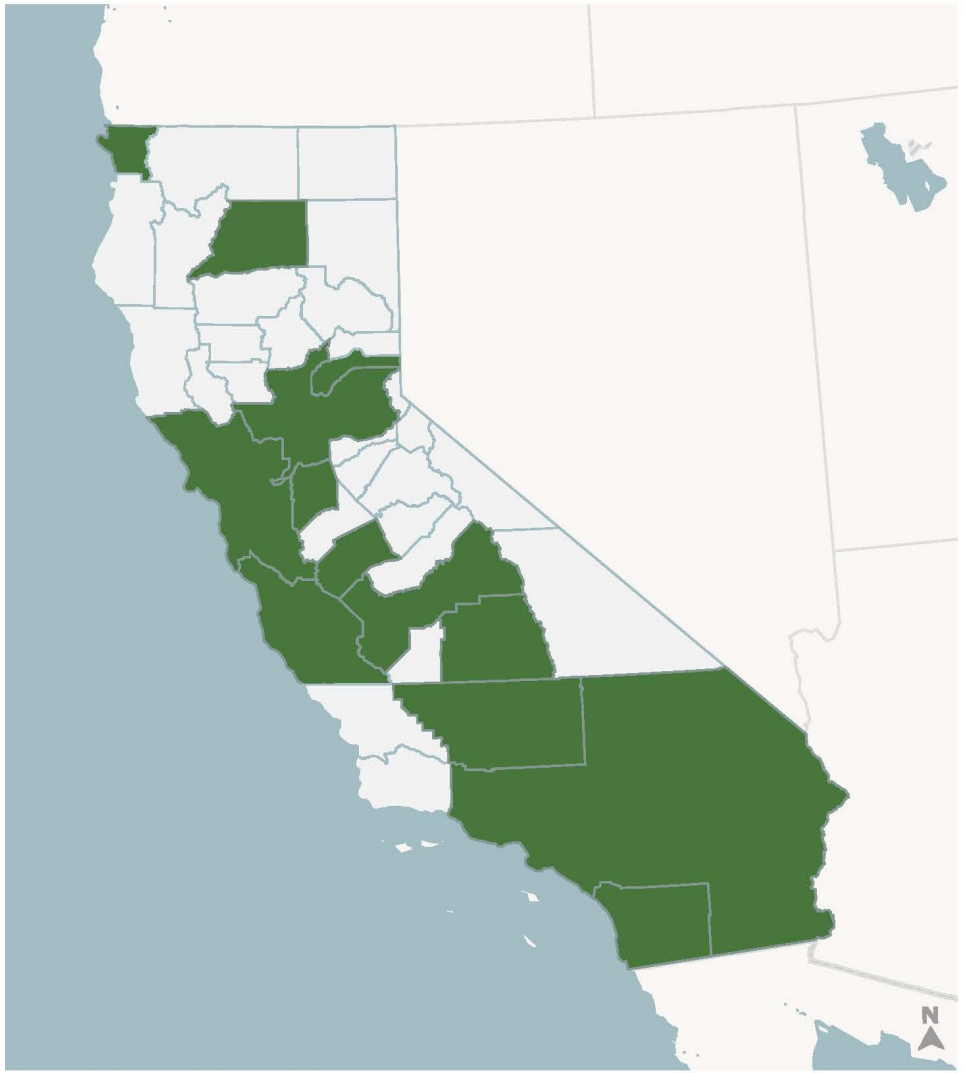


Figure 2. Agencies Interviewed

Follow Up Interviews

Key Findings

- **Model Years & Scenario Practices**
  - Land use scenarios tied to RTP/SCS with little flexibility for project-specific tailoring
  - Analysis years often outdated and misaligned with Caltrans project timelines
- **Project-Level Use**
  - Limited technical support for project-specific adaptations or validations
  - Agencies avoid formal review roles due to staffing limits and impartiality concerns
- **Guidance & Review Gaps**
  - No standard review procedures for external applications
  - Strong interest in Caltrans-led guidance, but limited internal capacity to implement

Follow Up Interviews

Key Findings

- **Validation & Transparency**
  - Few MPOs conduct formal benchmarking or require sub-area validation
  - External users responsible for most QA/QC; public model documentation is limited
- **External Travel Representation**
  - External trips truncated at model boundaries, underestimating VMT near edges
  - Only a few agencies use big data tools (e.g., Replica) to extend trip lengths
- **Induced VMT Forecasting**
  - Major inconsistencies across agencies
  - Most use regional-scale analysis only; project-level methods are rare or informal
  - Little adoption of Caltrans hybrid (model + elasticity) methods
  - High uncertainty on how to forecast and validate induced VMT for CEQA

Model Review

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; Land use and demographic sensitivity tests are often insufficient
- Models show low sensitivity to recent travel behavior changes.
- Induced travel are not modeled.
- Time-of-day shifts and DTAs are not common
- Tolling effects may overestimate demand
- Freight, visitor, airport, and external travel components are often incomplete.
- ABMs offer detailed insights for regional policy but are complex, resource-intensive, variability, and long runtimes that hinder project-level use.

Project Review

Project Application Review

Transparency

Project documentation lacks transparency.

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

Assumptions for project-level updates are not well documented.

Analysis Year

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

Interpolation and extrapolation may overstate congestion relief

Few projects explain or adjust for this

Growth factoring would be considered speculation under CEQA

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.

Project Review Summary

	Project 1	Project 2	Project 3	Project 4
Documentation	Very little documentation included in project report and website	Most available on project website	Very little documentation included in project report and website	Very little documentation included in project report and website
	Some pieces available by request, others undocumented	Some documents unavailable	Some pieces undocumented	Some documents only available by request
Base Year (BY) Mismatch				
# Years between Source Model BY and Project BY	6	3	3	2
Mismatch resolved by…	Adj. BY model #s	Ignored	Not Known	Ignored
Project Opening Year (OY) Mismatch				
# Years between Source Model BY and Project BY	6	3	3	2
Mismatch resolved by…	Adj. BY model #s	Ignored	Not Known	Ignored
Cumulative Year (OY) Mismatch				
# Years Between Source Model CY and OY+20	10	9	3	7
Mismatch resolved by…	Extrapolation	Extrapolation	Growth Factoring	Extrapolation
Purpose and Need (P&N) Elements	Improved Operations Reliability Person Throughput	Reduce Congestion Person Throughput Improve Operations	Reduce Congestion Safety Improve Operations	Reduce Congestion Improve Operations
Issues Related to Modeling P&N	No Peak Validation No Validation of Transit Lines Relevant to Project	No Peak Validation No Validation of Transit Lines Relevant to Project	No Peak Validation	No Peak Validation
Level of Concern Color Coding	Little/No	Minor	Moderate	Major

Findings and Recommendations

Key Challenges and Limitations

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

Recommendations

- **Adapting Regional TDMs for Project Applications**
  - Coordinate with MPOs, RTPAs, and local agencies
  - Evaluate funding gaps for adapting models
  - Legislation to support project-level model maintenance by Caltrans or regional agencies
  - Launch a technical assistance program to support and refine modeling practices
  - Explore automating common project-level inputs, following examples like SACOG's tools.
  - Update RTP Guidelines to require clear documentation, validation standards, and project-level instructions.
  - Develop and apply checklist rigorously
  - Promote use of DTA in congested urban areas
  - Guidance on how to account for Induced VMT
- **Developing Alternative Models for Project-Level Applications**
  - Support district-level project-focused models
  - Research and update the Induced Travel Calculator using recent, California-specific data

Questions?

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