Developing and Refining the Base Year Model

After obtaining relevant data and taking appropriate steps to prepare it, the process of developing and refining models for use in the planning process can begin. This chapter focuses on model architecture, calibration and validation, developing the base year scenario, and standardizing reports and outputs.

Model Architecture

Model architecture refers to the overall structure and flow of the model. It represents the organization of data, sequences, assumptions and algorithms in the modeling process. Before building the model architecture, the anticipated uses of the model should be considered, including desired outputs and analytical functions required by users and stakeholders. These include project intent, data availability, and resource needs which are covered in detail in Chapter 2 - Preparing for Model Development, and Chapter 3 – Preparing Model Data.

The steps in the model architecture design process are undertaken concurrently, because they are interdependent. For example, the available resources and data availability will have an impact on the type of model that is built. Similarly, the requirements of a model may inform stakeholders' willingness to procure data and secure available resources.

There are many types of travel models available for use in forecasting, but the two most common are the Trip-Based Model and the Activity-Based Model. The model approaches and types of trip distribution models are detailed in Tables 1 and 2.

Table 1 Modeling Approaches

Model Step	General Description	Sub-Category	Primary Inputs	How it Works
TRIP-BASED				
How Many Trips? (Trip Generation)	Aggregate trips made in model region. Represented by Productions (P's) and Attractions (A's) by Traffic Analysis Zone (TAZ)	Aggregate Approach	Population, Households, Employment, Income, Vehicle ownership, School/University Enrollment, Shopping Centers	Cross-Classification Estimated survey coefficients by defined input categories applied to corresponding input data for category Regression - Estimated coefficients applied directly to inputs based on estimated relationships
		Disaggregate Approach	Simulated population, Simulated households, Employment, Income, Vehicle Ownership, School/University enrollment, Shopping Centers	Simulated population and household of model region used in statistical choice models to determine total trips per individual / household and region by zone
Where are the Trips Going? (Trip Distribution)	Determination of all the zones where the P's from each end up as (A's) Represented as a table of zone pairs (P's) and (A's)	Gravity Model	P and A data from Trip Generation stage, Travel impedance data including travel time and cost for all zone pair combinations.	Trips more likely to be attracted to areas with lower travel impedance (time and cost) and also large relative attractiveness between the two. Large generators go to larger attractors.
		Destination Choice	P data from the Trip Generation, Travel Impedance data, Zone attractiveness data - Employment, School Enrollment	Probability of travel to various destinations based on either distinct traveler characteristics (disaggregate) or average population characteristics of zone and cost (time and monetary expense) between zones
What Mode is used? (Mode Choice)	Determines the mode used for a trip between an origin and destination zone.	Discrete Choice models	Income, auto availability, age, population density and accessibility. Travel time data for all modes, cost, availability of modes, perceived comfort of modes, trip purpose	Probability of a trip using a particular mode based on simulated person characteristics, availability of competing modes, density of O and D zones, travel times of each mode, cost.

Model Step	General Description	Sub-Category	Primary Inputs	How it Works
ACTIVITY-BASED				
How Many Tours and Trips?	Series of interconnected choice models applied to each simulated person based on income, age, employment, household size, number of autos and others.		Simulated population, Simulated households, Detailed employment, Income, Vehicle Ownership, Age School/University enrollment, shopping center locations	Statistical choice models applied to each simulated person and household to obtain number of trips made based on time of departure, purpose of trip, traveling alone or with others.
Where are the Tours and Trips Going?	Determine all the zones to which each simulated person will make a tour and eventually a trip of a particular purpose		Data on all tours/trips for every simulated person and household. Travel impedance data including travel time and cost for all zone pair combinations. Information on trips that make up tours. Joint travel activity. Data on destination zone characteristics like employment	Destination Choice model that determines the probability of travel to various destinations based on each simulated person's characteristics, the characteristics of destination zones and the cost (time and monetary expense) of travel between all zone pairs
What Mode is used?	Determines the mode used by a simulated person to make a trip between an origin and destination zone.	Discrete Choice models	Household and personal characteristics from land use data such as income, auto availability, age, population density and accessibility. Travel time data for all modes, cost, availability of modes, perceived comfort of modes, trip purpose, accessibility of zone.	Probability of a trip using a particular mode based on simulated person characteristics, availability of competing modes, density of O and D zones, travel times of each mode, cost.

Table 2 Choice Model Types

Feature	Gravity Model	Destination Choice Model	Discrete Choice Model
Focus	Aggregate trip flows	Behavioral destination choice	Individual decision-making
Inputs	Zone-level data	Zone and behavioral data	Individual-level data
Outputs	O’s and D’s from Trip distribution	Probabilities of destination choice leading to O’s and D’s from Trip Distribution	Probabilities of alternative choices
Flexibility	Limited	Moderate	High
Application	Trip distribution	Trip distribution	Trip Choice, Mode choice, Route choice
Behavioral Detail	Minimal	Moderate	High

Trip-Based Modeling Approach

Trip-based is the original modeling approach and serves as the foundation for travel demand modeling. It provides a sequential approach to predicting travel behaviors. It consists of four steps and involves iterative processes. The steps include:

Step1: Trip Generation

Trip generation focuses on estimating the number of trips created in the model. This includes trips produced and attracted by households, businesses, or other establishments within a Traffic Analysis Zone (TAZ). Every trip has two ends: a trip production and a trip attraction. Trip productions are the locations where trips begin, while trip attractions are where trips end. For example, a trip could be produced at a home and attracted to a workplace, school, or shopping center.

Step 2: Trip Distribution

Trip distribution determines where the trips generated in Step 1 are going. It allocates trips between origin and destination pairs by considering factors such as impedance (travel distance, time, cost) and the relative attractiveness of each destination. The more attractive the destination, the more trips will be drawn to it, while the opposite is true for the impedance where if the impedance rises, the likelihood of travel between two zones is reduced.

Step 3: Mode Choice

Mode choice, or mode split, focuses on determining which mode of transportation people will use for their trips, applying factors to reflect the relative proportions of trips made by competing modes. These modes include driving, public transit, biking, walking, or carpooling. A mode can also be broken down into smaller sub-divisions; for example, automobiles can be divided into single-occupant vehicles (SOVs) and high-occupancy vehicles (HOVs) and transit into various forms of bus, rail, and ferry where applicable.

Step 4: Traffic Assignment

Traffic assignment involves assigning trips developed in the mode choice step to specific routes or paths through the transportation network. The goal is to model the routes travelers will follow to their destination and assess how the transportation system will accommodate the demand, including congestion effects. It uses network input data such as roadway speeds, roadway facility type, area type, tolls, transit lines, and other key inputs.

Traffic assignment methods are categorized based on their complexity, data requirements, computational demand, and assumptions about traveler behavior and network conditions. The following are typical traffic assignment methods:

- **User equilibrium assignment** is the most common method used by models. In this method, travelers adjust their routes in response to congestion, ensuring no traveler can reduce their travel time by switching routes. It reflects real-world traffic conditions where travelers spread out across multiple routes.
- **All-or-nothing assignment** assumes that all trips between origin-destination pairs take the shortest available path, typically based on free-flow travel times. This method works best when volumes are low and congestion effects are negligible. It is useful for preliminary analyses, truck pre-loading, or setting up a base scenario before applying more complex assignment methods that represent actual behavior.
- **Dynamic traffic assignment** is used for specialized models such as evacuation modeling or traffic operations analysis via microsimulation. In this method, traffic flow (mesoscopic) or individual vehicles and their driving dynamics, such as acceleration, deceleration, and queueing, are modeled to account for demand during specific time periods in dynamic response to traffic conditions.

Activity-Based Modeling Approach

Activity-based modeling uses the entire population of the region of interest to simulate known group characteristics like age, occupation, sex, and race. Each simulated person is allocated to a simulated household and the model processes are a series of interconnected choices made by the simulated individuals. The interconnected choices are called the Activity Sequence. The choices considered in the sequence include:

- Does a trip need to be made?
- What is the primary purpose of the trip?
- What is the primary destination of that trip?
- When will the trip be made?
- Will the trip be made with others or will the simulated person go alone?

- Will there be intermediate stops before the primary destination?
- What is the mode to be used?

The considerations are similar to the aggregate steps in the four-step process. The primary difference is the process is done in a disaggregate manner at the level of a single-person record. The decisions of each simulated person are aggregated into journal entries of tour and trip records, similar to results from surveys, and further aggregated to trip tables by purpose and mode. There is also consideration for joint trip activity, and time of trip departure. Traffic assignment, the final step follows the preparation of trip tables and is identical in execution to what is done in Trip-Based models.

When to Use Trip-Based vs Activity-Based Models

The trip-based approach is useful for scenarios that involve basic capacity analyses. Since its initial development, the range of uses has been expanded to include items like Project Development & Environment (PD&E), interchange justification/modification report, and corridor analyses.

In recent years, there has been an emphasis on other transportation concerns like travel demand management, Intelligent Transportation Systems (ITS) implementation, and others that are not represented well by the sequential aggregate trip-based approach. The activity-based approach better captures actual trip patterns given that the cumulative transportation decisions of each person are captured as they make related tours and associated trips. This functionality is required when there is a desire to evaluate for example, the impacts of shifting trip departure time, or the impact of variable tolling in managed lanes on congestion that the aggregate trip-based approach has difficulty representing.

Calibration and Validation

Travel demand models are powerful tools that require rigorous calibration and validation efforts after initial model development to ensure the reasonableness and reliability of results.

After specific model architecture has been designed and the basic structure is setup following estimation, the model is assembled from available data. This is the core component of model development and involves verifying default inputs, checking the reasonableness of results, and adjusting parameters as necessary until results make sense.

- **Verifying Inputs**
  Verification of inputs involves checking all the data, scripts, and parameters necessary to build, test, and refine the model. This involves making sure that all the data necessary for model development is available and that it is of high quality and suitable for use in developing a model that will produce reasonable results. Chapter 3, Preparing Model Data, details how to check key input data categories and perform general QA/QC for model use.
- **Checking Reasonableness**
  This process involves running the model with the initial inputs to produce baseline results. These results are systematically analyzed using tools such as spreadsheet summaries to compare key performance metrics against validation targets (eg, observed data). Visual analysis through charts and maps is employed to highlight discrepancies such as overestimated trip volumes or mode shares that deviate significantly from observed trends.
- **Adjusting Parameters**
  Once reasonableness checks have been undertaken and discrepancies identified, it is necessary to adjust parameters and re-check inputs until the model produces results that make sense and allow confidence in its use. The identified discrepancy will dictate the required adjustments. Every step in the process should be scrutinized to determine the appropriate changes to be made.

It is important to recognize that verifying inputs, checking reasonableness, and adjusting parameters are interrelated and must be undertaken as a group. The general process of verification and adjustment of models during model development is referred to as calibration and validation.

Model Calibration

Travel demand models are closed systems trying to represent an open system—the real world—where human behavior is influenced by constantly changing factors, some of which may be unpredictable or inconsistent. Consequently, travel demand models are inherently limited in their ability to capture all the variables and relationships that affect human decision-making. As a result, key information may be missed or inaccurately reflected, reducing explanatory power and creating significant discrepancies between predicted and observed travel behavior when checked for reasonableness. Calibration is necessary to minimize these deviations by refining initial estimates developed in estimation or assertion of parameters to better align predicted outcomes with real-world observations.

Model Validation

While calibration adjusts model parameters to better fit the vetted data used to create the model, validation ensures that these parameters hold true against other independent datasets that were not part of the estimation process, providing a check against overfitting. It is different from calibration because it focuses on using an independent dataset and is intended to provide an assurance of reasonableness that stakeholders desire to ensure confidence in forecasting. A common validation method compares the model's estimated traffic volumes on specific corridors with observed traffic counts. If the model accurately captures these volumes, it suggests that the traffic assignment process is performing well. Similarly, mode choice validation can involve checking the predicted share of trips by different modes (e.g., car, transit, walking) against known ridership or survey data.

Validation is not just about ensuring the model works with the current data but also about confirming that the model will hold up in future scenarios, such as new infrastructure projects, policy changes, or demographic shifts. Ideally, the observed data used in validation are data not used for model estimation or calibration, but this is not always feasible. Validation data may include additional data collected for the same year as the estimation or calibration of the model or data collected for an alternative year. Sensitivity testing (using alternative input data or assumptions) of individual model components and the entire model set is also necessary when validating a model. A well-conducted validation procedure provides the confidence that the model can reliably inform decision-making in real-world planning.

Preparing for Model Calibration and Validation

Before beginning model calibration and validation, consideration should be given to selecting and verifying the right data, setting benchmarks and accuracy guidelines, and addressing unique circumstances that may impact the process.

Selecting and Verifying the Right Data

Adequate preparation for model validation begins with choosing appropriate input data, including socioeconomic data and transportation network data.

Input data must be continuously reviewed throughout the validation process, because errors in the data might not become apparent until the model is executed. Socioeconomic data and networks should be verified early, since trip generation models rely heavily on accurate input data. Examples of items to be checked include:

- Total population and households per zone
- Population per household where the ratio is less than 1
- Zones with population but no households and vice-versa
- Missing network attributes like speeds and area types

Setting Benchmarks and Accuracy Guidelines

Different stages of the travel demand model require specific benchmarks. These have been developed throughout the modeling practice based on historical precedent and planning experience to ensure that results make sense from the perspective of reliability, reasonableness, and accuracy. The benchmarks also encourage confidence in applying models and disseminating results by providing an agreed-upon standard in which all stakeholders are invested.

- Trip Generation Model Benchmarks
  The results of trip generation are the primary driver of all calculated trip activity in subsequent trip steps. Consequently, meeting benchmark results for trip generation is among the most important for model validation purposes. These benchmarks ensure that the resulting trip activity is reasonable relative to the input population, household, school enrollment, and employment. They are typically represented as ranges to allow for regional and behavioral variations in modeling jurisdiction. Examples of benchmark metrics for trip generation include:
  - Total number of trips
  - Total number of trips per zone
  - Aggregate number of trips per household in the model
  - Number of trips per household by zone
  - Number of trips per worker in a zone
- Trip Distribution Model Benchmarks
  Trip distribution benchmarks are established to ensure that the model's

assignment aligns with observed travel behavior captured in household surveys, other travel surveys, and available origin-destination (O-D) data sources. Examples of benchmark metrics for trip distribution include:

- Average trip length by trip purpose
- Trip length frequency distributions
- Percent of intrazonal (within the same zone) travel
- Coincidence ratios

- Mode Choice Model Benchmarks
  Owing to the relatively low non-auto mode share in most regions of the country and the highly variable transit availability outside of large urban metropolitan regions, benchmark values for mode choice are less well developed than for other steps in the modeling process. In lieu of standard benchmarks, direct validation comparisons of trip totals by mode and purpose to observed data for the region of interest are undertaken. Example comparisons include:
    - Transit ridership totals from agencies versus model station boarding/alighting
    - Household travel/activity survey comparisons where transit or other modes are involved
    - Census data for work travel (CTPP)
    - National Household Travel Survey (NHTS)
    - Other surveys like Transit On-board Surveys
- Traffic Assignment Model Benchmarks
  Traffic assignment, as the final step in the four-step modeling process, provides the opportunity for direct comparisons with readily observed traffic, making it the stage where the most extensive set of benchmarks is typically applied. Benchmarks for traffic assignment involve checking how well the model replicates real-world conditions, focusing on minimizing variances between modeled and observed data. Common industry standard benchmark metrics include:
    - Correlation of model volumes to counts
    - Total volume on links with counts to actual counts

- Root mean square error (RMSE) comparisons
- Aggregate total vehicle travel activity in the model, such as by miles and hours, and the comparison to inputs like population
- Comparisons by sub-categories such as:
- By volume group
- Roadway facility types (interstates, arterials, collectors, etc.)
- By geographic district
- By assignment time period (AM peak, midday, PM peak, off-peak)
- Speed calibration by type of facility, particularly along corridors [less common].

Special Circumstances

After the benchmarks are reviewed and compared, some situations may need further review and adjustment such as special generators, trip tables with no survey data, travel time discrepancies, and other adjustments. These common special circumstances are described below.

- **Handling Special Generators**
  After the overall calibration and validation are complete and the results are satisfactory, there is a need to look closer at some locations. Locations like universities, airports, theme parks, and hospitals generate higher-than-normal trip volumes. Standard trip generation rates do not account for these specific conditions. Custom trip rates or adjustments may need to be implemented based on the specific nature of the generator. For example, university trips may be estimated using student and staff numbers, class schedules, and events like sports games that increase traffic.
- **Estimating Trip Table Without Survey Data**
  Large-scale travel surveys can be expensive and time-consuming. When survey data is unavailable, traffic flow, mobile phone, GPS, or vehicle identification data can be used to estimate the trip table. The data sourced used depends on the data quality and network structure, and congestion must be considered in the estimation process. There are other concerns when using these alternative data sets such as the lack of contextual information.

- **Resolving Travel Time Discrepancies**
  Typically, there are differences between the initial travel times used to calculate impedances in trip distribution and mode split and those resulting from traffic assignment, because the latter reflects real-world congestion. To address these discrepancies, travel times from traffic assignment are commonly fed back into earlier steps, such as the beginning of trip distribution, and the subsequent steps are rerun until an equilibrium is reached. Classical methods, such as the Method of Successive Averages (MSA), are commonly used to determine when the change in output values between feedback runs is small enough to indicate a stable result (known as convergence). Typically, feedback is received in regions that realize regular congestion for at least some periods of the day. This is not generally a concern in uncongested regions.
- **Understanding Defensible Adjustments**
  All parameter adjustments must be reasonable, defensible, and properly documented. Since various validation techniques have been employed in Florida, it is important to understand the types of adjustments used for Florida models. This allows for guidance for when adjustments are not reasonable in model development and updates. Chapter 6, Resources, provides references to Florida-specific and national resources on reasonable calibration and validation adjustments and benchmarks.

Calibrating and Validating New versus Existing Models

Calibrating a new model is a data-intensive process and requires establishing baseline relationships that demand multiple iterations of model parameter tweaks to achieve equilibrium. Each step of the four-step model must be calibrated individually and sequentially, with comprehensive data collection at every stage. Similarly, validation in a new model requires verifying each step following calibration sequentially to ensure each produces outputs that fall within acceptable benchmarks. Because of the sequential nature of the process, errors will cascade, so it is just as important to calibrate and validate earlier steps as later steps.

For an existing model, calibration and validation efforts may be more focused and targeted, concentrating on updating specific inputs or parameters. Given that the existing model has already undergone calibration and validation in its initial development, the requirements for calibration may be more relaxed unless significant structural model changes have been introduced or behavioral patterns have changed from the last calibration effort. Adjustments are typically incremental and fine-tuned to specific datasets or evolving travel behaviors. However, it is critical to ensure that these targeted adjustments maintain overall consistency and do not disrupt the integrity of the model by worsening calibration and validation results as a whole. As with calibrating and validating new models, it is important to check results against benchmarks to verify results.

Increasing Model Reliability and Accuracy

Model calibration and validation are completed as an iterative procedure during the development and refinement stages of the modeling process. Validation may include some calibration components if household survey data are available; however, survey data are not required when adjusting the model to match traffic counts and parameter adjustments are making no structural changes. It is best practice to examine every step of the modeling process in detail. For example:

- Trip generation rates can initially be adjusted based on surveys to ensure benchmark results are realized. After at least one complete iteration, further adjustments may be necessary to enable the correct magnitude of trips in assignment results that better fit local traffic counts, particularly when there are special generators or unique conditions in the study area.

- Trip distribution will require tuning the behavioral response to travel impedance (travel time or cost). This will also be based on survey data. Examples of adjustments include:
  - Friction factor edits
  - Choice Model coefficient edits (if using destination choice)
  - Adjustment of intrazonal trip percentages

  These adjustments ensure more realistic trip patterns between zones. This may be confirmed by including a trip length frequency distribution, average trip length, and other checks outlined in the benchmark section that make sense for trip purpose and geography.

- For mode split, the initial estimates of transit ridership may need adjustment based on observed transit usage, information from recent onboard survey data, or other data conveying emerging trends in travel behavior. This may include adjusting coefficients related to travel times, waiting times, cost, and accessibility. It is particularly important to ensure that trip distribution and mode choice adjustments are made as a singular effort with a close eye on each step, as transit and non-motorized trip-making are location-specific. Consequently, poor trip distribution results will have an outsized impact on mode choice.

- Traffic assignment will also require extensive adjustments to enhance validation, but they typically do not require survey data. Several items may be investigated, including:
    - Adjustments to the network's link capacities and speeds within reason.
        - Checking functional class/facility types
        - Checking area types
        - Adjusting input free-flow speed based on probe data
    - Careful evaluation of centroid connector loading points for trips and deletion/addition of shifting locations as necessary to represent realistic traffic loading patterns.
    - Careful evaluation of network fidelity
        - There may be a need to include links to ensure critical connectivity that otherwise would be omitted.
        - Ensuring that items like ramp loading, collector-distributor representation, one-way patterns, and grade separations versus at-grade intersections are correctly represented.
        - Proper representation of tolling and traffic prohibitions.

Guidelines for calibration and validation represent optimum levels of accuracy that are practically achievable following a comprehensive validation effort after each step. In many cases, however, model validation efforts are focused on highway assignment statistics, with minimal effort expended on validating trip generation, trip distribution, and mode choice. In such cases, the model may not correctly capture the trip-making behavior patterns in the region. It is essential to focus on all the steps together to minimize the likelihood of this occurrence.

Charting a course for model calibration and validation is easier with some combination of local area knowledge, understanding what constitutes acceptable model results, and knowledge and experience of the cause and effect of different model adjustments.

Setting Accuracy Guidelines During Validation

Setting accuracy guidelines in travel demand model validation requires a thoughtful, context-sensitive approach. While numerical benchmarks can provide general guidance, the models used in transportation planning are applied to diverse contexts, each with unique datasets, assumptions, and objectives. Relying on rigid, universal metrics may lead to suboptimal outcomes. Instead, accuracy guidelines must reflect the specific characteristics and goals of each project.

For instance, in a highway study, the primary outputs might be roadway volumes and speeds, whereas in a transit study, the focus might be on ridership levels at specific stations. Intermediate outputs such as average trip lengths or percent intrazonal trips do not directly influence planning decisions, although they are crucial for ensuring the accuracy of final results. Intermediate outputs contribute to the overall reliability of the model, because errors in the early stages will compound and affect the final outputs.

One of the challenges in validation is determining acceptable error ranges. Chapter 6 of Developing a Model, Resources, provides links to various travel modeling benchmarks with acceptable error ranges, such as the National Cooperative Highway Research Program (NCHRP) Reports 365 and 716 and Florida model validation reports.

While the reports provide guidelines, specific model use cases may require exceptions to the recommended guidelines to be considered. For example, underestimating transit ridership by 20 percent might still allow for a successful project, but a similar error in forecasting roadway congestion could result in infrastructure that fails to meet demand. As a result, error ranges must be defined based on the project’s context and expert planning and engineering judgment. Generally, if a model's results are comparable to or better than those from similar models, and the consequences of the error do not result in the need to take action regarding planned investments, there is reasonable confidence in its accuracy.

The model calibration and validation process relies on both rigorous statistical analysis and informed professional judgment. Statistical analysis provides the framework, but successful calibration also requires practical experience and regional knowledge. Practitioners must balance data-driven approaches with practical insight to make informed, defensible adjustments. This requires an understanding of the specific conditions the model represents and a continuous learning mindset that allows for refinement based on exposure to new data and modeling structures.

Developing the Base Year Scenario

The model development process results in a model with a base year that has been through the extensive calibration and validation effort previously described. The base year scenario is an approximation in the model of known travel behavior and conditions in the region in the recent past. The following describe characteristics of the base year scenario:

- The inputs used are typically from the most recent year in which full datasets, such as the U.S. Census, have been compiled and are available for model development.
- The network represents conditions such as number of lanes, free flow speeds, and functional classification of roadways for the same year as the land use input data being used.
- It serves as the reference point, particularly for forecast year growth and defines the model that has been built, calibrated, and validated against known data.
- It is an essential scenario following which reasonableness may be ascertained for model use for all other planning purposes.

Standardized Reports and Outputs

To finish the base year model development process, the final assignment results should be analyzed. The findings are reported to stakeholders when the review confirms that the model results are reasonable and fit for developing forecast-year alternative scenarios for planning needs.

Review Model Results

Reviewing results involves compiling outputs from the model following each run, such as the loaded networks, the final trip tables used for assignment, and intermediate outputs from each model step. Several tools and techniques are typically utilized to review results, including:

- GIS thematic mapping of the loaded network
- Charts and graphs of various input and output metrics

- Automated scripts on the networks often prepare tabular outputs
- Trip table analysis in matrix format as well as other efficient data storage formats often done with scripts

The primary goal is to serve as a final quality and reasonableness check of all the prior work in developing and refining the model. Careful evaluation of the reporting requirements is needed to determine which of the reporting options, visualizations, and strategies are best employed to convey the information. Common items checked include aggregate O-D flows, land use growth, bandwidth maps showing traffic volumes for each scenario, transit route and station usage, and volume-to-capacity maps highlighting deficient areas on the network. Model calibration and validation results for the base year are also reviewed.

Report Findings

Once the review has been completed and the results are deemed reasonable, findings should be reported to the model development stakeholder community. Documentation of model development includes:

- Input data description, review, and considerations for use
- Calibration process including initial estimated and final adjusted parameters for each step
- Final output and validation results
- Assumptions made in model development

The model components should be packaged in easily sharable formats, organizing model files and folders logically with metadata, where appropriate. Share the model in the format requested by the model owner(s) (typically through cloud or physical storage), and provide a model user guide.

Next Steps

Once the base year has been developed, forecast year data inputs and alternative scenarios are developed and used for planning analysis. This process is described in Chapter 5, Developing and Refining Forecast Year Scenarios.

This chapter has explored the processes involved in developing and refining a model, from model architecture through to reporting findings and analyzing results. The importance of calibration and validation in maintaining model accuracy is discussed in depth as this is the core of model development. To stay current with best practices, professionals are encouraged to engage continuously with the statewide and nationwide modeling community, participate in professional seminars and workshops, and check out recent academic publications for new research and technological advancements in the field.