

Tulsa Transportation Model – Methodology, Assumptions

(Methodology Adapted from A Transportation Modeling Primer, University of Wisconsin & Calibrating and Adjustment of System Planning Models, Distributed by Department of Transportation)

Transportation planning uses the term 'models' extensively. This term is used to refer to a series of mathematical equations that are used to represent how choices are made when people travel. Travel demand occurs as a result of thousands of individual travelers making individual decisions on how, where and when to travel. These decisions are affected by many factors such as family situations, characteristics of the person making the trip, and the choices (destination, route and mode) available for the trip. Mathematical relationships are used to represent (model) human behavior in making these choices. Models require a series of assumptions in order to work and are limited by the data available to make forecasts. The coefficients and parameters in the model are set (calibrated) to match existing data. Normally, these relationships are assumed to be valid and to remain constant in the future.

Transportation planning is required in the United States as a condition to receive federal transportation funds for larger urban areas. Requirements for urban transportation planning were first enacted in legislation passed on 1962. These have been expanded and modified in subsequent legislation, most recently through the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) and the Transportation Efficiency Act (TEA-21). ISTEA specifically listed 15 factors that must be considered in urban transportation planning. These factors have led to planning regulations that require planning agencies to deal with air quality issues, multimodal planning, better management of existing systems, expanded public input and financial analysis requirements. Generally they have led to a greater role for transportation planning in urban areas, especially with a need to consider a wider range of alternatives and consequences of transportation investment choices.

Transportation planning is a complex process that involves a basic sequence of steps. Several can take place at once and it is not unusual to repeat some of the steps several times. Travel demand models are used in the forecasting step of the process as the means to predict how well alternative plans perform in meeting goals. The basic steps in the transportation planning process are the following:

- Problem definition: This step identifies the key transportation, socio-economic and land use issues and problems facing the community. This step may also involve definition of the size of an area to be studied, determination of the scope of the study and the establishment of a committee structure to oversee the planning process.

Tulsa TMA uses census definitions to define the geographical base for collating data related to population and employment. Employment by place of work is collected from the State Employment Commission, and for Populations INCOG depends on Census.

- Define goals, objectives and criteria: A consensus should be developed by elected officials and citizens about the future of the community and its transportation system. Goals are developed for the quality of transportation service, environmental impacts and costs. Some of these will likely be in conflict. A good planning effort will identify the trade-offs between these factors among alternatives in a clear, concise way to help make decisions. Along with goals it is important to identify more specific objectives and criteria which can be used to specifically measure how well alternative plans perform in meeting the more general goals.

INCOG conducted several consensus building exercises throughout the planning period, starting with a vision meeting. Goals and objectives were developed using the input from area planners, policy makers and citizen input

- Data collection: Data must be compiled about the present status of the transportation system and its use. This could include traffic data, transit ridership statistics, census information and interviews of households about their travel patterns. Data are also gathered on land use, development trends, environmental factors, and financial resources. This will assist in problem definition and in developing methods to forecast future travel patterns. Good data are essential to the planning process. The statement 'garbage in/garbage out' applies in transportation planning. Without good data, the results of the planning process have little real meaning and can lead to the wrong projects selected and a wrong direction for the region.

INCOG primarily relies on data from sources in the region such as cities, utility based information, projections both near term and long term. Long range Transit model and mode split is not developed in the INCOG region considering the small share of the over all transit trips. Therefore the data is heavily skewed toward Traffic counts, auto occupancy, and household information.

- Forecasts (Modeling): Data from existing travel is used to make forecasts of future travel using travel demand models. This requires forecasts of future land use and economic conditions as well as understanding of how people make travel choices. Forecasting requires large amounts of data and is done under many assumptions. The basics assumptions and procedures used for travel demand forecasting are set out in section II of the primer.

Gravity based Trip distribution model is employed after carefully considering the landuse model inputs in to the process and based on the NCHRP #365 report.

- Develop alternatives: Forecasts are used to determine the performance of alternative future land use and transportation systems. Alternatives normally include different land use and transportation systems and mixtures of highway and transit services and facilities. Since land use affects travel and travel affects land use, both must be considered.

Several roadway alternative networks were developed based on the input from various cities and counties. The alternatives were narrowed down to a total of three, the no-build alternative (present plus committed network), build 2025 alternative for 2030 and the enhanced alternative for 2030. Then the enhanced alternative was further refined given the finer level of detail that city/odot or other stakeholders wished to test.

- Evaluation: Results of forecasts are used to compare the performance of alternatives in meeting goals, objectives and criteria. This information may be extensively discussed by interested citizens, elected officials, different government agencies and the private sector. Ultimately decisions are made by appropriate elected or appointed groups for future transportation projects.

- Implementation plan: Once decisions are made, plans should be further developed and refined for implementation.

A Primer on How is Travel Modeled?

Models are used in a sequence of steps to answer a series of questions about future travel patterns. The basic questions asked and the modeling step they involve are as follows:

1. What will our community look like in the future?

- How many people will there be? (population forecasts)
- What will they be doing? (economic forecasts)

2. What are the travel patterns in the future?

- How many trips will be made? (trip generation)
- Where will the trips be? (trip distribution)
- What routes will be used? (traffic assignment)
- What will be the effects of this travel? (impact analysis)

Each of these steps are explained below including a discussion of common assumptions, limitations and issues related to their use.

Population, Economic and Land Use Models

Before forecasts are made of travel, it is necessary to develop forecast of future population, economic activity and land use. Transportation planning is directly linked to land use planning. Trips are assumed to follow future land use patterns.

How many people will there be? (Population forecasts)

What activities will people engage in? (economic forecasts)

Please see landuse documentation for this discussion.

Travel Demand Models

The travel forecasting process is at the heart of urban transportation planning. Travel forecasting models are used to project future traffic and are the basis for the determination of the need for new road capacity, transit service changes and changes in land use policies and patterns. Travel demand modeling involves a series of mathematical models that attempt to simulate human behavior while traveling. The models are done in a sequence of steps that answer a series of questions about traveler decisions. Attempts are made to simulate all choices that travelers make in response to a given system of highways, transit and policies. Many assumptions need to be made about how people make decisions, the factors they consider and how they react a particular transportation alternative.

The travel simulation process follows trips as they begin at a trip generation zone, move through a network of links and nodes and end at a trip attracting zone. The simulation process is known as the four step process for the four basic models used. These are: trip generation, trip distribution, mode split and traffic assignments. These models are used to answer a series of questions as explained in the remainder of the primer. In addition the process used to represent urban areas and the use of model results will also be described.

How is the city represented for computer analysis? (Zone/Network system)

Travel simulations require that an urban area be represented as a series of small geographic areas called travel analysis zones (TAZs). Zones are characterized by their population, employment and other factors and are the places where trips begin (trip producers) or end (trip attractors). Trip making is first estimated at the household level and then aggregated to the zone level. Trip making is assumed to begin at the center of activity in a zone (zone centroid). Trips that are very short, that begin and end in a single zone (intrazonal trips) are usually not directly included in the forecasts. This limits the analysis of pedestrian and bicycle trips in the typical travel demand modeling process since they tend to be short trips.

Zones can be as small as a single block but typically are 1/4 to one mile square in area. INCOG TMA region uses 536 zones of which 514 are internal zones.

The following steps summarize the overall model calibration and adjustment process.

Step 1. Run the region-wide transportation system models using default values for model parameters. If old model parameters are available from previous studies or O-D surveys, they are used in the initial runs. More recent data, such as that from small sample surveys, are used to update these parameters.

Step 2. From the initial results of the model runs, develop region wide values such as trips/person and VMT/person.

Step 3. Compare the region-wide values developed under Step 2 with typical values shown in appendix A.

Step 4. Develop screen lines and cut lines for your area. A screen line located along Arkansas river was used as a bench mark.

Step 5. Having evaluated the results from the above steps, determine whether system level, local or a combination of problems have occurred in the application of the model. Modifications to the model can be made by adjusting various equations, parameters or variables as described in the following sections of the manual. In some cases, adjustments to more than one item may be necessary to obtain appropriate results. Simulated volumes from the traffic model can be raised or lowered to match ground counts by examining and modifying, either individually or in combination, the following:

- Network Characteristics
 - Centroid Connectors
 - Roadway Speeds and Capacities
 - Intrazonal Times
 - Coding Errors

- Trip Generation Rates
 - Socioeconomic Data
 - Household Income
 - Production and Attraction Rates
 - Special Generators
 - Trip Balancing Factors

- Auto Occupancy

- Trip Distribution
 - Mean Trip Length
 - Estimating Trip Length
 - Non-work Trip Purposes

- Traffic Assignment
 - Equilibrium