

## 2 | Trip Generation Basics

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### 2.1 Concept of Site Trip Generation

Trip generation is one measure of travel behavior. It is based on the notion that people regularly travel to or from a particular land use and location and that the amount and type of activity at the location—whether retail, office, residential, or service-oriented—uniquely determines the amount, type, and mode of that travel. The calculation of the number of trips entering or exiting different kinds of activity and land uses forms the foundation of trip generation estimation.

As an illustration of trip generation, consider that people leave their homes every day to travel to work, go shopping, go to school, visit friends, or attend appointments. Each departure from the home is considered a trip. Each return to the home is likewise considered a trip. If a cordon is placed around the residence to record the comings and goings over a 24-hour period, the number of trips the dwelling unit generates per day can be determined. If four trips leave the home—for instance, one to work, one to school, one to shop, and one to the dentist—and these same four trips return to the home on the same day, the dwelling unit has a trip generation rate, for that particular day, of eight trips per day (four outbound and four inbound). If additional trips are made to or from that dwelling unit by visitors, by delivery vehicles, or other service personnel, these trips would also be considered trips generated by the residence.

Similarly, travel to and from any type of location can be counted. Each specific type of establishment—a factory, a store, an office building, or an entire shopping center—is considered a trip generator.

As noted above, the fundamental measurement for trip generation is trips. In technical terms, a trip has an origin and a destination at its two ends (known as trip ends). Each trip end is a part of a trip. For site trip generation, the analyst is usually interested in trips entering (inbound) and exiting (outbound) a site. An entering trip end is a destination trip end; an exiting trip end is an origin trip end. Common usage throughout this *Handbook* is to refer to the inbound and outbound trip ends as “trips” because they are the site’s portion of those trips.

### 2.2 Person Trips and Vehicle Trips

Trips may be made via various modes of travel: as a pedestrian, bicyclist, transit patron, personal passenger vehicle driver, personal passenger vehicle passenger, truck driver, or truck passenger. The guidance in this *Handbook* enables the analyst to record and subsequently analyze trips in units of either person trips or vehicle trips.

The term “person trips” refers to trips made to or from a site by each individual person using any mode (personal passenger vehicle, truck, pedestrian, transit, bicycle). Two people in a personal passenger vehicle counts as two person trips. “Vehicle trip” generation refers to the number of vehicles traveling to or from a site. If a vehicle has two people in it, it still counts as one vehicle trip.

## 2.3 Study Sites and Proxy Sites

The basic premise upon which all trip generation estimates are based is that the number of trips entering and exiting two development sites with the same land use, size, and dimension, and setting will be comparable. The general procedures presented in this *Handbook* provide guidance on how to find and use trip generation data from development sites that are comparable to the development site being analyzed. Throughout this *Handbook*, the development site for which a trip generation is being estimated is called the **study site**. The comparable sites with relevant trip generation data are called **proxy sites**.

Nearly all data presented in the current *Trip Generation Manual* data volumes have been collected at low-density, single-use, homogeneous, general urban or suburban developments with little or no public transit service and little or no convenient pedestrian access. These proxy sites are called **baseline sites** in this *Handbook* because they are the starting points for most vehicle trip generation estimation recommended in the following chapters.

## 2.4 Uses of Trip Generation Data

The basic product of the procedures in this *Handbook*, to the limits possible with available or readily collectible data, is an estimate of the inbound and outbound trips by mode (personal passenger vehicle, truck, transit, bicycle, pedestrian) for a study site. These trip generation estimates are used for a variety of functions, such as

- Determining site access and circulation requirements for a study site;
- Estimating future traffic volumes upon which off-site transportation improvements are based;
- Determining fees for use in addressing potential impacts to the transportation systems; or
- Evaluating the implications of requests for potential zoning or land use changes.

In some cases, the modal trip generation estimates can be used for purposes beyond trip generation such as to assess parking demand, forecast regional travel for special generators, or estimate vehicular emissions or other environmental measures. Appendix L discusses potential connections between site trip generation estimates and travel demand models, especially as they relate to special generators.

## 2.5 Trip Generation Database

### 2.5.1 Source of Trip Generation Manual Data

The data presented in Volumes 2 and 3 of the *Trip Generation Manual* (known as the data volumes) are from studies conducted throughout the United States and Canada. The data were contributed on a voluntary basis by various state and local governmental agencies; consulting firms; individual transportation professionals; universities and colleges; developers; associations; and local sections, districts, and student chapters of ITE. In many cases, the data were originally contained in published reports or unpublished analyses conducted by such groups. The sources of these reports or analyses are listed in Appendix N. The source numbers for studies contained in each land use are listed on the land use description pages in Volumes 2 and 3 of the *Manual*.

### **2.5.2 Data Collection**

Some of the data reported in the *Manual* were collected using automatic counters configured to count vehicular traffic entering and exiting a site. These counts were taken on driveways of sufficient length to avoid the double counting of turning vehicles. In some cases, counts were non-directional and therefore did not distinguish between entering and exiting vehicles.

Manual counts often supplemented the automatic counts to

- Obtain vehicle occupancy and classification;
- Check the reliability of the automatic counters; or
- Obtain directional counts during peak periods when a non-directional automatic count was being conducted.

In other cases, only manual counts (or video counts interpreted manually) were conducted during peak periods.

Additional information regarding site characteristics was obtained through personal interviews, field measurements, telephone conversations, or mail-back questionnaires.

### **2.5.3 Data Storage**

The *Trip Generation Manual* data are stored in a trip generation database maintained at ITE Headquarters. The amount of data submitted for an individual site varies from one peak-hour volume to seven days of directional hourly volumes. All data received are initially examined by ITE staff for validity and reasonableness before being entered into the database. Each data record is referenced in the database by a source number, the month and year of the measurement, the metropolitan area (when known), and a three-digit land use code. Data for more than 170 land uses are organized within 10 major land use categories. Additional land uses are added to the database as data become available.

### **2.5.4 Data Age**

The database compiled to produce the *Manual* contains data from the years 1960 through 2013. The data were obtained primarily from volunteer sources. The data are carefully reviewed by ITE professionals with specific expertise and responsibility for trip generation calculations and analyses. This review includes consideration of several factors including

- Completeness of both land use independent variable and traffic counts;
- Relationship and consistency to prior data within database;
- Variations from typical land use in the stated category; and
- Other characteristics (such as employment density, seasonal or time-of-day issues, area type, mixed use issues, and extensive use of non-automobile modes).

In addition to reviewing data when initially submitted, ITE professionals review each land use code data set prior to a new edition. This review is primarily focused on codes with new data and considers the age of the data and whether conditions or trends indicate that substantial land use or cultural changes have affected trip generation patterns. Statistical tests (including combinations of variations from averages, standard deviation expansion, clustering of recent data,  $R^2$ , T-tests, and F-ratios) are used to determine if differences are significant between older data and newer data.

Prior to publication of the 8th Edition, ITE investigated whether changes in banking industry technology (in particular, automated teller machines and, more recently, electronic banking) and customer practices during the 1990s could have resulted in travel pattern changes. The ITE analysis concluded that pre- and post-2000 bank trip generation data were significantly different. As a result, all data prior to year 2000 were removed from the database for the two banking land uses—Walk-in Bank Land Use Code (LUC 911) and Drive-in Bank (LUC 912).

The primary advantage of using only current data is they may more accurately reflect current trip characteristics associated with a given land use. The disadvantage is the potential decreased data sample and the consequent increased effects of sites with atypically high or low trip generation to have an undue influence on overall trip generation estimates for the land use.

## 2.6 Evolution of Trip Generation Estimation

The *Trip Generation Manual* has been the primary source of vehicle trip generation data for transportation impact analyses in the United States and Canada. The majority of the data in the *Manual* were collected at general urban and suburban single-land-use sites with their access isolated from other land uses consistent with traditional zoning, such as office parks, shopping centers, and residential subdivisions. When early editions of the *Manual* were published, new development was occurring mostly on greenfield sites in suburban and exurban communities or on large vacant tracts of land within the belts of partially developed land surrounding large cities. The combination of land use segregation<sup>3</sup> and development located distant from city centers resulted in trips to and from those sites being made predominantly by personal passenger vehicle. As a result, for the analyst conducting impact analyses of a single-use development in a suburban or exurban site, the *Trip Generation Manual* vehicle trip generation data are relevant and accurate.

Development patterns and building types in recent years have shifted to include increasingly denser, mixed-use and infill development and redevelopment in urban locations with significant transit service. Studies have concluded that the vehicle trip generation data contained in the *Manual* overestimates vehicle trips generated by development and redevelopment in compact, urbanized areas where walking, bicycling, and transit are viable modes of transportation—termed “multimodal sites” in this *Handbook*. This edition of the *Handbook* addresses the issue and provides guidance for the estimation of person and vehicle trips at multimodal sites.

The application of suburban data in dense or multimodal urban settings can in some cases overestimate motor vehicle demand. The result has been past decisions where:

- modes such as bicycle, pedestrian, transit, and rideshare (carpooling and shared mobility) may have been largely ignored, resulting in inadequate support or capital
- mitigation of vehicle impacts may have exceeded needs
- potential imbalance of transportation fees, exactions and public improvements may have occurred
- parking may have been overbuilt
- the consequences of urban development on greenhouse gases may have not been properly understood

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<sup>3</sup> As a result of consumer preferences, developer trends, zoning, availability of financing, and public infrastructure spending.

## 2.7 Communicating the Basis for Site Trip Generation Estimates

The process of describing trip generation concepts can result in confusion on the part of other professionals, elected and appointed officials, and the general public. Policy discussions can unintentionally misinterpret aspects of trip generation estimation techniques. The following sample statement is intended to help the analyst explain the basis for trip generation estimates derived with the aid of *Trip Generation Handbook*.

“Trip generation estimates developed for this study are based on the 9th Edition of the *Trip Generation Manual* published by the Institute of Transportation Engineers (ITE). The *Manual* is the most widely used industry resource for this type of data. The trip generation data are organized by land use types, with more than 170 different categories of land uses. For each category the *Manual* provides a data set for use in estimating the number of vehicle and person trips generated by a site based on its characteristics such as physical size or intensity. Trips may be estimated by direction (entering or exiting the site) and for time periods typically pertaining to a full day (weekday or weekend), peak hours of the adjacent roadway, and peak hours of the particular land use. Used properly, the *Trip Generation Manual* provides an objective basis for estimating trips generated by a proposed development.”

Appendix K contains sample presentation slides to help the analyst communicate the same message in a public forum.