1-2017

Issues in Trip Generation Methods for Transportation Impact Estimation of Land Use Development: A Review and Discussion of the State-of-the-Art Approaches

Kristina Marie Currans
Portland State University, curransk@gmail.com

Issues in Trip Generation Methods for Transportation Impact Estimation of Land Use Development:

Review and Discussion of State-of-the-Art Approaches

Paper No. 17-01450

Kristina Currans, Portland State University
Email: kcurrans@pdx.edu

Overview

As agencies develop more robust planning objectives for creating sustainable and livable communities, the research community has continued developing supportive tools and methods to provide more accurate and robust means for estimating transportation impacts for site-level development review. This is a review of the state-of-the-art trip generation methods for land use transportation impact estimation; those that have improved upon the Institute of Transportation Engineers' (ITE) *Trip Generation Handbook* methods. First, it provides an overview of the more recent available and peer-reviewed estimation methods (see table to the right). Second, we offer a discussion of the successes of state-of-the-art approaches using common themes of research to identify corresponding consistency with theories of travel behavior and urban economics (see text boxes below). The main objective of this work is to identify the largest and potentially problematic gaps in the state-of-the-art methods available for practice in order to allow researchers, agencies, and practitioners to both be aware of these limitations and forge forward new innovations to solve these gaps.

Themes of Research

Estimating People/Overall Activity

There are few studies in the travel behavior literature that attempt to understand the overall demand of travel—not segmented into mode-specific metrics—let alone trip generation research. Furthermore, all methods assume that person trip generation rates, for any given land use, do not vary across a region. This implies that two of the same businesses, one located in the urban core, the other in a suburban area, would generate the same number of people through the door. This contradicts theories such as bid-rent that suggest businesses pay a premium to develop in more accessible areas.

Built Environment

The built environment may include any of the six D's: density, (land use) diversity, design, destinations, distance to transit, demand management. Although there is a lack of consensus for whether behavior, such as mode choice and trip rates, do vary by the built environment, ten methods evaluated here include the built environment in their estimation process, placing a great importance of urban context in estimating variations in trip generation—specifically as it pertains to changes in mode shares or mode-specific trips. Only two methods account for TDM strategies (beyond transit access): metered parking within 0.1-miles of the development; proportion of surface parking; and various transportation demand management programs.

Who are the People?

Few methods account for socio- or economic-demographic indicators. Currently, there are two ways to incorporate demographics in trip generation analysis: studying the trip-makers or studying the area-wide market in the study area. An alternative to accounting for demographics using explicit variables in analysis is to incorporate the measure in how the land use is defined (e.g., luxury condominiums, discount superstores or grocery stores, toy/children's store, baby store) although this segmentation may be a statistically inefficient use of the data. In practice, trip generation studies rarely consider the socio-demographics of the establishment's market. Without information about who is traveling to these establishments, we have a limited ability to control for specific variations in demographics using existing data.

Land use (dis)aggregation

Methods that directly adjust ITE's vehicle trip rates rely heavily on ITE's undocumented categorization of land use types, while methods that use household travel survey data or are constrained by too few data, aggregate land use categorization into broader categories (e.g., retail, service, residential). Since the user of these data is often the developer—and the stage of development review often only provides a rough estimate not always corresponding with the final product—the (dis)aggregation of categories plays a big role in how efficiently these data are used. The incentive for studying the trip-maker's motivations for activities results in a more complete understanding of why we observe variations in travel behavior and how we might better estimate or predict it, therefore we must give more attention to the reasons for the demand for activities themselves, and the corresponding derived nature of travel.

Mixed and/or multiuse methods

A mixed-use development (sometimes called a multiuse development) is defined as "an integrated development (usually master planned) consisting of at least two complementary and interactive land uses designed to foster synergy among activities generated by the land uses" (ITE). Literature discussing mixed-use developments, trip generation, and internal capture tends to reflect the data analysis of large planned communities ranging from 5 to 2,000 acres. The term 'mixed-use development', however, includes a broader definition in practice than considered in ITE-related studies. Mixed-use development includes any area where the mix of land uses results in trip chaining between the land uses. While there is a growing literature on the overall transportation impacts of mixed-use planned developments towards an analysis that examines the influences of mixed uses on infill development within existing communities—we understand less about how these infill developments function within an existing mixed-use community—like historic downtowns, urban commercial corridors, or the central business district.

	Urban Context Adj. (PSU)	Smart Growth Adj. (UCD)	Urban HTS Adj. (PSU)	NCHRP 758 (Daisa)	NCHRP 684 (ITE)	EPA MXD (Ewing)	MXD+	TCRP Report 128 (Arrington)	URBEMIS	CalEEMod	SF Impact Guidelines	NYC Guidelines	DDOT
Data	Site	Site	HTS	HTS	Site	HTS	Site/ HTS	Site	Previous Studies	ITE/HTS/ other	Site	Site	Site
Adjustment to ITE	X	X	X	X	X	X	X		X	X	X		
Urban Vehicle Trips	X	X	X	X	X	X	X	X	X	X	X	X	X
Direct Estimation (Person Trips, PT)												X	X
Direct Estimation (PTs by mode)								X					X
Mode Share			X	X	X	X	X		X	X	X		
Vehicle Occupancy			X			X	X		X	X	X		
Trip Length						X	X			X			
Land Use Types	3	6	Any	Any	6	Any	Any	1	Any	Any	Any	Any	2
Area Type	Infill	Infill	Infill +	infill +	MXD	MXD	MXD	TOD	Any	Any			
Built Environment	X	XX	X			XXX	XXX	X	XXX	Location	Location		
Parking		On-street							Supply/ Price				
Socio-demographics		AREA*(ish)*				TRIP MAKER	TRIP MAKER	DEV. LEVEL			LAND USE		
Peak Hour	PM	AM/PM	AM/PM	AM/PM	AM/PM	AM/PM	AM/PM	AM/PM			PM	AM/PM	AM/PM
Daily			X	X		X	X		X	X	X	X	
Variable Hours			X	X		X	X						
Internal Capture					X	X	X						
Ready to Use	X	X	X	Method	X	X	X	X	X	X	X	X	X
Data Development Area	PDX	CA	PDX, SEA, BALT	---	TX, FL	ALT, BOS, HOUS, PDX, SAC, SEA	ALT, BOS, HOUS, PDX, SAC, SEA, TX, FL	PDX, PHILA, NJ, D.C., SF	---	CA, but allows for localized inputs	SF	NYC	D.C.

Funding and support provided by:

Portland State UNIVERSITY

NITC NATIONAL INSTITUTE for TRANSPORTATION and COMMUNITIES

U.S. Department of Transportation Federal Highway Administration