Methodology to Gather Multimodal Urban Trip Generation Data

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Assessments of the impact of new land use development on the transportation network often rely on the ITE *Trip Generation Manual* informational report. Current ITE rates generally represent travel behavior for separated, single-use developments in low-density suburban areas. However, a more compact urban form, access to transit, and a greater mix of uses are known to generate fewer and shorter vehicle trips—and quite possibly more trips overall, especially in heavily urbanized areas like Washington, D.C. Local and national interest exists for generating data that expand upon existing trip rates (and similar parking generation rates) to include sites in diverse, dense contexts. The lack of adequate data on multimodal urban trip generation led the District Department of Transportation in Washington, D.C., to develop and test a streamlined methodology that meets the needs of practitioners who are evaluating the transportation impacts of new developments in dense, multimodal environments. This methodology focuses on capturing all trips to and from a site and the mode of all travelers, not just personal vehicle trips. The methodology was tested at mixed-use multifamily residential buildings but is intended for future use at a wide range of sites. This paper presents the methodology and rationale for a robust national data collection effort.

Assessments of the impact that new land use development has on the transportation network often rely on the ITE *Trip Generation Manual* (*1*). Current ITE rates generally represent travel behavior for separated, single-use developments in low-density suburban areas. However, a more compact urban form, access to transit, and a greater mix of uses are known to generate fewer and shorter vehicle trips (especially in heavily urbanized areas like Washington, D.C.) For dense, mixed-use contexts, reliance on the sites typically represented in the ITE report can lead to erroneous conclusions about the impacts of development. Potential consequences include poor policies; overmitigation for vehicle trips, which could, in turn, induce motor vehicle travel; and communication of the wrong information to neighbors and other stakeholders. Both local and national interest exists for generating data that expand upon existing trip rates (and similar parking generation rates) to include sites in diverse, dense locations.

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A number of studies have attempted to address the shortcomings of ITE's existing data in the *Trip Generation Manual* on smart growth, in-fill, and locations of transit-oriented development. Many of these studies seek to adjust current ITE rates for different contexts, often relying on data from household travel surveys or stated-preference surveys, as is done for monitoring of travel demand management. A few studies have developed separate trip generation databases by using data collection similar to the ITE methods. As a result, a number of methodologies for rate adjustments and multimodal data collection now exist, but no commonly accepted methodology exists in the United States.

In the District of Columbia, the lack of adequate data on multimodal urban trip generation led the District Department of Transportation (DOT) to take these prior studies and develop a streamlined methodology that meets the needs of practitioners who are evaluating the transportation impacts of new developments in dense, multimodal environments. Importantly, this methodology focuses on capturing all trips to and from a site and the mode of all travelers, not just personal vehicle trips. This paper presents this methodology and makes a call for a more national data collection effort.

BACKGROUND

District DOT

As a municipal transportation agency, the District DOT's primary need for trip generation data is to evaluate the predicted impacts of new developments on the transportation network. In the context of a robust multimodal transportation network, the majority of the trips are not expected to be in personal automobiles. Mitigation of impacts, therefore, needs to be focused on all modes. Traditional traffic impact analyses have struggled to provide such focus because the most robust travel data at the site level are for automobile trips. Tube counts for proxy sites are relatively easy and affordable to acquire, either through local data collection or by using the ITE *Trip Generation Manual.* Collecting data at the site level for nonautomobile modes is more complicated because mode choice cannot be simply observed in a mixed-use context; gathering those data requires some level of interaction with the traveler.

Previous Studies

In the United States, few cases involving site-level multimodal data collection have been explicitly documented, but those that have been universally involve a count-and-intercept survey (*2–6*) frequently conducted in tandem with counts at doors with an exclusive access characteristic [e.g., from a garage or directly from a transit station (*7*)].

Schneider et al., for their study of trip generation and smart growth, used a count-and-intercept survey (*2*). The survey included up to 10 questions (the number depending on branching related to earlier questions and the need for clarification). For example, to deal with the question of how to tabulate those who traveled by multiple modes, the surveyor asked clarifying questions such as, "Walked all the way?" The survey instrument included check boxes for all modes that the interviewee used to access a site. Mode classification could then be done during later processing, eliminating surveyor bias in determining the primary mode of travel. Similarly, Clifton et al. used a combination of long and short surveys and counts (*3*). They opted for a longer survey instrument with up to 24 questions on their long form and just four on their short form, with a response rate of 19% for the long survey. The longer survey captured demographic information (age, gender, household car–vehicle–transit pass ownership), mode attitudes (respondent would rate statements such as "walking here is safe and comfortable"), and time and money spent in a location. The response rate for the short survey was higher but not specified. Finally, in a study looking at in-fill development sites in California, Kimley-Horn and Associates used a similar methodology (*4*). That study's intercept surveys had up to 15 questions, and preliminary results showed that the return rate was between 7% and 20%. This methodology was also recommended as a way of capturing multimodal trip generation at in-fill sites by NCHRP Report 758 (*8*).

Related studies focus primarily on internal capture at sites with multiple uses; NCHRP Report 684 is an example (*5*). It also relies on counts and intercept surveys; its data collection field guide requires surveyors to ask and record answers to seven to 12 questions about mode, origin, and destination.

One of the variations across these studies is the interview capture rate, but whether the different response rates were because of refusals or simply different staffing levels and the different lengths of time required for completing each survey is unknown.

Outside the United States, data on multimodal trip generation such as these studies have tried to capture are available in national databases. In particular, the United Kingdom has a national database of vehicle counts, multimodal survey data, and contextual data for a range of uses in the Trip Rate Information Computer System (TRICS) (*9*). Similarly, the New Zealand Trips and Parking Database provides multimodal estimates and includes even more of the contextual factors found to affect trip generation than the Trip Rate Information Computer System (*10*). These databases are particularly relevant given that development patterns in the United Kingdom and New Zealand have many similarities with those in the United States, although the data are very likely not directly transferrable across borders.

DATA COLLECTION METHODOLOGY

The District DOT sought to create a data collection methodology that would produce standardized, and thus comparable, data across multiple sites. Moreover, data collection methods had to be replicable to create and to populate a database of site-specific multimodal trip generation that could be used to estimate the trip generation impacts of future developments. This format is analogous to ITE's widely understood and accepted database of vehicle trip generation. With this objective for the project, the general discussion of trip generation at the beginning of this paper, and the review of previous studies, the following criteria guided the data collection strategy:

- The approach had to encompass a site-specific strategy;
- The method had to obtain counts of person trips and mode shares;
- The method had to be simple and streamlined to ensure accuracy and usability; and
- The method had to be replicable.

Given these criteria, a review of best practices and reliance on relevant prior experience, the authors decided on the data collection strategy described here in detail. The strategy includes collection of relevant context data, and, finally, a person count and mode estimation approach. The latter methodology uses door entrance–exit person counts to quantify the number of person trips to a site. The door counts are complemented by an intercept survey to determine the modes by which people arrive. This process allows the ultimate model to reflect person trips by mode at the sites.

Each decision point in the development of the methodology was assessed for its ability to address the District DOT's core need for trip count and mode data. Similar to the prior studies, this methodology relies on door counts and intercept surveys to establish site-level mode splits. Differing from previous data collection efforts, the District DOT's method focused very directly on the primary data points needed for improving the development review function: a count of all travel in and out of a building and an estimate of the immediate mode selected by the travelers. Many of the reviewed methodologies also inquired about demographics, origin, destination, and trip chaining. These data, while useful for broader studies, are not immediately applicable in assessing a land development's transportation impacts. For example, when proposed developments are reviewed, demographics necessarily remain unknown, so collecting demographic data has dubious benefits to the study purpose. In addition, impact mitigations determined during development review concentrate on improvements to the immediate vicinity of proposed developments, thus limiting the value of understanding trip-chaining habits. Ultimately, the District DOT decided that adding questions to the intercept detracts from the core study purpose by increasing the burden associated with the survey in time and personal information, likely reducing the response rate.

The District DOT piloted this methodology at 16 mixed-use residential sites during the winter of 2013–2014. A test run of the methodology and data collection instrument led to initial refinements before the full pilot. The additional lessons learned from that pilot informed the final methodology recommended here. While the methodology was piloted primarily at multifamily residential properties, some of which contained neighborhood-serving retail, the methodology was developed to be compatible with data collection at a variety of land uses, pending future tests.

Collection of Site- and Area-Specific Data

Travel behavior, including number of trips and mode choice, is a function of land use and transportation infrastructure supply. An extensive literature has established the relationship between these components. Any future trip generation models developed from these data will, therefore, be reliant on both site- and area-specific data to contextualize the trip counts appropriately. While much of the information is available in municipal or national databases and does not change over time, such as location of a rail transit station or a parking garage, other context variables, including parking utilization and quality of bus stops, are time sensitive and may not be available from existing sources. These latter variables need to be collected at the time of data collection. This study did not focus on selecting context variables to build a model. However, the literature review identified in the broader study suggested several variables that would be good context measures. Therefore, to allow maximum flexibility in development of future trip generation models, area-specific data were collected during the pilot to supplement those available from existing sources.

The recommended site data collection includes the following key variables:

- Construction type (high rise, low rise, etc.);
- Major use;
- Size of individual uses:
  - Total square footage,
  - Office square footage,
  - Retail square footage, and
  - Number of residential units;
- Parking space count (potentially by who can access, if that information is available); and
- Number of doors by type (uses accessed and modes served).

Furthermore, although more important for reference than prediction, the site address should also be maintained.

At the same time as the count and survey data are collected, contextual data that could influence mode share and trip generation should also be collected. Documenting this information at the same or similar time as the trip generation data collection occurred is important so that the context will accurately match behavior. In the pilot, for a quarter-mile around the site, the following were collected:

- Bus shelter quality assessment,
- Bicycle rack availability,
- Bicycle rack utilization, and
- Parking utilization on street.

A number of other important contextual variables would be expected to influence behavior (e.g., distance to or number of nearby rail stations, bike share stations, bus stops, etc.), but as these are fixed locations available from regional databases over the long term, they were not included in this list for collecting at the same time as the counts and surveys.

Collection of Count and Mode Share Data

The pilot study collected data only during the peak hours of travel on the local network. Traditionally, these hours are between 7:00 and 10:00 a.m. and between 4:00 and 7:00 p.m. As this area of study emerges, practitioners may wish to examine alternative peaks depending on mode, generator type, or other variables. Counts were made on a Tuesday, Wednesday, or Thursday in dry weather conditions on a day without a holiday, early school release, a significant regional vehicular crash, transit system shutdown, or other event that would cause irregular behavior and bias the counts.

All count and survey data were collected in 15-min intervals during the collection period. The goal was a full 3-h data set in each peak to capture the highest 60-min period. After an initial attempt to record the exact time of each count and interview during the test run, this precision was deemed unnecessary and time consuming; it appeared sufficient to gather information in 15-min increments, which is in line with how the peak hour for a generator is typically determined.

Counts

Surveyors count the number of persons entering and exiting each building by door. While this methodology is designed to be simple and thus easy to understand and replicate, questions may arise about what really counts as a trip. To avoid potentially biasing judgment calls in the field, the methodology assumes that every person should be counted whenever that person crosses any entrance threshold of the building. Thus, the study established the rules below:

- Count all individuals, regardless of age.
- Count all individuals entering and exiting a doorway. Keep separate counts of those entering and those exiting. All individuals entering and exiting include people who may not seem to be making a relevant trip, such as people
  - Traveling between different uses located in the same building,
  - Taking a smoking break,
  - Walking a dog,
  - Delivering a package, and
  - Going for a jog.
- For vehicles with one or more passengers, the counter should record the driver and the passengers in separate columns to allow vehicle trips to be compared with person trips in vehicles.

Intercept Surveys

People were intercepted as they entered or exited the building and queried about their travel mode to or from the site. After an initial attempt during the test run to ask multiple questions about both arrival and departure, the research team abandoned this approach to focus only on the most immediate trip (arriving or departing). Generally, people were more receptive to the surveyors on exiting a retail location, so the surveyors were less likely to approach people entering a retail establishment, focusing instead on those exiting. Interviewers surveyed quickly and efficiently. Each survey was limited to 20 s. Surveyors and counters indicated, on the data collection form, which doorway or funnel point was being surveyed. This information ensured that the samples and counts were clearly matched. A door leading from a garage into a building will likely have a higher percentage of drivers than another door leading onto a sidewalk, hence the importance of keeping accurate records.

As a concession to field conditions, surveyors were instructed to attempt to survey as many people as possible, although, from a statistical perspective, collecting a systematic sample in which the first person is selected at random and every *k*th person is interviewed after that would be preferable. Given this concession, surveyors should be instructed to avoid surveying multiple persons within a single travel group. If people are traveling together, their responses are not independent, a situation that violates an important condition of statistical inference. In addition, some modes may accommodate groups better than others, a situation that would introduce bias into the survey sample. In contrast, avoiding groups could introduce a bias if groups tend to use one mode over another or are particularly common at certain land uses. This issue could be a topic for future investigation: looking at how group travel behavior does or does not influence overall site mode shares.

A question can be phrased in many ways, and opinions vary on whether it should be scripted or the field staff should have latitude to phrase it in a way most natural to them. Theoretical statistical principles suggest a script, but field experience shows that respondents may react negatively to scripted questions, particularly if the surveyor seems uncomfortable with the phrasing or the question comes across as stale and automated. In this case, subjects are more likely to refuse, and fewer data are collected. Scripting also precludes sensitivity to local customs, in some situations asking "Did you get here by car today?" and allowing the respondent to answer "Yes" or "No, I took the bus." In other situations, the better question would be open ended: "How did you get here today?" Essentially, these are the same question, and surveyors familiar with local language rhythms will be able to connect better with respondents by asking the local version; in turn, they will be able to stay fresh in their presentation if they can vary the way they ask.

In an effort to maintain simplicity, field staff should be instructed to focus on an individual's most immediate mode and to avoid the walk to a door from a car, bus, bicycle rack, and so on. This focus differs from the way that some past studies have approached the mode issue. From previous experience, this methodology assumes that most individuals will answer with their primary mode of transportation. For example, trips to rail or bus should be noted (and would usually be reported) as trips attributable to these transit modes rather than as a walk trip. The walk portion of their trip is assumed as a component of accessing the mode.

However, for those who used two modes, for example, cycling to a bus, the interviewer should record the mode associated with the site. If the bicycle is used between the site and the bus, then the immediate mode is bike. If the person is traveling from the site by bus to access a commuter rail line, then the immediate mode is bus.

As the forms in Figures 1 and 2 show, modes should be marked as follows:

- Drive alone: drove alone in a private vehicle;
- Carpool–high-occupancy-vehicle (HOV) driver: driver of a private vehicle with one or more passengers;
- Carpool–HOV passenger: passenger in a private vehicle with one or more passengers;
- Shared vehicle: traveled in a for-hire vehicle like a taxi or a vehicle from a transportation network company (e.g., Uber);
- Carshare (including round-trip and point-to-point service) vehicle: a separate category, as such vehicles demonstrate greater efficiency in the use of curbside and garage space;
- Bus: whether local, express, or private;
- Rail transit: includes both light and heavy rail;
- Bicycle: bicycled to or from the site from or to the last location by using a personal bike or bikeshare;
- Delivery: UPS, FedEx, and the like;
- Recreational trip: for example, a jogger or someone taking a smoke break who is not traveling to another destination; and
- Refused to answer (not technically a mode but to be recorded).

The survey's only additional question asked where those traveling by car had parked. Interviewees were given three options:

- On street,
- In garage or surface lot on site, and
- Off-site other.

Data Collection Instrument

This methodology uses three survey–count sheets (Figures 1 through 3), each to be used in one of the following situations:

- The survey and count form (Figure 1) is used in locations where one surveyor can count and survey at one location or for garages.
- The garage count form (Figure 2) is used at garage entrances where the mode can be inferred by the vehicle exiting or entering the garage.
- The count-only form (Figure 3) is used for high-traffic locations where someone is surveying separately. For efficiency, where appropriate, a counter may watch multiple doors while separate staff people survey at each door.

ANALYSIS

The analysis of the data combined the count and survey data by using the following three steps:

1. Determine the surveyed mode share by door for the entire period of morning and afternoon data collection. Using the 3-h period helps to account for times with relatively few surveys that would otherwise skew the results.
2. Apply the mode share from Step 1 to the counts by door to calculate a weighted mode split for each door. Calculating this split by door mitigates potential data skewing from the location of doors: for example, a door leading to a garage may have extremely high vehicle counts, while another door right in front of a bus stop would have a high proportion of bus riders. Application of the survey mode share by door to the counts by door is important for accurately representing these differences.
3. Combine the counts by door to determine mode split for the site overall.

A few issues could arise during this analysis process. These issues and suggested resolutions include the following:

- Number of surveys greater than counts at a given door. Assume that the number of surveys is the count, as it is unlikely that surveyors spoke to someone who did not use the door. If a surveyor consistently turns in sheets for which the number of people surveyed is higher than the number of people counted, the surveyor should be retrained to record the data correctly. Staffers at low-volume doors who are responsible to both count and interview must be sure to include the full count (i.e., those who were interviewed along with those who were not interviewed in the count column).
- Legibility. Refer to the staffing plan to determine who worked at a particular door, and contact them with questions.
- Doors with no survey data. If a door was missed in the data collection plan, return to the site to conduct an additional day of surveying under similar survey conditions (weather, time of year, etc.).

PILOT STUDY RESULTS

For the pilot, midrise residential properties with ground-floor retail were targeted because the District of Columbia is seeing a great deal of this type of development. To gain perspective on the diversity of development there, buildings were selected to represent a range of the mix of uses within the development (neighborhood serving mainly ground-floor retail), transportation options nearby, parking alternatives (including sites with no dedicated parking), size of the development (nearly all more than 75 units), age (all at least 3 years old), and location context. The buildings were clustered in four neighborhoods in the District of Columbia that have recently seen substantial growth.

MULTI MODAL **TRIP** **GEN**ERATION STUDY

Building ID:	____________________	**Date:**	____ / ____ / 2015	**Hour:** *(circle one)*	7am-8am / 4pm-5pm
Address:	____________________		Tue Wed Thu		8am-9am / 5pm-6pm
Door(s):	____________________	**Counter:**	____________		9am-10am / 6pm-7pm

Time *after hour*	**In or Out** *of Building*	**Raw Count** *all persons crossing building threshold*		**Travel Mode** *only count those responding to survey, do not make assumptions based on observations*													**IF AUTO:** Where Parked?		
				Auto					**Transit**										
		Door A:	Door B:	Drive Alone	Carpool Driver	Carpool Passngr	Hired Car *(taxi/Uber)*	Carshare *(rental)*	Bus	Metro (rail)	Train	**Walk Only**	**Bike Only**	**Rec. Trip***	**Deliv-ery**	**Asked; Declined to Answer**	**Lot/ Garage**	**On Street**	**Other**
:00 to **:15**	Inbound																		
	Outbound																		
:15 to **:30**	Inbound																		
	Outbound																		
:30 to **:45**	Inbound																		
	Outbound																		
:45 to **:00**	Inbound																		
	Outbound																		

Recreational trip – trip origin is same as destination (e.g. dog walker, smoker, jogger, etc…)

In case of emergency, call 911.
In the event of issues during data collection, please call team coordinator ______________________________ at (_____) _______-________.

form revised April 15, 2015

FIGURE 1 Survey and count form.

MULTI MODAL **TRIP** **GEN**ERATION STUDY

Building ID: ______________________

Address: ______________________

Door(s): ______________________

Date: ____ / ____ / 2015

Tue Wed Thu

Counter: ______________

Hour: *(circle one)*

7am-8am 4pm-5pm

8am-9am 5pm-6pm

9am-10am 6pm-7pm

Time *after hour*	**Land Use**	**In or Out** *of Building*	**Raw Count** *all persons crossing building threshold*	**Travel Mode** *only count those responding to survey, do not make assumptions based on observations*													**IF AUTO:** Where Parked?		
				Auto					**Transit**										
				Drive Alone	Carpool Driver	Carpool Passngr	Hired Car *(taxi/Uber)*	Carshare *(rental)*	Bus	Metro (rail)	Train	**Walk Only**	**Bike Only**	**Rec. Trip***	**Deliv-ery**	**Asked; Declined to Answer**	**Lot/ Garage**	**On Street**	**Other**
:00 to **:15**	Residential	Inbound																	
		Outbound																	
	Retail	Inbound																	
		Outbound																	
:15 to **:30**	Residential	Inbound																	
		Outbound																	
	Retail	Inbound																	
		Outbound																	

**Recreational trip – trip origin is same as destination (e.g. dog walker, smoker, jogger, etc…)*

NOTE: second half of hour on rear of sheet!

In case of emergency, call 911.

In the event of issues during data collection, please call team coordinator______________________________ at (_____) _______-_______.

form revised April 15, 2015

FIGURE 2 Garage count form.

MULTI MODAL **TRIP** **GEN**ERATION STUDY

Building ID: ______________________________ **Date**: ____ / ____ / 2015 **Hour**: *(circle one)* 7am-8am 4pm-5pm

Address: ______________________________ Tue Wed Thu 8am-9am 5pm-6pm

Door(s): ______________________________ **Counter**: ______________ 9am-10am 6pm-7pm

Time *after hour*	**Land Use**	**In or Out** *of Building*	**Raw Count** *all persons crossing building threshold*	**Travel Mode** *only count those responding to survey, do not make assumptions based on observations*													**IF AUTO:** Where Parked?		
				Auto					**Transit**										
				Drive Alone	Carpool Driver	Carpool Passngr	Hired Car *(taxi/Uber)*	Carshare *(rental)*	Bus	Metro (rail)	Train	**Walk Only**	**Bike Only**	**Rec. Trip***	**Deliv-ery**	**Asked; Declined to Answer**	**Lot/ Garage**	**On Street**	**Other**
:30 to **:45**	Residential	Inbound																	
		Outbound																	
	Retail	Inbound																	
		Outbound																	
:45 to **:00**	Residential	Inbound																	
		Outbound																	
	Retail	Inbound																	
		Outbound																	

**Recreational trip – trip origin is same as destination (e.g. dog walker, smoker, jogger, etc…)*

NOTE: first half of hour on front of sheet!

In case of emergency, call 911.

In the event of issues during data collection, please call team coordinator ______________________________ at (_____) _______-_______.

form revised April 15, 2015

FIGURE 3 Count-only form.

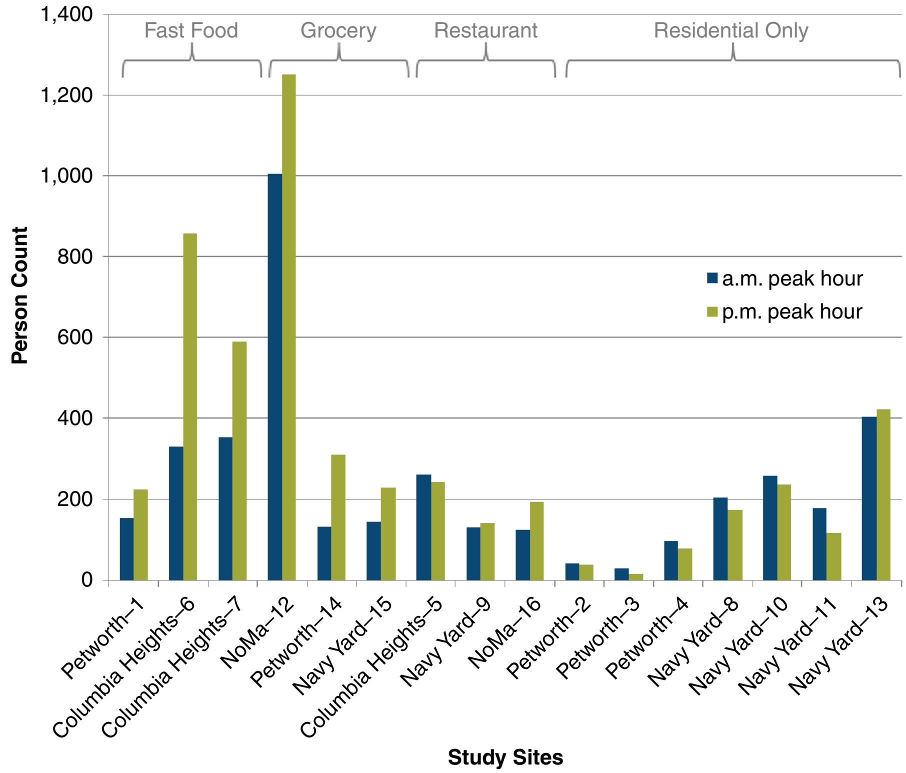

FIGURE 4 Peak hour person counts by site.

Figure 4 shows peak hour person counts by site, clustered by land use mixes. Counts are generally higher in the evening peak than in the morning, except at the sites that are exclusively residential. Figures 5 and 6 compare mode share by site and reflect similar morning and evening patterns. When looking at these results, one should realize that the sample is small and, far from being a statistical sample, was deliberately stratified to encompass a variety of use and data collection contexts. Generalizations of the data with the goal of statistical inference are not warranted.

Perhaps not surprisingly, walking proved to be the dominant mode of travel, with a median value for the afternoon peak of 41% and a maximum of 67%, as Figure 7 shows; private vehicle followed with

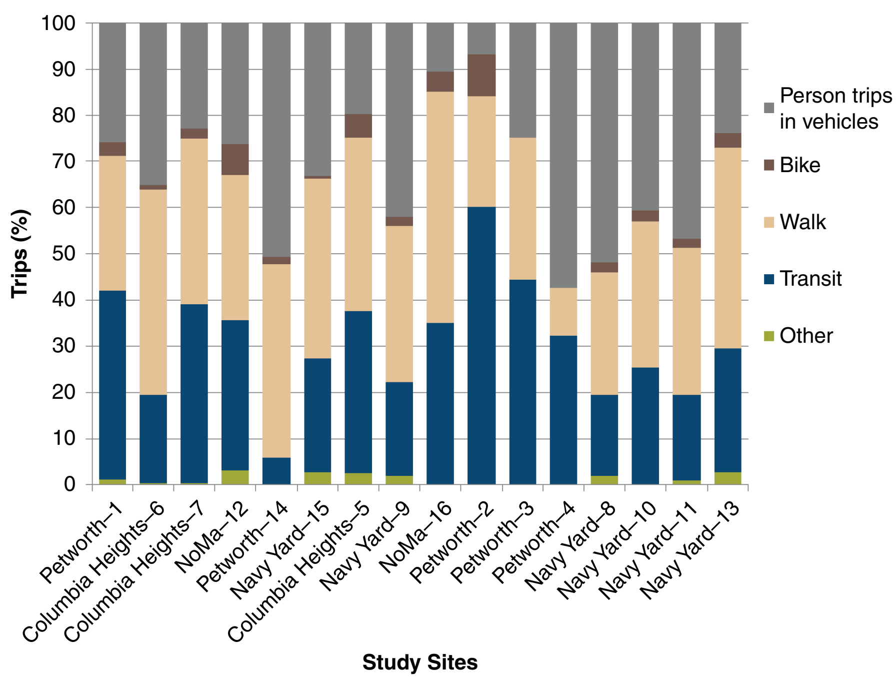

FIGURE 5 District DOT pilot counts, morning-peak mode share.

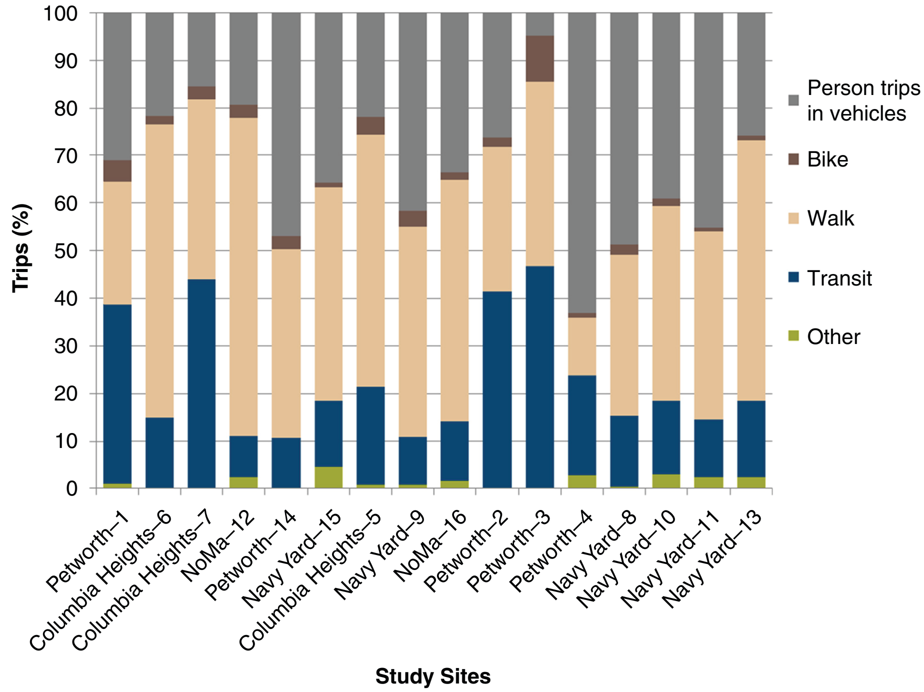

FIGURE 6 District DOT pilot counts, afternoon-peak mode share.

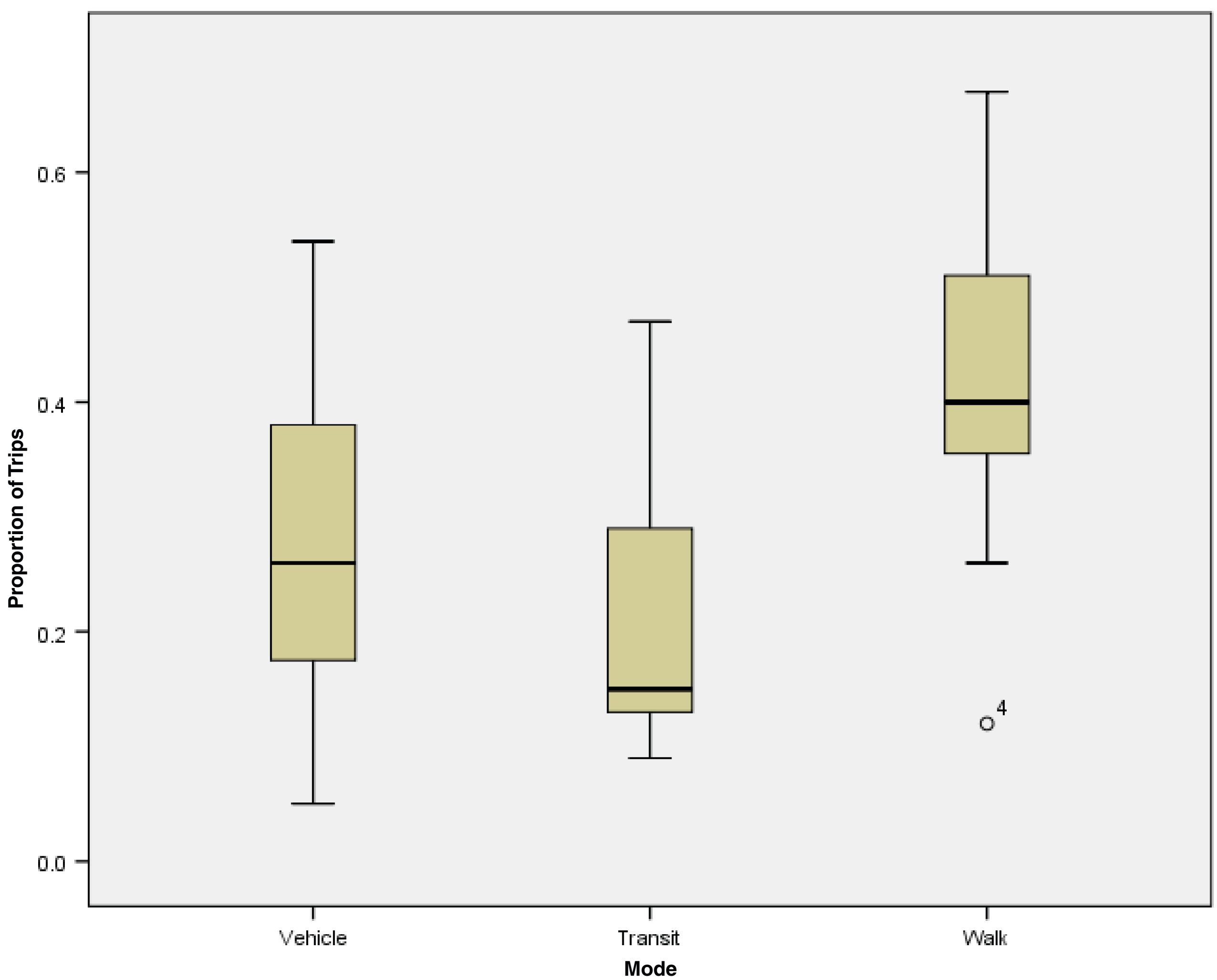

FIGURE 7 Box plot of estimated District DOT mode share (afternoon).

a median of 23% and maximum of 54%. Transit was very close with a maximum of 47% but a lower median of only 15%. The very compressed lower end of the transit boxplot indicates that transit usage at about half the sites is in a small range (between 11% and 16%), but the upper portion shows much greater variation, with transit shares ranging from 21% to 47%.

The results of the pilot data collection were compared with the data in the ITE *Trip Generation Manual.* Overall, ITE overpredicts vehicle trips and underpredicts person trips (if one assumes an occupancy of 1.13 persons per vehicle on the basis of national journey-to-work data). Both these findings are consistent with the authors' expectations, given the multimodal options available, the range of trips captured, and the different trip-chaining behavior of urban residents (generally more frequent, shorter trips to nearby destinations than would be seen in suburbs). These relationships are illustrated in Figure 8, which shows ITE vehicle trip predictions and estimated person trips compared with the data collected for this effort, with the diagonal line delineating a perfect correspondence. Points above the line show where the District DOT estimated more trips than ITE and vice versa for points below the line. The person trips (circles) are generally above the line and vehicle trips (triangles) are almost all below the line.

The results were also compared with several existing models for estimating trips from sites, all of which pivot from ITE data. These models predict slightly better than ITE, but all do so by applying reductions to baseline ITE predictions. Because no theoretically compelling argument suggests that single-use, suburban data would systematically translate to multiuse urban contexts, the finding underscores the importance of developing better tools to predict vehicle trips as well as trips by other modes. Furthermore, to plan trip impacts in urban environments adequately, trip generation must go beyond auto trips to include impacts on a broad set of travel modes.

This effort confirmed that existing models, even if functionally and theoretically reasonable, are not estimated on a sufficient data set to make them useful for the task at hand. A large part of that problem is the result of a paucity of data. These models are built on limited travel survey data or even more limited site-specific data, while the 9th edition of ITE's *Trip Generation Manual,* released in 2013, contains site-specific data from more than 5,500 sites. Thus, the model comparisons are ultimately a call to collect information of national scope and develop a comparable data set that can be used to model urban contexts.

CONCLUSIONS AND FUTURE EFFORTS

The District DOT's ultimate vision for this project is to develop a robust database of urban, multimodal trip generation data from a variety of land uses and to produce statistically valid models capable of more accurately predicting travel impacts. As documented in the literature review, the District DOT is not the first to see this need, but this methodology is proposed as a streamlined, practitioner-oriented approach to continue to move the effort forward. To get to the eventual models, the District DOT envisions the following interim steps:

1. Local data collection. Collect additional data from a wide range of land uses throughout the District of Columbia. Additional data can be collected by integrating trip generation requirements into comprehensive transportation reviews as part of the District DOT's development review process, by integrating collection of trip generation data into performance monitoring reports and by using local sources to fund data collection by the District DOT. This process includes building the underlying database architecture needed for collecting and storing data.
2. National effort. Build a coalition of peer cities and jurisdictions to contribute data to a centralized database. Collection of trip generation data is costly and time consuming; however, the burden can be shared across multiple partners, and data can be aggregated for mutual benefit. Broadening the base may require modifications to the methodology proposed here so as to ensure that the methodology functions in other contexts or to allow additional questions to be added to the surveys in response to local data collection needs. As an example, San Francisco has already begun data collection by using a modified draft version of the District DOT's methodology with additional questions about parking availability in response to local regulatory needs.
3. Comparable site procedures. Until models can be developed (pending adequate data and model development), determine a process for using data as comparable sites.

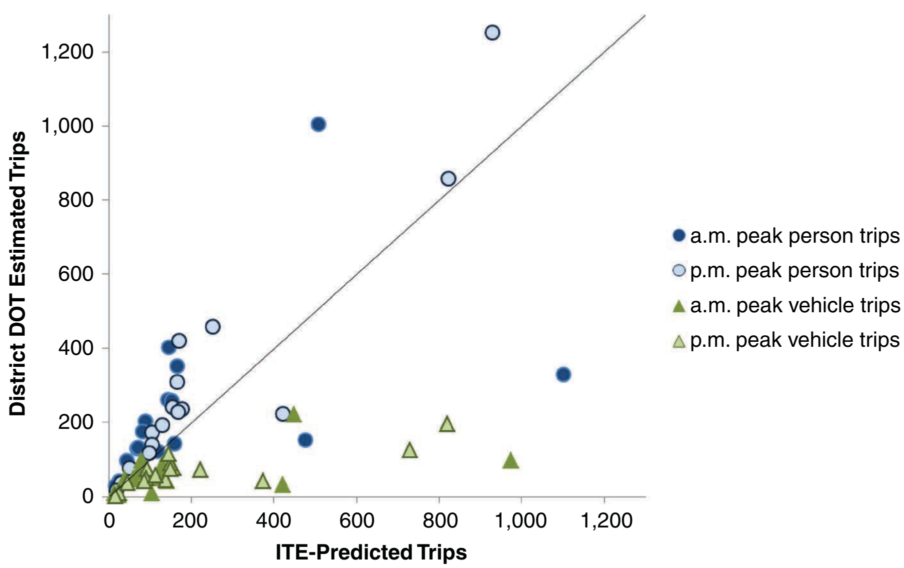

FIGURE 8 District DOT person counts and estimated vehicle trips versus ITE-predicted trips.

4. Model development. As the database reaches critical mass, models that predict expected trip generation rates for various land use types can be developed.

5. Ongoing data validation and integrity. Perform periodic data validation tests to ensure that the models are accurately reflecting observed travel behavior. This step may require refinement of the context variables to be collected along with site-specific travel behavior information. In addition, data will need to be continually collected to ensure that the database remains fresh and reflects current travel behavior. Potential emerging data sets such as cell phone data may be used.

The work reported here represents an important first step in closing the identified gap between existing trip generation tools and the reality of travel behavior in urban, multimodal contexts. The District DOT is committed to continuing this effort until a robust and uniform data set has been developed that will provide the basis for developing new tools to estimate better the transportation impacts of new urban or in-fill development.

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