Evaluating Two Low-Cost Methods of Collecting Truck Generation Data Using Grocery Stores

INFORMATION ON THE RATES OF TRUCK TRIPS GENERATED BY DIFFERENT LAND USES IS UNCOMMON BUT NECESSARY FOR FREIGHT PLANNING AND MODELING ACTIVITIES. THIS RESEARCH EVALUATED TWO RELATIVELY LOW-COST METHODS OF COLLECTING TRIP GENERATION DATA USING GROCERY STORES IN THE GREATER SEATTLE, WA, USA AREA.

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INTRODUCTION

Trucks dominate freight transportation in the United States, carrying the majority of freight by weight and value.[1] One important tool for understanding and analyzing truck activity is trip generation information, which quantifies the number of vehicle trips that are produced by specific types of land uses or businesses. Accurate truck trip rates are necessary to make informed decisions that address not only efficient freight movements but also traffic, land-use, and environmental decisions, and they are a critical input into freight models. In comparison with passenger trip generation tools, which are used in many jurisdictions, truck trip generation has received far less attention. A National Cooperative Highway Research Program (NCHRP) report on trip generation summarized truck generation data in the United States, concluding that "the current state of the practice in truck trip-generation data falls short of the needs of today's transportation engineers and transportation planners."[2]

This study had two purposes. One was to evaluate and compare, as part of this effort, two easy-to-implement methods of collecting truck trip generation data. The other was to collect usable Institute of Transportation Engineers (ITE)-styled data for a common generator of truck trips. We selected conventional grocery stores because they are a ubiquitous feature of our urban landscape.

DATA COLLECTION METHODS

Current truck trip rates used by transportation professionals typically rely upon survey-based rate tables from sources such as the ITE *Trip Generation Manual*[3] or from numbers developed by local jurisdictions. Since truck data collection is underfunded and sometimes complicated to implement, the truck trip rates for many land uses are unavailable (especially compared with passenger car generation data), or it is based on only a few studies.

A handful of methods exists for collecting truck trip data. Fischer and Han's comprehensive study of truck trip generation focused on surveys and outlined three overall approaches—vehicle classification counts, roadside intercept surveys, and travel diaries.[2] Of these methods, roadside intercept surveys (using observers) were indentified as the most effective method of classifying trucks.

Jessup, Casavant, and Lawson profiled four travel diary surveys to collect truck data—the telephone interview, mail-out/mail-back survey, combined telephone and mail-out/mail-back survey, and roadside intercept/personal interview.[4] While their study looked at urban freight data in general, their efforts to detail the advantages and disadvantages of four common freight data-collection survey methods helped to develop data-collection methods used in this study. Their work found that the most common data-collection method has been to mail surveys to shippers and truck owners. Mail surveys are easy to implement and low in cost but tend to have low response rates. In comparison, telephone surveys can achieve slightly higher response rates, but they pose the challenge of identifying and reaching the most relevant respondents. Roadside interviews were noted as being easy to implement, but they also have a high labor requirement. The authors determined that the combined telephone and mail-out-survey method produced higher response rates than mail-only surveys.

STUDY APPROACH

The work of both Fischer and Han[2] and Jessup et al.[4] suggested the importance

of using multiple data-collection methods to enhance the data's validity. As a result, we selected two data-collection methods and applied them to the same locations. We initially selected phone interviews, because this approach represented the least resource-intensive method of trip generation data collection. In addition, we could easily find grocery store telephone number contacts using available databases. We also selected manual counts because this method would serve as validation for the telephone interview findings and because this approach could provide more detailed information on truck rates and types.

The guiding idea behind this effort was that once a suitable approach was developed for collecting truck trip-rate data for one specific land use, the methods could potentially be applied to other common regional land uses, contributing toward more accurate truck trip rates for use in a planned regional freight model. Given the large number of potential truck trip generators that could provide usable input for a modeling process, developing an accurate but manageable data collection approach was of interest.

Grocery stores were selected for this study because of their ubiquity and due to regional interest in truck travel generated by this land use. According the U.S. Department of Labor, the grocery industry is made up of two major sectors: supermarkets and convenience stores.[5] Within the supermarket classification are several subsets of grocery stores, but this study focused on what the Food Marketing Institute labels conventional supermarkets, which are full-line, self-service stores that have more than $2 million in annual sales.[6] There are an estimated 59,000 of these stores nationally.[5]

A database of all grocery stores in the central Puget Sound region was developed by compiling information from the four counties' (King, Kitsap, Pierce, and Snohomish) health departments. The eight grocery stores selected for this study were spread across the Puget Sound metropolitan area (Figure 1), and they were all adjacent to major arterials and of roughly similar square footage (23,000 to 53,500 square feet). With the exception of the regional Puget Sound Consumer Cooperative (PCC), which did not have a warehouse, all the other stores were part of national grocery chains, and each was partially supplied by company trucks that operate from regional distribution centers.

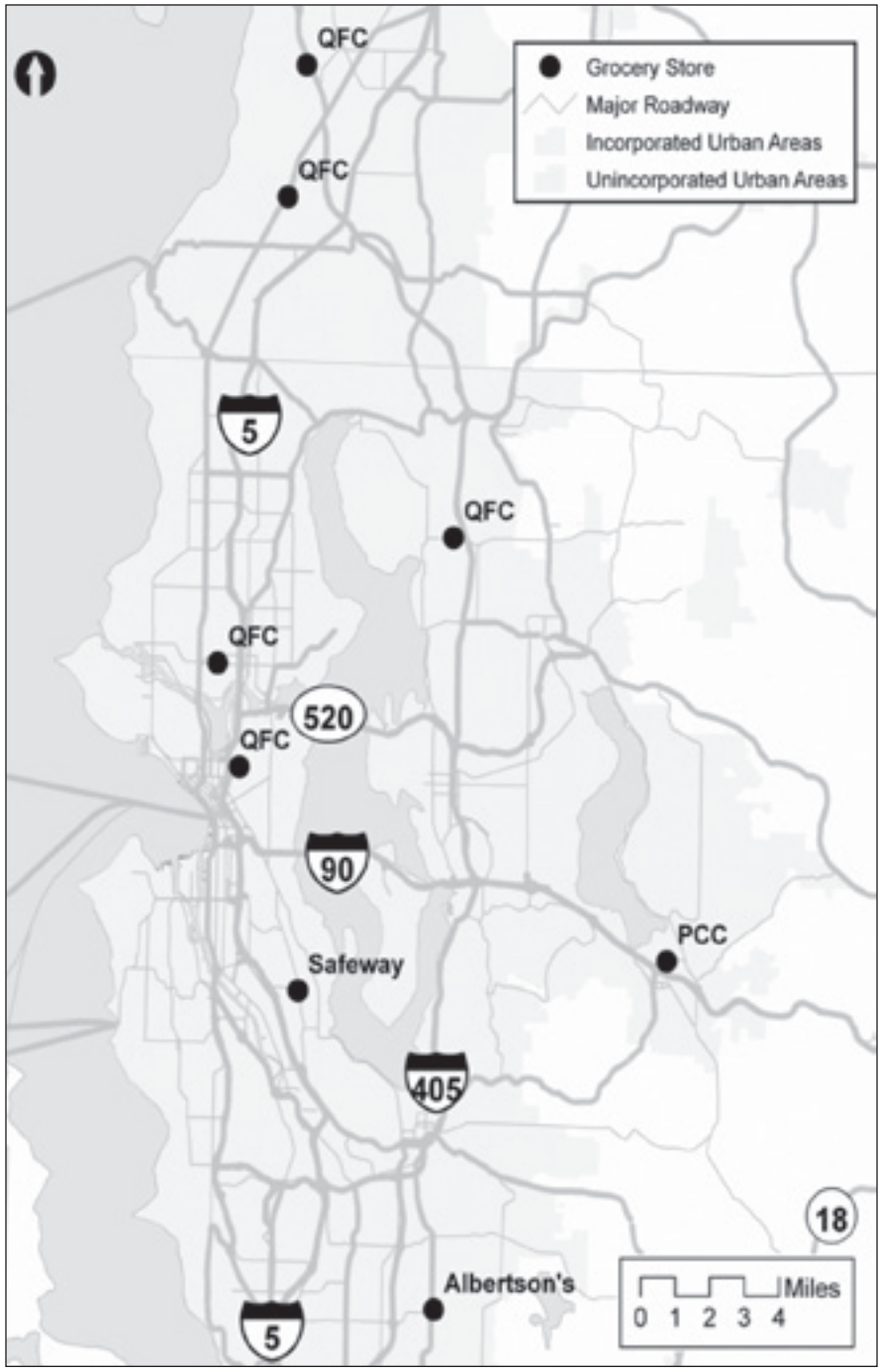

Figure 1. Geographic extent of the interview process.

DATA COLLECTION

Synthesis Report 298 on trip generation[2] guided the phone interview design process for this effort. The interview questions were chosen to be as efficient as possible. They focused on the information related to truck trip generation counts and delivery patterns, including the following:

- Typical hours of deliveries;
- Number of daily truck trips during the busiest days of the week;
- Any noise restrictions affecting delivery schedules;
- Average number of truck deliveries per day; and
- Whether there were specific days for particular products.

Table 1. Store characteristics and phone interview results.

Store and Location	Square Footage	Employees	Delivery Hours	Delivery Days	Peak Periods	Estimated Daily Number of Trucks	Loading Docks
QFC Wallingford	23,000	80	7 am to 12 pm	Mon to Sat	No Peak	10	1
QFC Kirkland	28,000	70	5 am to 11 am	Mon to Sat	Holidays, Mon; Fri	8 to 10	1
QFC Mukilteo	37,000	70	5 am to 11 am	Mon to Sat	Holidays, Mon, Wed; Fri	10	3
QFC Capitol Hill	46,984	100	5 am to 11 am	Mon to Sat	Holidays, Tue, Fri	8 to 10	1
QFC Lynnwood	53,500	72	5 am to 10 pm	Mon to Sat	Holidays, Mon, Wed, Fri	15 to 20	1
Safeway Othello	26,092	*	*	Mon to Sat	*	*	1
Albertsons Kent	46,000	60	5:30 am to 10:30 am	Mon to Sat	Holidays	15	2
PCC Issaquah	23,000	90–95	6 am to 2 pm	All days	Holidays, Tue, Fri	10 to 15	1

* Information not provided.

The questions on the interview form were revised on the basis of input from external reviewers from the Institute of Transportation Engineers (ITE).

Using a grocery store telephone database from the various health departments, an effort was made to identify and interview the individuals (typically store managers) who had knowledge of deliveries to the store. After a number of attempts to set up interviews, it became clear that the best time to conduct the interviews was generally between 9:30 a.m. and 11:00 a.m., after the morning rush of activity. The interviewing process quickly revealed that grocery store managers were reluctant to accept interviews any longer than five or 10 minutes; they were often busy handling multiple issues in the store. Each interview required several call backs and about one hour of project staff time per store.

An important discovery was that interview conversations provided sometimes unanticipated but valuable information that was relevant to understanding grocery store operation and truck trip generation rates. For example, questions about loading locations and truck sizes indicated that grocery stores are replenished by two types of truck-based systems, which directly affect generation rates—direct store delivery (DSD) and regional distribution centers. Additional research revealed that many stores, especially larger national chain stores, used their own chain's regional distribution centers. Most stores also depend on a DSD system by which retailers provide their products directly to grocery stores.[7, 8] Although both methods generate truck trips, the DSDs tend to be in smaller trucks (often with bread, snack foods, beer, and so forth) that operate through a store's front door (and frequently place the products directly on the store's shelves), whereas trucks from distribution centers tend to be larger and use side or back door loading docks. A Grocery Manufacturers Association national survey of grocery stores found that 66 percent of volume arrived by DSD and 34 percent from regional warehouses.[9] The same study observed a sample of stores and concluded that a grocery store with more than $2 million in annual revenue received an average of 11,700 DSDs per store per year, which indicated the relevance of this type of truck activity to the grocery business.[9] The number of DSD trips is expected to increase, suggesting that future grocery deliveries will involve more and smaller trucks.[10]

The phone interview process also indicated that grocery store truck deliveries are concentrated into time windows determined by efficiency for the grocery stores, truck operators, neighborhood noise curfews, and store staffing. The hours of delivery generally lasted from early morning to the afternoon, roughly from 5:00 a.m. to noon. All but one of the grocery stores accepted deliveries during this window six days of the week. The interview conversation also found that holidays typically produce peak days and hours but that higher volumes were reported to be delivered by the same number of trucks, which indicates that typical deliveries are less than a truckload. Further, it suggests that regardless of volume, grocery stores generate a certain number of daily or weekly truck trips.

The results from the phone interviews are shown in Table 1. Based on the telephone interview results alone, it was estimated that each store generated 12 truck trips per day.

MANUAL TRUCK COUNTS

This next step in the process was to conduct manual, on-site truck counts using observers. Data from manual counts tested the accuracy of the daily truck deliveries provided by grocery store telephone interview respondents. An observer form was developed that collected information on the following:

- The arrival and departure times of each truck;
- The size of the truck, (using the FHWA's 13-Bin Classifications);
- The company name on the truck; and
- Whether the truck unloaded anything.

The manual counts were conducted by experienced vehicle counters who received a short training session about counts specific to grocery stores. The best counting locations for capturing all truck arrivals for each grocery store site were initially determined by using Google Earth and Google Street, but as the observers gained more experience they were allowed to select the best location. In each case, the grocery store contact from the initial telephone interviews was called and informed that observers would be outside the store. Technically, this was not required, but this

Table 2. Manual count results.

	Manual Count One				Manual Count Two			
	Total Trucks	Front Door/ Loading Dock	Heavy Trucks (3+ axles)	Count Time/Month	Total Trucks	Front Door/ Loading Dock	Heavy Trucks (3+ axles)	Count Time
QFC, Wallingford	25	8/17	3	7 am to 2 pm (Mon, Aug)	16	0/16	6	7 am to 2 pm (Fri, Oct)
QFC, Kirkland	15	0/15	2	5 am to 11 am (Thurs, Nov.)	19	1/18	4	5 am to 11 am (Weds, Dec)
QFC, Mukilteo	18	8/10	6	5:00 to 11:00 am (Thurs, Oct)	17	16/1	0	5 am to 11 am (Weds, Oct)
QFC, Capitol Hill	14	14/0	6	5:00 am to 11 am (Fri, Nov)	18	18/0	3	5 am to 11 am (Weds, Nov)
QFC, Lynnwood	13	7/9	2	6 am to 12:00 pm (Thurs, Nov.)	*	*	*	
Safeway, Othello	15	5/10	2	6 am to 11 am (Weds, Nov)	15	8/9	4	6 am to 11 am (Thurs, Dec)
Albertson's, Kent	11	7/4	1	6 am to 11 am (Thurs, Dec)	15	0/15	6	6 am to 11 am (Fri, Nov)
PCC, Issaquah	23	16/7	3	6 am to 2:30 pm (Mon, Aug)	30	18/12	4	6 am to 2 pm (Thurs, Nov)

* Data was not collected

step was considered important to avoid any possible problems.

Sets of two (and up to four for large stores) counters were deployed to each site depending on the layout of the store, the shape of the parking lot, and the loading docks. For example, two counters typically covered a grocery store site with one loading dock because deliveries are often made at both the loading dock and through the front door. This arrangement also allowed for coverage during break periods.

The count times were selected on the basis of the delivery windows the store operators had indentified during the phone interviews. The assignments took into account the busiest day of the week to supplement the information gained through the interviews. The observers were also asked to count cars, since their workload allowed this and this information could be of value for other studies. Each count per store required 10 to 20 person hours. With the exception of one store, two sets of observation data were collected for each store. A summary of the manual count is shown in Table 2.

The data from the manual count observations indicate that between 14 and 30 trucks arrived (with an average of 18 trucks arriving) per store. This number is perhaps low given that the phone interviews indicated that some stores will accept a few deliveries outside of the given delivery windows. This is particularly true for the DSD deliveries.

The manual counts allowed for the recording of the length of delivery times, which varied greatly. The mean delivery time was roughly 27 minutes for each truck, with a minimum of 6 minutes and maximum of 73 minutes for all observed deliveries. Because the phone interviews indicated a difference between DSD and warehouse deliveries, truck class and location were examined. As expected, front door deliveries were generally made by the smaller, two-axle trucks, whereas both two-axle and three-plus-axle trucks delivered to loading docks.

CONCLUSIONS

This effort evaluated two methods of developing establishment-level truck trip-generation rates by using grocery stores as a case study. While more costly, the combination of telephone interview and manual counts was more effective than telephone interviews alone. Based on a $12-an-hour labor rate, the per-store cost to develop truck delivery rates was around $160 per store. (This included one hour to set up and conduct the phone interview plus six hours of counts by two observers.)

Phone interviews, while sometimes difficult to arrange, were relatively low cost and allowed direct communication with a receiver or general manager. Particularly when conducted by a skilled interviewer, the conversation with a grocery store manager proved to be a valuable step in data collection. In addition to providing each store's time window for deliveries, the interviews provided background information about each store's size, number of employees, and general information about delivery time and days—information that would be difficult, if not impossible, to obtain by other means. Information from the telephone interviews guided the manual on-site counts and provided a baseline measure-

ment of counts as well as other additional information that assisted in understanding the truck trip generation information. However, the telephone interviews reported five to 10 fewer trucks trips per day than were recorded by the manual observations. It was suspected that the undercount might be partially related to DSD deliveries since many DSD drivers directly arrive through the front door and often stock the shelves themselves without involving store employees. Their presence requires little involvement by employees in terms of unlocking back doors and unloading trucks and is thus less likely to be counted.

In comparison with the telephone interviews, the manual counts required more personnel time, including travel to the study sites and time involved in training, and thus they were more expensive.

The manual observations provided not only usable quantitative data but also descriptive information about delivery location, truck sizes and types, type of delivery company (from the information on the trucks), and unloading time. This data would be useful for both trip generation rates and understanding traffic impacts.

Based on the manual observations, the grocery stores in our study generated an average of 18 truck trips per day on a typical peak weekday. This number is based on multiple manual counts at eight grocery stores. The counts were during the peak morning delivery windows identified by the store managers during telephone interviews. These daily counts are probably low, as some of the stores accepted late deliveries outside of the receiving windows. ■

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