Truck Parking and Traffic on I-5 in California: Analysis of a Clipboard Survey and Annual Average Daily Traffic Data

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ABSTRACT

Truck parking is a major problem on I-5 in California as truck drivers regularly encounter parking that is at or near capacity, particularly when searching for overnight parking. This creates safety hazards for truck drivers as well as the traveling public. This study reports on the results of a clipboard survey of truck drivers (N = 85) on I-5 in California in Spring 2012. The survey focused on understanding the challenges faced by long haul truck drivers parking in the region and to evaluate the degree to which ITS applications in truck parking, such as real-time parking availability information, would be useful. The survey found that more than 70% of respondents (n=61) indicated that they had encountered truck stops where they would have liked to park but could not because it was full. About 30% of truck drivers stated that they would keep driving under such circumstances. More 50% of truck drivers reported that they encountered truck stops too full to park on I-5 at least every other day, and they predominantly encounter full parking when looking to stop overnight. In addition to completing the survey, researchers developed an approach to illustrate truck traffic over a corridor using Average Annual Daily Traffic (AADT) data. This approach to displaying public information can be used to help understand where truck parking demand is likely highest, as well as to help quantify long-haul truck traffic over specific segments of a highway corridor.

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KEY WORDS: Goods movement, truck parking, truck driver survey, AADT data

INTRODUCTION

Finding safe, legal truck parking on the highways of the United States is major issue for the long-haul trucking industry. Long-haul truck drivers are subject to a number of operating constraints on a day-by-day basis. On the regulatory end, truck drivers are subject to Hours-of-Service (HOS) regulations issued by the Federal Motor Carrier Safety Administration (FMCSA). These regulations govern the hours that truck drivers can drive during a consecutive shift. Current regulations, which are a valid through at least July 1, 2013, mandate that truck drivers carrying freight are permitted to drive up to 11 hours following 10 consecutive hours off-duty.

While the rationale for mandating truck driver rest is well motivated and understood, the practicalities of truck drivers finding safe and legal locations to rest is a separate challenge. Along interstate highways, truck stops, and public rest areas comprise the majority of spaces publicly available for a truck driver to use. These locations are limited in number and in size, and they are also spaced along the highway at distant intervals. If a truck driver, approaching the HOS driving limit encounters a cluster of truck rest areas that are full, he or she is generally faced with the choice of driving some additional highway distance to the next available rest area or park illegally. Illegal parking can include any location not designed for long-term truck parking. This includes the side of the highway, under overpasses, on-ramps and off-ramps, service roads, shopping center parking lots, and other locations that are not designed or intended for truck parking. Illegal truck parking can pose hazards to others if it occurs on the roads or

within a populated area. In most climates, truck drivers idle their engines overnight to power amenities, producing diesel emissions in the surrounding area. Just as important, illegal truck parking poses a hazard to the truck driver. These include the natural traffic hazards of road-side parking, as well as the criminal hazards of parking in remote locations far from the company of others. The reality of this second hazard has been highlighted by the case giving rise to Jason's law, which was written in response to a 2009 murder of a truck driver during a robbery that took place at a vacant gas station. Jason's law sponsored four key objectives (*1*):

1) Constructing safe public truck parking facilities next to commercial truck stops and travel plazas;
2) Opening up the legal use of existing facilities, such as weigh stations and park-and-ride facilities for truck parking;
3) Constructing additional turnouts along the Interstate system; and
4) Improving public truck parking facilities that are open seasonally, so they can be open year round.

These objectives seek to expand public truck parking supply and availability to long-haul truck drivers. There is consensus within the industry that the supply of truck parking needs to expand, but truck drivers also face an informational problem. Truck drivers that plan to park at a specific location, often learn that it is full by arriving there. There is little in the way of any formal informational systems that regularly update the status of truck parking over time. The result is that truck drivers cannot plan their travel in consideration of where parking is already or expected to be unavailable.

"Smart truck parking" is a term that has often been applied to systems that can improve the quality and use of information on truck parking availability. Broadly defined, smart truck parking has included the use of sensors that monitor and report parking availability at truck stops, as well as allowing truck drivers to make reservations at selected locations that provide secure parking. Today, the truck parking industry has very limited information on real-time availability. Part of the problem is a technical, sensor-based challenge. Counting trucks accurately is challenging, and information accuracy has to be very good. Public rest areas along I-5 in California have as few as six and up to about 40 spaces. If a sensing system over counts one in every 100 trucks, counts will quickly become inaccurate without recalibration of the availability information.

This paper details selected research that has been conducted with truck drivers and truck traffic on the I-5 corridor in California. Much of the work has been focused on evaluating the transportation needs and parameters of the corridor as well as surveying truck drivers to understand their travel and parking needs. The results of this research demonstrate a continued need for an industry and government focus on the issue of long-haul truck parking and suggest that accurate parking availability information would be a useful asset to the industry. The authors begin with a literature review of previous work conducted on truck parking in the United States (U.S.) and Europe. We then introduce the methodology and data sources applied in evaluating truck traffic and parking needs. In the results, we discuss insights from the survey as related to parking. We then illustrate how publicly available truck traffic data can provide a high level but comprehensive view of traffic patterns on a highway. We conclude with a discussion of the data and its implications for truck parking.

LITERATURE REVIEW

Previous research has documented a lack of truck parking across the country *(2).* A 2000 study of truck drivers in Tennessee found that more than 40% of parked trucks stopped overnight on roadways *(3).* In 2002, a state-by-state survey determined that 12 states, including California, lacked sufficient truck parking *(4).* In this study, California was been reported to have among the most severe truck parking shortages in the U.S. *(4).* On the 34 highway corridors with the highest traffic volumes, demand exceeded capacity at all public areas and 88% of private rest stops *(5).* In 2005, a study in Connecticut estimated a need for about 1,400 more truck parking spaces. In Maryland, a 2005 statewide study and a 2006 Baltimore-area study found substantial amounts of illegal truck parking on highway ramps and shoulders, with three major Baltimore area rest stops all over capacity *(6,7).* Another study completed in 2008 found that 82% of truck parking facilities in northern New Jersey were over capacity *(5,8).* Also in 2008, a report on Minnesota truck parking found that 20 of 35 public rest areas had significant capacity issues, with five that were over capacity more than 50% of the time *(9).* The study also found that 70% of freight companies did not have a parking policy, and 98% did not provide assistance to drivers who are seeking parking, with many considering it the responsibility of the individual truck driver *(9).*

A 2008 study in Illinois found that the majority of drivers are able to find appropriate parking, and those who are unable usually choose to park on access ramps that are less busy (*11*). A 2009 study in Wisconsin found that ramp parking was the second-most frequently observed truck parking issue (the most frequently observed was “capacity issues”) (*12*). In both states, drivers who are unable to find parking tended to be unfamiliar with the local parking situation. Ramp parking was most severe near Milwaukee, WI and Chicago, IL, the largest cities in their respective states. Policy recommendations emerging from these studies have included the expansion of truck parking at public rest areas, public-private partnerships to operate rest stops, modified parking enforcement rules and better driver education, including the use of intelligent transportation system (ITS) deployments to broadcast parking locations and availability to drivers through mobile phones and radio frequencies *(4).*

Previous research has suggested that truck drivers generally prefer to take short breaks at public rest areas, and overnight rests at commercial truck stops (*13*, *14*). Several driver surveys have reported that truck parking is often inadequate, leading to fatigued driving and unsafe parking. Data suggests that trucks are disproportionately represented in fatal highway accidents. While trucks constituted only 4.3% of U.S. highway vehicles in 2009 (*15*), they accounted for 7.1% of all fatal accidents that year (*16*). A 2006 U.S. Department of Transportation (DOT) study found that fatigue was the sixth largest driver-related factor in truck crashes, involving 13% of all truck crashes (*17*). Over 90% of respondents in a 2002 Virginia survey thought I-81 did not have sufficient truck parking spaces at night (*18*). A 2002 nationwide survey found that less than one-third of truck drivers could at least “frequently” locate parking at commercial stops (*13*). The top two reasons drivers parked on highway ramps and shoulders were both related to a lack of nearby commercial parking, indicating that most drivers would rather not park in those locations if they had the choice (*13*). Drivers also found it difficult to pre-plan their rest schedules due to frequent unexpected delays at shipper and receiver locations (*13*). At a 1999 forum on truck rest stops sponsored by the Federal Highway Administration (FHWA), truck drivers and driver associations consistently reported that it was often difficult to find parking at night (*19*).

To address these issues, previous research has sought to apply remote sensing as a means of monitoring truck parking availability in the U.S., as early as 2000 (*20*). ITS helps resolve the

truck parking shortage by collecting occupancy data and providing that information to drivers, so they are able to plan their breaks and locate parking in an efficient manner (*21*). Accuracy is highly important in truck-counting systems and has been a chronic problem. An Illinois pilot using inductive loops found that the observed error of approximately one vehicle per hour added up significantly over the course of several days and made the system unreliable (*21*).

In 2004, the Federal Motor Carrier Safety Administration (FMCSA) established the SmartPark program with a goal of providing real-time truck parking information by first implementing truck-counting technologies and then disseminating that to drivers and truck stop operators (*22*). As part of SmartPark, FMCSA conducted field tests of two technologies: video imaging and magnetometry (*23*). Video imaging had a high number of false positive detections, especially at night and in inclement weather, while magnetometers often could not accurately classify vehicles based on their size. Neither technology met the overall performance requirements (*24, 25*).

There have been several studies about the linkage between rest area locations and nighttime single-vehicle truck crashes. Both a 1999 Michigan study and a 2009 California study found that such crashes were significantly more likely to occur on highway segments that were 30 or more miles downstream of a rest area *(26, 27)*. A 2007 Minnesota study did not find such a correlation, although Minnesota rest areas were rarely more than 50 miles apart *(28)*. However, there was a positive correlation between the demand for parking at any one rest area, and the number of such crashes downstream from it.

Truck parking issues are not confined to the U.S. The European Union (E.U.) imposes strict driving time limits on truck drivers, but there is often insufficient parking at rest stops *(29, 30)*. There is also increasing concern about freight crime *(31)*. European countries also have been experimenting with the use of ITS to enhance truck parking availability information. The E.U.'s Secure European Truck Parking Operation Services (SETPOS) initiative, which ran from 2007 to 2009, established a standard for secure truck parking and developed an online information and reservations portal for both public and private rest stops *(35)*. SEPTOS was replaced by the LABEL initiative, which established a certification system for the security level of truck stops *(31)*. EasyWay was established in 2007 and deployed ITS to provide both static and dynamic information on truck parking availability through variable message signs, websites, and smart phone applications *(32)*.

METHODOLOGY

This study presents the results of a clipboard survey that was provided to truck drivers to evaluate their needs in the context of the truck parking on the I-5 corridor in California. Researchers conducted a clipboard survey in Spring 2012, which was administered at a private truck stop on I-5 in Lodi, California. The surveys asked a random sample of truck drivers (n=85) at truck stops questions about their travel patterns along the I-5 corridor, their parking needs, as well as the perceived utility that truck parking availability information would have for them. Truck drivers were given the option to self-administer the survey on a paper and clipboard or to respond to questions through an interview. Responses were analyzed to provide context for the travel needs and circumstances of truck drivers along I-5, as well as to evaluate their perceived utility to the provision of real-time parking availability and the capability of making parking reservations.

In addition, to evaluate the distribution of truck traffic on the I-5 corridor, researchers developed an approach using annual truck traffic data to determine where truck traffic is most

active along the corridor. The method is applied to two highways within California to illustrate the regional distribution of truck flows within key areas of the state.

Study Limitations

The survey data were collected over several days at a truck stop on I-5 near Lodi, California. The truck stop is very busy, rarely dropping below 50% parking occupancy, with considerable long-haul activity day and night. Nevertheless, the sample is not large or regionally distributed enough to be generalizable for the entire country or state. The results reflect the response of randomly selected truck drivers willing to take the survey during the afternoon and evening.

Results

The clipboard survey administered in 2012 was taken by 85 truck drivers. The sample was 95% male with an average of 17 years trucking and an average age of 48 years. To understand which communication mediums were common to truckers, respondents were asked to identify the communication devices that they carry with them in the truck. The distribution of responses indicated that the CB radio was still a dominant form of communication for truck drivers, but mobile and smart phones were also common. Collectively, 94% (n = 80) of respondents carried either a mobile or smart phone. Among all respondents, 53% (n = 45) carried a smart phone of some kind, while 48% (n = 41) carried a mobile phone, a small subsample carried both. Also relevant to trucking communications is their method of navigation. Global positioning satellite (or GPS), either portable or in-vehicle, played a role in 51% of the truck drivers surveyed (some had both). In addition, 29% had their routes determined by dispatcher instructions and over half, 51%, were also using their previous experience as a form of routing support. Figure 1 shows the distribution of response to both questions probing truck driver communications.

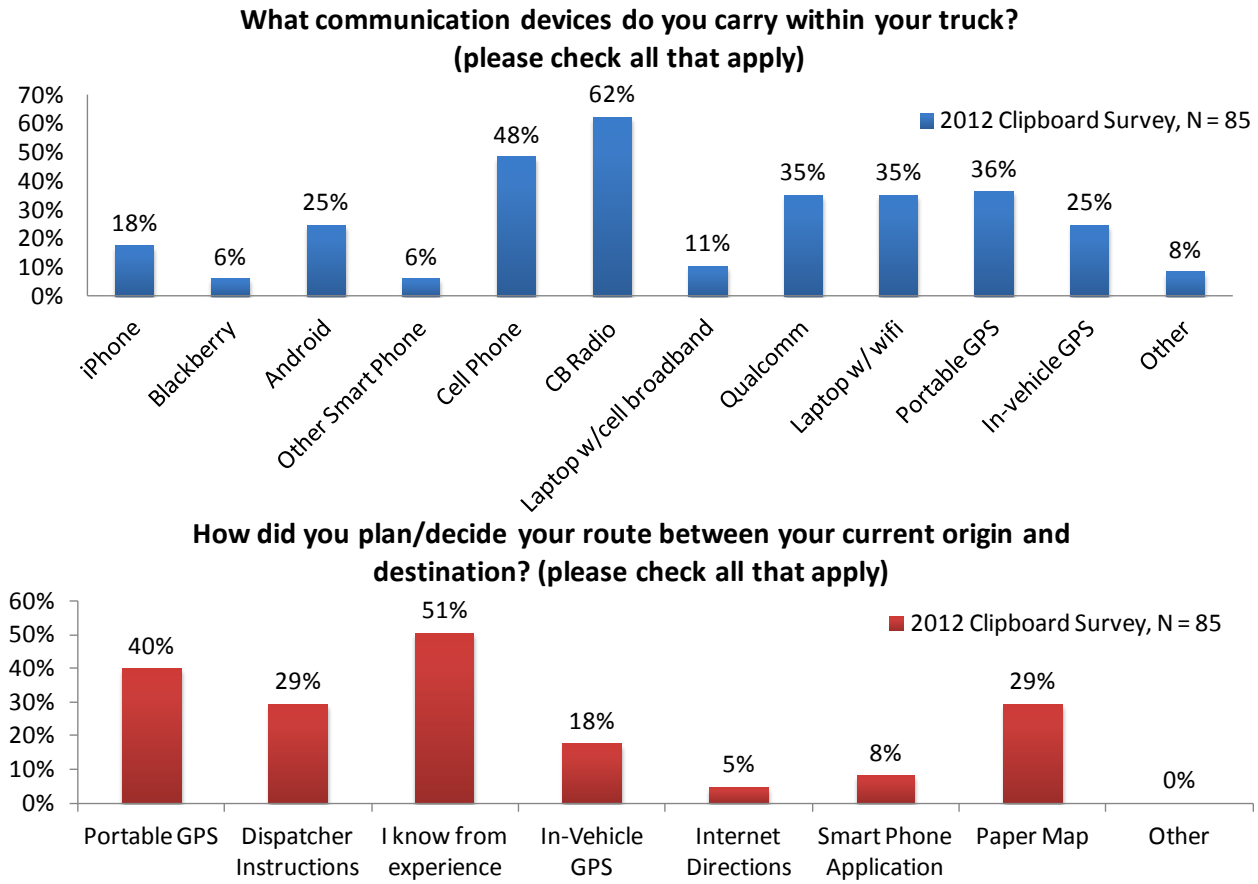

Figure 1 Equipment Used by Truck Drivers For Communication and Routing

Researchers asked a series of questions to probe the parking experiences of truck drivers. It should be noted that 95% (n = 81) of truck drivers surveyed indicated that they were long haul truck drivers in that they had spent the night in their truck the previous night or were planning to on the night surveyed. As part of their parking experience in this regard, respondents were asked if they had ever encountered parking that was too full to park. The question was asked in the context of the current trip as well as their previous trips on I-5. Several follow up questions asked the circumstances and frequency in which full parking was encountered. Figure 2 illustrates the distribution of response to this series of questions. The top graph shows that 55% of respondents had encountered parking too full to park at on their current trip on I-5, and that 78% had encountered similar constraints during previous experience on I-5 (nine and seven respondents skipped these questions, respectively). The middle graph follows up on those that stated "Yes" to this initial question to probe whether this occurred with overnight parking, daytime parking, or both. For those that had encountered full parking on this trip, the problem had overwhelmingly occurred when they were looking for critical overnight parking. In the context of previous trips, more respondents (31%, n = 19) said it had occurred for both overnight and daytime parking, reflecting the longer time context of the question. The majority (66%, n = 41), however, stated that their previous experiences with full parking on I-5 occurred when looking for overnight parking. Finally, the bottom graph of Figure 2 probed respondents on the frequency with which they encounter parking that is too full. The responses indicated by the dark bars were asked in

the context of all trips everywhere, while the light bars reflect responses in the context of I-5. The exact question asked is given within each graph of Figure 2.

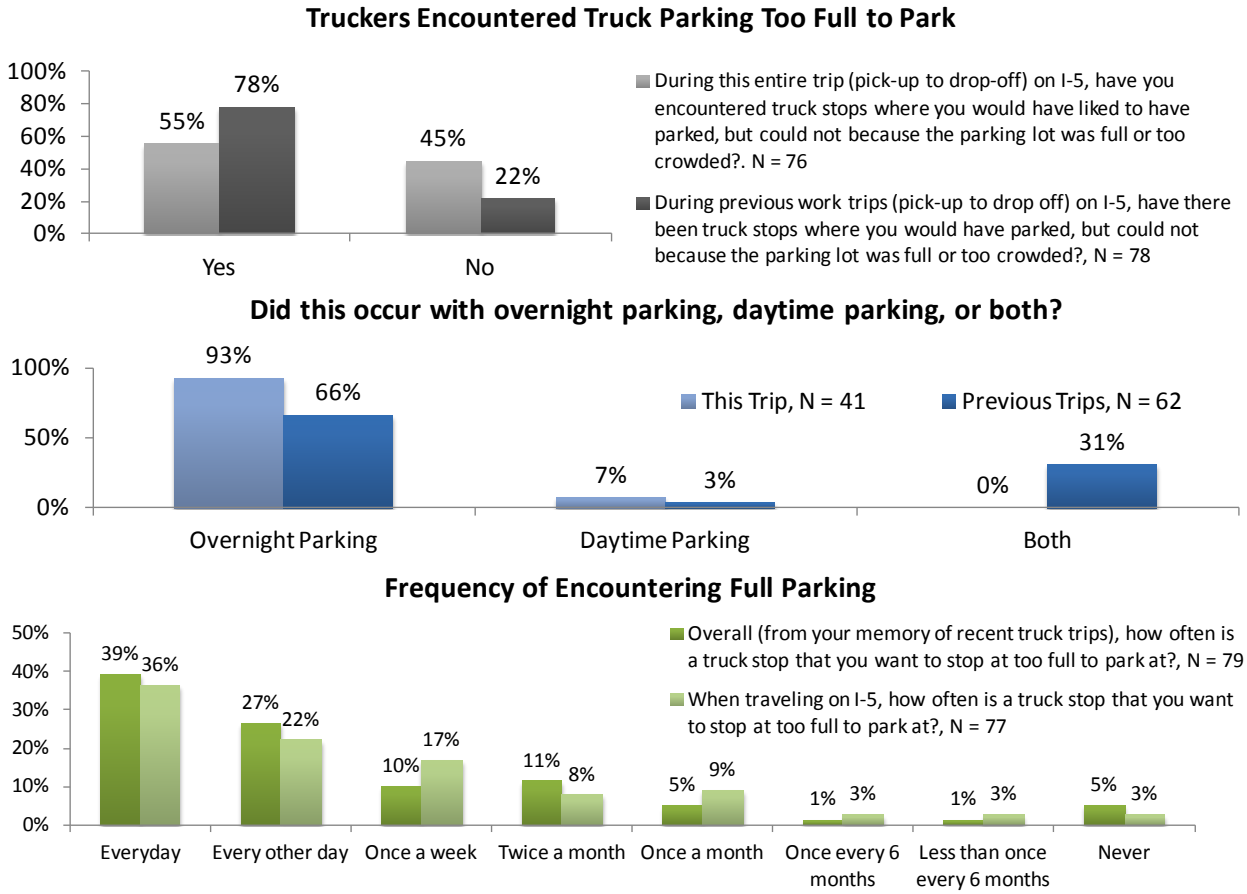

Figure 2 Truck Driver's Parking Experience

One of the objectives of the survey was to evaluate the utility of real-time parking availability information and parking reservation capabilities to truck drivers. These are among the most common ITS applications being developed for truck parking. The survey probed the perceived utility that truck drivers might obtain from such information by first describing the system briefly as follows:

> "For the following questions, imagine that there was a website that listed truck stops throughout your normal region of travel. This website provides real-time information on the availability of parking at truck stops within your region of travel and would allow you to make reservations for secure truck parking ahead of time. In addition, the website would give you information on services at the truck stop, such as food, showers, operational hours, etc."

This description was designed to be clear, simple, and succinct due to the need to keep the entire survey within three pages. Following this description, a series of ordinal scale questions were asked to evaluate whether such information would be useful to truck drivers. Figure 3 presents

the distribution of responses to questions that evaluate the utility of these applications to the truck driver and the perceived utility to industry as a whole.

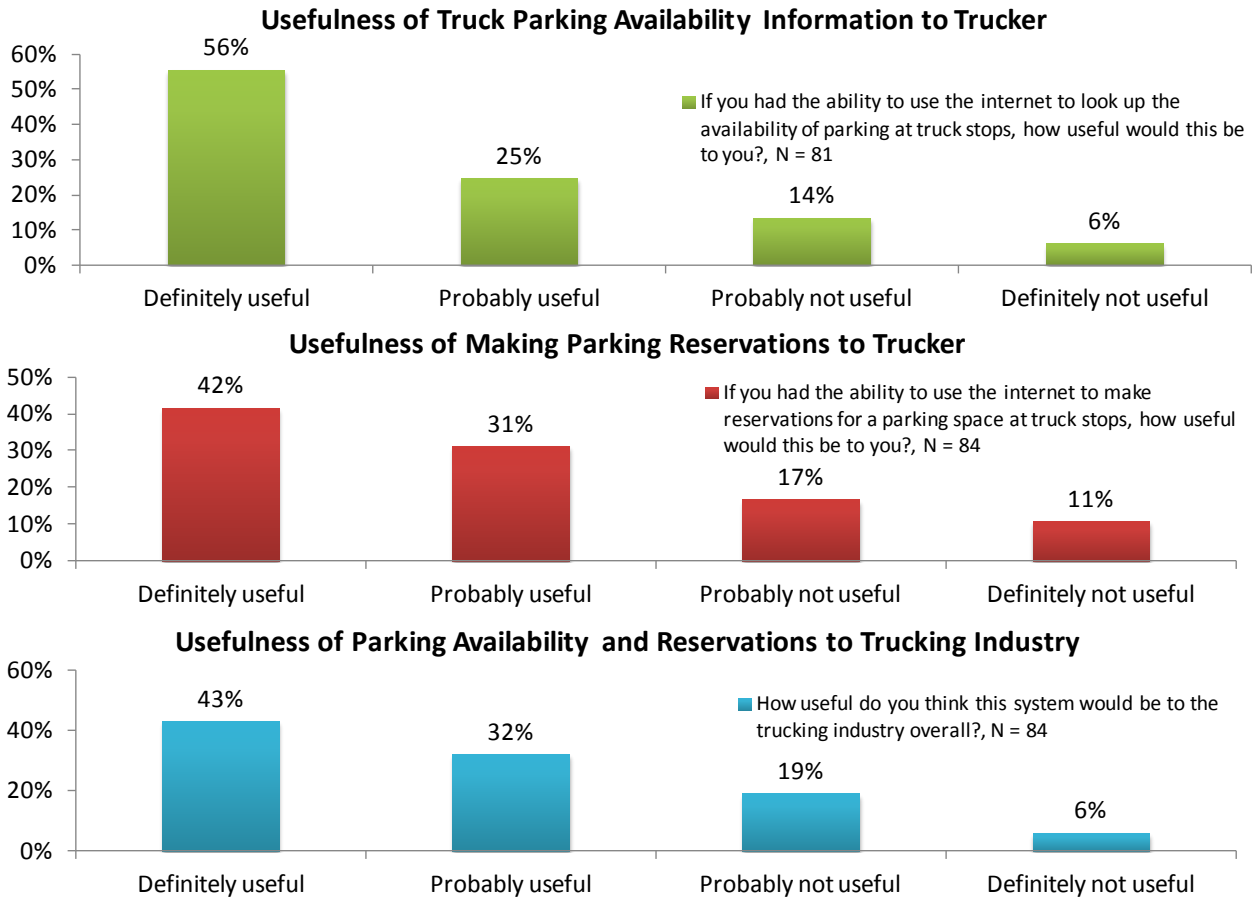

Figure 3 Utility of Real-time Parking Availability and Reservations to Truck Drivers

Figure 3 suggests that real-time parking availability information would be considered useful to the majority of truck drivers, as ~80% (n = 65) indicated that it would be probably or definitely useful. Reservations were also considered useful by 73% (n =61) of respondents, while 75% (n = 63) of respondents felt that such a system would be useful to the trucking industry overall.

The survey results strongly suggest that truck parking is still very much a problem on the I-5 corridor. The final questions attempted to ascertain the value that truck drivers might place on access to such real-time availability information. This question was motivated by a stated need to find a suitable business model to sustain the expansion and operation of ITS infrastructure. To provide some quantification of this value, respondents were asked:

> "What would **access to real-time truck parking availability information** be worth to you? At each price listed below, please indicate whether you would "Definitely," "Probably," "Maybe," "Probably Not," or "Definitely Not" subscribe to this service."

Figure 4 shows the structure of the question followed by the raw distribution of responses.

Subscription Price	Definitely Pay	Probably Pay	Maybe Pay	Probably Not Pay	Definitely Not Pay
$0 (free)	☐	☐	☐	☐	☐
$0.50 / month	☐	☐	☐	☐	☐
$1.00 / month	☐	☐	☐	☐	☐
$2.00 / month	☐	☐	☐	☐	☐
$3.00 / month	☐	☐	☐	☐	☐
$4.00 / month	☐	☐	☐	☐	☐
$5.00 / month	☐	☐	☐	☐	☐
$6.00 / month	☐	☐	☐	☐	☐
$7.00 / month	☐	☐	☐	☐	☐
$8.00 / month	☐	☐	☐	☐	☐

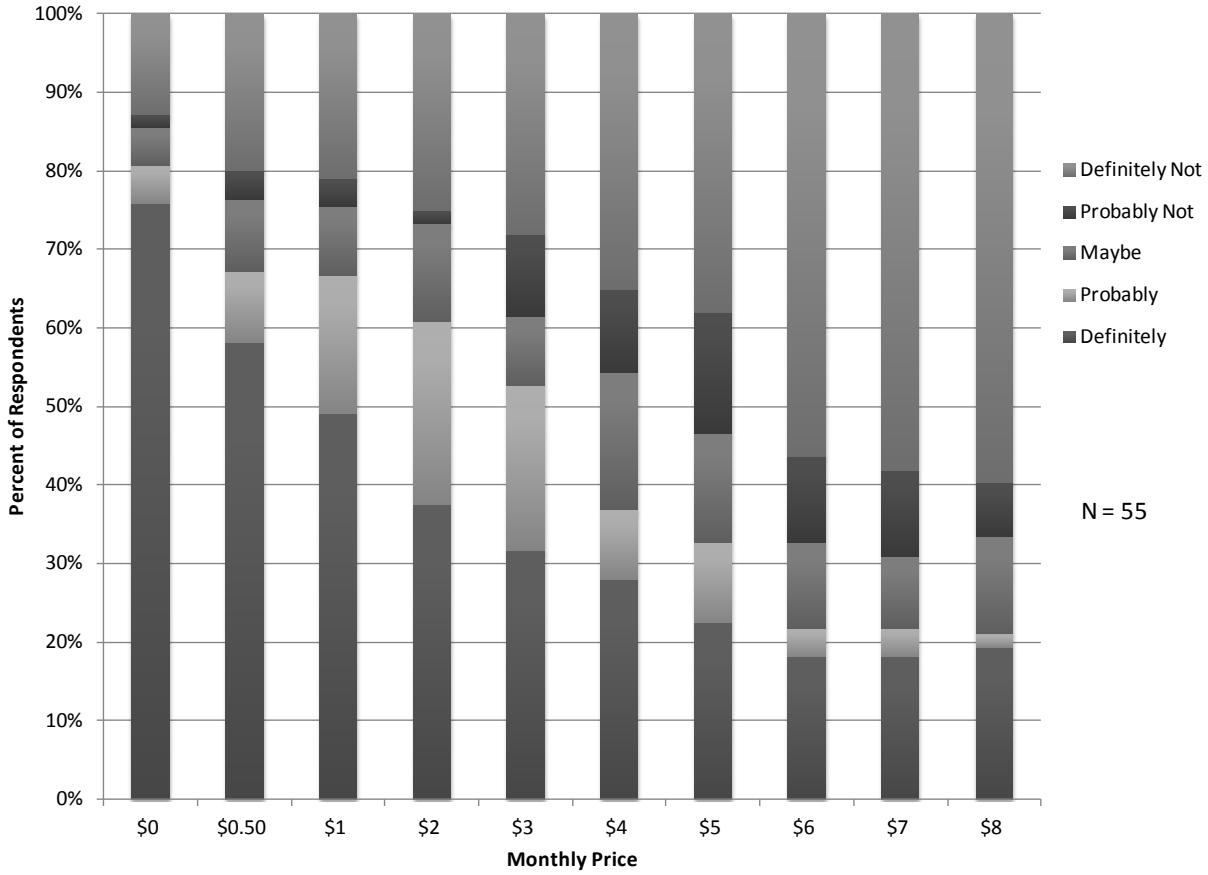

Figure 4 Stated Willingness-to-Pay for Parking Availability Information in 2012

Figure 4 presents the distribution of response for each price tier. The dark bars on the bottom indicate the percentage of respondents that stated that they would "definitely" pay the listed price. The light bars on the top indicate the percentage of respondents that stated that they would "definitely not" pay the listed price. The three bars in between illustrate the percentage of responses ranging from "probably not," "maybe," to "probably" pay the listed price. The transition of the price-by-price distribution shows that a majority of respondents would "probably" or "definitely" pay at least $3 per month to access parking availability data. As the price increases to $6 per month, the percentage of those indicating that they would "probably" or "definitely" pay for parking stabilizes at around 20%. There are several caveats to note about the response to this question. First, it is a stated willingness-to-pay question, and the respondent was making no financial commitment through their responses. Second, a number of respondents chose not to answer the question in part because it may not have been relevant to them or

because they did not understand the structure. The sample size is thus reduced from the broader sample. These issues may or may not influence actual (revealed) distribution of willingness-to-pay for availability information. The true price and market uptake will depend on a number of factors related to the specific qualities of the product (including information delivery and coverage). But the distributions do show that a sizeable share of respondents stated that such information had a value tangible enough to quantify and what value is placed on it under hypothetical circumstances.

Analysis of Truck Travel Activity Data

Beyond understanding the parking needs of truck drivers, addressing the truck parking problem requires an understanding of the corridors in which parking is a concern. There are a number of data sources that can aid in understanding the flows of trucks on the nation's highways. One data source that is publicly available consists of the traffic volume data collected through in-road sensors. These volumes are used to estimate average annual daily traffic (AADT), and less abundant specialized sensors such as weigh-in-motion (WIM) and automatic vehicle classification (AVC) sensors are used to inform the split of vehicles by axle count. These data, collected by states to inform the nation's Highway Performance Measurement System (HPMS), provide annual average estimates of truck traffic. In California, as well as other states, the data are complete and comprehensive but not necessarily organized in a way that provides a clear picture of corridor activity. The AADT data are, in effect, point estimates of average annual travel given at specific post miles. However, these data can be used to graphically illustrate five-axle truck traffic over the length of a highway. Analysts can do this by creating a data array in which each element represents an equally spaced post-mile position across the entire corridor. For example, each element could represent a single post-mile or a half post-mile from 0 to L, where L is the length of the corridor. Then the value of each element is assigned the AADT value with the post-mile that is nearest to it. The result is a plot that looks like a step-function, but when post-miles are identified with geographic references, an informative picture emerges. Figure 5 illustrates a plot of 2010 AADT data posted by Caltrans for five-axle trucks on I-5. The plot shows the relative magnitudes of five-axle truck traffic on I-5 from San Diego to the Oregon border.

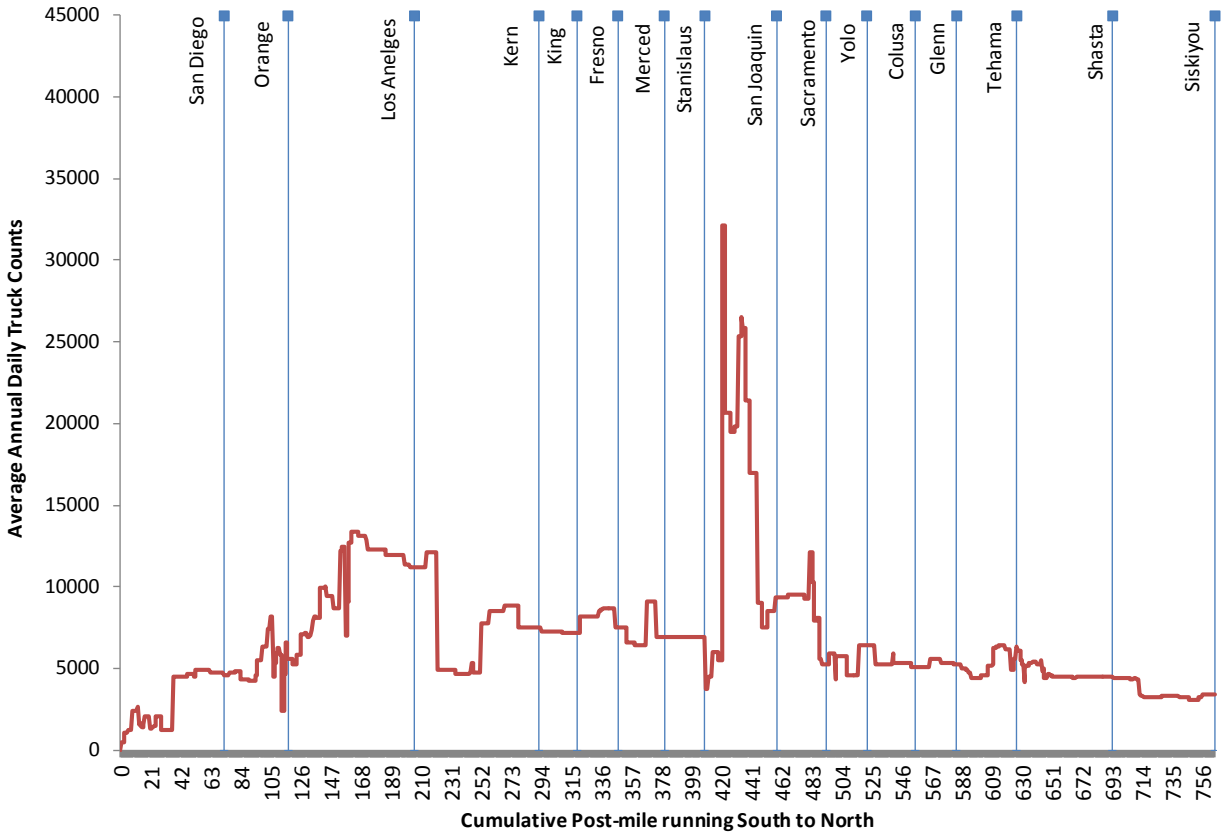

Figure 5 Average Annual Daily Five-Axle Truck Traffic on I-5 in California in 2010

Several key points emerge from the plot generated in Figure 5. First, using publicly available AADT data, a clear picture of the spatial distribution of truck traffic on the corridor immediately appears. There is a notable increase in truck activity in Los Angeles, before dropping in Kern County. This drop is where I-5 splits with State Route (SR)-99. The traffic picks up again at about the location where I-5 passes Bakersfield and is fed by a merge with SR-58. Moving north, five-axle truck traffic remains relatively constant, until San Joaquin. It is here that a large spike in five-axle activity is evident, and this likely results from substantial logistics operations that occur in this area as a result of an existing rail head and its interface with the Bay Area. This illustrates one aspect of AADT data in that it captures (but also identifies) regions with high levels of local five-axle truck traffic. The long-haul traffic is more identifiable as the constant values that persist across the rural counties between Bakersfield and Sacramento, as well as the Sacramento to the Oregon border. For example, the data presented in this way suggest that between Bakersfield and Sacramento, long-haul five-axle traffic represents about 7,000 trucks per day. North of Sacramento, long-haul traffic appears to be between 3,000 to 6,000 five-axle trucks per day.

This type of analysis can be done for any corridor in which AADT data are publicly available. For example, Figure 6 shows the same analysis completed for five-axle trucks on SR-99 running from Bakersfield to Red Bluff in the north. This graphical presentation of AADT data shows the relative magnitudes of five-axle truck traffic across the central valley. On SR-99, the spike of local traffic occurs in Bakersfield, and cross-valley traffic is consistently between 5,000 to 10,000 five-axle trucks a day on average.

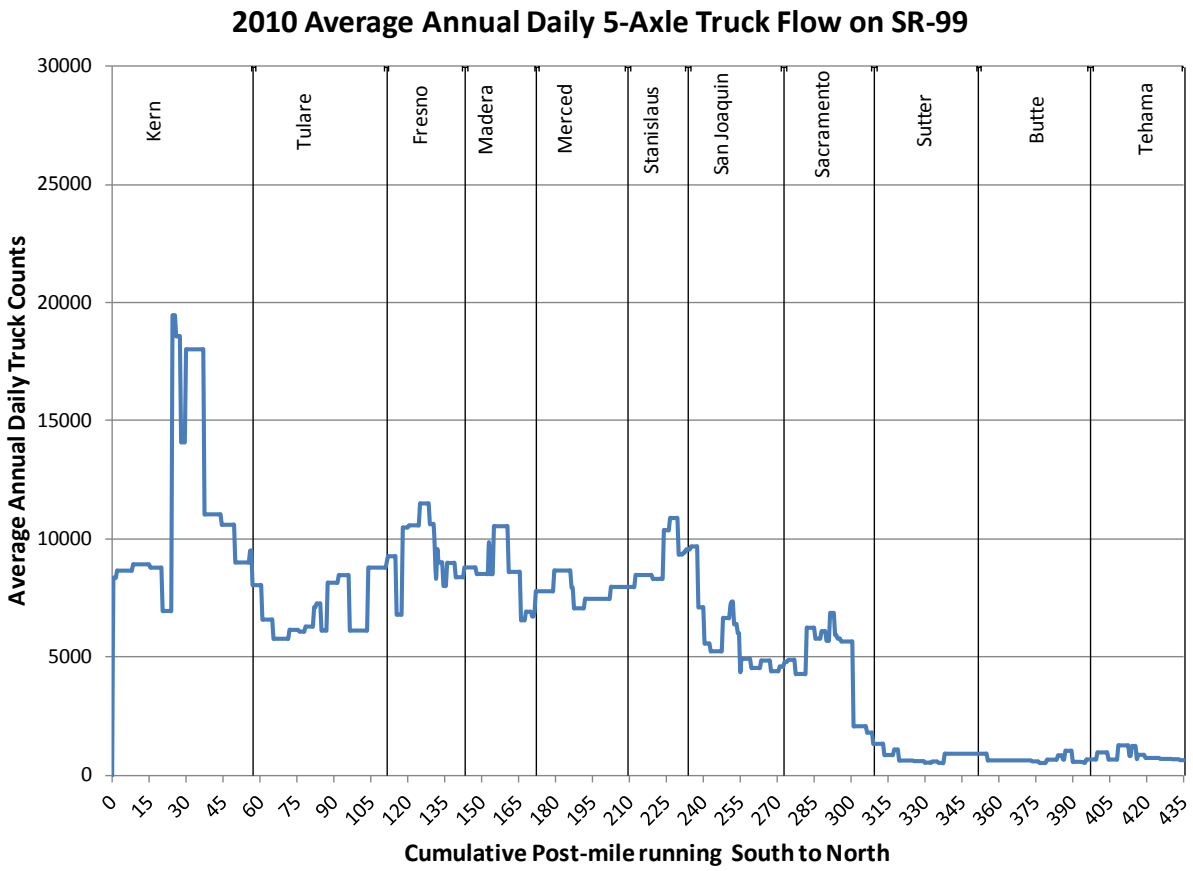

Figure 6 Average Annual Daily Five-Axle Truck Traffic on SR-99 in California in 2010

The use of AADT to graphically illustrate truck traffic could have value with a number of corridors in and outside of California. It is most useful for understanding the relative distribution and magnitude of truck flow in one simple picture. By virtue of the sensors in the road, the information is comprehensive of all traffic passing through. Its weakness is its lack of variability through the year. AADT provides one value for the entire year, and thus, it is most useful for strategic planning of infrastructure such as parking, where traffic is likely to exhibit similar patterns for many years.

CONCLUSION

This paper presented the results of a clipboard survey (N = 85) conducted in Spring 2012 of long-haul truck drivers on the I-5 corridor. The survey focused on questions related to parking activity and behavior and probed respondents on their perceived utility of real-time parking availability information and parking reservations. Respondents perceived parking on I-5 to be a problem. More than 70% of all respondents (n = 61) indicated that they had encountered truck stops where they would have liked to park but could not because it was full. About 50% of all respondents reported that this had occurred on their current trip and such encounters predominantly occur when searching for overnight parking. The survey also probed respondents to evaluate whether real-time truck parking availability data would be useful. Roughly 76% (n = 65) of all respondents indicated that they thought it would, and similarly 74% (n = 63) felt that a

system delivering this information would be useful to the trucking industry as a whole. A willingness-to-pay question suggested that a majority of truck drivers might be willing to pay up to $4 per month for access to such information about truck stops in their region, and a smaller minority would be willing to pay more.

Researchers also showed that publicly available AADT data can be used to profile the truck traffic on a corridor. With these profiles, planners and policymakers can gain a graphical understanding of traffic distribution on a corridor. The advantage of this approach is that it is comprehensive to all traffic on a given highway (by virtue of in-road sensors), and a graphical representation can provide understanding on the relative magnitude of local and long-haul truck traffic traveling through a region. Since AADT data are collected by states, it provides a resource that can be used to identify regions in which parking and other infrastructure assets are likely to be in high demand.

The objective of this study was to gain knowledge of the needs of truck drivers with respect to parking and the distribution of truck traffic on the I-5 corridor. This information can be used to further advance the use of ITS in truck parking, as the planning and deployment of such technology is naturally better informed by user understanding and information on truck traffic patterns.

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