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Commercial vehicle parking duration in New York City and its implications for planning

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ABSTRACT

Freight vehicle parking has long been an issue in urban areas; however, literature is limited and little attention has been paid to parking duration. Using field-collected freight parking observation data from New York City, this study estimated a parametric survival model to predict parking durations based on several characteristics of a parked freight vehicle. Results indicated that vehicles delivering different types of items parked for differing durations, while vehicles that parked illegally were likely to park for a shorter period of time. The model was then employed to make predictions regarding how parking durations would differ based on vehicle and delivery characteristics. An elasticity analysis was performed on each significant variable, and planning recommendations were made in order to maximize the amount of vehicles parking legally. Recommendations for future research included expanding the dataset to obtain more accurate estimates and applying the duration model to optimize operations at a business or logistics firm.

1. Introduction

While the many businesses and residents of cities require goods of various types, delivery of goods to homes and businesses is often an afterthought in transportation planning. As a result, legal parking is often limited and loading zones are nonexistent in many delivery locations. In order to serve their customers, freight operators are often forced to park illegally. This can greatly increase the cost associated with operating in cities and can create unsafe conditions for other road users. This paper will analyze commercial vehicle parking in dense portions of New York City, an urban area that has been attempting to resolve its problems with urban freight for decades. Data collected by a team from the City College of New York will be used to develop a model, explaining factors affecting parking duration, predicting parking duration, and providing insights for future improvements.

The problems created by limited parking in dense urban areas have been the subject of much research. Yet most of this research has been dedicated toward passenger vehicles. Little attention has been given to any form of commercial vehicle parking, let alone commercial vehicle parking in urban areas. When considering truck parking, much of the published literature has focused on improving what is available at truck stops and rest areas along long-distance routes, mostly in rural areas. Nourinejad et al. (2014) noted the relative lack of research into commercial parking in urban areas when proposing a truck parking choice model that accounts for parking type and location. In this paper, we focus on parking duration. Duration is a consideration for all freight deliveries regardless if the vehicle is parked on- or off-street and, as such, is applicable for a wide range of urban parking scenarios.

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2. Literature review

While little specific research exists, relevant literature exists for certain distinct activities that are a significant portion of commercial parking in urban areas. These include the search for parking, limited parking availability, and the necessity for freight vehicles to park near their destinations.

2.1. Cruising for parking

The search for parking is a major component of parking-related research. Drivers searching for parking occupy valuable space in travel lanes, while much fuel and time is wasted as users must drive an additional distance to park and walk further to reach their final destination. Previous studies have indicated strikingly large values related to searching for parking in urban areas, with one showing that in the area surrounding Harvard Square in Cambridge, Massachusetts, 30% of moving vehicles were searching for parking during the peak hour, with an average searching time of 12 min. These numbers are not unusual, with most large cities having an average searching, or "cruising", time that is between 6 and 15 min, (Geroliminis, 2015). Complicating matters and partially explaining the large amount of traffic created by cruising, research has shown that a majority of drivers do not have a defined plan for parking before they near their destination, instead starting their search when they near or arrive at their destination, (Chaniotakis and Pel, 2015). Furthermore, some of the largest cities simply do not have enough legal parking spaces to accommodate the vehicle demand. This is the case in Beijing, where vehicle usage is increasing at a rate far greater than facilities are being constructed. A recently-published study conducted by Beijing City University indicated that the amount of vehicles in Beijing exceeds the number of parking spaces by more than three million, forcing the majority of vehicles to park on narrow city streets, significantly reducing capacity, (Wang et al., 2016). With an increasing number of vehicles fighting for limited city parking space, some of the problems facing large commercial vehicles become apparent. A 2017 study in Istanbul revealed that, on a busy commercial street, an additional vehicle parked for one hour resulted in an average of 3.6 additional drivers being forced to search elsewhere for parking. This significantly contributes to roadway congestion, with the authors noting that the external cruising cost is roughly equal to the external congestion cost (Inci et al., 2017).

2.2. Commercial parking

The issues caused by limited commercial vehicle parking are not restricted to dense urban areas. Trucks require a large amount of space to park and it is not always easy to provide enough parking to satisfy demand. A 2005 Nebraska study indicated that a large proportion of truck drivers believed that there was too little truck parking in parts of the state, with utilization rates at public rest areas and private truck stops high and growing, (Gaber et al., 2005). A 2014 Florida study showed similar results, indicating that the vast majority of rest areas along Interstate highways in the state had a maximum truck parking utilization rate near or above capacity, with capacity being exceeded by more than 100% in some cases, (Bayraktar et al., 2015). In all cases, trucks must park illegally when all legal parking spaces are in use, causing safety concerns. While truck parking in suburban and rural areas might be difficult to come by, constrained conditions in urban areas combine with limited parking to create difficult situations for commercial vehicles.

2.3. Commercial parking and routing in urban areas

Combining the problems of limited urban parking and limited truck parking, one arrives at the issue of commercial vehicle parking in urban areas. Trucks typically park in urban areas to make deliveries, and as such, the truck must be parked at or very close to the destination. When a legal parking space is not available, the trucks must park illegally in order to serve their customers. With the increase in shipments caused by a spike in online shopping, several cities have seen issues related to illegal parking increase during recent years. From 2006 to 2009, parking fines in Toronto increased by 70%, with UPS, FedEx, and Purolator alone paying an estimated CAN$2.5 million in fines in 2009 (Nourinejad et al., 2014). In 2012, commercial vehicles paid more than CAN$27 million in parking fines. While intended to serve as a deterrent, many companies simply consider parking fines to be a cost of doing business in urban areas (Wenneman et al., 2015). Observations taken during 2013 in Chicago indicated that trucks parked illegally over 28% of the time, compared to 3% for passenger vehicles, (Kawamura and Sriraj, 2015).

As with the previous issues, commercial parking in urban areas is a worldwide issue. A 2015 Italian study analyzed scenarios that could be implemented in order to alleviate some urban freight issues, including the designation of parking zones that would vary between passenger vehicle parking and freight loading/unloading based on the time of day (Marcucci et al., 2015). The issues surrounding urban parking are not restricted to large urban areas. Smaller urban areas, including Fargo, North Dakota, are facing issues created when commercial vehicles do not have dedicated loading zones, as delivery vehicles in higher-density areas must park illegally and block travel lanes (Chatterjee et al., 2008). Using 2001 data, researchers in Calgary developed a model for truck movements in that city. While the bulk of the model is outside the scope of this paper, stop duration is considered. Knowing the actual durations of stops made by delivery vehicles, a Monte Carlo process is used to assign durations to each modeled stop, with probabilities corresponding to those observed for a given stop purpose and location (Hunt and Stefan, 2007). In a 2017 study, Chiara and Cheah analyzed freight deliveries at urban shopping malls in Singapore. Parking durations of delivery vehicles at two malls were collected through various means and modeled through regression. Unsurprisingly, a higher number of items handled per worker was associated with a longer parking duration. Vehicles that were more full when entering the lot required more time to make deliveries, as did vehicles picking up items (Chiara and Cheah, 2017). This paper will expand on the limited literature regarding freight parking