Commercial Vehicle Parking Availability and Behavior for Residential Delivery in New York City

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Research Background

Quarterly Retail E-Commerce Sales
Source: U.S. Census Bureau News

- To business units
- Trucking Companies
- Full truck load
- High success of delivery attempts

- To residential units
- Major couriers and small parcel services
- Small size parcel, frequent attempts, multiple stops
- High failure of delivery attempts (12%)
- Alternative strategies do exist; however, customers still prefer delivery to home

Annually +15%
Proposed Research

Research Objective

To identify the unique freight parking issues in residential land use areas and to develop recommendations for improving:

- regulation of curb space; and
- last-mile delivery strategies

to accommodate the loading needs of commercial vehicles making delivery to residential land use areas.
Research Flow Chart

Commercial Land Use ➔ Mixed-use Land Use ➔ Residential Land Use ➔ Census Tracts Selection ➔ Evaluation of Parking Regulation ➔ Evaluation of Commercial Vehicle Parking Behavior ➔ Overall and Spatial Characteristics ➔ Unique issues in Residential Census Tracts ➔ Policies Recommendation

Cross Comparison

Database Used
- NYCDCP Lion
- NYCDCP PLUTO
- NY Census Tract
- Household Diary Study
- NYCDOT Traffic Sign STATUS
- NYCDOF Parking Violation
Census Tract Selection

Parking Violation Density Sorting

In each census tract

\[
\text{Violation Rate} = \frac{\sum_t \text{Violation Count}}{\sum_t \text{Curb Length}}
\]

Census Tract Groupings

\[
P_C = \frac{\sum_t \text{Commercial Area}}{\sum_t \text{Total Building area}}; \quad P_R = \frac{\sum_t \text{Residential Area}}{\sum_t \text{Total Building area}}
\]

Primary Land use

- \( P_C - P_R \geq 10\% \): Commercial Dominant CT
- \(-10\% \leq P_C - P_R \leq 10\% \): Mixed-use CT
- \( P_C - P_R \leq -10\% \): Residential Dominant CT

* \( \text{Commercial Area} = \text{office area} + \text{retail area} + \text{storage area} + \text{factory area} \)

After ranking the Census tracts for different land use type, the top five tracts by violation rate were selected
Commercial vehicle parking demand includes demand driven by commercial units and demand driven by residential units.

In previous research, zip code level of commercial demand in NYC was estimated using a freight-trip generation model. Model relied on local employment data to estimate demand as a function of land use or industrial sector and employment.[1]

By locating study areas in zip codes,

- In commercial use area, available space is already inadequate to accommodate commercial vehicles’ parking demand driven by commercial units
- Mix-used area and residential area have lower demand comparing to commercial area

Evaluation of Freight Demand

Demand for “residential” freight trips are estimated as number of total packages received by each selected census tract--- in Household Diary Study, packages received per week can be estimated as a function of household income.

<table>
<thead>
<tr>
<th>Census Tract</th>
<th>Sensitivity Analysis (Delivery Stops/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Est. Residential Package/day</td>
</tr>
<tr>
<td></td>
<td>5 package per stop</td>
</tr>
<tr>
<td><strong>Commercial</strong></td>
<td></td>
</tr>
<tr>
<td>96</td>
<td>10</td>
</tr>
<tr>
<td>109</td>
<td>5 to 6</td>
</tr>
<tr>
<td>112.02</td>
<td>18 to 19</td>
</tr>
<tr>
<td>113</td>
<td>8</td>
</tr>
<tr>
<td>114.01</td>
<td>53 to 57</td>
</tr>
<tr>
<td><strong>Mixed-use</strong></td>
<td></td>
</tr>
<tr>
<td>61</td>
<td>189 to 205</td>
</tr>
<tr>
<td>68</td>
<td>312 to 333</td>
</tr>
<tr>
<td>72</td>
<td>390 to 418</td>
</tr>
<tr>
<td>91</td>
<td>314 to 328</td>
</tr>
<tr>
<td>137</td>
<td>356 to 372</td>
</tr>
<tr>
<td><strong>Residential</strong></td>
<td></td>
</tr>
<tr>
<td>138</td>
<td>630 to 672</td>
</tr>
<tr>
<td>139</td>
<td>455 to 491</td>
</tr>
<tr>
<td>140</td>
<td>356 to 371</td>
</tr>
<tr>
<td>146.01</td>
<td>199 to 210</td>
</tr>
<tr>
<td>148.02</td>
<td>314 to 331</td>
</tr>
</tbody>
</table>

- Demand for packages in residential area is significant
- Commercial vehicles might have to make 20 to 70 stops in a single census tract if they deliver 10 packages per stop
Existing zoning regulations: Off-street Parking

New York Zoning Resolution (NYCZR)

No minimum off-street parking requirements in the study areas,

Off-street loading spaces for commercial vehicles are extremely limited, loading berth requirements only apply to commercial uses; no loading requirement exists for residential buildings
On Street Parking and Loading

Available spaces density in each land use type (Total available spaces/total curb length)

Convert the parking signage text into a quantitative dataset showing space availability during different time period

Visual Basic data mining algorithm

Checked entrance and hydrant locations in Google Street images

\[ n = \frac{\sum_i \frac{l_c}{N_s} - l_H^i - l_E^i}{l_T} \]

\( n \): Number of available spaces for commercial vehicles during a specific time frame in each land use area
On Street Parking and Loading

Available Parking Space Grouping

OPK: Open space where do not have any restriction

RPK: Regular meter parking space and space where have parking duration restriction

CPK: Dedicate for commercial vehicle including space where only allow truck loading and unloading and space for commercial meter parking
On Street Parking and Loading

Parking Space Availability
7am-7pm

No. of parking space/1000ft in 1/2 hour

C M R

OPK RPK CPK

Example:
In residential areas, there are about 15 spaces available per 1000 ft at any half hour time frame
OPK---10 spaces
RPK---4 spaces
CPK---1 spaces

✓ Residential area has the highest overall available rate, 90% of all available spaces are regulated as “open” parking or “regular” parking

✓ In commercial area, over 90% of all available spaces are regulated as “commercial dedicated”
On Street Parking and Loading

Spatial Distribution

Spatial Distribution

<table>
<thead>
<tr>
<th></th>
<th>Commercial</th>
<th>Mixed-use</th>
<th>Residential</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPK</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RPK</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>OPK</td>
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</tbody>
</table>

Commercial
Similar parking type share on street and avenue

Mixed-use
On avenue, more spaces are regulated as metered parking

Residential
On street, more spaces are regulated as Open parking
Road Network Characteristics of New York City

Avenue

Street
The highest violation rate occurs in commercial area

Violation rate in residential area is slightly higher than rate in mixed-use area
Commercial Vehicle Parking Behavior

Spatial Distribution

- The highest violation rate occurs on commercial area’s street.
- The second highest violation rate occurs on residential area’s avenue.
<table>
<thead>
<tr>
<th>Land Use Cross Comparison</th>
<th>Findings</th>
<th>Reasonable explanation</th>
</tr>
</thead>
</table>
| Commercial vs. Mixed-Use  | Parking space availabilities are similar  
Parking violation rate is much higher in commercial land use area | Higher demand for commercial deliveries in commercial land use area |
| Mixed-Use Vs. Residential | In Mixed-use area,  
Higher commercial freight demand  
slightly lower parking violation rate | In residential areas, around 90% of all available spaces are regulated as “open” parking or “regular” parking |
| Avenues’ violation rates | Parking violation rate on residential avenue is even higher than violation rate on commercial avenue | In residential area, Less “commercial dedicated” space  
High share of “open” spaces on streets push trucks concentrate on avenues |
Policy Recommendations

**Challenges**

- Households are now a significant generator of truck trips.
- Mismatch between available supply and demand in mixed-use and residential areas.
- Streets in residential areas are overwhelmingly dominated by “open” space. Loading and unloading activities of commercial vehicles on avenues are creating heavy negative traffic impacts.

**Future strategies in residential land use areas**

- Future zoning regulations should define explicit off-street access requirements including loading areas in residential buildings
- Dedicated delivery windows
- Dedicated parking spaces for parcel deliveries
Future Research

Preliminary results reveal commercial vehicles’ current parking situation in residential areas, future study will focus on:

- Understanding parcel delivery trucks’ behavior in residential land use areas
  ---Field data collection.

- Estimation of traffic impact of parcel delivery trucks’ parking behavior
  ---Micro traffic simulation model.
Thank you!