Modeling Impacts of Off-peak Delivery in the Greater Toronto and Hamilton Area

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May 25, 2022

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9th METRANS International Urban Freight Conference
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Background and objective

• Off-peak delivery (OPD) → delivery of goods during evening and overnight periods (7 pm – 6 am)

• Province of Ontario relaxed noise bylaws during the pandemic and wants to make this permanent to allow OPDs

• The objective is to quantify the impacts of OPD on road network
GTHA Commercial Vehicle (CV) Model

- A 3-stage model

- Regression models as opposed to trip rates
- Special generation for CP, CN terminals and YYZ
- Integrated with the GTAModel
- Calibrated for 2016
- Outputs volumes for AM, midday, PM, evening and overnight
CV model: trip generation

Table: Number of Industry Classes by Preferred Model

<table>
<thead>
<tr>
<th>Preferred Model</th>
<th>Light Truck</th>
<th>Medium Truck</th>
<th>Heavy Truck</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>9</td>
<td>6</td>
<td>7</td>
<td>22</td>
</tr>
<tr>
<td>B</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>C</td>
<td>6</td>
<td>9</td>
<td>5</td>
<td>20</td>
</tr>
<tr>
<td>Total</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>45</td>
</tr>
</tbody>
</table>

Light
- Pickup, Cube Van, or Cars with Trailers
  (Do not include employee commuting trips or personal trips or customers)

Medium
- Single Unit Trucks

Heavy
- Tractor Only
- Tractor and One Trailer
- Tractor and Two or more Trailers
CV model

• Trip Distribution
  • Doubly constrained gravity model
  • Peak period, peak hour and AM/PM directionality

• Traffic assignment
  • Multiclass user equilibrium
Passenger demand: GTAModel V4

- An operational agent-based micro simulation model primarily used for forecasting passenger travel in the GTHA.

- Based on TASHA (Travel Activity Scheduler for Household Agents) for activity scheduling and mode choice.

- Estimated and calibrated to the 2016 Transportation of Tomorrow Survey
OPHD scenario modeling

- Shippers survey
- Establishment counts
  - Employment
  - Special generation
  - External trips
- Peak period factors
- Peak hour factors
- Peak hour directionality
- TASHA passenger demand

Regression models

Truck trip generation

- Truck trip distribution
  - Update travel time
    - Convergence reached?
      - Yes
      - Model volume matches road count?
        - Yes
        - Truck generation by OPHD industry classes
          - OPHD trip distribution
            - Adjust truck trip distribution
              - Update travel time
                - Convergence?
                  - Yes
                    - OPHD assignment completed
                  - No

Adjust regression estimates

Input data
- Base model components
- Off-peak scenario modeling
OPD scenarios

• 3 industry classes
  • Retail
  • Grocery-related wholesale
  • Accommodation and food

• 4 levels of shifts: 10%, 20%, 30%, 50%
  • With 30% shift, 4% of all trucks (0.45% of all vehicles) are shifted

• For each shift level, two cases:
  • 1) Induced and 2) non-induced passenger demand
  • 1a) Retail and wholesale to evening 100%, 1b) 50% to evening (7-11 pm), 50% to overnight (11 pm – 6 am)
Results: daytime (6 am - 7 pm) traffic

- Light and medium truck VKTs increase due to rerouting to highways

- Speed changes uniformly

- Travel times of light and medium do not drop as much as heavy and auto
Results: off-peak traffic

• Travel time rises in the evening

• OPD trucks have substantially better travel times
Results: impacts of induced demand

Change in travel time (6 am - 7 pm)

<table>
<thead>
<tr>
<th></th>
<th>30% Shift</th>
<th>50% Shift</th>
</tr>
</thead>
<tbody>
<tr>
<td>Auto w/o induced</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Auto w/ induced</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Light w/o induced</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Light w/ induced</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medium w/o induced</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medium w/ induced</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heavy w/o induced</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heavy w/ induced</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

[Bar chart showing % change in average travel time for different vehicle types and shift conditions]
Results: system-wide net benefit

<table>
<thead>
<tr>
<th>Vehicle type</th>
<th>Daytime traffic (6 am - 7 pm)</th>
<th>Evening traffic (7 pm - 11 pm)</th>
<th>Trucks participating in OPHD</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>w/o induced</td>
<td>w/ induced</td>
<td>w/o induced</td>
</tr>
<tr>
<td>Auto</td>
<td>-6,021</td>
<td>-3,426</td>
<td>157</td>
</tr>
<tr>
<td>Light</td>
<td>-78</td>
<td>201</td>
<td>90</td>
</tr>
<tr>
<td>Medium</td>
<td>-46</td>
<td>-12</td>
<td>32</td>
</tr>
<tr>
<td>Heavy</td>
<td>-304</td>
<td>-478</td>
<td>176</td>
</tr>
<tr>
<td>Total</td>
<td>-6,449</td>
<td>-3,715</td>
<td>454</td>
</tr>
<tr>
<td>Total vehicle-hour saved</td>
<td>-7,962 (w/o induced)</td>
<td>-5,530 (w/ induced)</td>
<td>-1,967</td>
</tr>
</tbody>
</table>
Key takeaways

• Light trucks would benefit the most (followed by medium trucks)
  • Highest travel time savings in the off-peak
  • Worse off during daytime

• Carriers serving Toronto and Peel region businesses would benefit the most

• Total daily travel time savings of 5,530 vehicle-hours
Questions/comments?