Impact of Off-Peak Delivery on Urban Freight Movements during the Pan American Games

METRANS International Urban Freight Conference
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Major Sporting Events

Major challenges for freight stakeholders

- Influx of spectators
- High demand for goods
- Road network restrictions

Provides incentives and opportunities to make improvements to operational efficiencies and practices.
Off-Peak Delivery

• Potential benefits
  – Travel time savings
  – Delivery time savings
  – Increased parking availability
  – Emission reductions

• Challenges
  – Receiver participation
  – Noise bylaws
2015 Pan Am and Parapan Am Games

- 7,000 Pan Am Athletes
- 1,608 Parapan Am Athletes
- 250,000+ spectators
- 41 countries
- Extensive Games Route Network (GRN)
Source: Ministry of Transportation - Ontario, 2014b
Data

- Games travel times
  - Expected conditions \textit{with} the Pan Am Games
- Business-as-usual (BAU) travel times
  - Expected conditions \textit{without} the Pan Am Games
- Delivery log data
  - Customer order quantity
  - Delivery order
Research Questions

1. What will be the impact of the Pan Am Games on current Nestlé operations?

2. What are the benefits of advanced route planning rather than a call-and-place method for normal Nestlé operations outside of the Games?

3. Can off-peak delivery be used to mitigate the impacts from the Games?
Step 1: Identify Potential Off-Peak Customers

Step 2: Potential Off-Peak Customer List Refinement

Step 3: Off-Peak Customer Selection for Clustering

Step 4: Capacity Constrained K-Means Clustering

Step 5: Vehicle Routing
1. Impact of Pan Am Games on Nestlé's Normal Operations

- Direct comparison of travel times between
  - Pan Am Games conditions (Games)
  - Business-as-usual conditions (BAU)

- Maintain delivery order as found in delivery logs
6.4% increase in travel time during the Games

Games vs BAU Travel Times

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Games Travel Times</th>
<th>BAU Travel Times</th>
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</thead>
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<tr>
<td>1</td>
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2. Impact of Advanced Routing on Travel Times

- Comparison of advanced routing against a call-and-place delivery model
- All customers are delivered to during the daytime
  1. Incorporate heuristic model
  2. Estimate travel times for each cluster
Advanced Routing vs Call-and-Place Travel Times

25.9% average reduction in travel time

Scenario

Total Travel Time (Minutes)

- Call-and-Place
- Advanced Routing
3. Impact of Off-Peak Delivery during the Pan Am Games

- Impact on travel time using:
  1. Strategic selection using customers identified by type
  2. Random selection using customers identified by type
  3. Strategic selection using customers identified by proximity to the GRN
  4. Random selection using customers identified by proximity to the GRN
Customer Breakdown by Scenario

- Identification by Proximity to the GRN
- Identification by Customer Type
- Daytime Customer

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Number of Customers</th>
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<td>8</td>
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</tr>
<tr>
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</tbody>
</table>

Purpose  Background  Case Study  Methodology  Results  Conclusion
26% average reduction in travel time
### Identification by Customer Type

- **Scenario 1**
  - Strategic Selection: 2200 minutes
  - Random Selection: 2300 minutes

- **Scenario 2**
  - Strategic Selection: 1800 minutes
  - Random Selection: 1900 minutes

- **Scenario 3**
  - Strategic Selection: 1600 minutes
  - Random Selection: 1700 minutes

**Number of Off-Peak Clusters**

- Scenario 1: 1, 2, 3, 4, 2, 3, 4, 5
- Scenario 2: 1, 2, 2, 2, 3
- Scenario 3: 1, 2, 2, 3
Identification by Proximity to the GRN

Total Travel Time (Minutes)

Number of Off-Peak Clusters

Scenario 1

Scenario 2

Scenario 3

Strategic Selection
Random Selection

1 2 3 4

1 2 3 4
Impact of Off-Peak Delivery during the Pan Am Games - Summary

- Average percentage travel time reductions
  - Strategic selection by customer type: 1.5% Decrease
  - Random selection by customer type: 1.8% Increase
  - Strategic selection by proximity to the GRN: 2.9% Decrease
  - Random selection by proximity to the GRN: 1.6% Decrease
Impact of Off-Peak Delivery during the Pan Am Games - Summary

- Maximum percentage travel time reductions
  - Strategic selection by customer type
    - 6.3% Decrease
  - Random selection by customer type
    - 2.6% Decrease
  - Strategic selection by proximity to the GRN
    - 7.7% Decrease
  - Random selection by proximity to the GRN
    - 5.4% Decrease
Conclusions

1. Large sporting events, like the Pan Am Games, can have travel time impacts on normal freight operations
2. Advanced routing can help reduce travel times compared to call-and-place methods of delivery
3. Off-peak delivery can be used to reduce overall travel times, especially when efforts are focused around the GRN
Limitations

- Missing pieces of the puzzle
  - Parking search time
  - Delivery time
- Receiver participation
  - Assumptions were made concerning which customers would participate in the off-peak delivery program
Thank you!

Questions?