Local “hives” a new model for urban goods distribution

VREF Conference on Urban Freight

I.D. Cardenas, R. Gevaers, J. Beckers

University of Antwerp, Department of Transport and Regional Economics.
Logistics in the on-demand economy
High costs for urban areas

Source: eMarketer, Company Reports, Accenture Analysis (April 2019)
Micro-condolidation

- Close – Fast – Clean
Modeling micro-consolidation

- Parametrization
- Demand allocation
- Routes generation
- Outputs and visualization
- Economic analysis
- Validation
## Module 1. Parametrization

<table>
<thead>
<tr>
<th>Scenario Parameters</th>
<th>City Parameters</th>
<th>Company Parameters</th>
<th>Cost parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Facilities network (hubs, micro-hubs and nano-hubs)</td>
<td>• Road network</td>
<td>• % of packages served</td>
<td>• Labor costs factor</td>
</tr>
<tr>
<td>• % of volume flowing through the network</td>
<td>• Potential locations for facilities</td>
<td>• Drop rate: deliveries per stop</td>
<td>• Infrastructure costs factor</td>
</tr>
<tr>
<td>• Changes on vehicles’ characteristics</td>
<td>• Policies and restrictions to freight</td>
<td>• Point of access to the city network</td>
<td>• Equipment costs factor</td>
</tr>
<tr>
<td></td>
<td>• No. and locations of packages in the city</td>
<td>• Time needed per stop and per package</td>
<td>• Vehicle costs factor</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Vehicle characteristics</td>
<td>• External costs factor</td>
</tr>
</tbody>
</table>
Module 2. Demand allocation

Depends on:
- Geographical characteristics
- Demand of the city
- Drop rate
- % of packages served

Forecasts:
- Average of stops per area unit
- Average of package/stop per area unit
Module 3. Routes generation

Depends on:
- Road network
- Scenario parameters
- Average of stops per area unit
- Average of package/stop per area unit
- Points of access
- Service time
- Vehicle characteristics

Forecasts:
- No. of kilometers per type of road
- Total time to serve
- Throughput on the facilities
Module 4. Economic analysis

Depending on:
- Labor costs factor
- Infrastructure costs factor
- Equipment costs factor
- Vehicle costs factor
- External costs factor
- No. of kilometers per type of road
- Total time to serve
- Throughput on the facilities

Forecasts:
- Operational costs per category and total
- Total external costs
- Sensitivity analyses
Module 5. Outputs and visualization

Companies
• Baseline to forecast the challenges and benefits of switching to another logistics model
• Estimate changes on the demand patterns
• Benchmark the initiatives on sustainability

Cities
• Assess the effect from policies and restrictions
• Evaluate potential interventions
• Estimate the effects from the location of logistics facilities
• Gain insights on the freight transport behavior in the city
Module 6. Calibration and validation

Data
- 4 parcel logistics companies operating in Belgium
- 3-month window deliveries... parcels, all possible characteristics
- Protected by NDA
- Surveys at the shopping streets to catch the behavior of “low density” companies

Interviews
- Validate parameters: especially the costs
Preliminary Results

- Scenario 0: Situation As-is
  - 36,000 parcels/day
  - 6 companies / 70% share
  - Microscopic transport simulation

- Scenario 1: 50% shift to bikes using 1 microhub
- Scenario 2: 100% shift to bikes using 1 microhub
- Scenario 3: 50% shift to bikes using 4 microhubs
- Scenario 4: 100% shift to bikes using 4 microhubs
TOTAL KILOMETRES TRAVELLED BY VANS

- Km in highways
- Km in primary roads
- Km in secondary roads
- Km in small roads

Baseline
1-hub 50%
1-hub 100%
4-hub 50%
4-hub 100%

TOTAL KILOMETRES TRAVELLED BY VANS

Baseline
1-hub 50%
1-hub 100%
4-hub 50%
4-hub 100%

0 500 1000 1500 2000 2500 3000 3500 4000 4500

Km in highways Km in primary roads Km in secondary roads Km in small roads

13
External Costs

<table>
<thead>
<tr>
<th></th>
<th>Baseline</th>
<th>1-hub 50%</th>
<th>1-hub 100%</th>
<th>4-hub 50%</th>
<th>4-hub 100%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Externalities</strong></td>
<td>768.20 €</td>
<td>586.76 €</td>
<td>164.35 €</td>
<td>580.19 €</td>
<td>179.31 €</td>
</tr>
</tbody>
</table>
OPERATIONAL COSTS - LAST MILE

<table>
<thead>
<tr>
<th></th>
<th>Cost/stop</th>
<th>Cost/parcel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>2.00 €</td>
<td>1.00 €</td>
</tr>
<tr>
<td>1-hub 50%</td>
<td>2.50 €</td>
<td>1.50 €</td>
</tr>
<tr>
<td>1-hub 100%</td>
<td>2.25 €</td>
<td>1.25 €</td>
</tr>
<tr>
<td>4-hub 50%</td>
<td>2.00 €</td>
<td>1.00 €</td>
</tr>
<tr>
<td>4-hub 100%</td>
<td>2.25 €</td>
<td>1.25 €</td>
</tr>
</tbody>
</table>
ADDITIONAL TRANSSHIPMENT COSTS

- €

- 5,000.00 €
- 10,000.00 €
- 15,000.00 €
- 20,000.00 €
- 25,000.00 €

Baseline  1-hub 50%  1-hub 100%  4-hub 50%  4-hub 100%
TOTAL COSTS/ PARCEL

- €

Baseline
1-hub 50%
1-hub 100%
4-hub 50%
4-hub 100%
Urban distribution a “hive” concept

- Cooperation
- Community
- Logistics
Cooperation
Cooperation
Cooperation

Before Deregulation

After Deregulation

Airline market

Hub

Hub
Impact on Community
Impact on Community
Impact on Community
What type of products?

- **Fixed Frequency**
  - Personalization
  - Standard

- **Personalization**
  - Standard

- **Fixed Frequency**
  - Standard

- **Standard**
  - Personalization

Examples:
- **Hello Fresh**
  - Personalization
- **Just Eat**
  - Standard
Conclusions and further research

Model

- Calibrating some of the variables
  - Service time for bikes
  - Personnel for transshipment
  - Parking costs
- What is the “best” configuration
- Which percentage of the freight can fit in the micro hub model

Impacts

- Implications for cohabitation / collaboration / cooperation / etc.
- Implications for communities: reduction in traffic, increase on bikes, land use, shopping behavior
- Implications for business models: added value on the last mile returns/ on-demand logistics / hyper local procurement / customized services
Thank you for your attention!

Ivan Cardenas
Ivandario.cardenasbarbosa@uantwerpen.be