Human-Powered Cargo Cycle Operation and Impacts
Lessons from Paris and New York

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What is a cargo cycle?

- Primarily human-powered bicycle or tricycle with cargo carrying capacity
Commodities/Sectors Served

- B2C retail/restaurant deliveries
- B2B food deliveries
- Last mile parcel / courier
- Other sectors
  - Office Supplies
  - Pharmaceuticals
  - Waste/Recycling

Dominant uses in North America; primarily small, local businesses

Increasingly prevalent in Europe (NOT in North America); both local and large international operators
Public Sector Involvement

EUROPE
- Funded pilot studies (EU and Local)
- Some operating subsidies
- Flexible use of dedicated infrastructure
- CV Access Restrictions
- Recognition schemes

NORTH AMERICA
- Limited research to date
- Limited financial investment
  - “Capital” grants
  - Government contract for recycling
- Ambiguous operating regulations
- Few access restrictions
- Limited formal recognition of “green” best practices
## Recent Research

<table>
<thead>
<tr>
<th>Author(s)</th>
<th>Description</th>
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<tbody>
<tr>
<td>Dablanc (2011)</td>
<td>Monitored the operations of La Petite Reine, a cargo cycle company performing deliveries from a consolidation platform in central Paris, France</td>
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<tr>
<td>Browne, Allen, and Leonardi (2011)</td>
<td>Conducted a before and after analysis of an office supply company replacing van deliveries with cargo cycle operations from a micro-consolidation center in central London, UK</td>
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<td>Verlinde et al. (2014)</td>
<td>Conducted a before and after analysis of a major parcel company implementing a mobile depot utilizing cargo cycles to replace motor vehicles for last-mile delivery in Brussels</td>
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<tr>
<td>Gruber, Kihm, and Lenz (2014)</td>
<td>As part of ongoing “Ich ersetze ein Auto” project, studied the market potential for replacing motorized (car and van) courier operations with cargo cycle operations in Germany</td>
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<td>Tipagornwong &amp; Figliozzi (2013)</td>
<td>Modeled the cost competitiveness of cargo cycle vs. motor vehicle delivery operations in Portland, OR, USA</td>
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Primarily focused on costs to individual operators and market potential for use
Two Projects

- Traffic Performance Assessment: Freight Tricycle Operations in NYC
  - How does freight tricycle traffic performance compare to that of motorized vehicles?

- Citywide Externality Assessment: Cycling for Goods in Paris
  - How has the city-wide market for cargo cycles grown since 2001?
  - What are the associated transport externality savings?
NYC Project Summary

1. Conduct comprehensive state-of-the-practice review
2. Conduct original survey of North American operators
3. Collect GPS data from two local cargo cycle operators
4. Estimate traffic performance measures using combined GIS/Visual Basic analysis
5. Estimate externality savings for vehicle replacement scenarios (including sensitivity analysis)
## NYC Case Studies

### CITY BAKERY
- Local green bakery chain
- 7 locations - Midtown/ Downtown Manhattan
- 2 trikes / 5 total drivers
- Typical day: 7 AM – 7 PM
- Morning tour + on-demand deliveries

### CITY HARVEST
- Local food rescue non-profit
- 120+ potential Manhattan locations (by all vehicle types)
- 19 trucks - Long Island City
- 3 trikes - Midtown and Upper East Side / 1 driver per trike
- Typical Day: 12 PM – 12 AM
- Donation pickups < 50 lbs
Performance Measures

- Corridor Moving Speeds
- Travel Time/Stopped Time Delay
- Stop Durations

- Air Pollutant and GHG Emissions
- Space Consumption
NYC Traffic Results

- Speed competitive vs. truck
  - Sensitive to trip length, load size, and trip urgency
  - Benefits greater on streets vs. ave

- Low stopped-time delay → high travel time reliability

- Short stops little influenced by regulations

- Trike trip distance often < motor vehicle trip distance
NYC Externality Results: City Bakery Cycle vs. Van

- **Sensitivity Analysis**
  - Relative space consumed by van = 2.8 to 8 times cargo cycle
  - Savings .7 to 2.3 x benchmark \(\rightarrow\) most sensitive to vehicle age

<table>
<thead>
<tr>
<th></th>
<th>Cargo Cycle</th>
<th>Direct Replacement</th>
<th>Combined Tour</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Road Space Consumed (\text{m}^2\text{hrs})</td>
<td>10.1</td>
<td>44.1</td>
<td>39.2</td>
</tr>
<tr>
<td>Total Parking Space Consumed (\text{m}^2\text{hrs})</td>
<td>15.2</td>
<td>55.7</td>
<td>50.3</td>
</tr>
<tr>
<td>Total Space Consumed (\text{m}^2\text{hrs})</td>
<td>25.3</td>
<td>99.8</td>
<td>89.6</td>
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</tbody>
</table>

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<thead>
<tr>
<th></th>
<th>(\text{PM}_{2.5})</th>
<th>(\text{CO}_2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rate (grams/km)</td>
<td>0.037</td>
<td>833.3</td>
</tr>
<tr>
<td>Estimated Annual Savings (kg) (metric tons)</td>
<td>0.5 (11.6)</td>
<td>0.45 (10.3)</td>
</tr>
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For more detailed discussion see project report: [http://www.utrc2.org/sites/default/files/pubs/Final-Freight-Tricycles-NYC.pdf](http://www.utrc2.org/sites/default/files/pubs/Final-Freight-Tricycles-NYC.pdf)
Paris Project Summary

- Conduct original survey of Paris cargo cycle operators
- Determine new cargo cycle freight activity since 2001
- Determine modal origin of cycle freight trips
- Estimate and monetize benchmark externality savings
- Conduct sensitivity analysis of estimates
Paris Project Results

- 2 firms moving 42 tkm (2001) → 15 moving about 147 tons per day over 980 tkm (2014)
- Operators rely heavily on electrically-assisted cargo cycles (70% of the tkm)

Savings
- Small vs. Paris total transport externalities
- Considerable vs. savings from city-wide passenger mode shifts

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<thead>
<tr>
<th></th>
<th>Benchmark</th>
<th>CO₂</th>
<th>Congestion</th>
<th>Local Pol.</th>
<th>Noise</th>
<th>Total</th>
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<tbody>
<tr>
<td></td>
<td>tkm/day</td>
<td>euro/tkm</td>
<td></td>
<td></td>
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<tr>
<td>Electric cargo</td>
<td>657</td>
<td>0.0001</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
<td>Old M2W</td>
<td>-180</td>
<td>0.161</td>
<td>0</td>
<td>2.548</td>
<td>0.093</td>
<td>-504</td>
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<tr>
<td>Old vans</td>
<td>-612</td>
<td>0.055</td>
<td>7.3</td>
<td>0.890</td>
<td>0.013</td>
<td>-1,703</td>
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<tr>
<td>Old trucks</td>
<td>-53</td>
<td>0.035</td>
<td>2.879</td>
<td>2.237</td>
<td>0.039</td>
<td>-161</td>
</tr>
<tr>
<td>Total</td>
<td>-</td>
<td>-64</td>
<td>-1,155</td>
<td>-1,122</td>
<td>-27</td>
<td>-2,368</td>
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</tbody>
</table>
Benefits of Cargo Cycles

**FOR OPERATORS**
- Reliable travel times in congested traffic (within limited radius)
- Infrastructure use flexibility
- Parking flexibility (and reduced fines)
- Lower vehicle maintenance and fuel costs
- Driver health benefits
- Demonstrated commitment to sustainability

**FOR URBAN AREAS**
- Reduced GHG and air pollutant emissions
- Some reduced noise impacts
- Reduced impacts on congestion / road and parking space consumption
- Reduced exposure to heavy vehicles (especially for non-motorized travelers)
- Not inherently incompatible with pedestrian/bicycle-friendly infrastructure
Challenges

OPERATIONAL

- Lower speeds in uncongested conditions
- Lower economies of scale vs. fully utilized larger vehicles
- High driver costs (#, worker’s compensation insurance)
- High cost for transloading
- Requires dense market within limited radius; usually located in expensive CBD
- Customer perception/fear of the unknown

REGULATORY

- Ambiguous vehicle classifications
- Inhospitable infrastructure (e.g. bridge security ballards)
- (Il)legality of electric assists
Acknowledgements

- **NYC Project:**
  - Funding Agencies: NYSERDA - Joe Tario, NYSDOT – Bob Ancar
  - Participating Carriers
  - Industry Participants: Revolution Rickshaws, City Bakery, City Harvest
  - Other Agency Supporters: NYC DOT - Stacey Hodge, Hayes Lord
  - CCNY Researchers: Dr. Camille Kamga, Jialei Cheng, Penny Eickemeyer, Abhishek Singhal, Quanquan Chen, Emmanuelle Lezais, Rianna Yuen

- **Paris Project:**
  - Funding Agency: Volvo Research and Education Foundations (VREF)
  - Industry Participants: Coursier.fr, La Petite Reine, Novea SAS, La Poste (the French postal service), Urban Cycle, SCS Dragonet, The Green Link, Team Distribution Logistique, and Vert Chez Vous
Questions?

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