

# Supply and demand analysis for green crowdshipping

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# Introduction (1/2)

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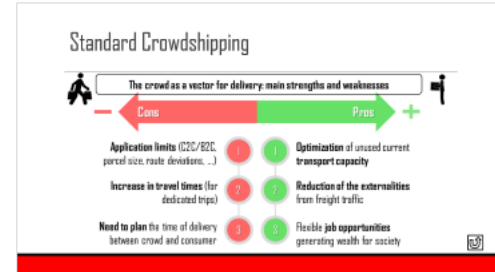


💡 Sustainable Urban Freight Transport (UFT) Solutions

# Introduction (2/2)

## Crowdshipping: an innovative solution to UFT

"...is a sharing mobility service delivering goods via the crowd" (McKinnon, 2016)



- Is it capable to reduce congestion and polluting emissions?  
→ usually it relies on dedicated trips with private motorized vehicles!

## 💡 Green Crowdshipping

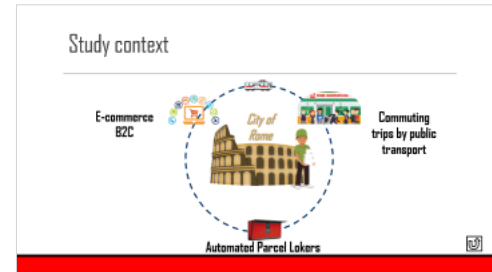
(use of non-dedicated public transport trips)



# Research question

- under which conditions green crowdshippers will produce the service and the customers buy it?

Research project: green crowdshippers using the metro during their regular home-to-work trips in the city of Rome



# Methodology

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- Stated Preference Surveys
  - Bayesian D-Optimality efficient design developed using JMP (by SAS)
    - 4 different questionnaire blocks each including 3 choice exercises with 2 alternatives for a total of 24 different attribute levels' combinations.
  - $\approx 240$  respondents
    - inhabitants of the city of Rome (demand-side survey)
    - metro users (supply-side survey)

# Attributes and levels

Demand-side survey		Supply-side survey	
Features	Levels	Features	Levels
Shipping fee (with respect to current national shipping companies)	<ul style="list-style-type: none"> <li>• Lower (+1)</li> <li>• Typical (-1)</li> </ul>	Location of APL	<ul style="list-style-type: none"> <li>• Inside metro stations (+1)</li> <li>• Outside metro stations/adjacent buildings (-1)</li> </ul>
Shipping time (with respect to current national shipping companies)	<ul style="list-style-type: none"> <li>• Lower (+1)</li> <li>• Typical (-1)</li> </ul>	Remuneration	<ul style="list-style-type: none"> <li>• 3 €/delivery (+1)</li> <li>• 1 €/delivery (-1)</li> </ul>
Parcel tracking	<ul style="list-style-type: none"> <li>• Available (+1)</li> <li>• Not available (-1)</li> </ul>	Delivery booking	<ul style="list-style-type: none"> <li>• Real-time booking (+1)</li> <li>• Off-line booking (-1)</li> </ul>
Delivery date and Time schedule flexibility	<ul style="list-style-type: none"> <li>• Yes (+1)</li> <li>• No (-1)</li> </ul>	Bank crediting modes	<ul style="list-style-type: none"> <li>• Single delivery (+1)</li> <li>• Every 5 deliveries (-1)</li> </ul>

# Utility specifications

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MNL1 demand-side model:

$$\begin{aligned}V_A &= \beta_1 * \text{Shipping Fees}_A + \beta_2 * \text{Shipping Times}_A + \beta_3 * \text{Parcel Tracking}_A + \beta_4 * \text{Delivery Planning}_A \\V_B &= \beta_1 * \text{Shipping Fees}_B + \beta_2 * \text{Shipping Times}_B + \beta_3 * \text{Parcel Tracking}_B + \beta_4 * \text{Delivery Planning}_B \\V_{\text{no choice}} &= \beta_5 * \text{Age} + \text{ASC}\end{aligned}\tag{1}$$

MNL2 supply-side model:

$$\begin{aligned}V_A &= \beta_1 * \text{Location of APL}_A + \beta_2 * \text{Remuneration}_A + \beta_3 * \text{Delivery booking}_A + \beta_4 * \text{Bank Credit Mode}_A \\V_B &= \beta_1 * \text{Location of APL}_B + \beta_2 * \text{Remuneration}_B + \beta_3 * \text{Delivery booking}_B + \beta_4 * \text{Bank Credit Mode}_B \\V_{\text{no choice}} &= \beta_5 * \text{Age} + \text{ASC}\end{aligned}\tag{2}$$

# Econometric Results

## ● DEMAND

Econometric Results - Demand

	Coeff. (B)	T-stat
Age	0.0905	7.65
Shipping fees* (a) Lower	0.6750	6.76
Shipping time** (a) Lower	0.5870	6.85
Parcel tracking*** Present	0.6960	7.38
Delivery date/time flexibility**** Yes	0.7860	8.87
"no choice" (ASC)	-5.2300	-8.90

Adjusted R-squared: 0.299

\*base level: "topical"; \*\*base level: "1 point"; \*\*\*base level: "not available"; \*\*\*\*base level: "6"; (a) with respect to current national shipping companies

## ● SUPPLY

Econometric Results - Supply

	Coeff. (B)	T-stat
Age	0.0473	4.25
Location of APL* <i>Inside metro stations</i>	0.5840	8.42
Remuneration** <i>3 E/delivery</i>	0.4890	8.02
Delivery booking*** <i>Real-time booking</i>	0.3350	4.90
Bank credit mode**** <i>Single delivery</i>	0.5330	7.84
"no choice" (ASC)	-3.390	-7.03

Adjusted R-squared: 0.281

\*base level: "Outside metro stations/adjacent buildings"; \*\*base level: "6 E/delivery"; \*\*\*base level: "60 days booking"; \*\*\*\*base level: "Every 3 deliveries"




# Scenario Analysis

## ● DEMAND

Scenario Analysis - demand


<i>Demand-side simulation</i>	<i>Scenario 1</i>	<i>Scenario 2</i>	<i>Scenario 3</i>	<i>Scenario 4</i>
Shipping fees (with respect to current national shipping companies)	Lower	Typical	Lower	Typical
Shipping fees (with respect to current national shipping companies)	Typical	Typical	Typical	Typical
Parcel tracking	Available	Available	Available	Available
Delivery date and time schedule flexibility	Yes	Yes	No	No
<i>Probability of adopting a crowdshipping service</i>	<i>66.1 %</i>	<i>59.7 %</i>	<i>16.4 %</i>	<i>12.4 %</i>



## ● SUPPLY

Scenario Analysis - supply

<i>Supply-side simulation</i>	<i>Scenario 1</i>	<i>Scenario 2</i>	<i>Scenario 3</i>	<i>Scenario 4</i>
Location of P/L	Inside metro stations	Inside metro stations	Outside metro stations/adjacent buildings	Outside metro stations/adjacent buildings
Remuneration	2 €/delivery	16 €/delivery	20 €/delivery	16 €/delivery
Delivery booking	OFF-line booking	OFF-line booking	OFF-line booking	OFF-line booking
Task creating modes	Single delivery	Single delivery	Single delivery	Single delivery
<i>Probability to act as a crowdshipper</i>	<i>84.0%</i>	<i>54.0%</i>	<i>46.0%</i>	<i>12.0%</i>



# Implications (1/3)

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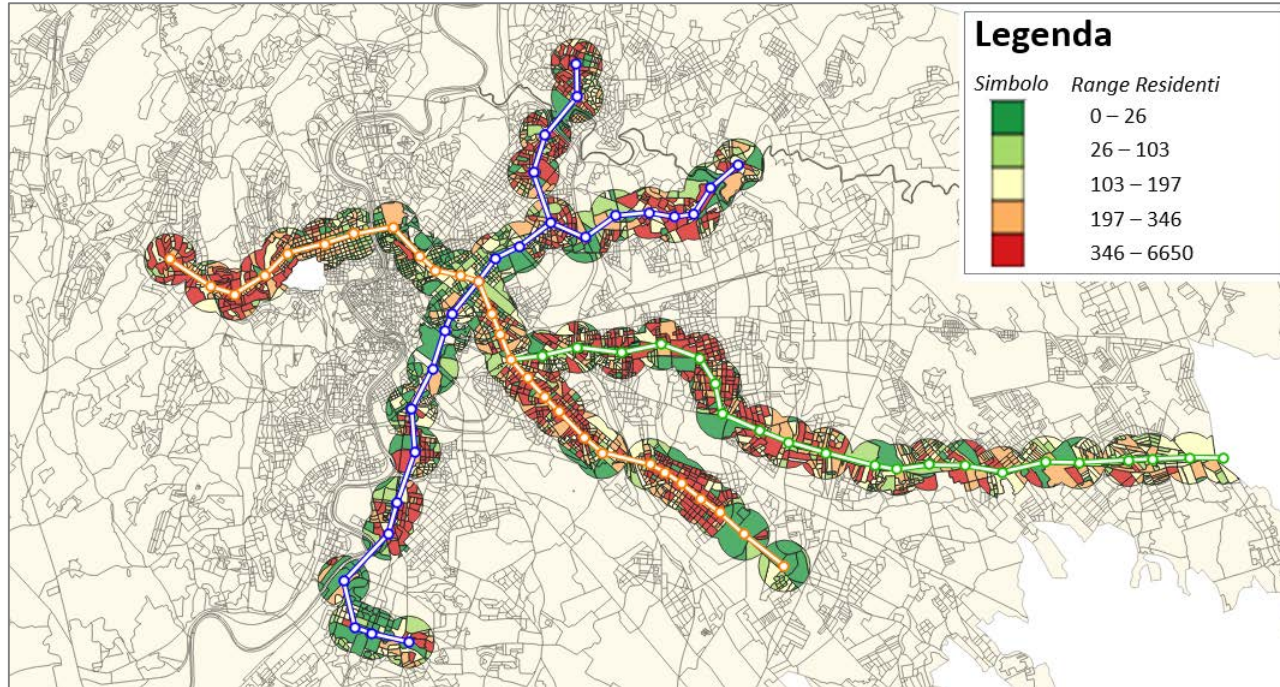
$$\begin{aligned} & E\text{shopping rate} \left[ \frac{\text{orders}}{\text{day inhab}} \right] \\ &= \frac{\left( \text{Web Shopper} [\%] * \text{Physical shipment} [\%] * \text{Ecommerce frequency} \left[ \frac{\text{orders}}{\text{year inhab}} \right] \right)}{250} \\ &= 0.0262 \end{aligned}$$

where:

- Web Shopper is the percentage of the population making at least one online purchase;
- Physical shipment is the percentage of orders requiring a physical shipment;
- E-commerce frequency is the annual average frequency of online purchase;
- 250 is the number of days in one year, excluding week-end days and public holidays.

(Netcomm, 2016; 2017)

# Implications (2/3)



inhabitants located in the surrounding area of the metro stations (adopting a catchment area of 800m radius for each stop)

# Implications (3/3)

<b>Demand SCENARIOS</b>	Metro users* [users/peak hour]	Inhabitants**	Probability to adopt crowdshipping service	Potential demand [orders/day]
SCENARIO 1			66.10%	14'100
SCENARIO 2			59.70%	12'730
SCENARIO 3	113'347	647'154	16.40%	3'500
SCENARIO 4			12.40%	2'640
<b>Supply SCENARIOS</b>	Metro users* [users/peak hour]		Probability to act as a crowdshippers	Potential crowdshippers [crowdshippers/day]
SCENARIO 1			84.6%	38'350
SCENARIO 2			54.8%	24'840
SCENARIO 3	113'347		46.0%	20'850
SCENARIO 4			12.8%	5'800

\*Users of the Rome's metro lines during the peak hour (Roma Mobilità, STATUS 2016).

\*\*Inhabitants in the 800'meters catchment area (elaboration from census data ISTAT 2011, <https://www.istat.it/it/archivio/104317>).

# Conclusions

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- APLs location is the most relevant feature (more than remuneration)
- The possibility to plan the delivery date and its time schedule has the highest impact on consumers' utility
- Comparing demand/supply → the service can rely on a sufficiently large base of potential crowdshippers so to be able to manage a substantial number of delivery requests
- There is a potential market for the new service and it is important to pay attention to its design

# On-going research endeavours



- Quantifying the environmental effects via Traffic Simulation Modelling
- Test a real-life pilot study (interlibrary loans)
  - Financial, contractual, legal (etc.) aspects
- Including Crowdshipping in the SUMP-logistic in Rome



ROMA  
CAPITALE



THANKS FOR THE ATTENTION

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