E-carsharing: a methodology to assess the market potential

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Project: Eletric Car Sharing
Funded by the Friuli Venezia Giulia Region, Italy
Sustainable mobility: 90% fuel subsidies
Project: Eletric Car Sharing

Product innovations, private firms involvement, zero-emission passenger vehicles

Innovations:
• Station E-cars (E-way Milan)
• E-car fleet management (Guidami Milan)
• E-carsharing (Car2go S. Diego, Autolib Paris)

Research, software, experimentation
Questions and doubt

- Will our innovations work in the FVG region?
- How could they properly be implemented?
- How many people or firms will be using them?
- Will the revenues cover the costs?
Carsharing: definition

Carsharing is a model of car rental where people rent cars for short periods of time, often by the hour.

Cars are managed by an organization, such as commercial business, a public agency, a cooperative, or ad hoc grouping.
Niche market with impressive growth rates

Tabella (1): Utenza e veicoli car sharing nel mondo, anno 2006.

<table>
<thead>
<tr>
<th></th>
<th>EUROP A</th>
<th>NORDAMERICA</th>
<th>ASIA</th>
<th>AUSTRALIA</th>
<th>TOTALE</th>
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<tbody>
<tr>
<td>Utenza</td>
<td>213.424</td>
<td>117.656</td>
<td>15.700</td>
<td>1.130</td>
<td>347.910</td>
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<tr>
<td>Veicoli</td>
<td>7.686</td>
<td>3.337</td>
<td>608</td>
<td>65</td>
<td>11.696</td>
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</tbody>
</table>

- North America - July 2008: 33 operators, 318,838 members, 7,505 vehicles
- Switzerland - Mobility 2012 - 2,600 vehicles, 1,300 locations.
- Italy, ICS, 2011, 599 vehicles, 404 parking places, 17,925 member, located in 12 Italian cities.
Literature on:

• The growth and expansion of carsharing
• Administrative or logistical aspects of running a carsharing organization
• The actual usage of the carsharing vehicles, the people who have chosen to join a carsharing service
• How the adoption of carsharing impacts vehicle kilometers travelled and vehicle ownership
• The familiarity with the concept of carsharing and willingness to accept it
What is the actual market potential of carsharing?

1. Schuster et al. (2005): a simulation model
2. Catalano et al. (2008): discrete choice model
4. Ducan (2011): detailed calculations with further restrictions
Carsharing operating companies: cost comparison tool (Mobility, CH)
• Focus on auto type and kilometers driven

Calculate your savings by using car sharing!

Which vehicle category matches your requirements?
- Small cars
- Mid-range cars

What do you use your passenger car and/or public transport for?
- Car (PC) 100%
- Public transport (PT)

How many kilometres do you drive/travel each year (PC + PT)?
- Occasional driver
- Frequent driver
What do you use your passenger car and/or public transport for?

- Car (PC): 25% 75%
- Public transport (PT)

How many kilometres do you drive/travel each year (PC + PT)?

- Occasional driver: 5'000 7'500 10'000 15'000 20'000
- Frequent driver

With your selection, you will save: CHF 3632.-
in combination with public transport (75%) and CarSharing (25%)
FIGURE 1  Conceptual model of carsharing versus ownership decision. Attitudinal factors affect the cost switch point, which is the monetary value on which the decision is based.
Assumptions

- Attitudinal factors are not considered
- Focus on vehicles instead of individuals
- Focus on monetary costs
FIGURE 2  Influence diagram of the economic decision to own or share. This is an expansion of the center (cost) component of Figure 1. All nodes are explicitly considered in the simulation, and arrows represent relationships modeled either through equations or correlations.
CSO costs in Baltimore

• the Flexcar program in the nearby Washington, D.C., metropolitan area in March 2004

• The annual membership fee is $25, the hourly rate is $9, and the mileage fee is $0.35.
Travel behaviour

• The NHTS included a 1-day trip diary, with information on these variables, as well as trip distance, purpose, and vehicle used (24,000 trips taken in 4,515 vehicles).

• Daily travel time was multiplied by 365 to get annual travel time, assuming a representative travel day.
Results for Baltimore

• In the base case, carsharing was chosen 1,474 out of 35,500 trials, or 4.15 ± 0.10% of the time.
• Expensive Vehicles and Prestige Value: 3.69 ± 0.09%,
• Commuter-Based Operational Model: 14.77 ± 0.37%
• Comparable to the area transit mode share, which is 5.7%
• Preliminary evidence suggests that carsharing may prove a useful part of an integrated strategy to reduce the negative effects of auto dependence.
Limitations

• Travel patterns with limited details
• Non-monetary factors
• Socio-economic characteristics
• Etc ..........
Discrete choice model

\[ V_{\text{CAR}} = \beta_{T_{\text{TRAVEL}}} \cdot T_{\text{TRAVEL}} + \beta_{C_{\text{TRAVEL}}} \cdot C_{\text{TRAVEL}} + \beta_{T_{\text{PARKING}}} \cdot T_{\text{PARKING}} + \beta_{\text{CAR}} \cdot \text{CAR} \]

\[ V_{\text{CARPOOLING}} = \beta_{T_{\text{TRAVEL}}} \cdot T_{\text{TRAVEL}} + \beta_{C_{\text{TRAVEL}}} \cdot C_{\text{TRAVEL}} + \beta_{T_{\text{PARKING}}} \cdot T_{\text{PARKING}} \]

\[ V_{\text{CARSHARING}} = \beta_{T_{\text{TRAVEL}}} \cdot T_{\text{TRAVEL}} + \beta_{C_{\text{TRAVEL}}} \cdot C_{\text{TRAVEL}} + \beta_{T_{\text{PARKING}}} \cdot T_{\text{PARKING}} + \beta_{\text{NCARS}} \cdot \text{NCARS} + \beta_{\text{CS}} \cdot \text{CS} \]

\[ V_{\text{PUBLICTRANSPORT}} = \beta_{T_{\text{TRAVEL}}} \cdot T_{\text{TRAVEL}} + \beta_{C_{\text{TRAVEL}}} \cdot C_{\text{TRAVEL}} + \beta_{\text{PT}} \cdot \text{PT} \]
Nested logit model
Simulation for Palermo

- **Graph Description**: The graph illustrates the relationship between the car sharing kilometric fare (€/Km) and the choice percentage for different modes of transport.
- **Axes**:
  - **Y-axis**: Choice (%) from 0% to 45%
  - **X-axis**: Car sharing kilometric fare (€/Km) from 0.40 to 0.08

- **Lines**:
  - **CAR**: Blue line
  - **CAR POOLING**: Red line
  - **CAR SHARING**: Green line
  - **PUBLIC TRANSPORT**: Orange line

- **Observations**:
  - As the car sharing kilometric fare decreases, the choice percentage for car sharing increases.
  - The choice percentage for car sharing remains relatively constant across different fares, whereas the choice percentages for other modes show a clear trend with fare changes.

• Estimated with MATSim
Research questions

• What kind of vehicle usage patterns can carsharing accommodate in a cost effective manner?

• And how many vehicles in the Bay Area have driving patterns that meet the threshold at which carsharing becomes less expensive than auto ownership?
Travel diaries

• The 2000 Bay Area Travel Survey (BATS) is used to address this question. The BATS includes a sample of more than 15,000 households that were asked to keep a 2-day activity diary for each household member.

• The diary entries can be used to track the time, place, and mode for each individual’s travel movements. In the case of private auto trips, the specific vehicle used for a trip was recorded and this allows for a detailed accounting of the usage pattern for each vehicle owned by a BATS household (roughly 28,000 vehicles in total).
### Tariff Structure

#### Table 1: Pricing plans offered by Bay Area carsharing companies

<table>
<thead>
<tr>
<th></th>
<th>Annual fee</th>
<th>Minimum per month</th>
<th>Distance charges</th>
<th>Time charges</th>
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<tr>
<td></td>
<td></td>
<td></td>
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<td>Weekday</td>
</tr>
<tr>
<td>City CarShare</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Plan 1</td>
<td>$45</td>
<td>n/a</td>
<td>$0.25/km</td>
<td>$6.50/h</td>
</tr>
<tr>
<td>Plan 2</td>
<td>$120</td>
<td></td>
<td>$0.22/km</td>
<td>$5.50/h</td>
</tr>
<tr>
<td>Plan 3</td>
<td>$240</td>
<td></td>
<td>$0.22/km</td>
<td>$5.50/h</td>
</tr>
<tr>
<td>Zipcar</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plan 1</td>
<td>$50</td>
<td>n/a</td>
<td>First 290 km/day: no charge</td>
<td>$7.00/h</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Additional km: $0.28/km</td>
<td>$6.30/h or $65.70/day</td>
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<tr>
<td>Plan 2</td>
<td>n/a</td>
<td>$50</td>
<td></td>
<td>$5.95/h or $62.05/day</td>
</tr>
<tr>
<td>Plan 3</td>
<td>n/a</td>
<td>$250</td>
<td></td>
<td>$5.95/h or $62.05/day</td>
</tr>
</tbody>
</table>

The distance charges listed for Zipcar apply to all three zip car plans.
Carsharing costs

- Scenarios on the number of carsharing pods (current 175, 375 pods, ubiquitous access)
- Estimation of pod access costs
- Additional costs and benefits
  - Inconvenience associated with always having to reserve a vehicle in advance
  - No guarantee that a vehicle will be available at the time it is most needed.
  - Limited ability to choose a vehicle that most closely matches its needs and preferences.
  - Not having to worry about keeping a vehicle properly maintained and registered.
- Factors not considered for lack of good data
Two dimensions of driving behavior

• Carsharing for commuting
• Carsharing for non-work travel
<table>
<thead>
<tr>
<th>Pod location assumption</th>
<th>Vehicle ownership assumption</th>
<th>% of vehicles where carsharing cost is Less than ownership cost (%)</th>
<th>Less than ownership cost by at least $100 per month (%)</th>
<th>% of households owning at least 1 vehicle where carsharing cost is Less than ownership cost (%)</th>
<th>Less than ownership cost by at least $100 per month (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current locations (scenario 1)</td>
<td>Low cost (used subcompact)</td>
<td>3.7</td>
<td>0.9</td>
<td>5.4</td>
<td>1.1</td>
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<tr>
<td></td>
<td>Carsharing-equivalent (new compact)</td>
<td>6.5</td>
<td>4.9</td>
<td>9.3</td>
<td>7.1</td>
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<td>Expanded locations (scenario 2)</td>
<td>Low cost (used subcompact)</td>
<td>9.0</td>
<td>1.2</td>
<td>13.0</td>
<td>1.5</td>
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<td></td>
<td>Carsharing-equivalent (new compact)</td>
<td>15.6</td>
<td>12.5</td>
<td>21.5</td>
<td>17.6</td>
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<td>Ubiquitous (scenario 3)</td>
<td>Low cost (used subcompact)</td>
<td>23.5</td>
<td>3.3</td>
<td>31.2</td>
<td>4.6</td>
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<tr>
<td></td>
<td>Carsharing-equivalent (new compact)</td>
<td>29.9</td>
<td>26.2</td>
<td>37.5</td>
<td>34.0</td>
</tr>
</tbody>
</table>
Non-monetary considerations

• The vehicle belongs to a household that owns no more than one vehicle per driver
• The vehicle belongs to a household with more than one car
• The vehicle belongs to a household with children under 6 years old
• The vehicle was manufactured before 1970
• The vehicle is a light truck (e.g., pickup truck, van, or SUV).
Duncan’s conclusions

• A third of Bay Area households (more than 800,000) have at least one vehicle with a usage pattern that is economical conducive to carsharing.

• This combines with the quarter million Bay Area households that do not own a vehicle (as of the 2000 census) to make an impressive base of potential carsharing adopters.

• To put this in context, actual number of carsharing members across the entire US as of 2009 was less than 300,000.

• How well the cost saving potential of carsharing translates to more auto-oriented regions goes beyond the scope of this analysis but this certainly requires more attention.
Research question

• How could the discrepancy between the estimated market potential and the current market penetration be explained?
Our first preliminary methodology

**Urban environment:**
- City or village size
- Traffic and parking conditions
- Traffic regulation

**Socio-economic factors:**
- Car ownership, occupation, family size, n° of children, travel patterns

**Carsharing supply:**
- Pod locations, tariff structure, n° of vehicles

**Individual decision model:**
- Car ownership vs. carsharing
- Monetary and non-monetary cost and benefit factors

**Potential demand of carsharing:**
- Geographical and demographic features of the Region\State
Costs and benefits at individual level

- Net cost of owning a car = Vehicle depreciation + Car insurance + Risk of car theft and damages + Fuel cost + Vehicle registration fees + Parking cost during non-use + Park searching time + Transaction costs - Pleasure to have one’s own private car - Status symbol quality of one’s own car

- Net cost of carsharing = Use cost + Transaction costs + Risk of not finding a car for share when needed + Time to reach the pod - No nuisance for vehicle maintenance and parking - Ideological satisfaction
## Net cost of owning a car

<table>
<thead>
<tr>
<th>Type of settlement</th>
<th>Town Centre</th>
<th>Town Centre</th>
<th>Town Centre</th>
<th>Periph. Centre</th>
<th>Periph. Centre</th>
<th>Periph. Centre</th>
<th>Periph. Centre</th>
<th>Village Centre</th>
<th>Village Centre</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>User's occupation</strong></td>
<td>Active</td>
<td>Active</td>
<td>Retired</td>
<td>Retired</td>
<td>Active</td>
<td>Active</td>
<td>Retired</td>
<td>Retired</td>
<td>Active</td>
</tr>
<tr>
<td><strong>Car ownership</strong></td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Average simulated net cost of owning a car</strong></td>
<td>2,545</td>
<td>3,045</td>
<td>2,020</td>
<td>2,520</td>
<td>1,945</td>
<td>2,445</td>
<td>1,770</td>
<td>2,270</td>
<td>1,645</td>
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<td><strong>Opportunity cost of car ownership</strong></td>
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<td>2,113</td>
<td>2,113</td>
<td>2,113</td>
<td>2,113</td>
<td>2,113</td>
<td>2,113</td>
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<td><strong>Car insurance cost</strong></td>
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<td>450</td>
<td>450</td>
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<td>450</td>
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<td>450</td>
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<tr>
<td><strong>Risk of car theft and damages</strong></td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
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<td>200</td>
<td>200</td>
<td>200</td>
<td>200</td>
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<td><strong>Vehicle excise duty</strong></td>
<td>200</td>
<td>200</td>
<td>200</td>
<td>200</td>
<td>200</td>
<td>200</td>
<td>200</td>
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<tr>
<td><strong>Parking searching cost</strong></td>
<td>910</td>
<td>910</td>
<td>407</td>
<td>407</td>
<td>303</td>
<td>303</td>
<td>136</td>
<td>136</td>
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<td><strong>- Parking searching time per trip (min.)</strong></td>
<td>15</td>
<td>15</td>
<td>15</td>
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<td><strong>- N° of parking searches per year</strong></td>
<td>243</td>
<td>243</td>
<td>109</td>
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<td>243</td>
<td>243</td>
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<td>109</td>
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<td><strong>- Monetary value of parking searching time (per min.)</strong></td>
<td>0,25</td>
<td>0,25</td>
<td>0,25</td>
<td>0,25</td>
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<td><strong>Transaction costs (maintenance, refuelling)</strong></td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
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<tr>
<td><strong>Pleasure to have one's own private car</strong></td>
<td>200</td>
<td>200</td>
<td>200</td>
<td>200</td>
<td>200</td>
<td>200</td>
<td>200</td>
<td>200</td>
<td>200</td>
</tr>
<tr>
<td><strong>Status symbol quality of one's own car</strong></td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
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<tr>
<td><strong>Psychological cost of giving up the car</strong></td>
<td>500</td>
<td>-</td>
<td>500</td>
<td>-</td>
<td>500</td>
<td>-</td>
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## Net cost of carsharing

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<tr>
<th>Type of settlement</th>
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<th>Town</th>
<th>Town</th>
<th>Town</th>
<th>Town</th>
<th>Town</th>
<th>Town</th>
<th>Village</th>
<th>Village</th>
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<tbody>
<tr>
<td>User's occupation</td>
<td>Active</td>
<td>Active</td>
<td>Retired</td>
<td>Retired</td>
<td>Active</td>
<td>Active</td>
<td>Retired</td>
<td>Retired</td>
<td>Active</td>
<td>Retired</td>
</tr>
<tr>
<td>Car ownership</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Average simulated cost of carsharing</td>
<td>13,070</td>
<td>13,070</td>
<td>2,030</td>
<td>2,030</td>
<td>13,270</td>
<td>13,270</td>
<td>2,113</td>
<td>2,113</td>
<td>14,678</td>
<td>2,547</td>
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<tr>
<td>Carsharing payments to the CS operator</td>
<td>12,371</td>
<td>12,371</td>
<td>1,970</td>
<td>1,970</td>
<td>12,371</td>
<td>12,371</td>
<td>1,970</td>
<td>1,970</td>
<td>14,482</td>
<td>2,621</td>
</tr>
<tr>
<td>- Annual membership cost</td>
<td>180</td>
<td>180</td>
<td>180</td>
<td>180</td>
<td>180</td>
<td>180</td>
<td>180</td>
<td>180</td>
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<tr>
<td>- Charging for the distance travelled</td>
<td>1,055</td>
<td>1,055</td>
<td>326</td>
<td>326</td>
<td>1,055</td>
<td>1,055</td>
<td>326</td>
<td>326</td>
<td>3,166</td>
<td>977</td>
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<td>Transaction costs (booking, paying)</td>
<td>50</td>
<td>50</td>
<td>20</td>
<td>20</td>
<td>50</td>
<td>50</td>
<td>20</td>
<td>20</td>
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<td>Risk of not finding a car for share when needed</td>
<td>300</td>
<td>300</td>
<td>50</td>
<td>50</td>
<td>300</td>
<td>300</td>
<td>50</td>
<td>50</td>
<td>50</td>
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<tr>
<td>Cost of the time to reach the shared car pod</td>
<td>607</td>
<td>607</td>
<td>271</td>
<td>271</td>
<td>809</td>
<td>809</td>
<td>362</td>
<td>362</td>
<td>404</td>
<td>181</td>
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<td>- Time spent to reach the CS pod</td>
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<td>15</td>
<td>15</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>- Monetary cost of the time to reach the CS pod (per minute)</td>
<td>0.17</td>
<td>0.17</td>
<td>0.17</td>
<td>0.17</td>
<td>0.17</td>
<td>0.17</td>
<td>0.17</td>
<td>0.17</td>
<td>0.17</td>
<td>0.17</td>
</tr>
<tr>
<td>No nuisance for vehicle maintenance</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
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<tr>
<td>Ideological satisfaction</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
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<td>100</td>
<td>100</td>
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<td>Type of settlement</td>
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<tr>
<td>Location</td>
<td>Centre</td>
<td>Centre</td>
<td>Centre</td>
<td>Centre</td>
<td>Periph.</td>
<td>Periph.</td>
<td>Periph.</td>
<td>Periph.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>User's occupation</td>
<td>Active</td>
<td>Active</td>
<td>Retired</td>
<td>Retired</td>
<td>Active</td>
<td>Active</td>
<td>Retired</td>
<td>Retired</td>
<td>Active</td>
<td>Retired</td>
</tr>
<tr>
<td>Car ownership</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>- average N° of trips per year</td>
<td>240</td>
<td>240</td>
<td>100</td>
<td>100</td>
<td>240</td>
<td>240</td>
<td>100</td>
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</tr>
<tr>
<td>- distance travelled per trip</td>
<td>15.0</td>
<td>15.0</td>
<td>15.0</td>
<td>15.0</td>
<td>15.0</td>
<td>15.0</td>
<td>15.0</td>
<td>15.0</td>
<td>45.0</td>
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</tr>
<tr>
<td>- charge for km travelled</td>
<td>0.29</td>
<td>0.29</td>
<td>0.20</td>
<td>0.20</td>
<td>0.29</td>
<td>0.29</td>
<td>0.20</td>
<td>0.20</td>
<td>0.29</td>
<td>0.20</td>
</tr>
<tr>
<td>- average tour duration per trip in vehicle (hours)</td>
<td>0.5</td>
<td>0.5</td>
<td>0.5</td>
<td>0.5</td>
<td>0.5</td>
<td>0.5</td>
<td>0.5</td>
<td>0.5</td>
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<tr>
<td>- average dwell time (hours)</td>
<td>8</td>
<td>8</td>
<td>2</td>
<td>2</td>
<td>8</td>
<td>8</td>
<td>2</td>
<td>2</td>
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<tr>
<td>- total duration of a trip (in hours)</td>
<td>8.5</td>
<td>8.5</td>
<td>2.5</td>
<td>2.5</td>
<td>8.5</td>
<td>8.5</td>
<td>2.5</td>
<td>2.5</td>
<td>8.5</td>
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<tr>
<td>- Charge for time per hour</td>
<td>5.4</td>
<td>5.4</td>
<td>5.4</td>
<td>5.4</td>
<td>5.4</td>
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</table>
## Net benefit of carsharing vs. car ownership and % of carsharing per segment

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<th>Type of settlement</th>
<th>Town</th>
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<th>Town</th>
<th>Town</th>
<th>Town</th>
<th>Town</th>
<th>Town</th>
<th>Town</th>
<th>Village</th>
<th>Village</th>
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</thead>
<tbody>
<tr>
<td>Location</td>
<td>Centre</td>
<td>Centre</td>
<td>Centre</td>
<td>Centre</td>
<td>Periph.</td>
<td>Periph.</td>
<td>Periph.</td>
<td>Periph.</td>
<td>Village</td>
<td>Village</td>
</tr>
<tr>
<td>User's occupation</td>
<td>Active</td>
<td>Active</td>
<td>Retired</td>
<td>Retired</td>
<td>Active</td>
<td>Active</td>
<td>Retired</td>
<td>Retired</td>
<td>Active</td>
<td>Retired</td>
</tr>
<tr>
<td>Car ownership</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Net benefit of carsharing vs car ownership</td>
<td>-10,006</td>
<td>-9,506</td>
<td>-507</td>
<td>-1,007</td>
<td>-10,815</td>
<td>-10,315</td>
<td>-145</td>
<td>-645</td>
<td>-12,545</td>
<td>-40</td>
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<tr>
<td>% of carsahring</td>
<td>0.00%</td>
<td>0.00%</td>
<td>48.00%</td>
<td>90.90%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>19.60%</td>
<td>64.70%</td>
<td>0.00%</td>
<td>18.30%</td>
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</tbody>
</table>
Lessons learned
Crucial factors

Data requirements
• Travel patterns
• Car ownership data
• Definition of the geographical areas
• Carsharing tariffs and localization of CS pod
• Socio-economic variable (licenses per household, number of children)

Montecarlo simulations for the monetary and quantitative variable. Assumptions on the distribution or fitting the distribution with historical data

Estimation of the monetary value for the non-monetary variables
Our second preliminary methodology

- **Urban environment**
  City/village density, Traffic and parking level and regulation

- **Socio-economic factors**
  Car ownership level, Occupation, Family size, N° of children

- **Mobility patterns**
  Commuting trips, Non-commuting trips

- **Public transport**
  Frequency, Cost

- **Car sharing supply**
  Tariff structure, Pod location, n° and type of vehicles

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Household decision: Car ownership vs. carsharing
Monetary and non-monetary costs and benefits

Potential demand of carsharing
Thank you for your attention!