Carsharing services – Best practices

Basic definitions

Carsharing

Registration required, flexible car rental service supported by telematics system.

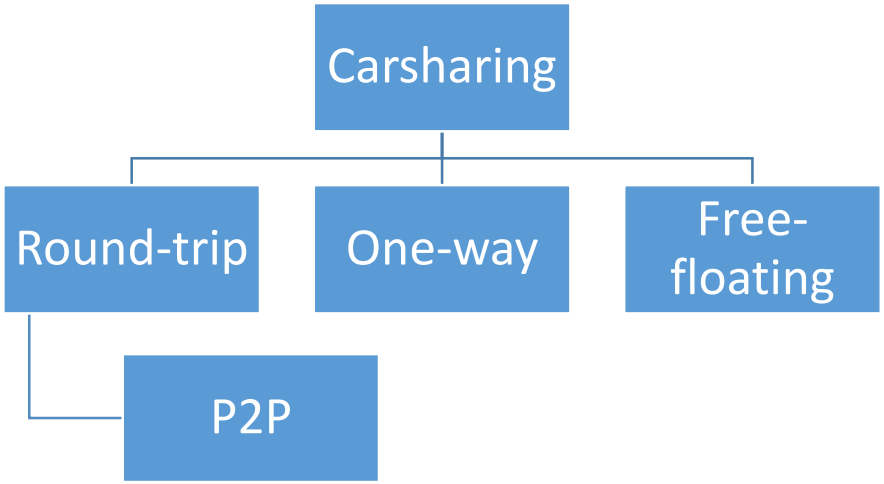
Type of services

Round-trip: Station based. Pick up and drop off points are the same.

One-way: Station based. Pick up and drop off points may be different.

Free-floating: the cars are available in a service zone. The customer shall leave the zone, but the drop off point must be in the zone. Usually the cars could park anywhere on the street.

Peer-2-peer (P2P): sub-type of round-trip services. The vehicles are owned by private people. The service provider mediates between owner and customer.



Effects of Carsharing services

Advantages

- Transportation related emission decreases
  - Carsharing is not an alternative to public transport, it complements the service of public transportation.

	Vehicles per households	
	Non-members	Members
USA	0,55	0,29
Canada	0,31	0,13

  - The activity of customers decreases throughout the years: they optimize their car use.
- Parking demand decreases
- Encourages environmentally conscious lifestyle

Disadvantages

- Encourage car use?
- Raise the number of car users?
- Air pollution increases on short trips due to catalytic converter operates under optimum temperature?

Criteria of carsharing station and zone selection

Geographical criteria

- **Population density**: the service area of a vehicle in carsharing service is limited. Recommended: >4000 people/km^2
- **Function of area**: residential or mixed (residential + business).
- **Quality of transportation**: conditions of car use, quality of road and public.
- **Visibility of carsharing vehicles**

Demographical criteria

- **Age**: mainly between 28 and 49.
- **Gender**: the rate of genders not relevant but men are more likely to join the service.
- **Education**: generally the members are more educated (university degree).

Rate of members with university or college degree [%]

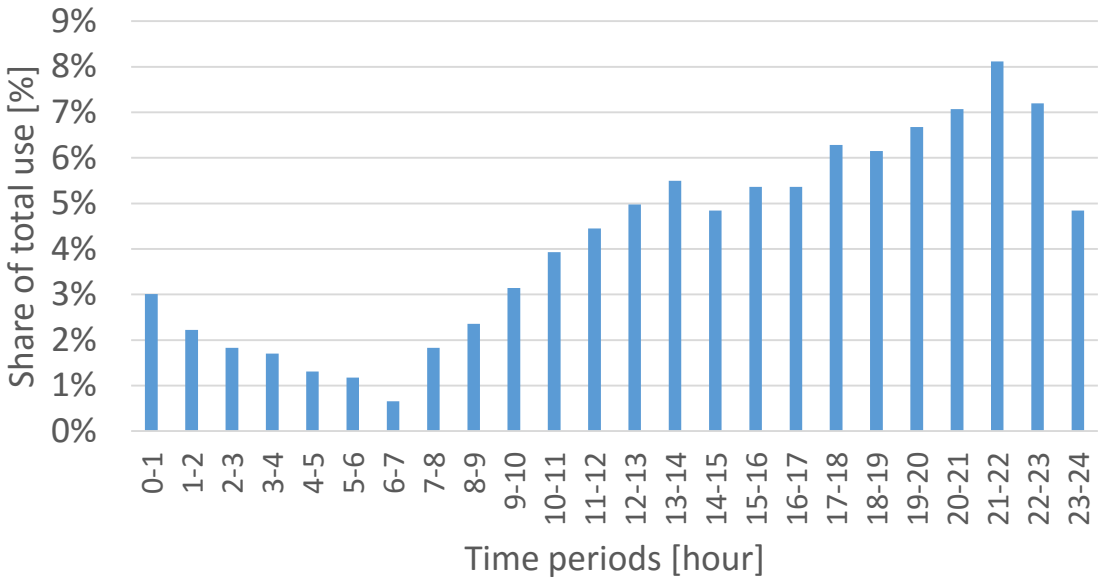
London	Brüsszel	Frankfurt	Olaszország
85	84,9	70	41

- **Employment status**
- **Income**: people are less likely to join under and over a specific income level.
- **Vehicle per household**: below average. The decline of number of vehicles could reach 25% between members.
- **Number of driver licenses per household**: ideally 1.

Round-trip and Peer 2 Peer services

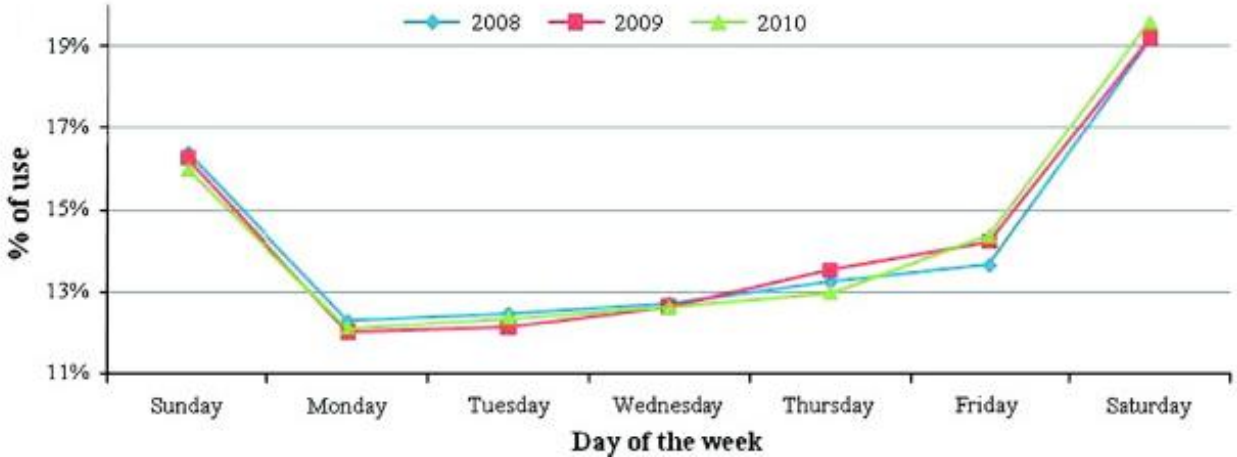
Characteristic

- Pick-up and drop off points are the same.
- The trips are done in the customer's free time due to the pick-up and drop off point restriction.
- Reliable service even with few cars.
- Distance between stations is important
- Expected number of customers is lower compared to other type of services.



Only P2P services

- Community based
- Divergence in fleet is not a problem



One-way services

Characteristic

- Station based, pick up and drop off point may be different.
- Relocating problem occurs. Possible solutions:
  - Operator relocates vehicles from time to time
  - Operator can deny specific routes
  - Operator encourages customers to use less vehicle together
  - The characteristic of city is taken into account during the development of stations.
- Since the routes are less limited the expected number of users is higher compared to round-trip services.

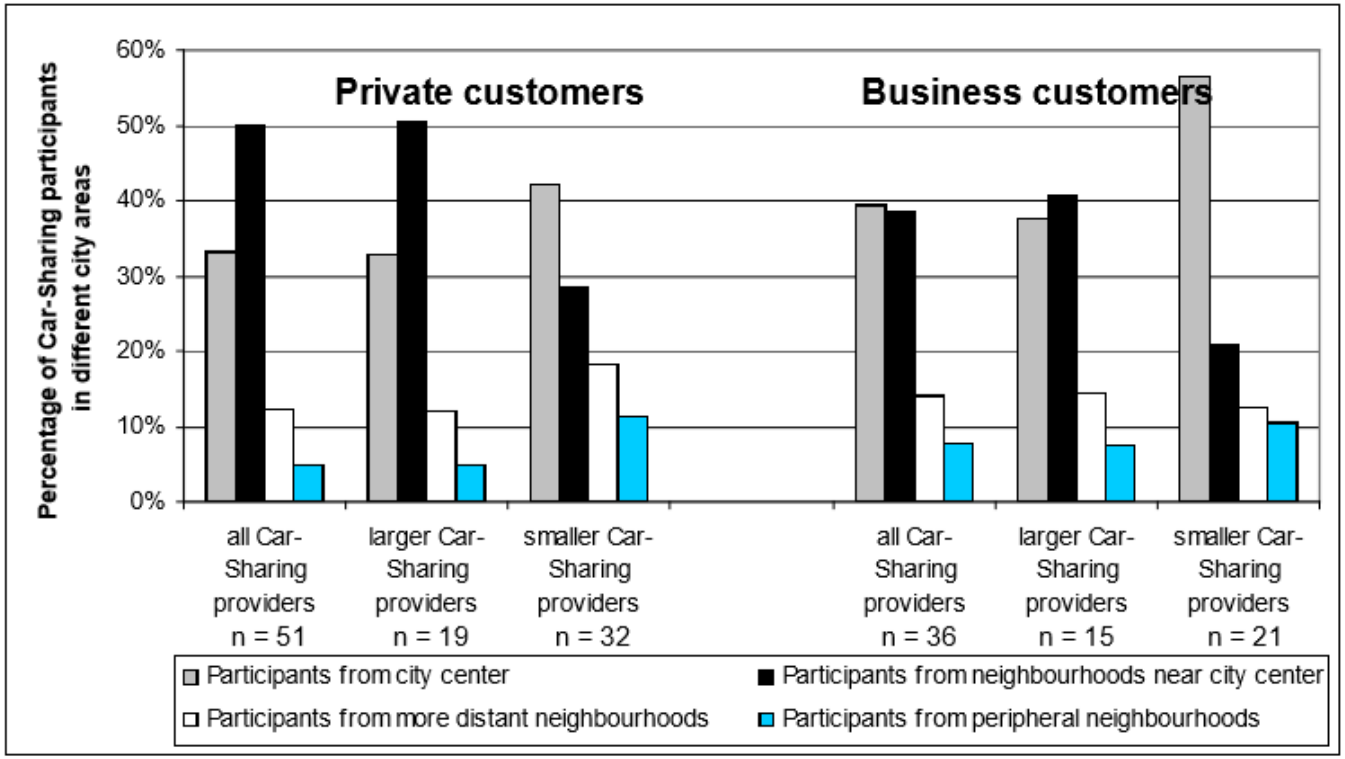
Free-floating services

Characteristic

- The drop off point can be anywhere within the service zone.
- The expected number of users is the highest compared to other service types.
- The problem of relocating is significant.
- High number of vehicles is needed to start the service.
- Mainly it is an advertisement for vehicle manufacturers.

State of carsharing in Europe

- First carsharing service: Switzerland, 1948
- 19 countries
- >200 operators
- >12 000 vehicles, annual mileage ≈23 000 km, utilization 6 hour per day
- >400 000 customers, 15 bookings per year
- 85% of customers are private customers



Round-trip carsharing services - examples

ZipCar (United Kingdom)

General characteristic

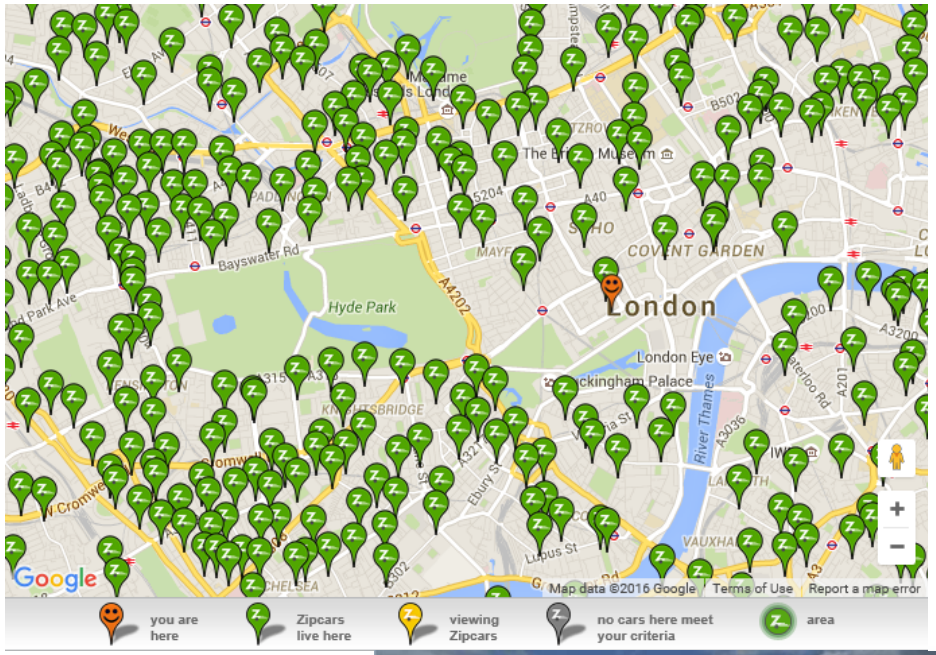
- ZiPCar operates in several countries, largest carsharing fleet
- After registration the customer can open the cars with a smartphone application, smart card is not necessary
- Reservation is required, maximum length of reservation is 7 days
- Several vehicle type can be found in the fleet
- Usually 1 car per station
- Gas card in vehicles, returning policy: at least ¼ tank of fuel
- Customer opinions: cheaper, than the cost of owning a vehicle; environmental friendly; convenient

Fares

- Fix and variable costs:
  - Membership fee: 6£ / month
  - Driving rates: min. 6 £ / hour, first 40 or 60 mile is free
- Zone fees and insurance are included in the price
- Variable fees (weekdays are cheaper)
- Discount fees for university students

Round-trip carsharing services - examples

ZipCar (United Kingdom)



meet tuscany

join now

vital stats

Name:	Ford Focus Auto "Tuscany"
Type:	hatchback 5 Door, 5 Seatbelts Automatic transmission
About Me:	"Whether you're taking a cheeky weekend getaway or just popping to the shops, the spacious Ford Focus makes any Ziptrip comfy and relaxing."
Good to Know:	medium capacity-bike with wheel off, 6-8 standard file boxes
Cost to Drive:	Monday - Friday hourly £7, daily £64 Saturday - Sunday hourly £8.50, daily £75

Rates displayed include fuel, insurance, and up to 60 miles free per day.

Covent Garden - Parker St
Camden

The Zipcars live in an on-street Car Club Only bay on Parker Street, near to the junction with Drury Lane. Please note that Parker Street is a one-way street and is accessed via Kingsway. WC2B 5PH

Nearby

Public Transport

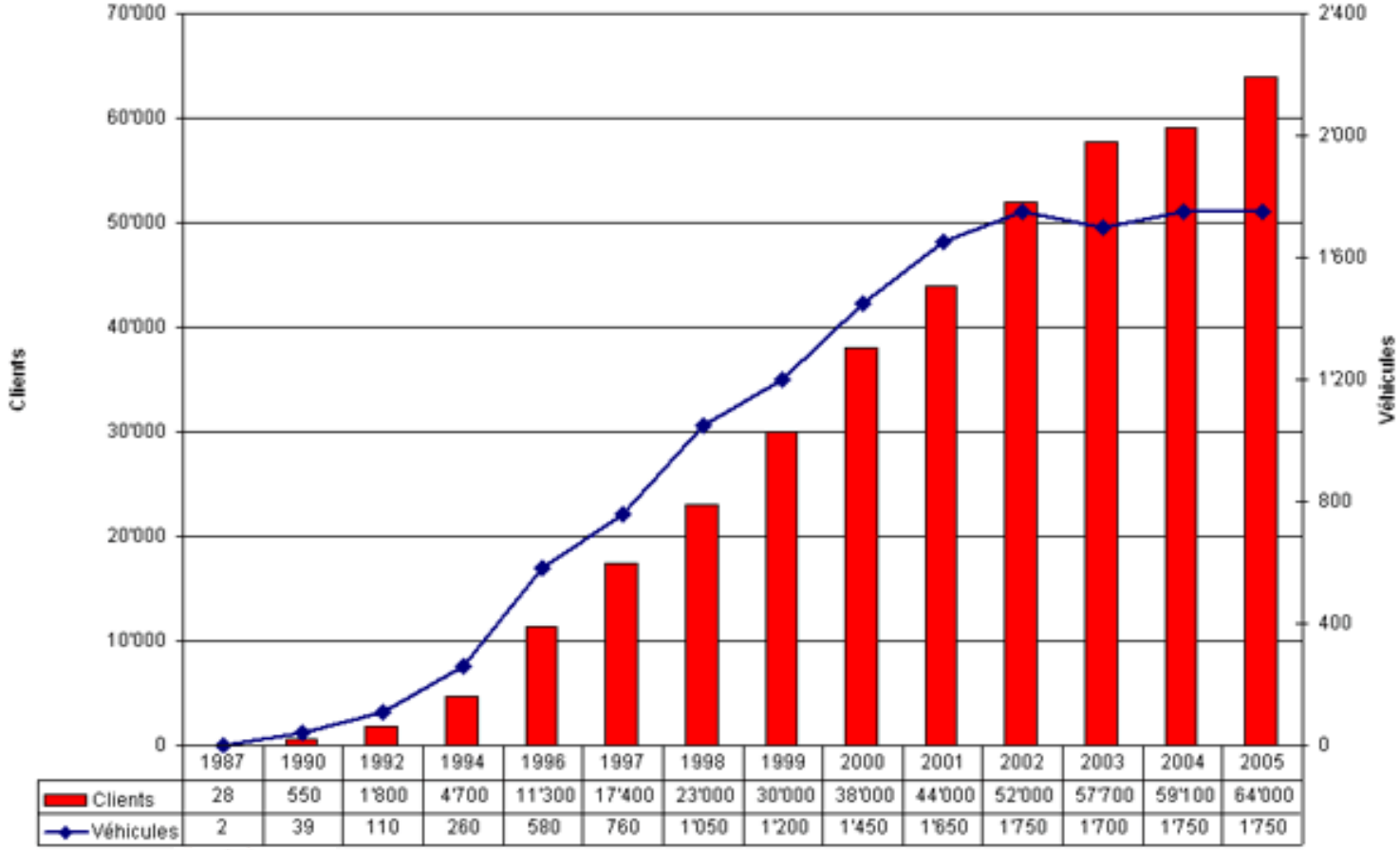
Petrol Stations

Round-trip carsharing services - examples

Mobility - Switzerland

General characteristic

- Customer categories: business and private
- Extra fee for booking via phone
- Discount for public transport users (train)



	1987	1990	1992	1994	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Clients	28	550	1'800	4'700	11'300	17'400	23'000	30'000	38'000	44'000	52'000	57'700	59'100	64'000
Véhicules	2	39	110	260	580	760	1'050	1'200	1'450	1'650	1'750	1'700	1'750	1'750

Round-trip carsharing services - examples

Getaround USA

General characteristic

- Peer 2 peer carsharing service
- No registration and membership fee
- Personal meeting is not required with owner
- Customer can rate the vehicle, owner can rate the customer
- Carsharing service operator’s source of income: owner of the vehicle
    - Installation fee of the device: 99$
    - 20$/ month
    - 40% of cost of use

Round-trip carsharing services - examples

Avalon CareSharing (Budapest)

General characteristic

- 3 public stations
- Several type of vehicles
- Personal meeting is required at registration
- Dedicated vehicles for business customers
- 24/7 call center
- Gas card in vehicles

Fares

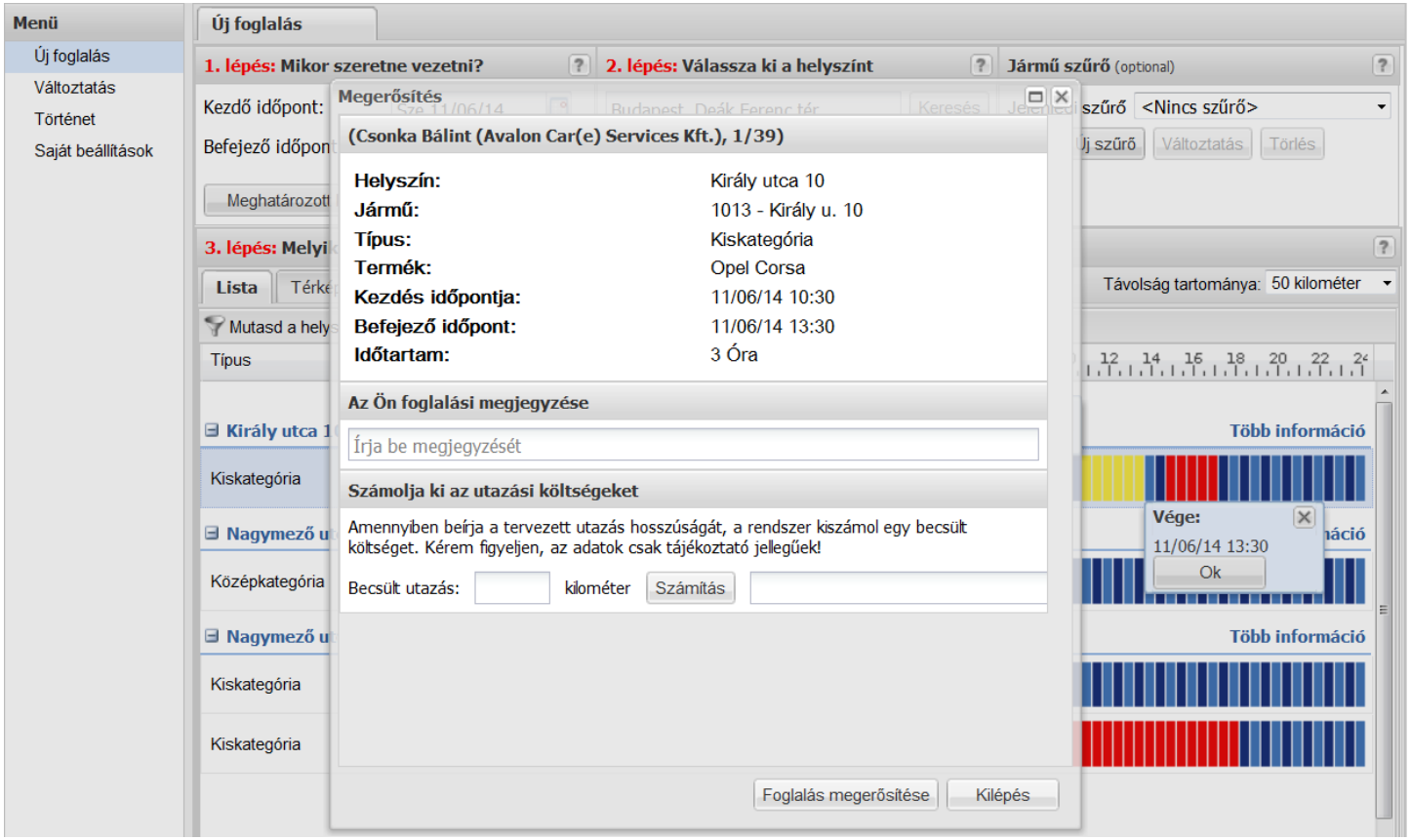
- Registration fee (consumable)
- Deposit or extra insurance fee
- Fix and variable costs:
  - Monthly fee: 3 tariff package
  - Driving rates /hour and /km
  - Variable rates (evening is cheaper, long journeys are cheaper)
- Basic insurance, fuel and highway fee are included
- No monthly fee with public transport pass (BKK pass)
- Payment at the end of the month

Round-trip carsharing services - examples

Avalon (Budapest)

Reservation

- Reserve vehicle on the website or via phone
- Modify reservation on the website or via on-board unit



One-way carsharing services - examples

CarCityClub (Italy)

General characteristic

- Stations can be found in several cities (Torino is presented here)
- In contact with other carsharing operators
- Fiat group vehicles: 30-40 vehicles, 65 stations, coverage area: 35 km^2
- Hybrid system: only several vehicle can be used in one-way system, the other vehicles must be returned to the pick up point
- Use of bus lines
- Free parking in the city
- Website only in Italian
- Tariff package for business customers

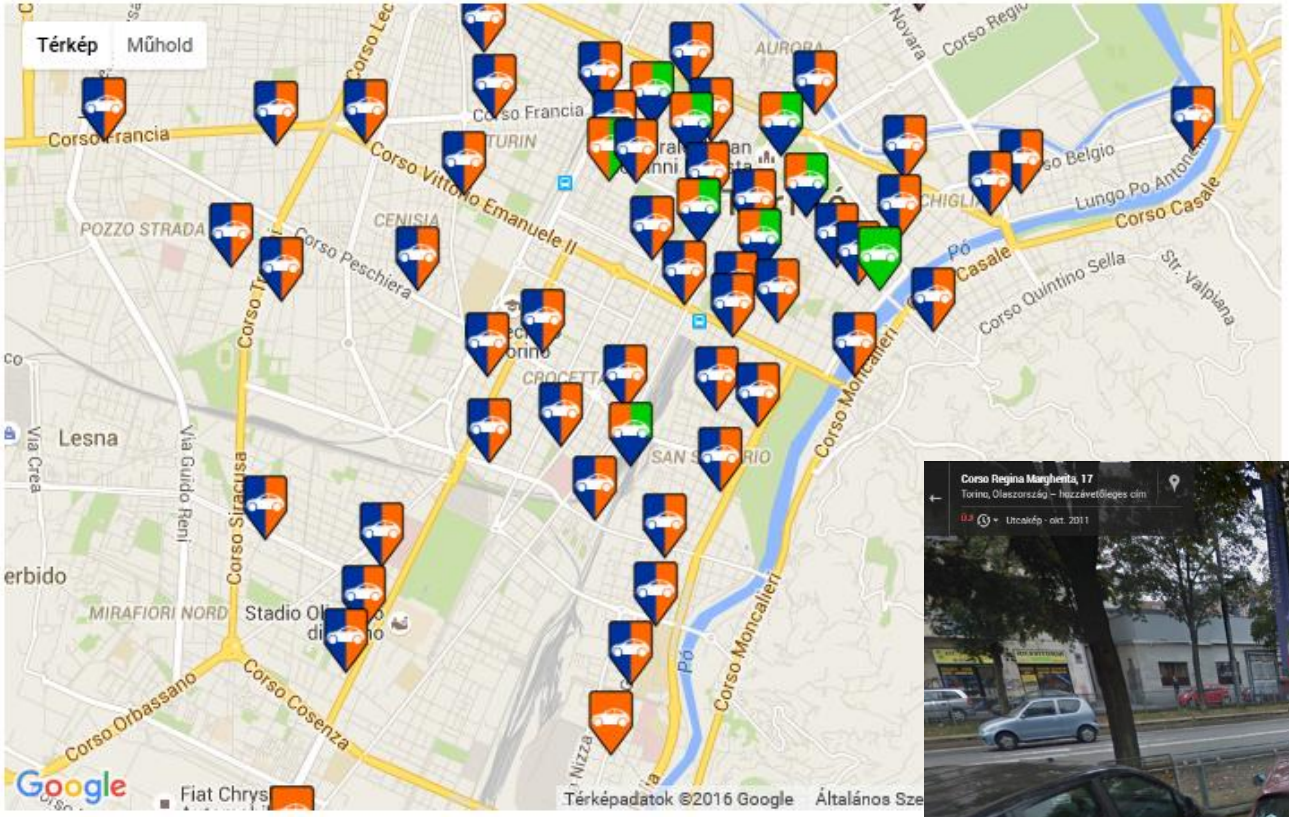
Fares

- Fix cost:
  - Annual fee (59€) or
  - Per occasion (19€)
- Variable cost:
  - Per hour and per km
- Different fees in different parts of the day

Példa one-way típusú szolgáltatásra

CarCityClub (Olaszország)

Classico ☑ Elettrico ☑ Andata ☑



Santa Teresa
Via Santa Teresa, angolo Via XX Settembre.

Stampatori
Via Stampatori, angolo Via Cernaia.

Solferino
Via Arcivescovado, angolo Piazza Solferino.

CLN
Piazza CLN, angolo Via Gobetti.

Free-floating carsharing services - examples

Multicity (Berlin)

General characteristic

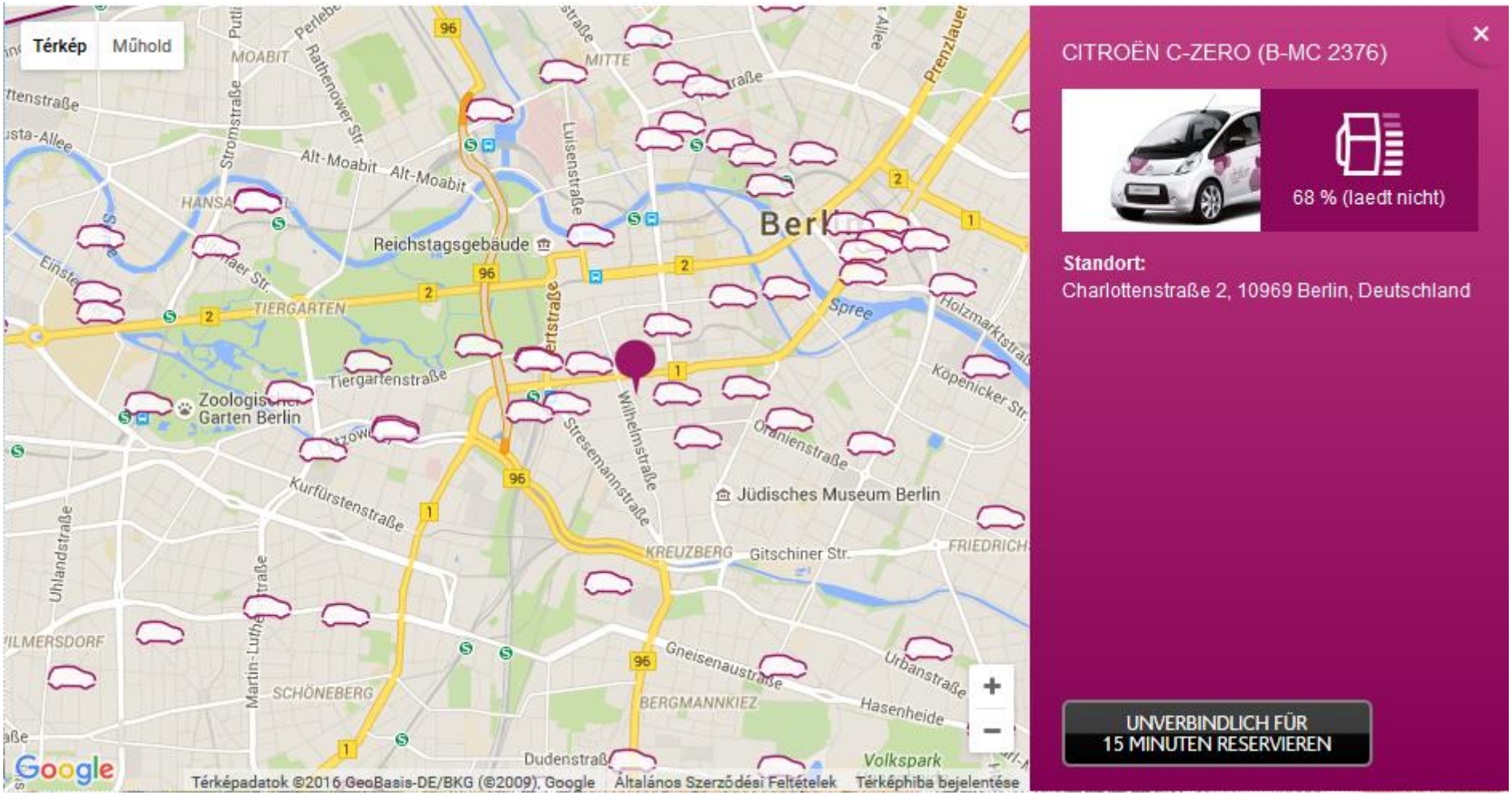
- Only battery electric vehicles: 350 Citroen C Zeros
- Multicity has dedicated parking places at charging stations, but vehicles can be left anywhere in the service zone
- Reservation is optional (website, telephone, smartphone application), but only 15 minutes in advance
- If the battery charge level is below 50% minutes and the customer start to charge the vehicle at the end of the trip, multicity gives 10 minutes for free
- The place of the vehicle and the state of the charge can be found on the website and in smartphone application
- Every customer can use a bikesharing service and an another round-trip carsrharing service
- Pets are allowed

Fares

- Registration fee: 9,90 €, 30 minutes of use included
- Variable cost:
  - Driving rate: 0,28€/minute, no minimum time of use.
  - Discount prices if the use is paid in advance

Free-floating carsharing services - examples

Multicity (Berlin)



Best-practices

General characteristic

- Online registration
- Reservation optional
- Reservation via phone is not free
- Vehicle selection on map, important information on the vehicle
- Customers take part in operation (fill up or charge the vehicle, relocation)
- Free parking
- Bus line use?
- Connection with other transportation modes
- Diverse vehicle fleet
- Visible stations and vehicles

Fares

- Registration fee consumable
- Differentiated variable cost:
    - Duration of reservation (short or long)
    - Timing of reservation (day or evening)

Comparison of carsharing services

Name of service	Number of		Service area	Veh. per station	Annual fee (HUF)	Driving rate per hour (HUF)	Reserv. time, driven km
	Customers	Vehicles					
ZipCar	767000	11000	USA, UK, Canada, Spain, Austria	2-6	21000	1160	1 h – 7d, <20 km free
Car2Go	250000	6000	17 cities worldwide	1-2	3000	3000	No limit
Mobility	64000	3200	Switzerland, 610 stations	4	72000	750-1050	No limit, 150Ft/km
AutoShare	12000	300	Toronto, 150 stations	1-3	10000	1500-2200	No limit
Drivenow	60000	1170	5 cities: Germany (4), USA (1)	1-2	10000	5000	No limit
Greenwheels	20000	600	Netherlands, Germany, UK	3	15000-35000	300-	No limit
City Car Club	20000	550	UK	2	20000	2000-3000	No limit, 65Ft/km
Autolib’	37000	1750	France, 35 stations	3	42000	3000	No limit, 115Ft/km
Stadtmobil	38000	1800	Germany, 7 cities, 800 station	2-5	11300	550-1200	No limit, 70Ft/km

Carsharing service – Quality analysis and assessment method

Literature review

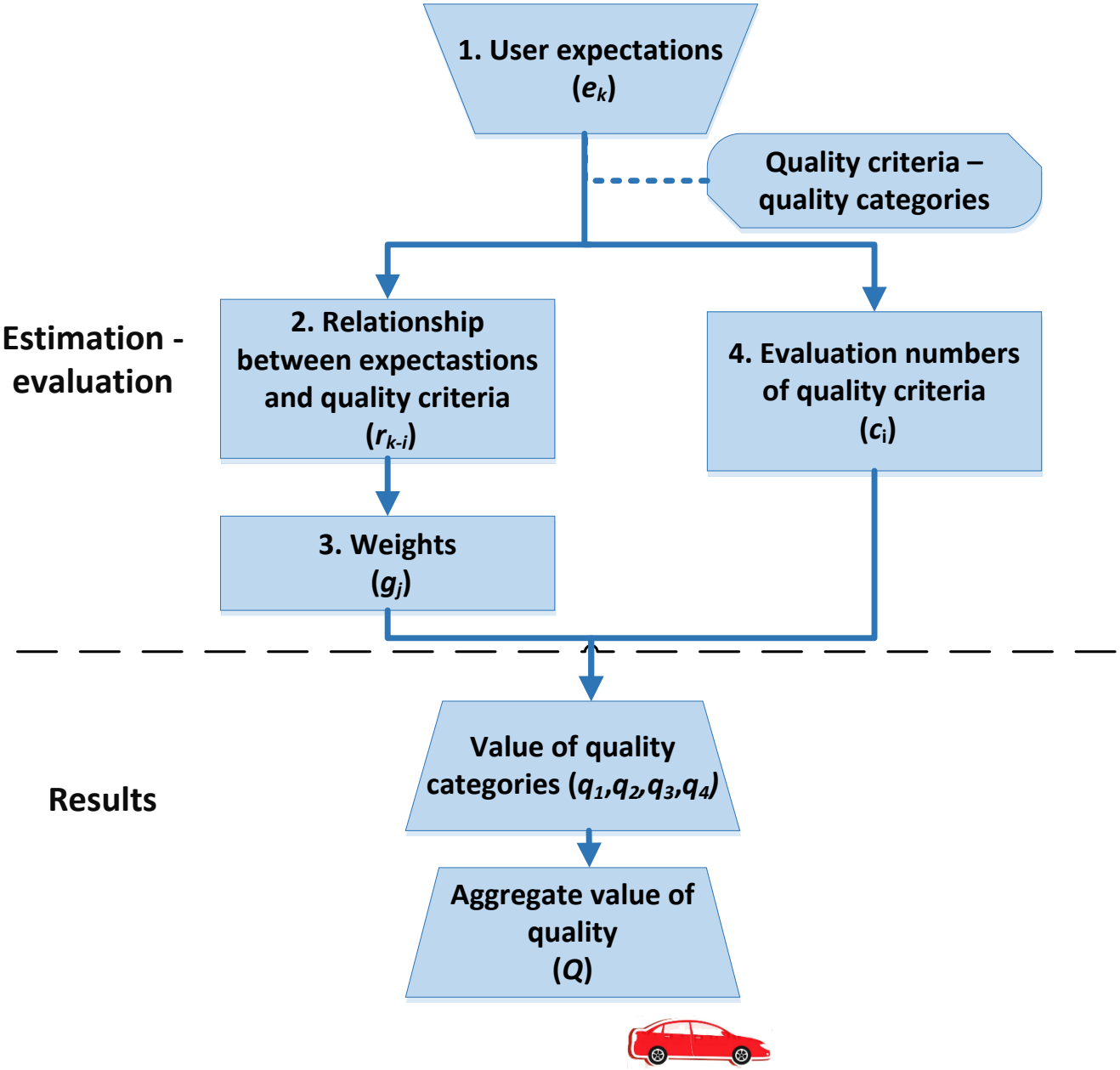
- Determination of user needs
- User characteristic
- Business models

- Lack of quality assessment method and demand model that can be used generally

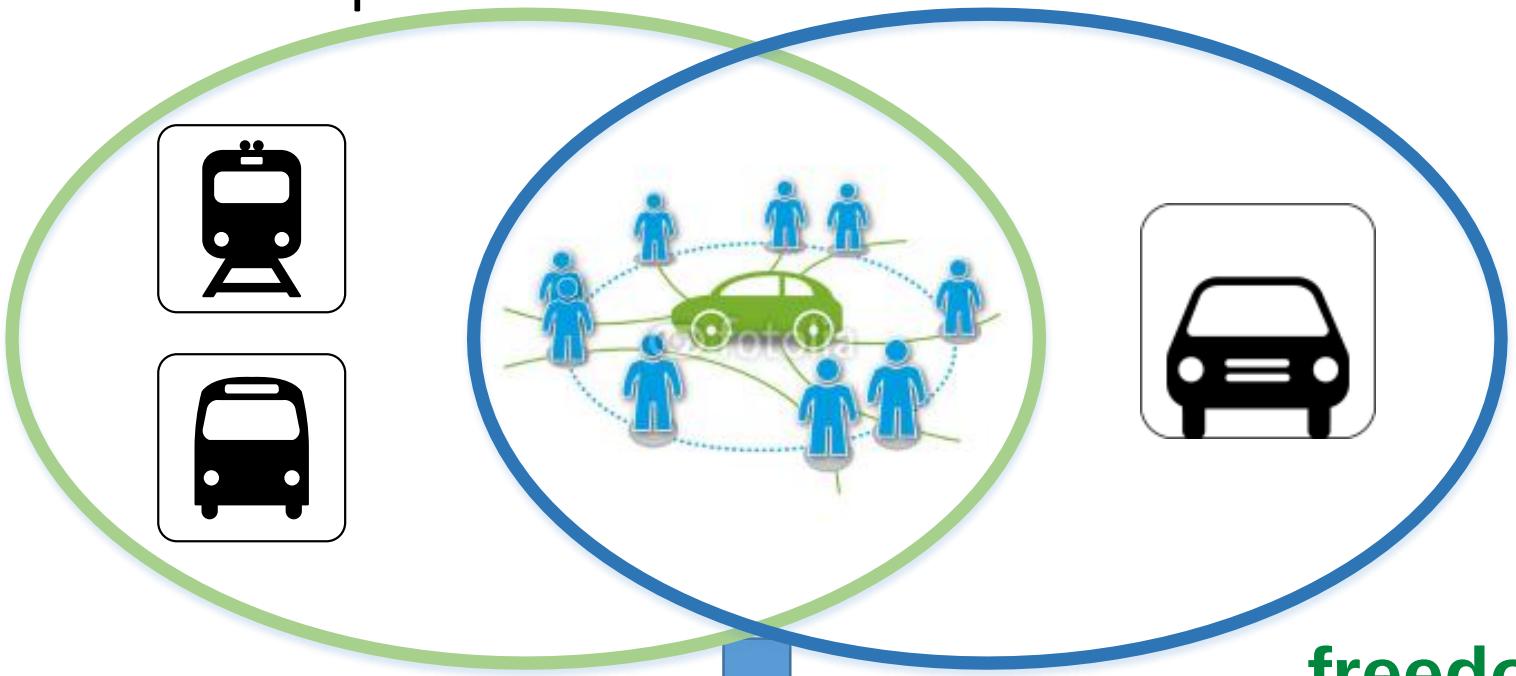
Aims

- Development of quality assessment method:
    - **Beneficial** for both user (traveller) and operator
    - **Easy-to-use**
    - **Personalized**
    - **Applicable** for different modes of transportation with slight modifications

Steps of qualiyt analysis and assessment method



1. User expectations (e_i)

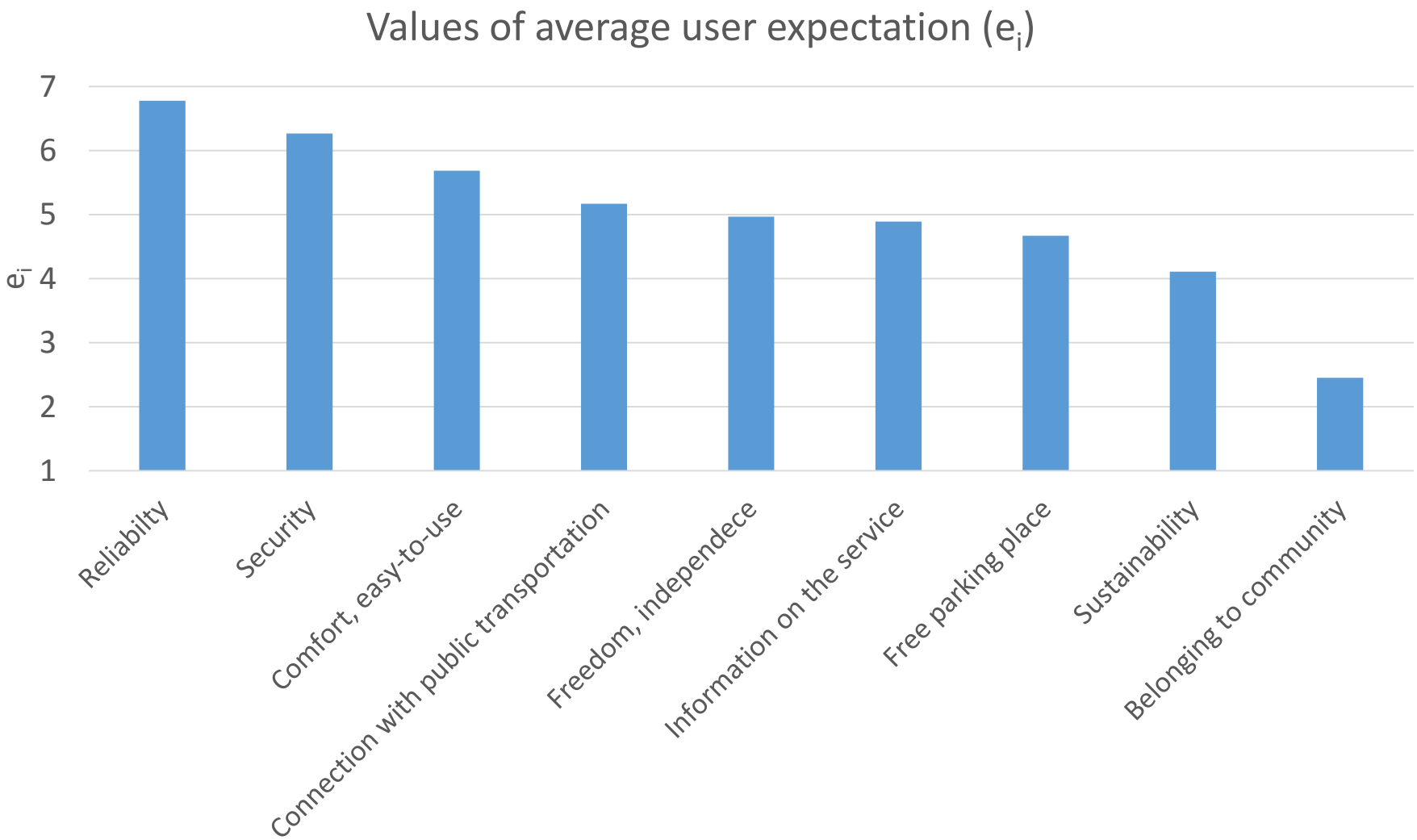


boundaries

freedom
reliability
costs

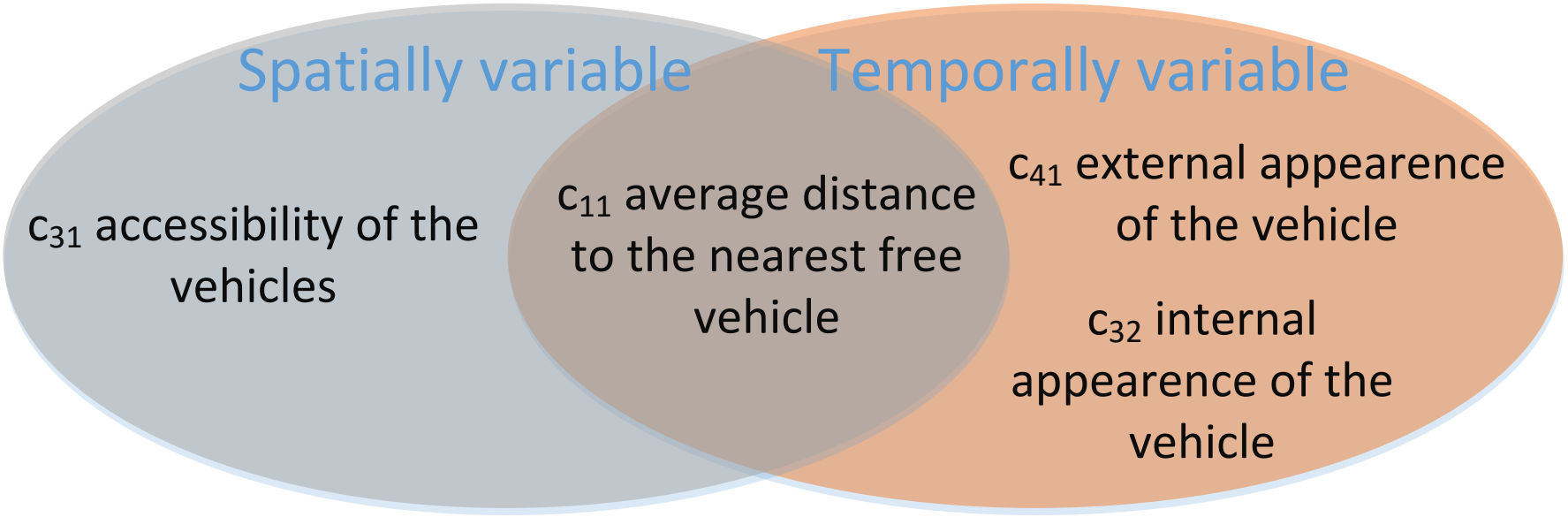
Low cost, high quality and density of cars in service area

1. User expectations (e_i)



2. Quality criteria (c_j)

- 18 criteria:12 criteria objective
- Data sources:
  - User characteristic
  - Properties of carsharing service
  - Areal properties



2. Quality criteria (c_j)

Service quality,
S_1={0, 11, 12, 13, 21, 31, 41}

- c_0: type of service
- c_{11}: average distance to the nearest free vehicle
- c_{12}: minimum and maximum period of use
- c_{13}: operating time
- c_{21}: reservation
- c_{31}: accessibility of the vehicles
- c_{41}: external appearance of the vehicle

Travel quality,
S_2={32, 33, 34, 35, 36, 37, 42, 43}

- c_{32}: internal appearance of the vehicle
- c_{33}: capacity of vehicle
- c_{34}: driving behaviour
- c_{35}: conditions of refuelling
- c_{36}: conditions of parking
- c_{37}: other necessary activites
- c_{42}: vehicle length
- c_{43}: vehicle safety

2. Quality criteria(c_j)

Manageability, S_3={51, 61}

- c_{51}: acceptability of the system
- c_{61}: information system

Environmental impact, S_4={44}

- c_{44}: CO_2 emission

3. Relationship between quality criteria and user expectations ($r_{i,j}$)

$r_{i,j}$ [%]		User expectations									Number of relations
		Freedom, independence (e_1)	Free parking place (e_2)	Connection with public transportation (e_3)	Reliability (e_4)	Comfort, easy-to-use (e_5)	Belonging to community (e_6)	Security (e_7)	Sustainability (e_8)	Information on the service (e_9)	
Quality criteria	Type of service (c_0)	18,8									1
	Average distance to the nearest free vehicle (c_{11})	10,7		34,5	25,7	14,1					4
	Minimum and maximum period of use (c_{12})	24,7									1
	Operating time (c_{13})	18,1			34,6						2
	Reservation (c_{21})	27,7									1
	Accessibility of the vehicles (c_{31})			65,5		6,4					2
	Internal appearance of the vehicle (c_{32})					17,8					1
	Driving behaviour (c_{33})				39,7	7,2		30,1			3
	Capacity of vehicle (c_{34})					15,4					1
	Conditions of refuelling (c_{35})					11,2					1
	Conditions of parking (c_{36})		100								1
	Other necessary activities(c_{37})										0
	External appearance of the vehicle (c_{41})					5,1	100				2
	Vehicle length (c_{42})					8,0					1
	Vehicle safety (c_{43})							69,9			1
	CO2 emission (c_{44})								100		1
	Acceptability of the system (c_{51})					14,89				31,1	2
	Information system (c_{61})									68,9	1
Number of relations		5	1	2	3	9	1	2	1	2	26

4. Calculation of weights (g_j)

$$g_j = \sum_{i=1}^{9} g_{i,j}$$

$$g_{i,j} = r_{i,j} \cdot \frac{e_i}{\sum_i e_i}$$

$r_{i,j}$ [%]

		User expectations									Number of relations
		Freedom, independence (e_1)	Free parking place (e_2)	Connection with public transportation (e_3)	Reliability (e_4)	Comfort, easy-to-use (e_5)	Belonging to community (e_6)	Security (e_7)	Sustainability (e_8)	Information on the service (e_9)	
Quality criteria	Type of service (c_0)	18,8									1
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	Other necessary activities(c_{37})										0
	External appearance of the vehicle (c_{41})					5,1	100				2
	Vehicle length (c_{42})					8,0					1
	Vehicle safety (c_{43})							69,9			1
	CO2 emission (c_{44})								100		1
	Acceptability of the system (c_{51})					14,89				31,1	2
	Information system (c_{61})									68,9	1
Number of relations		5	1	2	3	9	1	2	1	2	26

1

2

3

Results (q, Q)

- 4 quality categories
  - q_1: service quality
  - q_2: travel quality
  - q_3: manageability
  - q_4: environmental impact

$$q_k = \frac{\sum_j g_j c_j}{\sum_j g_j}, \forall j \in S_k$$

$$k = 1..4$$

- Aggregated quality: Q

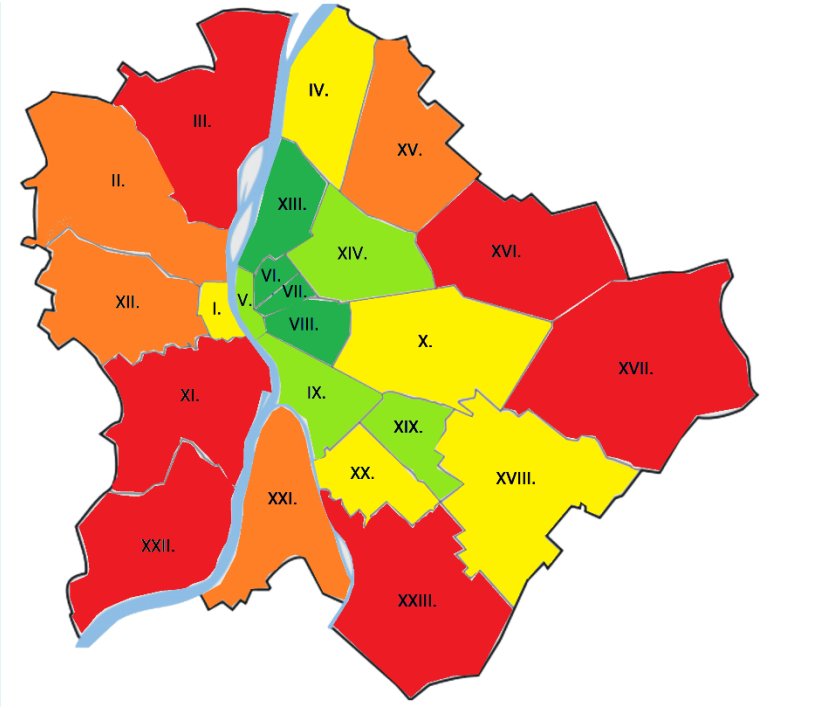
$$Q = \frac{\sum_j g_j c_j}{100}$$

- Service and aggregated quality are **temporally and spatially variable**

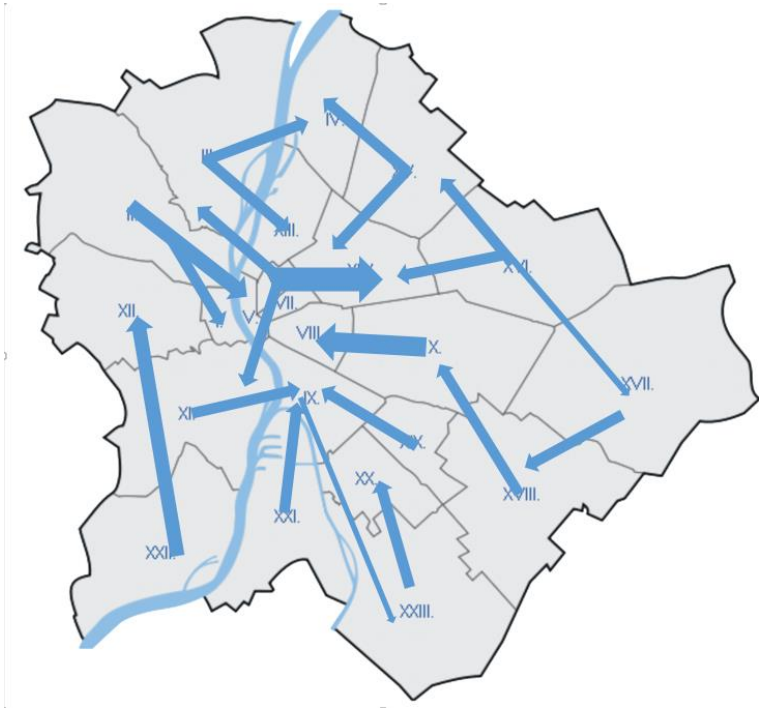
Application of quality analysis method in Wien (Neubau)

Basis of demand model

- Macro



- Micro



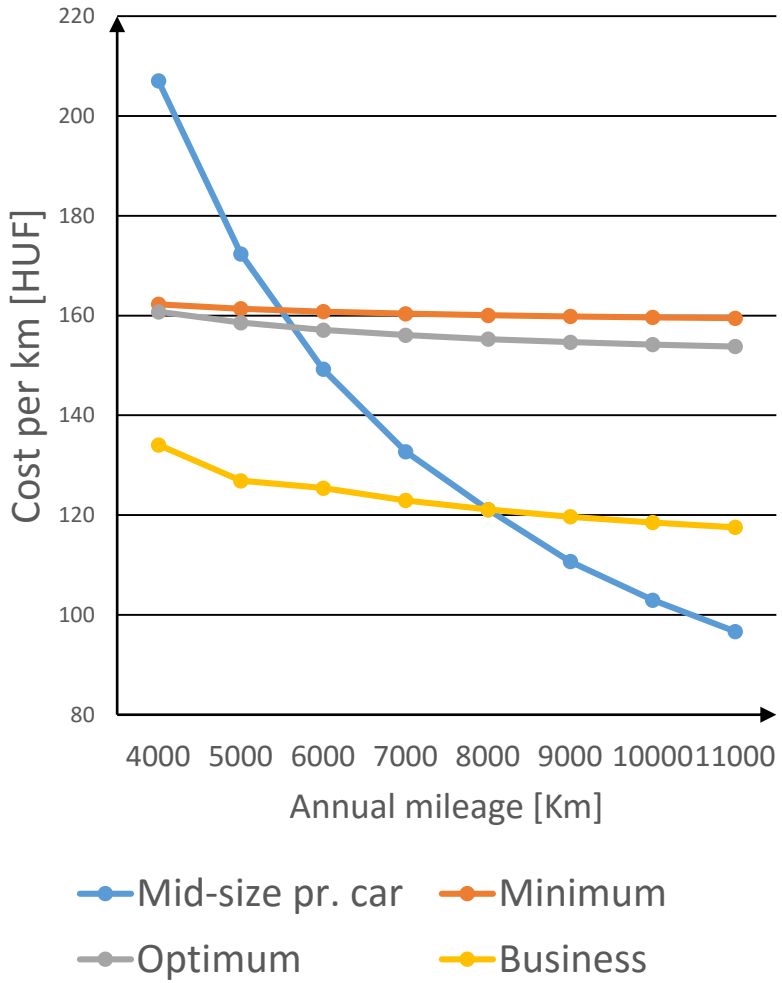
Demand: f(LF, Q, c)

Local features

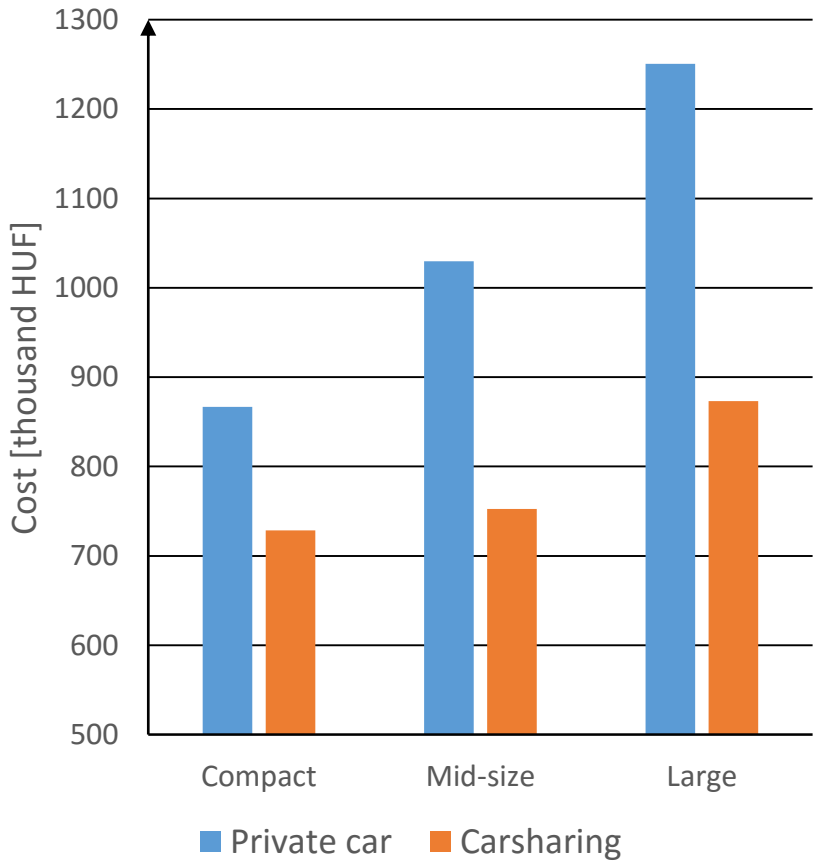
	Features	Favourable for carsharing service
Geographic features	Density	>4000 people/km^2
	Function of area	Mixed
	Visibility of stations	On the surface, busy intersections
	Other transportation services	Workplace on foot or by public transport Circumstances for a private car or biking are not favourable
Demographic features	Age	Mostly between 29 and 49
	Gender	Men are more likely to join
	Education	High (London: 85%)
	People per household	Families with children
	Rate of employment	High
	Income	Medium or high, not too high
	Vehicle per household	Below average (0)
	Number of driver licenses per household	1

Cost

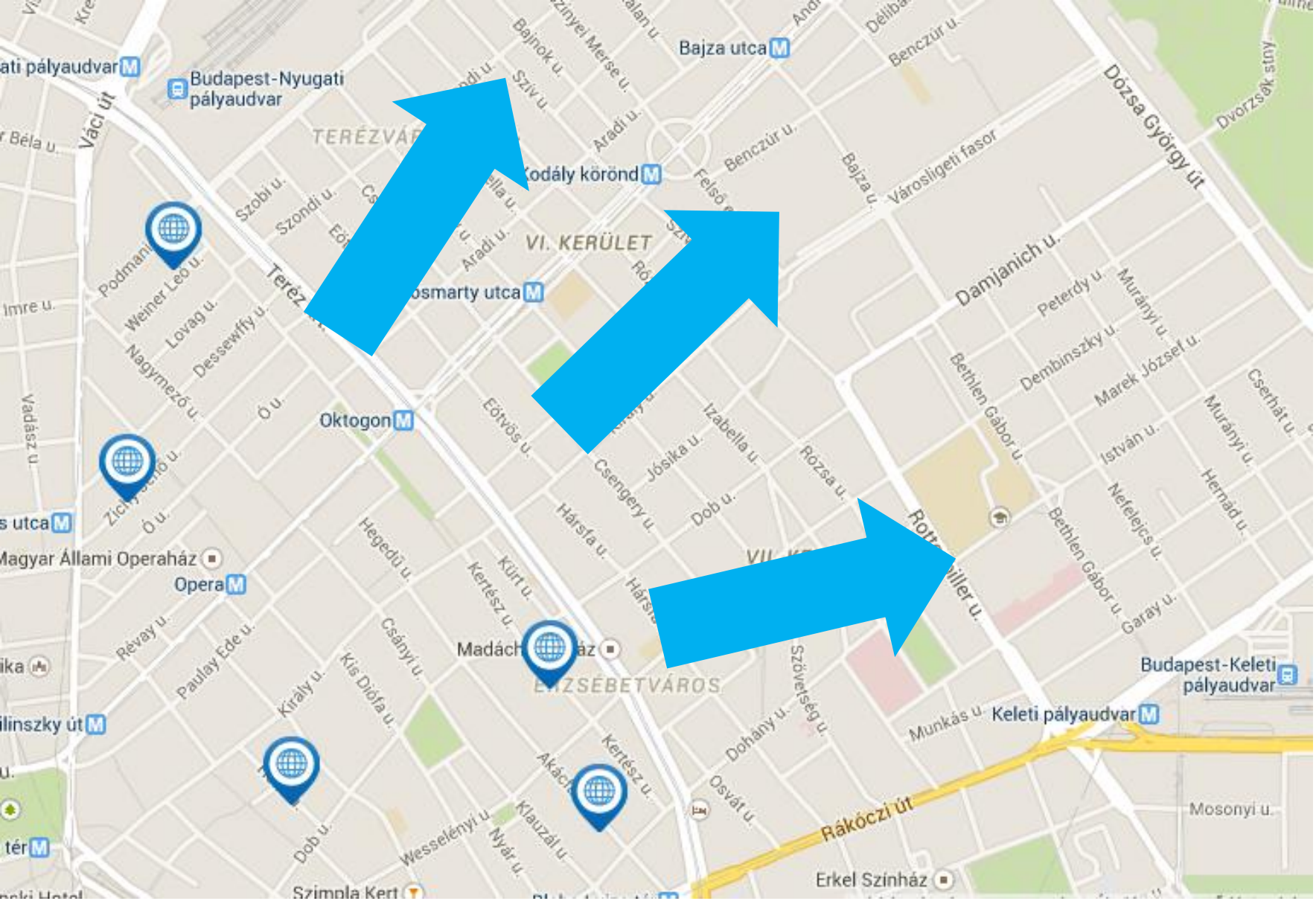
- Cost per km



- Cost of mobility



Willingness to join in Budapest



Possible direction to expand the operation area in Budapest

Maximum number of users can be served by one vehicle

$$u = \frac{365 \cdot 8}{\bar{b} \cdot \overline{t_b}} \left[\frac{user}{vehicle}\right]$$

365: number of days in a year [day/year]

8: optimal utilization of a vehicle per day [hour/(day*vehicle)]

$\bar{b}$: average number of reservations per customer [reservation/(year*user)]

$\overline{t_b}$: average length of a reservation [hour/reservation]

Budapes: u=33$\left[\frac{user}{vehicle}\right]$

Conclusion and direction of further research

- For travellers:
  - Decision support (middle and long term)
  - Integration of application to transportation system
- For operators:
  - Before start of service/ during operation
  - Effects of development plans and former developments
  - Cost benefit analysis
  - Evaluation of relation between local features, service quality and cost

Thank you for your attention!