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Final Report

Evaluation Car-Sharing (EVA-CS)

City of Munich

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**This is a translation of Part I of the report. The complete report in German is available at: http://www.ris-muenchen.de/RII/RII/DOK/SITZUNGSVORLAGE/3885730.pdf*

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Introduction

In 2010, the City of Munich was faced with a requirement by car-sharing companies to grant a special permit for parking in parking license zones.

This would constitute a privilege in terms of road traffic regulations, which are fundamentally against the granting of privileges. As a basic principle, a special permit is only justified if it is in the public interest.

The City of Munich defined being in the public interest as when the use of car-sharing vehicles would make more parking spaces available than it would require itself, and when the total number of vehicle kilometers driven in the city would not increase.

Prior to the date of this study's publication, numerous expert reports about car-sharing impacts were published throughout Europe, some of which received much media attention. These reports presented a very inconsistent picture. At closer inspection, however, they all show methodological differences that do not make a direct transfer to the City of Munich possible.

Therefore, the city council of the City of Munich, on the recommendation of the *Kreisverwaltungsreferat* (Department of Public Security and Order), decided on March 16, 2011 to launch a pilot project with limited duration and number of vehicles, thus limiting the risk in the event of a negative impact. In addition, the city decided upon a fee structure for parking and to conduct its own independent evaluation, which was to provide guidance in order to answer the following questions:

- Is privileged treatment of car-sharing providers for parking justified?
- Are the new car-sharing services in the public interest as defined?
- What impact will the new car-sharing services have on traffic?
- What can the City of Munich do to make sure the new car-sharing services have a positive impact?

Based on the results presented, the administration can now give the city council well-founded recommendations for further action as regards car-sharing.

Of course, this study, like every other scientific investigation, has its limits. Car-sharing customers were only surveyed about their behavior at one point in time, and a very early point in time, for that matter. The results may well be different in two or five years time. It could be the case, for instance, that the use of the new car-sharing services does actually motivate customers to purchase new vehicles in the medium term, leading to more traffic and an even greater parking problem.

But the exact opposite could also happen. It is possible that many more residents of Munich than was found in this study choose to sell their private vehicles or to not purchase a new one, because car-sharing services become increasingly user-friendly and do indeed work reliably in the long term. Perhaps the current strong growth in car-sharing services will make car-sharing rather than owning an increasingly natural part of urban mobility behavior. Maybe the new services will indeed play a substantial role in resolving the parking problem and reducing traffic, while at the same time allowing greater mobility (including automobile mobility) and a better quality of life, because of the new scope for public spaces and residential construction,

but also because car-sharing means that people do not have to look after and maintain their own cars, and the costs of mobility can be much lower.

As a result of this evaluation, the authors of this report are firmly of the opinion that it is a responsibility of cities, specifically the City of Munich, to manage the general conditions for the new car-sharing services with these three essential guidelines:

- Car-sharing companies should be supported in providing a service that is as attractive as possible.
- The parking spaces gained on public roads as a result of reduced car ownership should no longer be available for parking private cars and instead be used for other purposes in the public interest. Such purposes in the public interest are to be defined by the city council (for example: parking spaces for bicycles, mobility stations, areas for other public uses, such as "beer gardens", children's playgrounds and parks, even residential developments)
- Agreements should be reached with the car-sharing companies, who, in return for the support of the city, guarantee a minimum standard of quality for the car-sharing services. This should certainly be in the interest of the providers, as this would guarantee quality.

The second guideline is of particular importance: if this were not implemented, it is likely that the parking spaces gained would soon be filled by new private cars. This would mean that the impact of the new car-sharing services would be zero, or even negative. In this case, public interest would no longer be a basis for privileged treatment for parking, which would also destroy the basis of the new providers' business models.

We would like to thank the *Kreisvervaltungsreferat* (Department of Public Security and Order) of the City of Munich for placing its trust in us and providing us with professional support as the contracting body. We also want to thank, above all, the participating car-sharing companies DriveNow, car2go, Flinkster and CiteeCar for their very good, trust-based collaboration, in particular when it came to providing the necessary data and support in the sensitive matter of contacting their customers.

We hope you enjoy reading this Final Report. We are always grateful to receive constructive, or even critical, feedback.

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Part I

Definition of Task, Methods, Main Results

1. Definition of Task

The task of this expert report was to evaluate the new car-sharing services impact on traffic, in accordance with the decision of Munich city council of March 16, 2011. The objective of the evaluation is to determine whether or not it is in the public interest, and therefore justified, for the city to support car-sharing providers by granting special permits for parking in parking license zones.

This support will be considered in the public interest if it can be proven that the use of the new services reduces demand for parking spaces and reduces the amount of traffic.

For this expert report, the services of DriveNow, Flinkster and Zebramobil were taken into consideration initially. While provider Zebramobil ceased operation before the beginning of the first survey phase in 2013, providers car2go and CiteeCar only became active in Munich during the course of the project stage. Both of the new providers were incorporated into the evaluation in the second wave of surveys in 2014.

The services under examination can be divided into two groups, based on the parking license model used: the vehicles of providers Flinkster and CiteeCar are assigned to defined parking license zones and have to return to the respective zone at the end of the rental (zone-based). These systems thus work like station-based services, but with "virtual" stations in public parking areas. The services of DriveNow and car2go, on the other hand, do not involve a restriction to certain license zones, which means that one-way rentals are possible (i.e. the rental can end somewhere other than the starting point) (fully flexible system). These services are therefore viewed as station-independent. In this expert report, a distinction is made between the two types of service, where necessary.

This independent expert report, compiled in a collaboration between team red Deutschland GmbH, TU Dresden and omnitrend GmbH, addressed the questions arising. To this end, extensive preliminary studies were carried out first of all, which led to a detailed processing of the research field into an accepted action model, and hypotheses and extended questions derived from this[1]. Building on this, the concrete procedure for working through the task is outlined in the following chapter.

[1] See <doc 1>

2. Method: Work Steps and Data Basis

The evaluation was essentially based on data from three sources:

- Data from studies already existing about the topic, as well as existing figures, e.g. from the Statistical Office of the City of Munich or from accessible studies, such as Mobility in Germany 2008.
- Data on users and usage from the providers' back-end systems.
- Data from surveys, specifically:
    - Written and telephone surveys of users and randomly selected residents of Munich as a reference group.
    - Face-to-face/verbal surveys of selected users and
    - Face-to-face/verbal interviews with experts from various fields.

The surveys were carried out in summer 2013 and summer 2014. Although the 2014 surveys were initially only intended as a second panel wave for new customers surveyed in 2013, when car2go and CiteeCar entered the market an initial survey of these providers' customers was also conducted. Likewise, the back-end data of the two providers was analyzed for the first half of 2014 due to their later market entry. The following table shows an overview of the data collected in 2013 and 2014:

Data source	2013	2014
Back-end data	**DriveNow**: 278,222 1st HY 2013 **Flinkster**: 11,554 1st HY 2013 **car2go**: Only a few weeks of operation from June onwards **Zebramobil**: Cessation of business 1 month before start of survey **Citeecar**: 2013 not yet in market	**car2go**: 116,096 (1st HY 2014) **Citeecar**: 8,724 (1st HY 2014) Other providers were already analyzed in 2013 Largely comparable due to same period of year
User survey	**Initial survey** **DriveNow**[2] 07/13: 927 **Flinkster** 07/13: 193[3] **car2go** 07/13: 88[4] **Citeecar**: Not surveyed (07/13 not yet in market)	**Initial survey** **car2go** 07/2014: 138 **Citeecar** 07/2014: 273
User survey		**Follow-up survey**[5] **DriveNow**: 28 **car2go**: 8 **Flinkster**: 0
Population survey	**Representative survey** 07/13 (telephone): 1,004 people (distortions balanced out using comparative data from the Statistical Office)	
Group discussion, users	2 focus group discussions with customers of DriveNow, car2go and Flinkster: July 24/25, 2013: 2 groups (frequent users & infrequent users) of 12 people each	1 group discussion with customers of car2go and CiteeCar:
Expert interviews		6 expert interviews (ADAC (German Automobile Association), Gewofag, Munich Public Utilities / MVG (Munich Transport Corporation), Wogeno, IHK (Chamber of Industry and Commerce), ADFC (German Cycle Club)\

Table 1: Overview of data sources and survey dates

[2] (Unfortunately only 97 new customers were eligible for the follow-up survey; explanation: although Drive Now delivered 5,000 datasets as agreed, contrary to the agreement these only included 469 new customers instead of 2,500, due to a misunderstanding)

[3] Thereof, unfortunately only 5 new customers who are eligible for the follow-up survey; there were no more new customers available to survey

[4] Few initial customers immediately after market entry; all new customers

[5] Explanation of low number of cases:
1) Small new customer base from 2013 (see cell on left)
2) High panel attrition rate

One important aspect when developing the evaluation concept was to ensure that statements are valid and as free from distortion as possible. It was particularly important to be able to link the survey data to information read from the back-end data, taking data protection regulations into consideration. In this way, it was possible to produce representative data, using validly deducible weighting factors[6].

The registration duration and usage behavior were taken into consideration back in the survey concept phase. A total of four groups were formed and asked to take part in the survey. The following table provides an overview of the customers / residents written to, and their participation behavior:

Target group	Provider	Invitations	Participants[7]	Response
Target group A: Existing customers, no use in previous 14 days	**DriveNow**	2,908	427	**15%**
	car2go	1,133	133	**12%**
	Flinkster	762[8]	128	**17%**
	Citeecar	1,572	155	**10%**
Target group B: Existing customers, use in previous 14 days	**DriveNow**	1,612	403	**25%**
	car2go	Included in Group A[9]		
	Flinkster	173	60	**35%**
	Citeecar	409	83	**20%**
Target group C: New customers	**DriveNow**	469	97	**21%**
	car2go	311	89	**29%**
	Flinkster	26	5	**19%**
	Citeecar	255	35	**14%**
Target group W: Follow-up survey	**DriveNow**	92	29	**32%**
	car2go	81	8	**10%**
	Flinkster	1	0	**0%**
	Citeecar	No repeat survey		
Target group D: Population Munich 18+		Gross: 4,775 neutral losses: 2,370 net: 2,405	1,004	**42%**

Table 2: Overview of survey participants

[6] Also see chapter 10.5 and <doc 6>
[7] The group assignment was retroactively corrected using the back-end data
[8] Only customers who agreed to advertising were written to
[9] Because of a change in the registration, group assignment using back-end data was no longer possible

Using the participation rates, a correlation between usage frequency and survey participation can be seen. The resulting distortion has been balanced out using weighting.

3. Main Results

The following chapter will address the two central questions of the evaluation regarding the potential impact of the new car-sharing services on the number of vehicles and driving distances. Analyses of additional questions formulated and dealt with in the evaluation process can be found in chapters 7 and 8 (German Version only).

3.1. Reduction of the Number of Vehicles

Question: Does the use of car-sharing services lead to a reduction in the number of privately owned vehicles in the medium term, and thus a reduction of the parking problem, and if so, to what degree?

Answer: A clear yes

Reason: According to the population survey conducted, the average number of cars is 0.83 vehicles per household (Figure 1). This figure is different for car-sharing customers, sometimes substantially. Customers of zone based provider Citeecar only have, on average, one quarter of the vehicles of the Munich average. When it comes to Flinkster, another zone based provider, the average is approximately half of the Munich average. For the fully flexible providers car2go and DriveNow, the number of cars per household is roughly identical to the figures for the city as a whole.

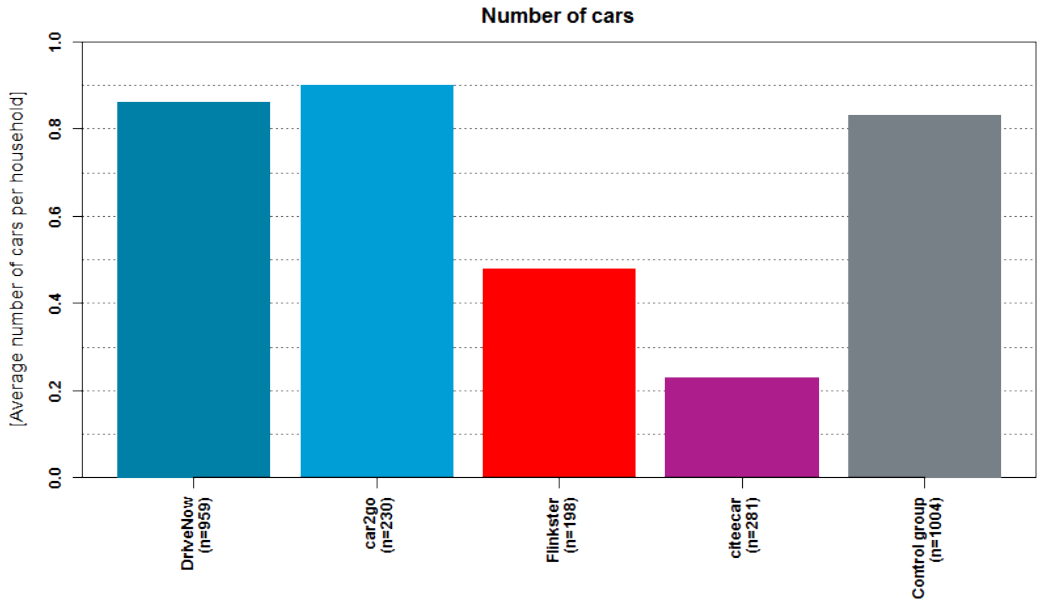

Figure 1: Average number of cars by provider

Households that frequently use car-sharing from one provider have a lower average number of cars per household (Figure 2). While, for example, where there is no or very rare car-sharing use, the number of cars per household is 0.81, the figure decreases where there is frequent car-sharing use to 0.46 cars per household.

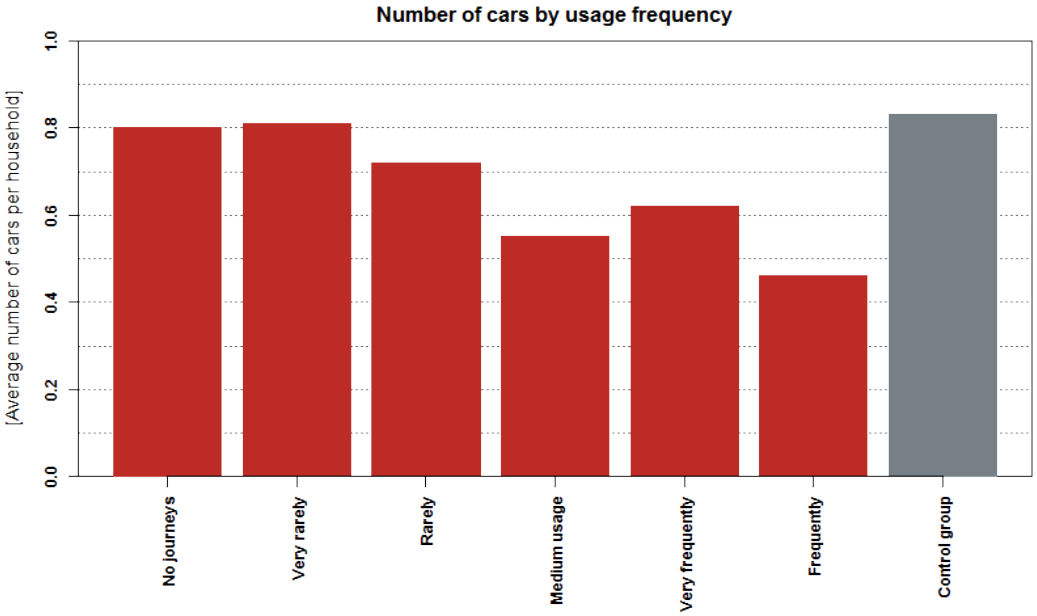

Figure 2: Average number of cars by usage frequency[10]

In the customer survey, 11.6% of those questioned said that they have already given up a car in their household because they use car-sharing (Figure 3). In addition, 39.8% of those surveyed said that they have chosen not to purchase a car. Of those surveyed who own at least one car in their household, 27.2% plan to, or are at least considering, giving up a car in the coming year. These findings are particularly strong among users of the zone based provider CiteeCar.

[10] Here, usage frequency is measured using the 20% quantiles derived from the back-end data, based on the average number of journeys per day.

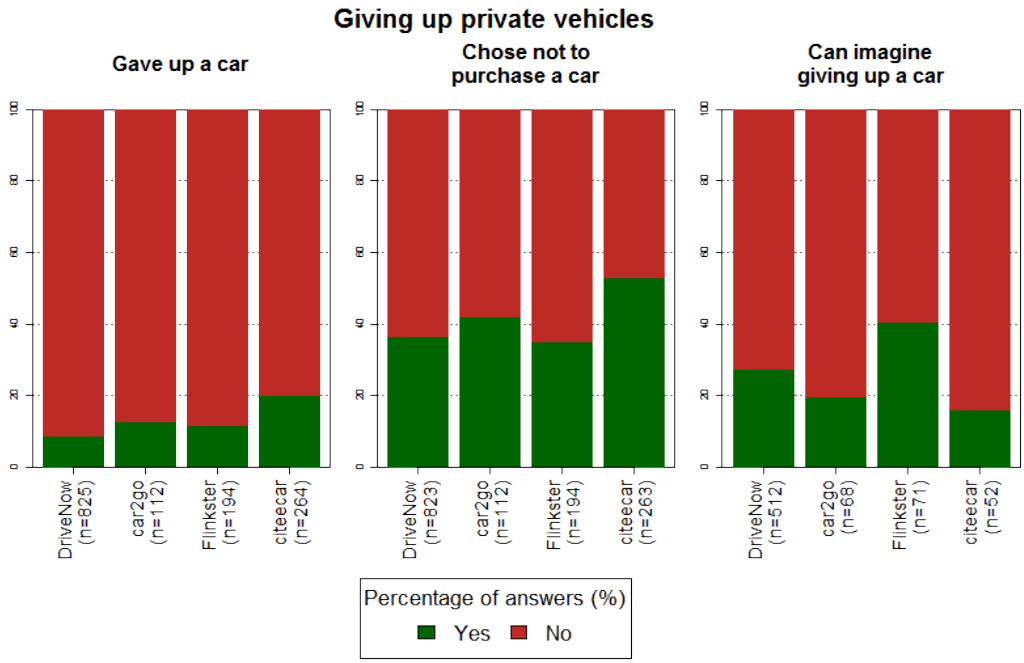

Figure 3: Percentage of households that have reduced their number of cars because of car-sharing

All questions on giving up private vehicles used the wording "influenced by the use of car-sharing". To quantify the influence of car-sharing further, participants were asked about the degree to which car-sharing was a factor in this decision (Figure 4). For at least 49% of the answers to the three questions, car-sharing was a "rather strong factor" or a "strong factor". In a comparison of providers, car-sharing played an above-average role for users of provider CiteeCar.

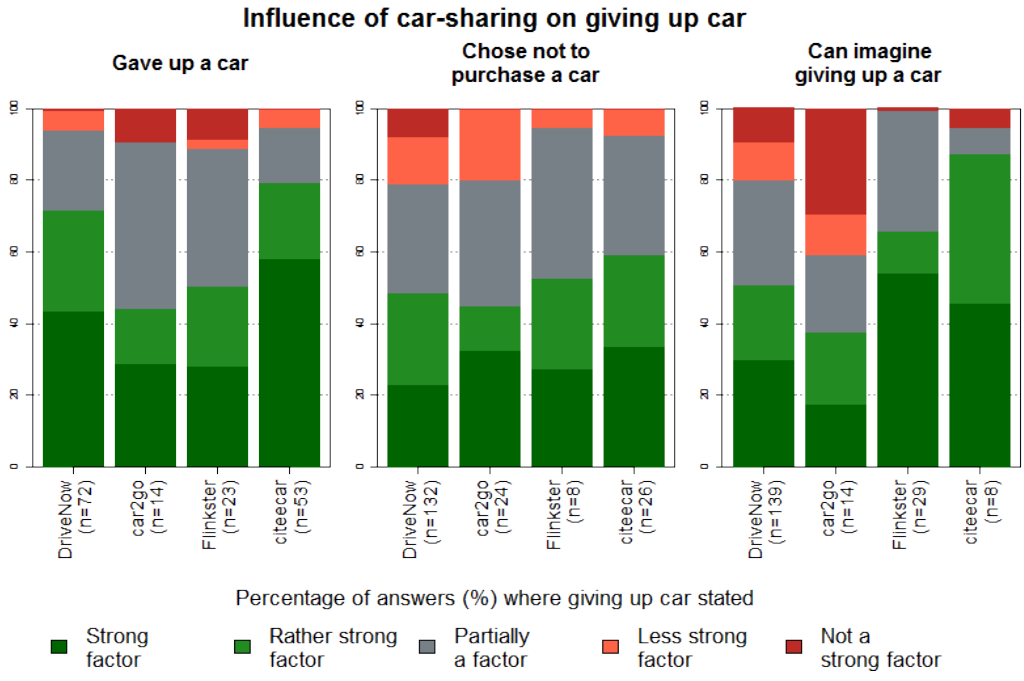

Figure 4: Percentage of households for which car-sharing influenced car reduction

There is a correlation between the intensity in which the car-sharing services of the individual providers are used and the giving up/not buying of vehicles. If no or very few journeys are registered in the provider data (1st quantile), 10% gave up their car and 34% chose not to buy a car. In the case of very frequent usage (5th quantile), the percentage of vehicles given up increases to 20% and the percentage of people surveyed who chose not to buy a car to 58%.

Starting from the responses to the questions regarding giving up cars and not buying cars, an estimate can be made, on the basis of the sample, as to how significantly the number of private cars has dropped due to the use of car-sharing services. Two scenarios are worked with (see Figure 5 and Figure 6).

If the giving up/not purchasing of vehicles where car-sharing was at least a "rather strong factor" in the decision is extrapolated to the providers' total number of customers, this would result in a reduction by 5,300 private cars (high scenario). If we only consider the vehicles given up where car-sharing was a "strong factor", this would result in 1,550 fewer cars. This lower figure is a relatively safe scenario. Due to the high user figures, the provider DriveNow contributes significantly to this result. In relation to this: at the time of the surveys, there were a total of 862 vehicles in operation among the four providers.

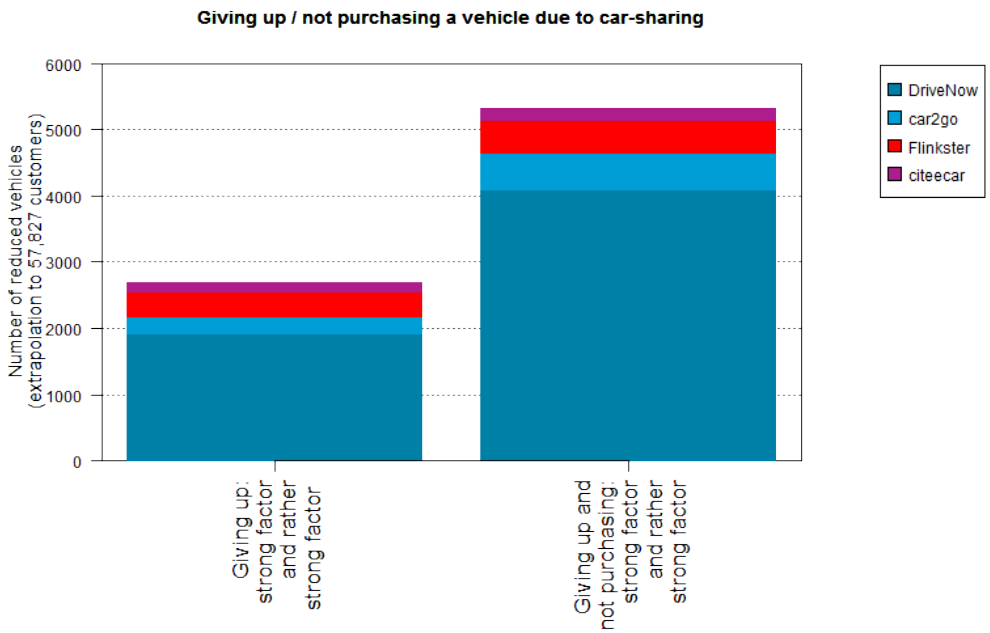

Figure 5: Extrapolation of cars given up (high scenario)

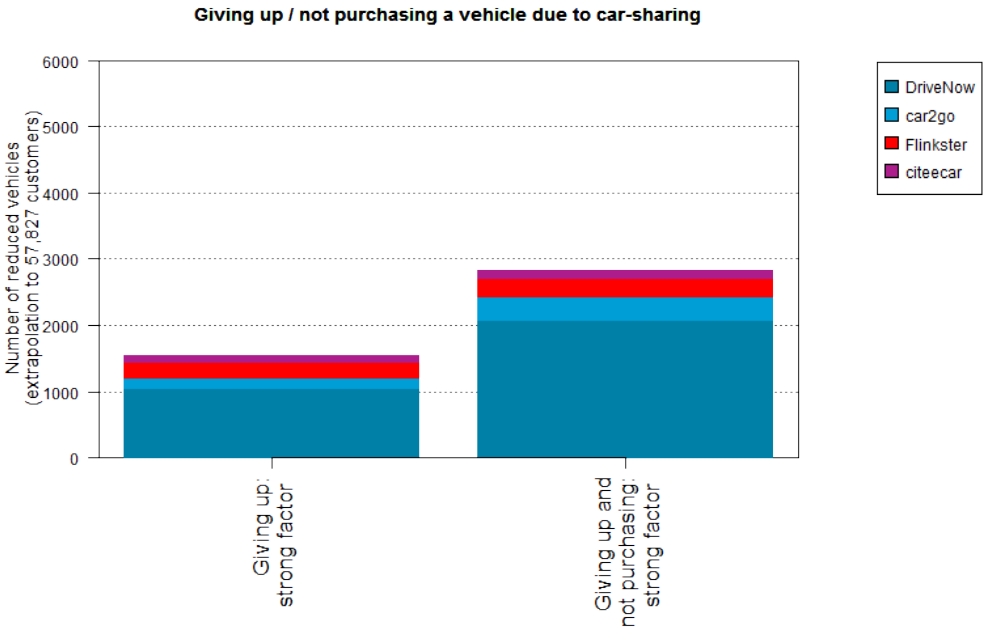

Figure 6: Extrapolation of cars given up (low scenario)

From the number of reduced private cars and the number of car-sharing vehicles used in Munich, so-called "replacement rates" can be calculated[11]. Replacement rates show how many private cars could be replaced by a car-sharing vehicle in the current market situation. The analysis for this is conducted separately for zone based providers and fully flexible providers.

Scenario	Reduction potential		
	Zone based	Fully flexible	Total
Giving up; *low scenario*	1 : 1.3	1 : 2.0	1 : 1.8
Giving up; *high scenario*	**1 : 2.0**	**1 : 3.6**	**1 : 3.1**
Giving up+not purchasing; *low scenario*	1 : 1.5	1 : 4.0	1 : 3.3
Giving up+not purchasing; *high scenario*	1 : 2.5	1 : 7.8	1 : 6.2

Table 3: Replacement rates derived from survey

For the zone based providers, the replacement rate in the low scenario is around 1.3, and in the high scenario around 2.0. For the fully flexible providers, the replacement rate fluctuates depending on scenario between 2.0 and 3.6. Whether zone based or fully flexible providers have a higher impact, however, also depends on the starting number of vehicles and the

[11] The calculation is carried out using the formula:

$$\frac{N_{Number\ of\ vehicles}}{\sum \frac{N_{Vehicle\ replaced|Influence\ of\ car-sharing}}{N_{Providers\ used}} * weight_{extrapolation}} = \frac{1}{X}$$

methodological question of how customers of more than one provider are dealt with (see section on Methodological Limitations). If the car-sharing system is taken as a whole, the replacement rate is between 1.8 and 3.1.

It can thus safely be assumed that each car-sharing vehicle replaces more than one private car, and car-sharing therefore contributes to a reduction of the parking problem. Even the high scenario is based on extremely cautious assumptions. Only those survey participants are considered who reported giving up a vehicle or not purchasing a new vehicle, who at the same time said that car-sharing was a "strong factor" in the decision.

Derived from this, it can be assumed that, on average, every parking space for a car-sharing vehicle makes three private parking spaces available in other locations: the overall balance is therefore around two parking spaces gained per car-sharing vehicle.

Based on the data, the following calculation can be carried out:

Parameter	Figure
Vehicles given up in total, high scenario	2,687
Thereof, inside the Mittlerer Ring (according to statements in user survey)	1,958
Result of parking area monitoring, estimated number of parking spaces occupied at the same time in parking license zones[12]	approx. 416
Total vehicle reduction	**1,542**

Table 4: Number of reduced cars in parking license zones

In total, therefore, around 2,000 parking spaces became available at the time of the study: of the approximately 1,500 parking spaces no longer required due to user reactions, around 500 are newly occupied by car-sharing vehicles.

Methodological Limitations:

The average number of cars per household is lower among car-sharing customers, since a low number of vehicles means there is more reason to use car-sharing vehicles. Therefore, without further limitations, the reduction rate can only be transferred to today's customer structure and customers' traffic behavior.

Regarding the questions on giving up or not purchasing vehicles, some of which were worded hypothetically, it is uncertain whether the answers given match real behavior entirely. Because of the low response rate in the panel survey, the results cannot be verified further.

[12] A maximum of 40% of the vehicles of DriveNow, Car2Go and Citeecar park at the same time in the license zone (40% of 744 = 298). Due to a lack of better data, for the 118 vehicles of Flinkster it is assumed that all use their special permit at the same time, which will never be the case in reality.
Total: 298 + 118 = 416

The survey data – and likewise all analyses – is weighted based on usage frequency. This reduces the distortion arising due to the dependence of survey participation on usage frequency. The risk of a false estimate does, however, still exist, as, in the questions regarding vehicle reduction in particular, the real decision process cannot be registered for each individual household.

The replacement rates based on the questions on car reduction and extrapolation are subject to uncertainties, especially for the zone based providers. Of the surveyed customers of zone based providers, the percentage of customers who only use zone based providers is 48%, while customers who only used fully flexible services was 84%. Of the remaining customers, who additionally use fully flexible providers, the allocation of the impact to one type of provider is difficult. We chose to use a ratio of 50:50 to allocate the impact between types of provider. Therefore, the results for the overall system of car-sharing have a particularly high degree of reliability.

Summary:

The average car figures show that car-sharing users tend to come, firstly, from groups with low private vehicle ownership, and, secondly, car-sharing, promotes lower vehicle ownership. As always in interconnected systems, both directions of impact are possible and present. Statements regarding the strength of both individual impacts, however, cannot be derived.

From the statements made by the car-sharing customers surveyed, it can plausibly be derived, with a very high probability, that **car-sharing** has a **reducing impact on car ownership**. Even in the "low scenario", which adopts a skeptical view of car-sharing, the impact is positive. The replacement rates range from 2.0 and 3.6 for fully flexible providers. If only the zone based providers are considered, the range is 1.3 to 2.0. For the overall system car-sharing, the replacement rate in Munich, at the time of the survey, ranged from at least 1.8 to 3.1.

Derived from this, **an overall balance of approx. 1,500 newly available parking spaces** can be assumed.

It would only be methodologically possible to identify clear figures on the change in car ownership if a longitudinal panel were used. For this, a sufficiently large group of car-sharing users (at least 1,000 people) would have to be observed over a period of several years. We recommend such an approach.

Overall, however, *the results cannot be generalized and transferred to other cities* as they depend on the situation and the general conditions in place. Studies in cities with low population density, a higher supply of parking spaces, no parking area management and so on, may result in other figures.

To ensure that these figures collected for 2013/2014 remain valid in the future, the City of Munich must ensure the continuation of its parking area management. **To reduce the parking problem and the number of private vehicles, we recommend**

- **allowing car-sharing providers to expand their services and to support this service development as far as possible, and**
- **supporting this, ensuring that the so-called "replacement rates" can be achieved by reducing parking spaces for private vehicles.**

In our opinion, the figures calculated (1.8 to 3.1) are suitable for highlighting the ratio to be aimed for: for every three parking spaces for private cars removed, one additional car-sharing vehicle can be provided.

3.2. Reduction of Driving Distance

Question: Does the use of car-sharing services lead to a reduction in the distances driven by car?

Answer: Yes, the driving distance drops, especially in households that have reduced their number of cars.

Reason:

Among all providers, according to those surveyed, the average annual household driving distance is only influenced very slightly by car-sharing (Figure 7). The difference is greatest for CiteeCar customers, at 380km per customer.

Customers of the providers car2go and DriveNow have a slightly higher average annual household driving distance per customer than the average for Munich's population. Customers of Flinkster and CiteeCar, on the other hand, are well below the household driving distance of Munich's population. The results are significantly influenced by the car ownership rate. When only the household driving distances of households with a private car are considered, the average driving distance of customers of car2go, DriveNow and Flinkster is higher than the average of Munich's population. To what extent this is (age) cohort-dependent could not be investigated.

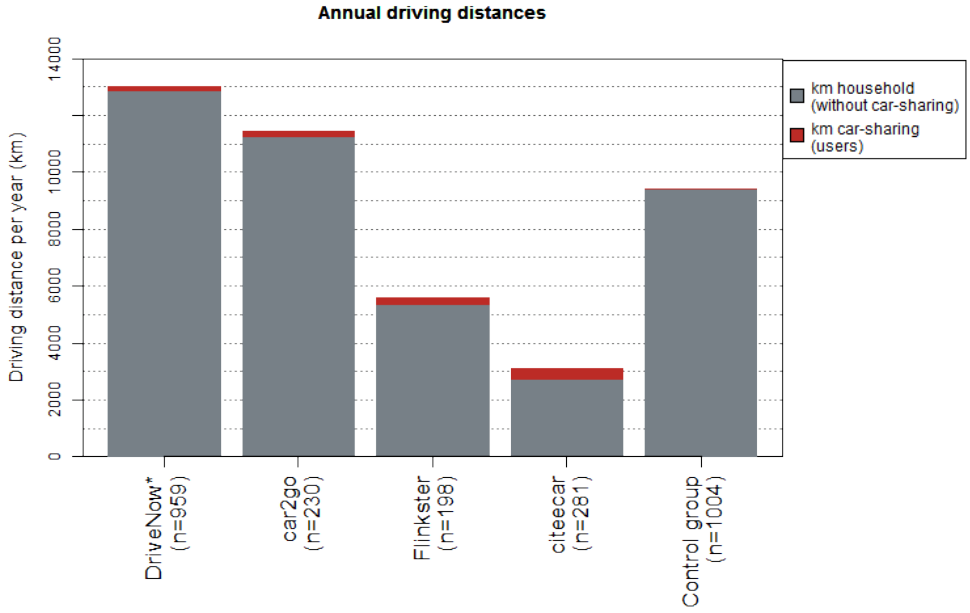

Figure 7: Annual driving distances of households by provider[13]

[13] . For DriveNow, there are no driving distances available from the back-end data. These were estimated, based on the usage duration and the average speed (v=23km/h) determined for comparable provider car2go.

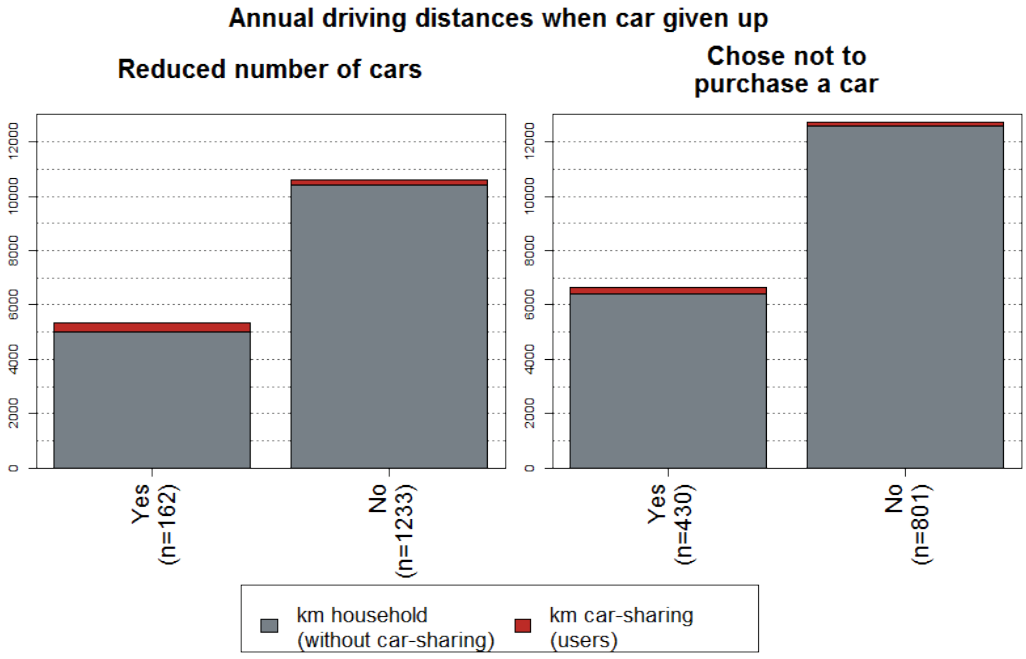

Figure 8: Annual driving distance of households after reduction of number of private cars

The driving distance can be considered in relation to the giving up of a car/decision not to purchase a car (Figure 8). Households reporting that they had reduced their number of cars in the past have a much lower driving distance than all averages considered. If the household driving distance for private vehicles and the car-sharing driving distance is considered per total number of households, it is 50% less for households that reduced their number of cars than for households that did not reduce their number of cars.

The annual driving distance of the vehicles that were given up was also gathered retrospectively in the customer survey. This is, on average, 9,000km and is somewhat higher than for vehicles given up where car-sharing was "not a strong factor" (Figure 9). A comparison with the average driving distance for all cars in Munich of 13,900km (Mobility in Germany 2008) confirms that it is vehicles not used very often that tend to be given up.

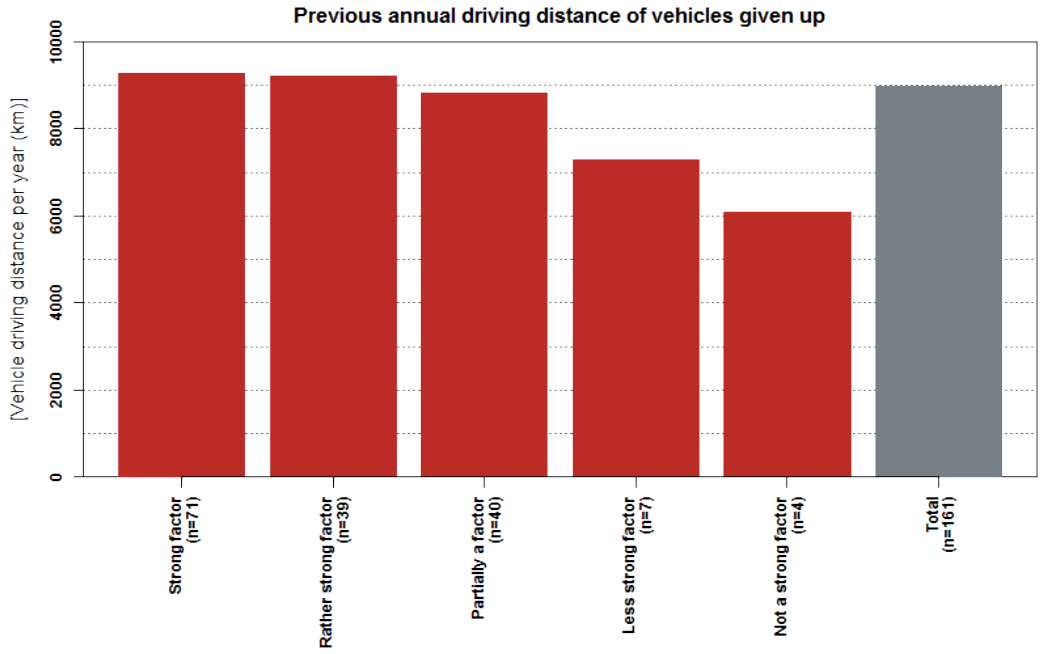

Figure 9: Driving distance of vehicles given up, based on influence of car-sharing on reduction of number of cars

For households that gave up a car, the reduction of driving distance can be quantified relatively accurately, using statements in the survey. It is conceivable, however, that this reduction effect is balanced out, or even overcompensated for, by the increased use of car-sharing. For an accurate quantification of the opposing effects, therefore, a balance of the annual driving distance by private car and car-sharing is compiled, which is extrapolated to all households using car-sharing. In this, the annual driving distances of private cars, the driving distance of customers surveyed by car-sharing vehicles and the driving distance of vehicles already given up (collected retrospectively in the surveys) are taken into consideration. Other impacts, such as the driving distance of vehicles not purchased and the increased use of the cars remaining after vehicles have been given up, are not taken into consideration.

Customers of	Balance of average household driving distance in kilometers, per year, for the effects found			
	Driving distance	Due to the use of car-sharing, the driving distance increases by:	Due to the giving up of vehicles, the driving distance decreases by:	Total effect (max.)
car2go	180,268,659km	3,005,688km	8,802,512km	-5,796,824km
DriveNow	597,341,722km	5,704,675km	30,921,332km	-25,216,657km
Flinkster	45,748,776km	1,700,498km	9,186,737km	-7,486,239km
Citeecar	5,993,452km	836,866km	3,568,100km	-2,731,233km
Total	**829,352,609km**	**11,247,728km**	**52,478,681km**	**-41,230,952km**

Table 5: Reduction of driving distances

The annual driving distance of private cars dominates the balance with a total of approx. 830 million km, driven by customers of all car-sharing providers (Table 5). The vehicles given up because of car-sharing have an annual driving distance of approx. 52 million km. With an annual driving distance of 11 million km, car-sharing only slightly increases households' driving distances (plus 1.4%). With the effects found, the total result is a reduction of the annual driving distance by 41 million km or around 5.0% in connection with car-sharing. This figure must be considered as an upper limit due to non-quantifiable effects and other possible effects which were not considered, such as greater use of remaining cars,.

Methodological Limitations:

The retrospective surveying of annual driving distances is subject to uncertainties, as these are not figures that every car owner analyzes and knows. If further changes occurred in the traffic behavior (e.g. due to car-sharing), the separation of before and after effects becomes even more difficult. A longitudinal panel survey would be much more suitable. Here, the current odometer reading is taken for certain dates, and the driving distance calculated from the data from several survey waves.

The annual driving distance balance extrapolated to all customers can only consider some of the reactions of road users and car-sharing customers. For example, increases in driving distance among the private cars remaining in households that gave up a car are not included in the balance. Furthermore, the driving distances of DriveNow vehicles are only estimated and potential differences in the usage structure compared to car2go are not considered. However, the results appear to be relatively solid: if we assume, for example, that not only the person surveyed, but all members of the household with a driver's license use car-sharing for the same driving distance as the person surveyed, this still results in a negative driving distance balance.

Summary:

Traffic behavior depends on many factors, such as the city structure, a person's own mobility style and, in particular, a person having their own car available, as this unlimited access makes usage become habitual. Only people and households who already use their own cars less consider and decide to make the step (relevant to traffic behavior) to give up their own car. Overall, the driving distance attributable to private motorized transport then becomes much lower. **Car-sharing can therefore be considered a key building block for reducing the driving distance of private motorized transport.**

The data also shows that merely entering into a contractual relationship with a car-sharing provider does not lead to a clear change in the annual distances that a person drives in their own car. The same applies when car-sharing is only used occasionally. **Major reductions only occur when the number of private cars owned by a household is reduced.**

Although it tends to be cars with below-average driving distances that are given up, this does create a reason for a significant change in behavior, with a noticeable easing of the burden on public roads. **The additional driving distances by car-sharing vehicles associated with today's usage structure only influence the overall driving distance minimally; the reduction of the driving distance of private motorized transport brought about by car-sharing outweigh these considerably.**

4. Overall Assessment

The study conducted provides the City of Munich with findings and decision-making aids for the classification of car-sharing services in Munich. The question arose as to what impact car-sharing services have on usage behavior of private motorized transport/public transport/bicycles, driving distance development on the one hand, and the space requirements and utilization of parking areas and transport areas on the other.

For this overall view, a multitude of findings and data sources had to be brought together. Some of the findings were consistent and solid in all parts of the study, while other results were less consistent or even contradictory, and some of the planned questions could not be clearly answered from the data acquired. This was partly due to the fact that the changes in behavior towards less use of a private car are always drawn out over a long period of time: not all households were addressed to the same degree, certain objective requirements are tied to subjective preferences, and an attractive car-sharing service must be an available option in particular decision/change situations. Therefore, the following can be noted:

For an integration of car-sharing services which is useful to individuals and advantageous to the city as a whole, a consistent, overall municipal concept is required. Car-sharing services are not always automatically identifiable as making a positive contribution to solving the problem in all situations. Rather, this contribution always depends on the accompanying framework (e.g. parking area policy, public transport services, bicycle policy, development of private motorized transport, etc.). In concrete terms, this means: without the City of Munich developing a parking area policy and without high-quality services offered by MVV (Munich transport association), car-sharing might not be able to deliver the advantages expected for users and the city.

However, this analysis clearly shows that the car-sharing services in Munich demonstrate positive impacts overall in all fields under the given circumstances: Households can remain mobile and enjoy cost savings, the total space required for vehicles and private cars is reduced, noise and exhaust pollution most likely decrease, greenhouse gas emissions almost certainly decrease, and the attractiveness of the surroundings increases.

The new car-sharing services can always be viewed as positive in all fields if they succeed at motivating users to give up their own cars, whether it's choosing not to make a planned purchase, or, in particular, giving up an existing car. The present data suggests such a development for a significant percentage of users.

In our opinion, there is no reason why the agreed services and regulations should not be continued. However, it must also be noted that this study cannot answer all of the research questions, and that, in particular, the user reaction may change over the course of time. We therefore strongly recommend:

- An extensive and publicly verifiable Monitoring and Evaluation Concept (M&E) should be made mandatory for all future agreements with car-sharing providers. No future traffic measures should be adopted and executed without an M&E concept.
- At the same time as continuing and, where applicable, expanding car-sharing, the supply of parking spaces for private cars in Munich should be limited further and/or

the parking fees adjusted. In Munich, urban space is particularly limited and expensive; only a conversion of car parking spaces can reduce this problem. Such policies would: 1) improve the attractiveness of the surroundings for the residents of Munich, 2) increase the usage and profitability of car-sharing services, 3) support the pollution control efforts in Munich (there is an urgent need to act here), 4) support the usage of bicycles and public transport and, 5) even help car traffic: if some car users opt not to have a private car, the conditions for the remaining users improve (easier to find a parking space, reach destination quicker, greater junction capacity, etc.). In such a case, in the long term and considering dynamic reactions, everyone would benefit from the approach.

- Because the impact on public transport usage is less clear, cautious optimism is advised. Overall, we do not expect any serious impact on public transport. We propose discussing further studies (e.g. with MVG (Munich Transport Corporation) etc.).
- Car-sharing concepts have an impact primarily on certain groups and in change situations. We recommend working with the providers to develop concepts to raise awareness for the various mobility options available when residents do not own their own car, especially in change situations (moving home, new residents, new students or apprentices, change of job, de-registration of a car, etc.).
- Strategically, car-sharing users who have not (for the time being) sold their cars are also important. These are a new target group outside the traditional environmentally aware scene and are won over to the idea of car-sharing for the first time by the new services. Here, the prospect exists that a certain portion of the group will give up their own car in the medium to long term.

5. Recommendations for Action

The recommendations above can be put in concrete terms as follows:

5.1. Accompanying Traffic Planning Measures

As outlined above, positive effects can be achieved for both the city and users if the number of private cars is reduced. Using the survey data, we can assume that every car-sharing vehicle used replaces multiple existing vehicles and leads to a rise in public transport usage. The new car-sharing services are thus beneficial to all road users, even those who use their own cars rather than the new car-sharing services. Therefore, the following traffic planning measures are recommended:

5.1.1. Conversion of Public Parking Spaces

Only by converting parking spaces to other public uses the parking spaces gained due to car-sharing can be secured. Without such measures, there is a high likelihood that the parking spaces gained due to the reduction in the number of cars will be occupied immediately by other vehicles moving in to take their place. A conversion of the public parking spaces gained due to car-sharing should therefore be a high priority for the City of Munich. Ideas include, for example, car-sharing parking spaces, bicycle infrastructure, parks or playgrounds.

5.1.2. Adjustment of Parking Space Regulations

In the field of residential construction, an adjustment of the parking space regulations to the new general conditions should be investigated. To the benefit of integrated shared mobility services (car-sharing and, for example, the new bicycle rental system of MVG (Munich Transport Corporation), economic advantages can be achieved due to the lower parking space quotas demanded.

5.2. Partnership with Public Transport

In our opinion, a closer collaboration between public transport and car-sharing services is a win-win situation. Not only do providers and public transport benefit mutually from a greater binding of users to these systems, but also the community in general benefits due to the effects described above. Therefore, collaborations between public transport and car-sharing providers should be supported by the City of Munich. Some conceivable examples are:

- Shared usage card
- Mutual discount systems
- Increased app integration
- Combined vouchers for new residents
- Mutual location and departure time information in the passenger information system/car computers.

5.3. Continuation of Evaluation and Monitoring

The car-sharing providers investigated are still relatively young. An extended evaluation could address questions that could not be answered in this study due to the relatively short observation period, for example:

- Will the current car-sharing usage rates measured continue at a similar level over time? If a saturation of the market occurs, will usage stabilize or will usage rates gradually decline?
- How will car-sharing usage behavior change when the current users, most of whom do not have children, start families?
- How will the services be used by the next, young generation?
- Can the 55+ age group, who have been underrepresented among users before now, be convinced to use the services?
- Will the car ownership reductions observed be confirmed in the long term?

Building on the findings gained in the EVA-CS, a continuation of the evaluation should include the following agreements with providers:

- Link to the city's survey site in new customer registration (with incentive)
- Establishing of a longitudinal study (possibly in collaboration with MVG (Munich Transport Corporation) customer panel
- Transmission of aggregated user data

5.4. Pilot Projects to Acquire New Target Groups

We take a critical view of the fact that the services up to now only address a very narrow spectrum of potential users. Therefore, one or several pilot projects should be carried out, in collaboration with the providers, to find ways to target other groups, for example households with a second vehicle they rarely use which thus offer high car reduction potential. Some feasible approaches are:

- Development of spatial focal points (e.g. airport or Garching campus, in areas with a high car ownership reduction potential), ideally in combination with mobility stations, following the model of the station at Münchner Freiheit, surrounded by a network of bicycle rental stations from the new MVG (Munich Transport Corporation) service.
- Monetary incentives to give up a vehicle or return residential parking permits, for example in the form of mobility credits for car-sharing services, public transport and bicycle rental systems.