Car sharing perspectives in a business as usual scenario: Findings from the STARS project

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Car sharing perspectives in a business as usual scenario: Findings from the STARS project

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Abstract

This paper summarises some interim results of the Horizon 2020 STARS project (http://stars-h2020.eu/) by giving insights on car sharing growth perspectives and expected changes from both operators and policy makers viewpoint. Actions and development plans in the short-medium term that are already being prospected in some European cities by car sharing operators, industrial players and policy makers concur to define the business as usual scenario analysed here and reconstructed through an extensive surveying activity. The analyses take into consideration the perspectives of different categories of car sharing, which are resulting from the classification of 186 existing car sharing services. Services are expected to grow in future, however operators belonging to different categories tend to be more optimistic on the expansion of the kind of service they are providing. Expansion to suburbs and fleets diversification are the most cited likely evolutions, while rising costs of fuel represent the worst threat.

Keywords: Car sharing; Growth trends; Mobility scenarios; Transport policies; Descriptive statistics.

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1. Introduction

Car sharing is a mobility solution that is rapidly evolving in Europe over the last years. Many reasons are supporting this growth: the introduction of different service typologies, the increasing interest of many car manufacturers and of the automotive sector (Le Vine, Zolfaghari, and Polak 2014), the technological innovation of the car used to provide the service (Shaheen and Wagner 1998), the reliability of these systems (Aneris et al. 2016), the diffusion of smartphones, flexibility and cost savings (Shaheen and Cohen 2007) and many more. A larger diffusion of car sharing services around the cities makes the service itself more visible to the potential users; then the established maturity of the organisations is making car sharing a more viable option to the eyes of the city population (Sprei 2017).

Car sharing can be an opportunity to improve transport systems in European cities and decrease their negative impacts, however research needs to be developed in order to understand how to achieve this. The Horizon 2020 European research project STARS (http://stars-h2020.eu/) aims to close the gap between the potential benefits of shared vehicle services and their real impacts in terms of congestion mitigation, environmental footprints and social inclusion, that are mediated by both individual preferences and social innovation patterns. In particular, the role of car sharing in improving mobility in European urban areas and in providing new business opportunities to the automotive sector will be assessed through an integrated approach, where the impact of car sharing on other travel modes (private cars, public transport and active means) will be quantified. To this effect, both business as usual and rupture mobility scenarios will be studied, the former referring to future projections of actual trends concerning the diffusion of car sharing in Europe, and the latter to an assessment of its full potential in presence of appropriate policy actions aimed at maximising social benefits.

Within such broader context, the focus of the present paper is to give answers to the following questions: given the car sharing growth trends in recent past, how car sharing will evolve in the near future? Are other actors going to be involved in this market? Will we have the same typologies of service or something is going to change? What will be the actions of policy makers and city administrators towards car sharing?

This paper summarises some interim results of the STARS project that give an updated picture of car sharing in Europe, its growth perspectives and evolutions in a business as usual scenario, therefore considering both the actions that are already being planned by the car sharing operators in the near future and the main opportunities and barriers deriving from existing local and national car sharing policies. In order to gather such information, a desktop research on existing European services was performed and a survey aimed at both car sharing operators and local authorities was implemented, and related findings are analysed in this paper.

2. Experimental activities

2.1. Desktop research

The first activity carried out by the project aimed to look at existing different practices of car sharing in Europe, by gathering relevant information through a desktop research. Among the 28 European countries under research, 186 car sharing services from 25 countries were scanned by the end of December 2017, since car sharing schemes were not yet available in three countries. Relevant data about business forms, use of technology, pricing systems, number of cars, insurance and reservation systems were gathered. It was also possible determine the type of car sharing in terms of operational scheme (roundtrip, free floating, etc.). Descriptive statistics on such rich database are reported in the deliverable 2.1 of the STARS project (STARS 2018a).

2.2. In-depth survey to car sharing operators

To gain more insights on the results of the desktop research, 56 car sharing organisations from 20 cities located in 12 European countries participated to an extensive online survey in January 2018, containing 84 questions referred to a range of topics including juridical form, technological features, reservation options (e.g. possibilities for last minute vs. long before actual use), financial characteristics (deposit, price per hour, per kilometre ...). This survey partially followed the method implemented in 2009 within the MOMO project (Loose 2010). Additional questions have also been made concerning the service dimensions (the number of customers, number of shared vehicles composing the fleet, the average travel distance, etc.).

Among all the questions, only those focusing on the expected services evolution under the current market conditions within each country in general and, more specifically, within each interviewed organisation will be analysed here. Related questions will be presented along with their answers respectively in subsections 3.2.1 and

3.2.2.

Most of answers came in the form of five points semantic scales (i.e. from extremely decrease to extremely increase), therefore the interviewee could only indicate one grade of the scale. An additional set of related questions were open ended and they investigated the reasons behind the indicated trends. Related answers were processed through a semantic analysis to extract simpler labels.

Since 12 car sharing operators out of 56 did not answer to such questions, they are not considered here; thus the final sample is composed by 44 services operating in 17 cities of 10 different countries, which are listed in the below Tabel 1. Whenever possible and interesting, answers were also jointly considered on a country basis: however only for three nations (namely, Germany, Italy and Belgium) a sufficiently large number of operators was involved to consider their views as representative of their respective country.

Table 1. In-depth survey respondents per country.

Country	**Cities**	**CS operators in the sample**	**CS operators in the sample [%]**
Belgium	Brussels, Gent	7	15,9%
Bulgaria	Sofia	1	2,3%
France	Paris	1	2,3%
Germany	Berlin, Bremen, Köln, Mannheim	12	27,3%
Italy	Milan, Rome, Turin	12	27,3%
Latvia	Riga	1	2,3%
Netherlands	Amsterdam	2	4,5%
Spain	Barcelona, Madrid	2	4,5%
Sweden	Göteborg	3	6,8%
United Kingdom	London	3	6,8%
Total		**44**	**100,0%**

2.3. City administrations survey

At the end of April 2018, seven cities located in Belgium, France, Italy and Netherland (out of the 20 where are located service operators that answered the previous survey) participated to a survey aimed at understanding the viewpoint of local authorities. This city administrations survey is structured in 31 questions pertaining to existing driving conditions, existing transport policies, existing public transport conditions, existing car sharing conditions, public sector support and technology readiness in the cities where the interviewed car sharing organisations are operating.

The city administrations survey is mainly composed by multiple-choice questions, plus some open-ended ones where a description of the relevant measures and/or the link to external sources (documents, laws, mobility policy plans) was asked. The purpose was to help the STARS consortium to understand the actions put in place by each city administration. The analysis of the feedback of this questionnaire has been less structured compared to the previous one, given the need to analyse a lot of qualitative information retrieved from the policy documents that were mentioned by the survey respondents. It will be reported in the following subsection 3.3.2.

While such a small sample is clearly not representative of all European cities, it was nevertheless considered in the present research as an interesting glimpse on the viewpoint of local authorities which should be considered along with that of the service operators, and that will be more consistently analysed in the following phases of the project.

3. Results and Discussion

3.1. Classification of car sharing systems

When considering the output of the above introduced surveys, it was realized that both business model and operational characteristic of the systems should be jointly considered to properly classify a car sharing scheme. Different services in fact are offered by different operators and have different implications for cities. Five different categories of car sharing are therefore considered throughout STARS (see Fig. 1), given by four different operational characteristics, which only represent car sharing providers with an own fleet, plus a fifth one jointly considering two car sharing business models where private cars are involved, both being characterised by a roundtrip homezone based operating system. This classification has been extensively tested to fit with the gathered data (STARS 2018a) and is consistently used within STARS to conduct the research and to present the results.

<table>
<tr><th colspan="2" rowspan="2">Category of car sharing</th><th colspan="3">Business model</th></tr>
<tr><th>Car sharing providers with an own fleet (A)</th><th>Peer-to-Peer car sharing (B)</th><th>Car sharing among neighbours (C)</th></tr>
<tr><td rowspan="4">Operational characteristics</td><td>Roundtrip station-based (1)</td><td rowspan="2">Roundtrip station-based</td><td rowspan="2"></td><td rowspan="2"></td></tr>
<tr><td>Roundtrip homezone-based (2)</td></tr>
<tr><td>Free floating with an operational area (3)</td><td>Free floating with operational area</td><td rowspan="2">Peer-to-Peer car sharing</td><td rowspan="2"></td></tr>
<tr><td>Free floating with pool stations (4)</td><td>Free floating with pool stations</td></tr>
</table>

Fig. 1 Categories of car sharing with examples of providers within each category. Source: updated version of the image available at http://stars-h2020.eu/wp-content/uploads/2018/10/Abstract-D-2.1.pdf

In this paper, where we do not analyse individual behaviours of car sharing users, these categories of car sharing were collapsed to three to gather enough observations (see lines in bold in Table 2).

Table 2. In-depth survey respondents per category of car sharing.

Category of car sharing	CS operators answering the task questions	CS operators answering the task questions [%]
Free Floating	**16**	**36,4%**
Free floating with operational area (FFOA)	*15*	*34,1%*
Free floating with pool stations (FFPS)	*1*	*2,3%*
Peer-to-Peer	**4**	**9,1%**
Roundtrip	**24**	**54,5%**
Roundtrip homezone-based (RTHB)	*2*	*4,5%*
Roundtrip station-based (RTSB)	*22*	*50,0%*
Total	**44**	**100,0%**

3.2. Operators' views on the evolution of current car sharing systems

3.2.1. General growth perspectives at the country level

Car sharing organisations were firstly asked to give their point of view about the most likely growth trends and further expected evolutions not only in the city where they are operating but also at the national level.

3.2.1.1. Expected changes in the number of car sharing users and operators

A couple of questions wanted to investigate how the number of car sharing active users as well as the number of car sharing operators are going to change over the next 5 years. The answer could be chosen within a range between "extremely decrease" and "extremely increase". Both questions have a sub-question, where it was asked to motivate the answers.

Almost all interviewees (98%) forecast an increase of car sharing users over the next five years. The main motivations supporting their expectation were the increasing population living in cities, the popularity gained by car sharing in recent years, the increase of car ownership costs and new mobility attitudes, especially related to the concept of using a car only when you need as opposed to owning a car. Moreover, parking issues and air pollution problems within cities are themes of which people are more aware of.

Looking into different car sharing categories, half of the operators dealing with roundtrip schemes forecasts a slight increase in the number of users while the other half a stronger increase. On the contrary, free floating operators seem to have a more optimistic perspective, since the two third of them believe in an extreme increase in the number of users, even if one of them expects an extreme reduction without indicating a motivation.

Analysing the answers aggregated by country, Belgian operators seem a bit more cautious, while German and Italian operators foresee an extreme increase in the number of car sharing users, probably supported by the positive trends observed in recent years (STARS 2018b).

Slightly different expectations emerged when it came to forecast how the number of operators is going to change

in the near future. The largest part of the interviewees think that such number will increase but not so sharply: there is an increasing demand for car sharing since the market is not yet saturated, therefore new market opportunities might attract new players. However, there is a group of interviewees which forecast a slightly decrease in the future number of operators, mainly because of the competition between operators and the merging of different medium-small operators into a large operator that can better face increasing operative costs.

Looking at different countries, a good number of car sharing organisations in Germany forecasts an unchanged situation, due to the attractiveness of the car sharing industry together with the huge quantity of investments required by some business models: in one hand big operators will enter in the market but on the other hand some operators will leave the market, because their economic resources are not enough. This is not the case of Italy and Belgium, where most of the operators believe in a slight or even strong increase in the number of car sharing providers.

3.2.1.2. Diffusion of different services

More specific questions about the diffusion of different typologies of car sharing at the national level were asked: the interviewees could choose an answer on a scale ranging from "extremely reduced" to "extremely more widespread".

Contrarily to Germany and Belgium, where a balanced growth is expected for different typologies of car sharing, 8 out of 12 Italian organisations think that free floating is going to be extremely more widespread, while an extreme reduction in station based car sharing is also expected. This might be partially explained by the high number of free floating car sharing organisations operating in Italy that took part to the survey, and by the closing or resizing of some station based services which occurred in past years in that country.

In general, free-floating operators foresee a more widespread diffusion thanks to the higher flexibility and the recent performances enhancement, whereas station-based systems leverage on their ability to cope with parking shortages, which also affects free floating services along with private cars, and on the increasing cities support.

Another interesting aspect is related to the different lines of thought of the organizations providing different services: the diffusion of both types of service is comparable according to station-based operators; on the contrary, for free-floating operators, only their own scheme will grow, while the station-based service will have an extreme reduction in terms of diffusion (about 12% of the total stated so). Unfortunately, nobody gave a motivation for such statement. In other words, operators understandably tend to be relatively more optimistic on the expansion of the kind of service that they operate.

3.2.1.3. Relationship with public transport

A couple of questions were oriented to understand to what extent car sharing will take away customers from public transport, and the integration of the two services compared to the current situation.

Most of the operators (55%) believe there will be no difference compared to the current situation in the customers shifting from public transport and almost a quarter (22%) think that less public transport users in the future are going to change their mobility habits in favour of car sharing, compared to the actual situation. The main motivation among interviewees falling in those categories was the complementarity of the services: they are convinced that public transport and car sharing services are not in competition to each other but together they aim to reduce the dependency from the use of private cars; in this perspective, an increasing use of car sharing services will push up the use of public transport and vice versa.

On the other hand, 6 respondents (14%) think that there will be more customers shifting from public transport to car sharing: the main motivation is that car sharing can offer a more tailor made solution than public transport in terms of flexibility, comfort and privacy.

According to what emerged in the previous question, almost all the respondents predict a stronger integration of the two services in the future. One of the main reason given by the interviewed is related to the interest of public transport operators to extend their sustainable mobility supply, gaining attractiveness and settling some first-mile, last-mile issues thanks to the integration with other mobility solutions such as car sharing; this integration is also one of the basis of the introduction of Mobility as a Service platforms (MaaS). Moreover, digitalization is a key point that will enhance the integration between different services, providing easier tools to individuate solutions that can satisfy the mobility needs of the customers through a real multimodal supply.

3.2.1.4. Foreseen impacts on car ownership and on the automotive sector

Regarding car sharing impacts on car ownership, most of the interviewees think that the number of owned cars will slightly or even extremely decrease (80%); most of respondents look at the car sharing like a connection between the mobility demand and the public transport supply, which will reduce the need of a private car. Another

question wanted to investigate which are the aspects that will characterize the relationship between the world of car sharing and the automotive sector, compared to the current situation. A selected list of aspects was presented and more than one answer could be chosen by each interviewee.

As showed in Fig. 2 below, more than 80% of the interviewees think that the automotive sector will continue to support car sharing even more than now, mainly because of new business opportunities as well as further synergies or alliances between car sharing operators and car manufacturers.

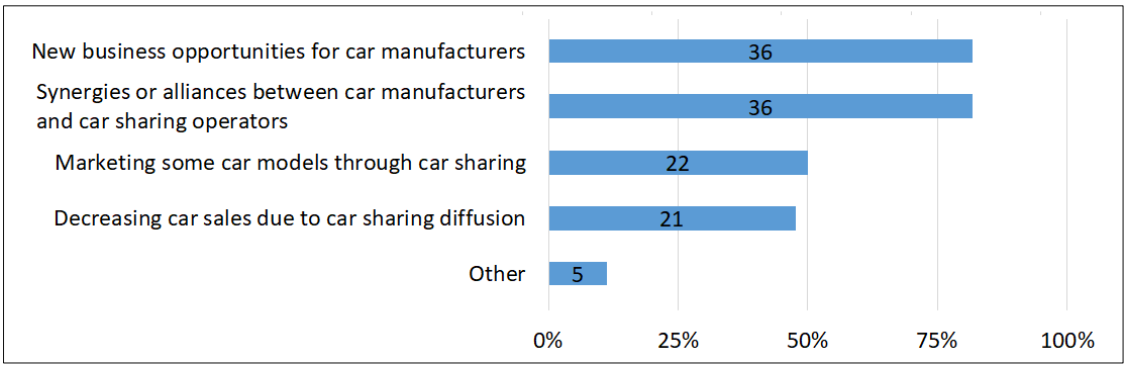

Fig. 2 Relationships between car sharing and automotive sector

These views were also shared by three out of the five operators that chose to select "other" giving the following more extensive answers:

- *"Automotive companies are convinced that in the long term, use of private cars in a city environment will become extremely difficult, if not impossible, and therefore car sharing services will define an alternative"*;
- *"Car manufacturers see opportunities and try to influence the implementation of car sharing services to make money: they now know that they can sale "car for use" rather than "car for ownership"*;
- *"More manufacturers will start their own car sharing services (as today BMW and Daimler)"*.

Furthermore, 50% of the operators believe that the automotive sector can benefit in terms of marketing by advertising some vehicles through car sharing services. On the other hand, almost half of the respondents are aware of a possible reduction in car sales due to the car sharing diffusion.

3.2.2. Stated development plans at organisation level

Beyond the general overview at country level that was presented in the previous subsection, answers related to each single organization future development are reported in the following subheads. As done before, answers are aggregated according to the previously introduced categorisation of car sharing services.

3.2.2.1. Changes in the fleet size and composition

Almost all interviewed car sharing organisations (90%) stated that they will increase the number of vehicles of their fleet. Not only changing in the number of vehicles were investigated, but also it was asked which kind of vehicles are more likely to become part of their future fleets from a list including city car, family car, sedan/crossover SUV, luxury vehicle, sports car, off-road car and van. It is interesting that most of the operators are looking at adding vans, i.e. medium-sized vehicle mainly used for carrying freight, in order to meet different users' needs and hopefully enlarging their customers base. A practical example of the reported forecast has been Enjoy in Italy, that introduced a fleet of vans beyond their city cars (Fiat 500) from March 2018.

3.2.2.2. Territorial expansion of the service

In this section, car sharing operators' perspectives in terms of spatial expansion of the service in other cities and of the extension of the current operative area in cities are presented.

Concerning the planned expansion in other cities, Table 3 below shows that those services who already operate in more than one city (and/or country) are understandably more favourable to a further expansion, while for those operating in only one city a future expansion is less likely. Organisations which foresee the expansion of their services are mainly motivated by the increasing demand as well as the intention to keep attracting new demand. One of the peer-to-peer operators stated that the main reason supporting the expansion is due to the lack of peer-to-peer services in the target city.

Looking at different categories of car sharing, it is interesting to observe that free floating organisations are operating in several cities and countries, while operators which are active in just one city mainly provide a station based service. This has clearly to do with the larger scale of investments due to the larger fleet size that is needed to set up a free floating service.

Table 3. Planned expansion in other cities by geographic span of the operator and category of car sharing, with column percentages

Actual geographic span	**Planned expansion**	**Roundtrip**	**Peer-to-peer**	**Free Floating**
Operators in one city	Total	7 (27,3%)	0 (0%)	2 (14,3%)
	of which: Likely	*3 (9,1%)*	*0 (0%)*	*2 (14,3%)*
	of which: Unlikely	***4 (18,2%)***	*0 (0%)*	*0 (0%)*
Operators in several cities in the same country	Total	7 (27,3%)	2 (50%)	5 (35,7%)
	of which: Likely	***7 (27,3%)***	*2 (50%)*	***5 (35,7%)***
	of which: Unlikely	*0 (0%)*	*0 (0%)*	*0 (0%)*
Operators in several countries	Total	10 (45,5%)	2 (50%)	7 (50%)
	of which: Likely	***10 (45,5%)***	*2 (50%)*	***7 (50%)***
	of which: Unlikely	*0 (0%)*	*0 (0%)*	*0 (0%)*
Total		24 (100%)	4 (100%)	14 (100%)

Regarding the extension of operating areas, almost the 40% of the interviewees does not have in program an extension of its operational area, while a 45% think about a future inclusion of suburban areas. In general, it is possible to observe that station based services are more favourable to the extension than free floating and that in both cases a projected inclusion of the countryside is not really commonplace.

3.2.2.3. Additional influential elements

A list of mobility issues was presented to car sharing operators, asking what are the most impacting ones. On the left-side of Fig. 3 the proposed impacting elements are listed while the right-side bar charts show the expected magnitude and direction of the impact on car sharing systems.

All the proposed elements seem to have positive or very positive impact on car sharing except the rising costs of fuel: almost a quarter of the respondents think that this can have a negative impact. This can be due to the fleets composition, which is presently mainly constituted by conventionally fuelled vehicles (STARS 2018a).

The rising costs of fuel and the positive opinion of car sharing operators about the diffusion of green vehicles (see Fig. 3) can have a positive impact on full electric car sharing services implementation. However, electric vehicles-based car sharing faces some additional issues. First, electric vehicles themselves are more expensive and their value at the time of resale is unclear. Second, the charging time of the vehicles reduces cars availability, thus electric-based car sharing fleets have to be bigger than conventionally fuelled fleets to provide the same overall car-availability (STARS 2018c).

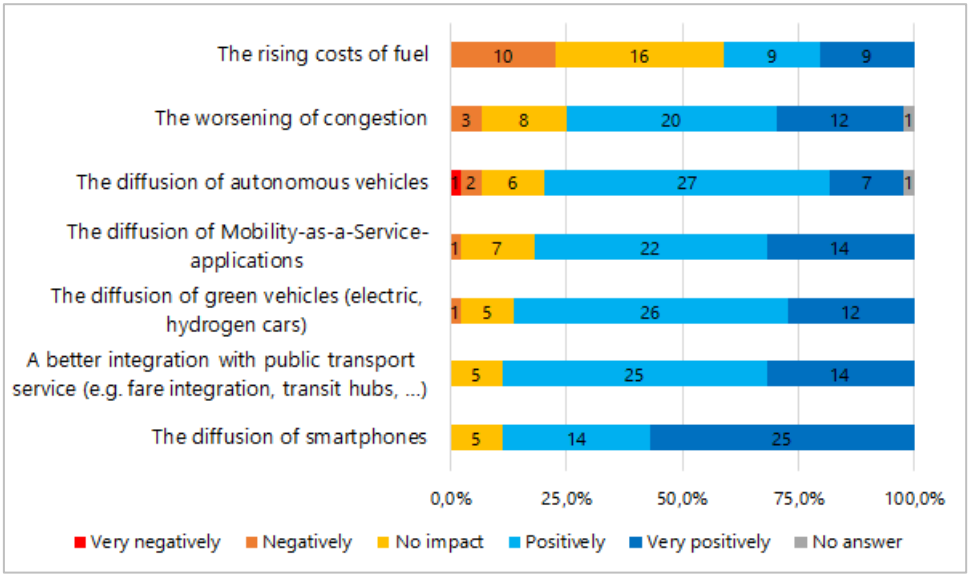

Fig. 3 Impacting elements on the car sharing growth

This makes electric-car sharing economically inefficient, compared to ignition engine fleets. For this reason, a public intervention for the funding of electric vehicles in car sharing fleets or reducing parking costs for electric vehicles to promote e-car sharing is expected (STARS 2018c).

3.3. Policies impacting on car sharing

3.3.1. Beneficial actions for car sharing operators

Car sharing organisations were asked to indicate the importance of a number of elements for their sector; respondents had to scale 15 elements, which are listed in Table 4 below, from very unfavourable (value=1) to very beneficial (value=5).

Table 4. Beneficial elements for car sharing

Actions	Average	Unfavourable	Neutral	Beneficial
Dedicated car sharing stations on public street space	4.76	0.0%	2.3%	97.7%
Reliability of the system	4.73	0.0%	4.7%	95.3%
Free access to paid parking zones	4.68	0.0%	2.3%	97.7%
User-friendliness of the system	4.56	0.0%	4.8%	95.2%
Car sharing parking lots on other public accessible spots (e.g. shopping centers, administration parking, hospitals, …)	4.56	2.3%	4.7%	93.0%
Access to limited traffic zones	4.51	7.0%	4.7%	88.4%
Access to public transport lanes or High Occupancy Vehicles lanes	4.49	4.7%	11.6%	83.7%
Tax credits/incentives to employers who use car sharing	4.49	0.0%	9.3%	90.7%
Integration with public transport (ticketing and subscription)	4.44	0.0%	9.3%	90.7%
Integration in new housing developments	4.24	0.0%	11.6%	88.4%
Low emission zones	4.17	4.8%	19.0%	76.2%
Changes in ownership or sale taxes for cars	4.08	2.4%	24.4%	73.2%
Incentives to scrap cars	4.05	2.4%	19.0%	78.6%
Standard and common rules (national or European level)	3.98	4.7%	30.2%	65.1%
Road pricing	3.92	2.4%	26.8%	70.7%

Dedicated car sharing stations on public streets are seen as the most beneficial measure (4.76), closely followed by the reliability of the system (4.73) and free access to limited traffic zones (4.68). While most of the items in the table refer to policy rules or measures, two elements (the user-friendliness and the reliability of the system) relate to the operational features of car sharing system. These latter two indicators get a very high score from the respondents. Thus car sharing organisations indicate that they depend on government's choices for a number of important matters, but equally they admit that the operators themselves must guarantee a performant and user-friendly product.

Most of the elements presented in the above Table 4 get a high score. Only two have an average value below 4 out of 5, namely standard and common rules at a national or European level (3.98) and road pricing (3.92). It is worth to mention that even though these two elements have the lowest average value, still more than 65% of all respondents consider both measures as slightly or very beneficial.

The respondents were also asked to name one additional policy option that would be particularly beneficial for car sharing. A number of parking-related issues mainly came forward. Car sharing services are striving for lower parking costs, faster procedures for requesting new car sharing locations, parking permissions for car sharing vehicles in resident park zones, integrated services within airports and train stations and law enforcement officers that invoice fines for people parking on car sharing stations.

Other policy options that came up were for example the removal of fiscal incentives for company cars or defining new legal benefits for car sharing when an employer gives the employee a mobility budget including car sharing. Respondents also expect governments to inform inhabitants about car sharing, to harmonize policies in different cities, to work on a regulatory framework, to boost innovations like electric mobility and to use shared cars themselves. Finally, one car sharing organisation indicated that bicycle and public transport infrastructures are necessary if public authorities want to lead more people towards shared cars.

3.3.2. Action put in place by the city administrations

City administration respondents were asked to indicate whether the city has a policy action plan for car sharing. Five out of seven cities had a specific action plan with defined targets. Although cities differed from one

another about the approach and support of car sharing, the majority was aware that this relatively new mobility branch will benefit from a stronger policy plan in the future.

The most visible policy options impacting on car sharing were those related to the public domain, and more specifically to public parking spaces. Five out of seven respondents stated that car sharing operators in their cities have free access to paid parking zones, independently from the typology of service they are providing (station based and free floating). The remaining cities did not warrant free access to paid zones and were not planning to do so in the future. On the basis of the mobility plans of different cities, it became also clear that several local authorities are planning to invest in (extra) fixed car sharing stations.

Fewer cities were willing to give car sharing organizations free access to limited traffic zones. Only three out of ten car sharing organisations indicated to have this kind of support from their city administration. It is interesting to notice that although all respondents represent big European cities, and all have large experience with different types of car sharing, they did not agree whether cities should support car sharing operators via free access to paid parking places or limited traffic zones.

Clearly, several measures can be seen as actions that reduce private car ownership: the cities under investigation, among other things, promote car and bike sharing, offer free access to park and ride areas to owners of a season ticket for public transport, install or enlarge a limited traffic zone, extent metro or tram lines and so on. The large majority of the cities indicate they offer integrated ticketing for different transport modes (e.g. a smartcard that can be used both for public transport and for other modes). The only city that hasn't an 'all-in' ticket yet, is planning to implement this. All these measures also indirectly stimulate the use of car sharing. If the alternatives for a private car, i.e. high-performance public transport, safe bicycle connections, etc., are well developed, then car sharing is more likely to succeed.

Six out of seven city administrations that took the survey indicate to use shared cars for service shifts, while the last one is actively planning to use car sharing in the future. In this way local authorities try to reduce their own fleet of vehicles. It was finally asked if the cities offer either marketing or financial support to commercial car sharing operators: more than half does, the others are not planning to do so in the future.

4. Conclusions

This research offered some insights about likely developments and the growth forecasts of car sharing services in the short term.

According to our expert survey, the number of users is likely to increase in each European country under research, probably with different expected growth rates depending on the local administrations actions. Among the different services, free floating schemes are considered more likely to keep growing, compared to station based and peer-to-peer systems. These forecasts are mainly justified in terms of the rising population living in the cities, the popularity gained by car sharing services, the rising costs of owning a car and lastly the increasing awareness of citizens about environmental issues.

The increase of the demand for car sharing represents an opportunity for the operators, which are forecasting an increase in their current turnover. Furthermore, on the basis of the gathered information, changes in the number of car sharing operators are expected in the near future: an increase in the number of service providers is the most likely option, with some exceptions where it is foreseeable the merging of small and medium services into a big one, or the creation of new partnerships among big players such as those which recently occurred.

Concerning collaborations with other services in the mobility landscape, a better integration with public transport is expected; clearly, the integration should embrace all car sharing organisations operating in each city in order to avoid unfair competition. It will be beneficial for both sides: firstly by reducing the number of users shifting from public transport, which needs to remain (or become) the backbone of urban mobility. Secondly, decision makers' intervention in promoting car sharing and active modes (such as cycling and walking) as first-mile and last-mile solutions might increase the use of sustainable options and decrease the use of private cars.

A better integration will hopefully bring to a reduction of car ownership: even if this could have a negative impact on the automotive industries, new business opportunities through synergies or alliance between car makers and car sharing operators are expected. The market of autonomous vehicles seems to go in the same direction: most of the operators believe that if autonomous vehicles are available in the mobility market, they will likely be a part of the future car sharing fleets.

Regarding the development of car sharing fleets, it is foreseen both a global increase in the number of shared cars and a wider diversification of the fleets. In particular, the idea of introducing van vehicles into car sharing fleets is quite widespread among different operators.

The increasing number of car sharing vehicles well fits with the possible extension of the current operating areas: most of the operators envisage an expansion to suburban areas, while the extension to the countryside is still seen hard to develop, mainly because of higher costs and a lower density of population.

Another aspect that came out from the STARS research is related to the expansion of current car sharing services: organisations that already operate in different cities and countries are more likely to expand their business, while those currently operating in single cities, which are relatively smaller, will continue to do so. The polarisation between big and small operators is therefore likely to increase in the future.

Among different elements that may impact on car sharing, the rising costs of fuel is the most feared. This is mainly due to current fleets composition, where electric vehicles represent less than the 30% of all shared vehicles. In fact, electric vehicle-based car sharing faces some additional problems (such as charging time, a bigger fleet to provide the same overall car-availability, the higher purchasing cost, the need of a charging infrastructure) that make electric-car sharing economically inefficient compared to ignition engine fleets.

However, most of the trips done by car sharing cars lie within the autonomy range of today's electric vehicles, so the two concepts seem to fit well (Fairley 2013). For this reason, a public program for the funding of electric vehicles in car sharing fleets as well as the construction of public loading infrastructure is probably needed to promote electric-car sharing. This can also have a push and pull effect on the adoption of private electric vehicles from other people (Fett and Ensslen 2018).

Some other policy makers/public interventions, which will probably boost the expected car sharing diffusion and growth, are foreseen. On one hand, the increase of reserved parking slots for car sharing services at the expense of public parking space could discourage the private car use. On the other hand, free access to limited traffic zones or its extension, which is a measure commonly required by car sharing organisations, need to be carefully evaluated by the city administrations: it can attract more users to car sharing services but it might produce an increase of vehicular traffic in those areas, finally making the overall transport system less sustainable.

Declarations

Availability of data and material

The datasets generated and/or analysed during the current study will eventually be available through the project webpage following the project Data Management Plan. The persistent web link to the open datasets will be available in 2020.

Competing interests

The authors declare that they have no competing interests.

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Authors' contribution

AC analyzed and interpreted the data regarding operators' views on the evolution of current car sharing systems and was a major contributor in writing the manuscript. MD helped in the interpretation of the data and reviewed the manuscript. JR and JM analysed the policies impacting on car sharing. All authors read and approved the final manuscript.

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