

CARSHARING. OVERVIEW AND PERSPECTIVES OF MARKET, CUSTOMERS, AND POLICIES

Report

Deliverable for SESMA (WP 4)

May 2020

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EXECUTIVE SUMMARY

Carsharing has existed as a market alternative to the personal vehicle for over three decades. During this period, multiple varieties of business models have emerged in cities and countries around the world. Despite the industry's impressive growth in clientele and geographic diffusion, carsharing still represents a rather small proportion of transport totals. This report summarizes the status quo of carsharing with a focus on the Swedish market, and offers an outlook for the industry's future.

Carsharing today is characterized by a multitude of user and business models. While the earliest carsharing models were station-based and round-trip only, multiple additional user options have been developed. Two examples are free-floating carsharing and peer-to-peer (P2P) carsharing. The different carsharing models complement each other even though they sometimes still are seen as substitutes and therefore as a threat to established models. The same is true for mobility services such as ridesharing and ride hailing which have had an upswing during the last 5 years. It is, from both user and urban planning perspectives, desirable that different mobility and carsharing services are accessible as they cover distinctively different user needs. It is also desirable that a multitude of operators are present on the market. A consolidation can in most segments however be noticed right now. This is likely to continue.

It is contested to what extent carsharing does contribute to more sustainable mobility patterns and lower emissions. Carsharing could on the one hand allow individuals to either abandon vehicles they own or decide *not* to purchase a vehicle when they might have otherwise. It could on the other hand motivate users to switch from low-emission travel modes to using a car. The latter is truer for free-floating carsharing, but even this model proves to be net carbon positive when looking at all users. Conventional stationary carsharing however has continuously proven to lead to a *reduction* in household transport emissions, a removal of personal vehicles from the roads, and to foregone purchases of personal vehicles. Depending on the operator and the location, stationary carsharing can replace all between 5 and 20 cars.

Carsharing's profitability remains uncertain. Most operators are still not profitable or can only be so because of subsidies from the corporations, often automotive manufacturers, they belong to. Another barrier is uncertainties in policies and legislation, as most jurisdictions still have not included carsharing in their regulations. This means that carsharing has to operate in "grey" zones or adapt to legislation that is not fit for the business model. This leads to lower acceptance among users, and lower profitability, as the case of parking fees which carsharing still is not excepted from in most countries shows.

We expect to see a specialization of carsharing offers to more narrow user groups, often facilitated through a commercial client, i.e. B2B solution. The most remarkable growth in demand is found in the residential sector as developers are reducing parking options wherever possible. Another major trend is the hybridization of business models, where one operator offers different types of carsharing plus mobility services in order to enable a car-free life.

TODAY'S MARKET — AND PERSPECTIVES FOR TOMORROW

This report is about carsharing, meaning an operator providing customers temporary access to cars at certain points or in a certain area. Customers pay for usage of cars based on time and/or distance; often they also pay for access to a pool of vehicles with a fixed monthly fee. Access to the vehicles is usually enabled through keyless solutions, and booking usually enabled via a mobile application. Payment is usually consolidated via credit card charging, but different payment consolidation models can apply depending on the country.

KEY TERMS IN THE CARSHARING DISCUSSION

The follow section presents a short description of terms that are frequently used in the context of carsharing. Latter sections of this report discuss different carsharing business models, which can combine different features described below:

Station-based carsharing (carpools, car clubs or carsharing services)

A commercial operator provides cars that users access and leave at specific stations. Members of the carsharing service can rent the cars by the hour or by the day. The cars must be returned to the same station as they were picked up from. The user pays for time and mileage in addition to fixed monthly or annual fees. There are also access fee-free alternatives with higher usage rates. In 2017, there were around 70,000 carsharing members in Sweden, with just under 2,000 shared vehicles running a total of between 200 and 300 million kilometres per year.

Free-floating carsharing

Free-floating carsharing is similar to station-based carsharing, except that cars can be picked up and left anywhere within a specified area (typically in the centre of a city), and do not have to be returned to the same parking spot ("instant access, one way"). The cars are rented by the minute or by the hour; the systems do not allow to rental periods longer than one day. Users have to be members of the sharing service, but fixed monthly fees are usually low or even zero (Terrien et al. 2016).

Peer-to-peer carsharing

Privately-owned vehicles are rented on a short-term basis to other private individuals. A broker's digital platform usually enables exchange and payment. The broker also supplies insurance. The individual renting the car pays for time and mileage. Both the individuals who share their cars and those who rent the cars have to be registered with the broker. Fixed monthly fees are unusual. In comparison to other European countries, P2P carsharing has a strong position in Scandinavia (Shaheen, Cohen, and Jaffee 2018; Wilhelms, Henkel, and Falk 2017)

Car rental

Conventional car rental, where a commercial operator provides cars at (a few) stations on a daily or weekly basis to private individuals, is also a vehicle sharing solution. The rental car industry even considers it to be an indispensable part of a vision for the future of mobility in which a shrinking number of individuals own a car.

A number of new variations in vehicle sharing solutions are emerging. Most are either hybrids of the above services, the same services run by new operators or based on new business models, or targeting specific customer groups.

Hybrid services

These are carsharing services operated by, or together with, other (non-carsharing) transport sector actors. An example of a hybrid service (currently in test phase) is Partio (operator: Hertz and Volvo Cars) where car owners can submit their cars to the rental car company, which then lends the car to a customer. Through this, the car rental company has the opportunity to meet a customer's needs without having to expand their own fleet. In Sweden, there are also two gas station operators (Circle K, OKQ8) which act as car rental companies.

Fractional ownership

To complement the car-sharing landscape, there is a new variation called fractional ownership where, for example, a car dealer can act as an intermediary. The setup thus involves two variations of the above basic forms. Fractional ownership means that private individuals pay for car and insurance per kilometres driven.

Already in 2014, Audi launched its "Audi Unite", a model for fractional ownership in Stockholm. The model offered multi-part agreements based on vehicle model, annual mileage and the number of drivers sharing a car. The participants were able to share the car with two to five acquaintances who also shared all maintenance costs. The service was however discontinued in 2017.

Car subscription

A recently emerging service, mainly offered by car manufacturers, is car subscription. Basically, it is a form of car leasing where the user pays a monthly fee that includes everything except fuel. It often also includes a possibility to switch to another type of car for a shorter period, for instance a larger car when transporting goods or going for a longer journey. This other vehicle can then be seen as a short-term sharing.

Leasing chain/used car leasing

An emerging version of leasing or subscription is a leasing chain, where the first user leases a new car, after which the car is refurbished and re-leased to a second user, then maybe to a third or even fourth user in a leasing chain. However, even if the same car is used by several users, it is not truly a carsharing service. It is nevertheless worth mentioning since it can constitute a form of circular business model. This setup is probably most profitable with EVs as combustion engines wear out faster. The risks of re-leasing used internal combustion engine cars is therefore higher for a leasing company.

Business to Business (B2B)

While many carsharing offers are targeted at end customers there is a rising number of operators targeting commercial actors. This is mostly done in their role as employers, fleet owners or real estate managers. While some operators target both private and commercial customers, others target the latter group exclusively. B2B services tend to be station-based. Offering carsharing services to real estate

owners is the fastest growing part of B2B carsharing as more and more housing and office developments want to be less car-dependent and designate less space for parking. Some are even obliged by local regulation to offer alternative mobility options that allow residents to fulfil their mobility needs without a private car. In some cases these services might be packaged into a mobility offer like mobility-as-a-service (MaaS).

Electric vehicles in carsharing

While most operators nowadays have electric or hybrid vehicles in their fleet there are, and have been, operators that exclusively employ electric/hybrid vehicles. In either case, the operator is also responsible for the charging of the vehicles. This will in most cases mean that the parking areas (in station-based carsharing) are equipped with charging stations, or that the subscription fee includes the cost of charging at public stations (in free-floating systems).

New Services on the Fringes of Carsharing

The following section will present short definitions of (mostly newer) services that carsharing is frequently associated, and sometimes even confused, with:

- Ride sharing: The sharing of car journeys so that more than one person travels in a vehicle, and prevents the need for others to have to drive to a location themselves. The most prominent platforms in Sweden are Skjutsgruppen and GoMore.
- Ride hailing: Like ride sharing, but real-time and usually operated by a Transport Network Company (TNC). The only actor on the Swedish market is Uber. (Shaheen and Cohen 2018)
- MaaS: Mobility-as-a-Service refers to the access to different mobility services/solutions (e.g. public transport, carsharing, bike pools, taxi) via a single booking- and payment solution, usually enabled by a mobile application. Public transport is usually the backbone for MaaS solutions while carsharing becomes an indispensable component for users that want to replace a private car. In Sweden, MaaS is currently only operated as pilots, even though the current Stockholm pilot (with Ubigo) aims at commercializing by 2021.

The reason why carsharing often is associated with ride sharing, ride hailing or MaaS is that these services are regarded as either complementary, competing or integrated with each other. The operation of ride sharing or ride hailing is completely independent of carsharing offers. It can from a user and transport planning perspective however be regarded as complementary. From an operator perspective they can well be seen as either complementary or competitive. (Stiglic et al. 2018)

MaaS is on the other hand highly dependent on the existence of carsharing offers. Carsharing is one of the major components in a MaaS package as it allows for a car free life — the main proposition of MaaS. So far there are no MaaS-schemes without carsharing, and MaaS-operators have so far not even considered starting to operate in areas where there is no carsharing operator present. Most MaaS schemes include only one carsharing operator, even when there are several operators present in an area. P2P-carsharing might be included as an addition to B2C-carsharing. P2P is however usually considered an inferior alternative as the quality of the delivery of the service often cannot be guaranteed. (Arby, Curtis, and Vanacore 2017)

GLOBAL MARKET DEVELOPMENT

Carsharing has expanded fast across the globe in the past decade and especially so after 2014 (Shaheen, Cohen, and Jaffee 2018). The worldwide number of carsharing members more than *tripled* between 2014 and 2016, from 4.84 million to just over 15 million. The majority of this growth is attributable to the Asian market, although all continents experienced positive growth. In both Europe and Asia, the ratio of members-to-vehicle has increased, signaling room for growth in the industry. In October 2016, one-way carsharing accounted for about 31 percent of total carshare membership and 26 percent of carshare fleets worldwide. Roundtrip carsharing represented 69 percent and 74 percent of membership and fleets, respectively. Europe is exceptional among the world's continents, with one-way carsharing memberships accounting for the majority (66 percent) of total membership. Carsharing membership in Asia, meanwhile, consists overwhelmingly (89 percent) of round-trip memberships. The number of carshare users in Europe alone is projected to grow to 15.6 million users and over 150,000 vehicles by the year 2020 (Schiller, Scheidl, and Pottebaum 2017).

THE SWEDISH MARKET

The number of carshare vehicles in Sweden has more than tripled in the past decade, from 575 in the year 2011 to 1,840 in 2018 (Figure 1). However, compared with penetration rates in other European countries, Sweden and Scandinavia have shown a rather slow uptake of carsharing services.

At the same time, the number of carsharing users has grown faster than the number of cars – which can be seen as a sign of efficiency. In fact, the number of carsharing users has passed a critical threshold – 1 in 100 Swedish citizens (or 1,5 in 100 Swedish citizens with a driver's license) were active car-sharing users in 2018 (Figure 2).

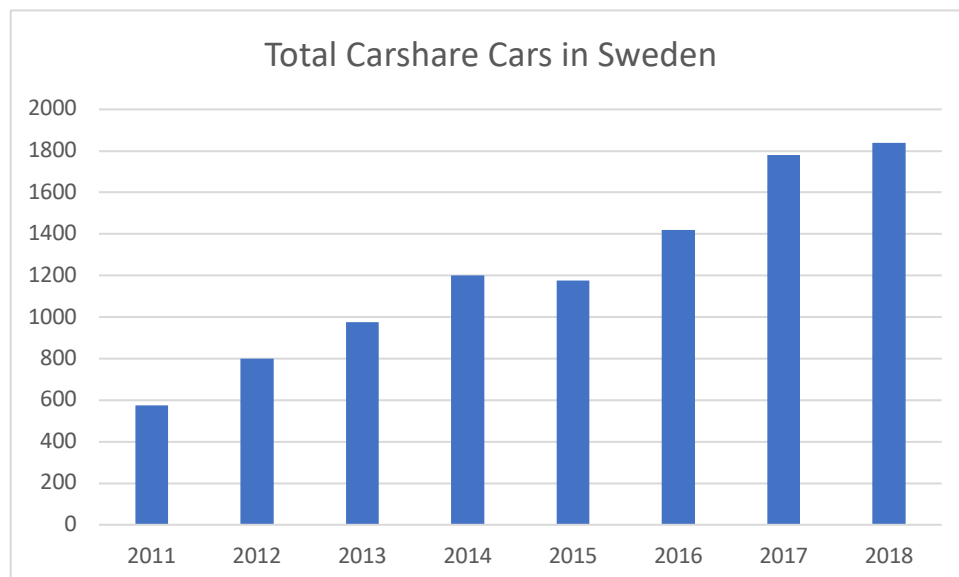


Figure 1: Carsharing vehicles in Sweden

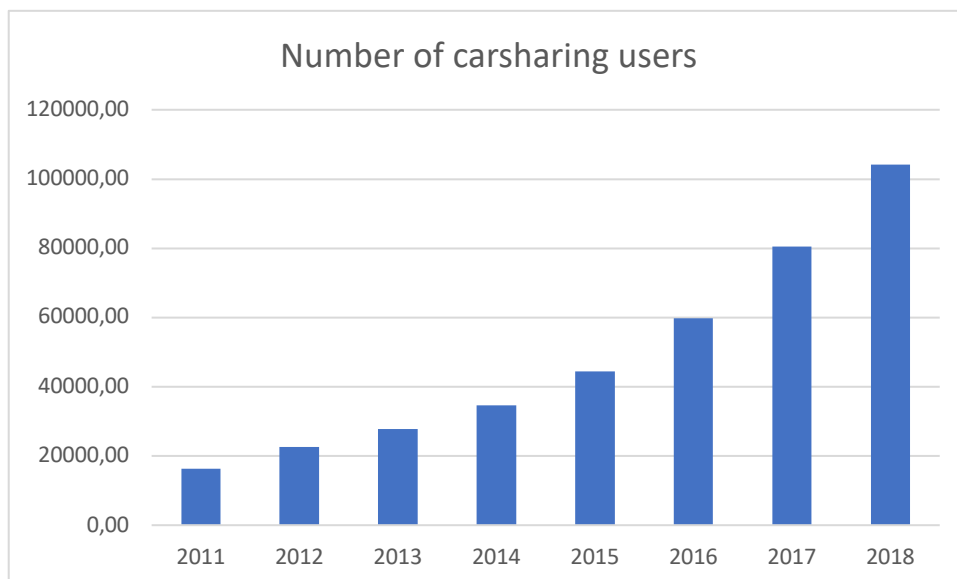


Figure 2: Carsharing users in Sweden

Source (figure 1 and 2): (2030-sekretariatet 2019)

Another important market in Sweden is the P2P carsharing segment. One of the operators, SnappCar, which represents about half of the P2P market, reports 4,000 registered cars and 40,000 registered users (renters). The platform is performing 50-70 rentals daily and is growing 100% every year. Go-More, the other major operator, is reporting numbers only for Scandinavia as a whole, with 20,000 registered vehicles. (www.gomore.se/press) This market is developing quickly, with new operators and new technologies, mainly aimed at keyless access, entering the market.

DRIVING FORCES FOR MARKET DEVELOPMENT

How will carsharing develop in the future? The market is influenced by a wide variety of external and internal drivers, both negative or positive. A recent survey conducted among European carsharing operators and experts found that the most positive driving forces of carsharing are, or will be, a further diffusion of smartphones; a better integration with public transport services; and the emergence of MaaS. The most negative factor for driving was identified to be raised costs of fuel. This conclusion was however based on the assumption of a fleet composition with only 30% EVs (Chicco & Diana, 2018). The increase of reserved parking spots for carsharing services and the reduction of taxes and parking fees for operators are from a public policy perspective seen as the most important keys to market expansion (see also pp.16 ff).

Despite the industry's impressive growth, carsharing's profitability remains uncertain. As discussed above, a number of carshare services are appendages of larger organizations (e.g. OEMs and/or traditional rental car companies) who use carsharing strategically (as a way to promote their cars) or experimentally (to test a proof of concept), and not necessarily for earning a profit. Lagadic, Verloes, and Louvet (2019) offer an autopsy of struggling carsharing business models in major European cities. Among others, they detail how Paris' Autolib service (one-way, B2C, electric vehicles) collapsed under its own success in 2018: As the company attracted a growing number of subscribers, competition for available cars increased and subscribers began driving less and less each week. Eventually

membership declined, but subscribers that had stopped using the service did not return to their earlier frequencies. Even at its peak frequency of use in 2015, the company was still not earning a profit.

Some of the (still mostly experimental) business model strategies that public and private authorities have begun to explore are:

- *Combined mobility* or Mobility as a Service (MaaS) integrates a carshare subscription into a broader transportation service offering that can include public transit and other private transportation service providers in a region. An ideal MaaS system allows for payment, ticketing, and booking of these different services through a bundled subscription. This innovation does however remain highly exploratory as different companies experiment with different technical platforms.
- *Hybridization of models* involves combining different business models into one and varying these offerings over space. This can for example be done by offering a free-floating carshare service in a city center and station-based carshare in the outskirts of that same city (e.g. Copenhagen's Green Mobility Service). Another version is to exploit the same fleet for both B2C and B2B, making use of the difference in peak demand times over the course of a day, as suggested in (Clark et al. 2015).
- *Lease-to-share* schemes in which a leased car can serve as a shared P2P vehicle when it is not in use. This reduces the cost of leasing while returning a great profit to the leasing company (e.g. SnappCar in Amsterdam, GoMore in Sweden).
- *Dynamic pricing* that adjusts the price of carsharing to encourage use during off-peak times and allow for market-based car balancing.

Other strategies involving new actors in the carsharing arena could be:

- *Partnerships between two carsharing companies* to reduce the costs of IT platforms and personnel, increase usage rate, and a greater availability of cars for customers
- *Retailers* offering discounts and free parking to users of carsharing services as a way to attract customers
- *Real estate and residential developers* offering carsharing to residents as a way to circumvent parking maximums in urban areas (Lagadic, Verloes, and Louvet 2019)

These driving forces provide a rough picture of an overall market growth. We can also expect to see a couple of changes and trends in the way carsharing will be provided in the coming years: Interaction with new mobility services, expansion of the B2B-segment, more establishments in smaller and medium-sized urban areas, the packaging of different carsharing options, and repositioning of vehicle manufacturers.

A major change will be carsharing services' interaction with "new mobility services". Even though carsharing has a relatively long history the headlines of mobility innovation today are captured mostly by concepts like ride sharing or ride hailing, not at least as a consequence of the enormous investments that have been made in those services. As with the different carsharing models themselves – especially station-based vs. free-floating – it is to be seen whether they will become complementary or competing models. Looking at mobility behavior trends such as an increasing number of customers omitting car ownership, and an increase in multimodality, it is likely that people will use a variety of services in a complementary way (Le Vine, Zolfaghari, and Polak 2014).

Another major shift in the landscape of actors is towards B2B-services where operators target more specific, albeit smaller, user groups. B2B usually offers a more stable revenue stream. It also makes it easier to tailor offers to the customers compared to B2C-services which need to find a “one-size-fits-all” solution in terms of cost structure, location, vehicles, and payment models (P. Wells et al. 2017). B2B carsharing has historically focused on replacing commercial fleets but more recent development shows an expansion towards the residential sector. (see a deeper analysis on p.15 ff)

While many carsharing schemes were and still are established in major cities throughout Europe (especially free-floating) there is still considerable scope for carsharing in smaller and medium-sized urban areas. One factor is the higher possibility of securing political support as a majority of residents will benefit from carsharing solutions. Another factor is the relatively big quality of life improvement in such areas. The benefits are usually not significant enough in large cities. In smaller/medium-sized municipalities it is also easier to include carsharing into a more comprehensive transport planning solution as these municipalities usually deal with a smaller number of actors and operators (Steorn and Goldmann 2017)

We can, given these developments and trends in mobility behavior, also expect “portfolio packages” on the market where operators offer several carsharing varieties in a more integrated fashion. Users that want to replace a private car usually can today not rely only on one solution but need free-floating carsharing for spontaneous short trips; station-based carsharing near their home for trips that can be planned ahead; and car rental for longer trips and vacations. Currently, it is mainly enthusiasts of a car free life that are willing to go these lengths in meeting their mobility needs, while the majority of users will require a much simpler, more integrated solution. (Peter Wells et al. 2018; Corwin and Pankratz 2017; Meyer and Shaheen 2017)

Automakers around the world are considering adopting carshare models, often in parallel to their existing traditional produce-and-sell models due to a mix of opportunities and threats to traditional car selling models. The decline of the personal motor vehicle as a status symbol, plus pressure from cities struggling with congestion and national governments focused on reducing emissions, give OEMs reason to at least consider carsharing models (Firnkorn and Müller 2012). Bellos, Ferguson, and Toktay (2017) offer an explanation for why high-performing luxury car brands like BMW and Mercedes have been the first to offer their own carsharing services. As fuel economy standards become stricter, a car-sharing service allows high-end OEMs to increase the fuel efficiency of their *entire fleet* without cannibalization because customers that prioritize high performance are typically higher-income customers that are more likely to own their own vehicle, and thus less likely to subscribe to carsharing. In short, the customers that subscribe to carsharing tend to prefer fuel efficiency over engine performance, so offering a carsharing service doesn't eat into luxury OEMs' existing customer base, and may even expand it.

EVIDENCE FOR THE CLIMATE IMPACTS OF CARSHARING

The environmental benefits of carsharing are not guaranteed. On the one hand carsharing could allow individuals to either abandon vehicles they own or decide *not* to purchase a vehicle when they might have otherwise. On the other hand, carsharing might also allow car-free households to use a vehicle when they would have otherwise taken public transit, walked, bicycled, or chosen not have made a

trip. This substitution effect has been observed for ridesharing (i.e. Uber and Lyft) in large American cities (Schaller 2018; Clewlow and Mishra 2017). Whether carsharing can be considered a “low-carbon” form of transportation depends on what type of transportation habits new adopters are transitioning from; how the service changes users’ travel behavior once they’ve adopted it; and how the fuel mix of carshare vehicles compares to the fuel mix of the vehicles previously used.

Martin and Shaheen (2011) found, using a survey of over 9,000 carsharing users in the USA and Canada, that the net effect of joining a carsharing service was a *reduction* in household emissions. While the majority (71 percent) of respondents reported modest increases in total emissions (e.g. carless households driving a little more), the remainder of respondents reported comparatively large decreases in driving due to households choosing to either drive their existing vehicles less or avoiding purchasing a vehicle when they otherwise would have.

Other studies offer evidence that carsharing is an attractive substitute for certain types of trips with individually-owned car (Ceccato and Diana 2018); that business-to-business car services free employees to take modes of transportation *other than* their personal vehicles to work (Clark et al. 2015); and that it removes personal vehicles from the road (E. Martin, Shaheen, and Lidicker 2010; Schreier et al. 2018; Clewlow 2016).

Over twenty-five percent of users of a (then) experimental free-floating car service (car2go) in Ulm, Germany, expressed that they would be likely to forego the purchase of a personal vehicle if the carsharing service were to become permanent (Firnborn and Müller 2011). Free-floating carsharing services have since left the “experimental” phase and is commercially available in cities across Europe and the United States. An analysis by Fromm et al. (2019), which surveyed over 10,000 users of two free-floating carsharing services in 11 European cities (car2go and DriveNow) reports that between 3.6 and 16.1 percent of regular users claim to have sold a vehicle due to the availability of carsharing. The report also estimates that between 14.3 and 40.7 percent of users have suppressed the purchase of a new vehicle due to the availability of carsharing. Predicting precisely what users *would do* if carsharing had not been available is of course impossible. The researchers dealt with this difficulty by asking users about their vehicle ownership status before and after joining the carsharing service, and what they would do if the carsharing service was discontinued in their region.

A case study by Boyer (2016) shows how a 4-vehicle carsharing cooperative in the rural United States serves the transportation needs of a 75-person village without access to public transit and where bicycling and walking would be impractical for trips outside the village. The very high user-to-vehicle ratio plus the fact that the vehicles are fueled by on-site solar panels results in dramatic energy and cost savings to members. The success of this cooperative, however, depends heavily upon communication and carpooling among neighbors. This service was facilitated by a simple internet scheduling tool.

THE CARSHARE CUSTOMER LANDSCAPE

An plethora of research examines how individuals’ socio-demographic characteristics and place of residence influence the likelihood of them using carsharing. The results of these studies generally show

that carsharing subscribers tend to be wealthier, more highly educated, live in car-free households, and use a greater variety of transportation options than the average driving population.

MOTIVATIONS FOR USING CARSHARING

An in-depth qualitative study by Schaefers (2013) categorized users' motivations for subscribing to carsharing as 1) value seeking, 2) convenience/time-saving, 3) lifestyle reasons/connection to a community, and 4) environmental reasons. The latter two categories appeared however to complement the first two rather than drive decision making. These findings confirm the rather mixed research results associating individuals' environmental ideology/concerns to the adoption of carsharing. Whereas the results from some studies show a statistically significant association between respondents' environmental ideology and carsharing membership (e.g. Burkhardt and Millard-Ball 2006), other studies find no significant association (B. (Brenda) Zhou and Kockelman 2011), while Münzel et al. (2019) finds the association significant in the case of B2C carsharing, but insignificant in the case of P2P carsharing in Europe. Lavieri et al. (2017) finds that individuals who live a relatively "green lifestyle" are more likely to have subscribed to carsharing, although the authors' operationalization of "green lifestyle" is a composite of an individual's transit use and the walkability of their neighborhood, which tend to associate independently with carsharing membership.

In a Turin-based study, Ceccato and Diana (2018) find that carsharing is most common among young men, in households with relatively few cars, and relatively little parking nearby. The authors find evidence that carsharing complements (rather than displaces) public transit trips, while carsharing replaces driving trips. Similarly, a study of carshare users in Basel, Switzerland, found that carshare subscribers are more likely to come from car-free households, and households with at least one bicycle. They are also more often seasonal public transit ticket holders (Becker, Ciari, and Axhausen 2017). The authors (ibid.) find that both station-based and free-floating subscribers are more highly educated, which is consistent across carsharing literature (Burkhardt and Millard-Ball 2006; Kopp, Gerike, and Axhausen 2015)—although Zhou and Kockelman (2011) find that education level is a convex variable with higher levels of carsharing membership among the least educated *and* most educated respondents. Meanwhile, station-based subscribers are more likely to plan their trips whereas free-floating subscribers tend to reserve their vehicles within an hour of use. This corresponds to evidence that free-floating carsharing is more often used to "fill gaps" left by public transit, or when public transit is not available at the precise moment the traveler needs it.

An in-depth study of individuals' travel patterns by Kopp, Gerike, and Axhausen (2015) yields results very similar to those cited above: Subscribers to BMW's free-floating *DriveNow* service in the cities of Munich and Berlin come from households with half as many cars per person on average, drive less during the week, and ride a bicycle significantly more than non-carshare subscribers. They also tend to live in neighborhoods with better access to rail-based public transit and higher population density. Contrary to many studies show that station-based carshare subscribers tend to use public transit more often than the general population, this study shows no statistically significant difference in public transit use frequency between free-floating carshare users and the general driving populations of Munich and Berlin, leading the authors to suggest that free-floating carshare subscribers "prefer individual modes of transport" (p. 463).

Lavieri et al. (2017) found that individuals who lived in high-density neighborhoods and had used car-sharing in the past were more likely to express interest in adopting AVs as part of a carshare model rather than owning an AV themselves. The authors concluded “...perhaps the most effective way to move AV adoption toward a sharing model (rather than an ownership model) is to enhance neighborhood densification” (ibid. p.9).

IN WHAT TYPES OF PLACES ARE CARSHARING MOST COMMON?

Several studies have confirmed that the best markets for station-based carsharing are in high-density urban neighborhoods (Stillwater, Mokhtarian, and Shaheen 2008; Grasset and Morency 2010). It is however not certain that carsharing is more common in high-density cities than in their relatively low-density counterparts. Münzel et al. (2019) examined which factors explain the presence of B2C and P2P carsharing in large western European cities. The authors analyzed cities greater than population 150,000 in the UK, Belgium, France, Netherlands, and Germany (n= 177 cities total). They found important variations in carshare availability in different countries, and different cities. On average, German cities had the most B2C cars per capita, French cities had the most P2P cars per capita, while UK cities had the lowest level of both types of carsharing. Variables associated with higher B2C car access include the presence of a university, a higher proportion of Green party voters, a lower proportion of car commuters, a lower proportion of public transit commuters, and the presence of P2P cars. Variables associated with higher P2P car presence includes a higher proportion of university-educated population (however the presence of a university is *inversely* related to the number of P2P cars), lower population density, and the presence of B2C cars. The authors (ibid.) suggested regulations that restrict insurance coverage for renting out one’s own car to be an explanation to the relatively low presence of carshare cars in the UK .

BUSINESS MODELS AND PRODUCT-SERVICE SYSTEMS

Business models can be understood as cognitive instruments that explicate causal linkages among traditional elements of a business like customer segments, value propositions, communication channels, monetization, suppliers, and key resources (Johnson and Suskewicz 2009; Bohnsack, Pinkse, and Kolk 2014). New business models can take advantage of opportunities that emerge from shifting social, technological, or political landscapes. Carsharing represents one consequence of improvements to smart phone technology plus policies at all scales of government that—for various reasons— increase the costs of owning, fueling, parking, insuring, and repairing personal vehicles.

Traditionally, personal vehicles have been sold as part of a business model in which ownership, maintenance, insurance, and disposal of the goods (i.e. the vehicles) are transferred completely from seller to consumer. Carsharing—in its many variations—represents a product service system (PSS) in which customers purchase temporary *access* to a vehicle without gaining neither exclusive ownership nor responsibility for its maintenance.

Tukker (2004) identified eight varieties of PSS, several of which still involve the exchange of a product and some that involve no products at all. Between these extremes lies *use-oriented* PSS in which the service provider retains ownership of a product and responsibility for its maintenance, while customers can lease, rent, or share access to the product. Since use-oriented PSSs are rewarded for the successful delivery of a service rather than the sale of a high volume of goods, service providers have an incentive to employ a smaller number of high-durability products that can be easily upgraded and returned to circulation (Hawken, Lovins, and Lovins 2010; Mont 2004; Tukker 2004).

SUCCESS FACTORS OF CARSHARING BUSINESS MODELS

The academic literature on carsharing has over the last decade described a variety of carsharing business models, emerging in different contexts, spurred by different types of businesses (e.g. car rental companies, OEMs, start-ups), and aimed for different types of customers. While the different categories of business models are detailed on pp. 4ff., the following section discusses the circumstances in which certain business models thrive and others struggle.

Remane et al. (2016) developed a carsharing business model taxonomy using a three-step analytical process that elaborated upon earlier classifications by Cohen and Kietzmann's (2014). They began by identifying 94 different carsharing companies in English- and German-speaking markets and developed a taxonomy based on 15 dimensions drawn from academic literature and empirical data. They then performed a cluster analysis grouping similar types of business models into statistically similar, and mutually exclusive categories. The analysis identified seven clusters based on the type of trip (roundtrip vs. one-way), type of vehicle offerings (multiple vehicle types vs. single vehicle types), access points (station-based vs. free-floating), and access methods (manual vs. automatic). The clusters were:

- 1) roundtrip, multiple vehicle types, e.g. Flinkster, Zipcar, Stadtmobil (n=26)
- 2) roundtrip, single-purpose vehicles, e.g. Hertz 24/7, Zen Car (n= 11)
- 3) roundtrip, cooperative, e.g. City Carshare, Mobility CarSharing (n=21)
- 4) one-way, free-floating, e.g. Evo, DriveNow, Enjoy (n=12)
- 5) one-way, station-based, Autolib (n=4)
- 6) p2p, manual access, e.g. Turo (n=14)
- 7) p2p, automatic access, e.g. Car Next Door, Sharoo, Drivy (n=6)

These categories revealed some interesting patterns. Firstly, car rental companies that had developed carsharing operations (e.g. Avis and ZipCar) tended to appear in cluster 1—round-trip with multiple vehicle types, while OEMs that had developed carsharing businesses (e.g. BMW's DriveNow) fitted in the one-way, free-floating cluster. Schiller, Scheidl, and Pottebaum (2017) commented that OEMs may be using free-floating carshare *strategically*, as a way to promote their vehicles rather than earn a profit off the carsharing service (p. 3). Clusters 4 and 5 can be booked *by the minute*, and therefore tend to substitute for public transit and taxis. Clusters 1,2,3, and 7 only allow for round-trip hourly rental, so they were more often used for short shopping trips. For customers, the features of cluster 6 most closely resemble the experience of traditional car rental, in part because users have to return the keys to the car owner.

A vehicle's energy source may also implicate different business models. Electric vehicles (EVs) may for example benefit from slightly different business models than vehicles used in traditional petroleum-fueled carsharing. Kley, Lerch, and Dallinger (2011) used a morphological analysis to reveal new questions that can be applied to the development of an EV carsharing business model. These were for example: *Who owns each component? Are the battery and vehicle owned by separate entities? Who is responsible for maintenance and aftersales service? What types of billing are possible? How exclusive is access to the product? Is charging infrastructure private, semi-public, or public? Is charging infrastructure unidirectional or does it feed back into the electric grid? How is charging billed: No fee? Pay per use? A fixed rate?* This example shows that EV carsharing business models' success will depend on different factors than carsharing with ICE drivelines.

EVs have played a significant role in promoting small, but significant changes in the carsharing landscape over time. There was early excitement about EVs as part of carsharing business models in the early 2000s, but EVs were quickly replaced with conventional and hybrid vehicles due to high costs, high insurance premiums, low reliability in the first generation of EVs, limited range, logistical challenges related to data management, and a coinciding economic downturn. (Shaheen and Chan (2015)) At first, EVs were most commonly used for short, station-based trips to solve the last-mile problem. Some of the first EV carsharing schemes were restricted to single jurisdictions to prevent long-distance driving far away from charging stations, which were owned by the carshare company itself. The University of California-Riverside's "intellishare" program, for example, used one-way EV cars and didn't allow uncharged cars to be rented. Recent growth in one-way carsharing has used free-floating and one-way rentals between airports and cities. Both Car2Go and BMW-Sixt free-floating services have worked with cities to prepay for parking spots for their electric fleets. Public policy has helped propel EVs as part of carsharing more recently by, for example, offering discounted parking and discounted tolls for EVs in the United States.

BUSINESS-TO-BUSINESS CARSHARE MODELS

The business-to-business (B2B) carshare model remains relatively unexplored by academic literature. B2B carsharing involves an entire organization subscribing to carsharing services, often to be used by employees for business trips. A B2B carsharing service offers multiple hypothetical advantages for both carshare businesses and their clients. According to Clark et al. (2015), B2B carsharing could be helpful to carsharing businesses as a way to even out imbalances in the use of carsharing vehicles over a period of time. In other words, it could allow for greater fleet utilization throughout e.g. the workday or a week. It offers organizations a way to eliminate the potential administrative challenges of either a) owning and operating its own car fleet or b) managing the reimbursement for business travel in employees' personal vehicles.

B2B users (i.e. individuals who use B2B carsharing through their workplace) report reductions in drive-alone commuting to work and reductions in household vehicle use for non-commute purposes (Shaheen and Rodier 2004; Clark et al. 2015; Italian Ministry of the Environment 2009), although a study of university employees with discounted access to carsharing showed that the most frequent carsharing users were more likely to have a public transit subscription than eligible employees who opted not to use the service (J. Zhou 2012). These results offer evidence that workplaces with existing

limitations on parking and existing incentives for employees to use public transit may induce additional vehicle travel by offering carsharing schemes.

A 2015 study that surveyed both B2B carshare members and workplace transportation managers in the UK found that most B2B members (68 percent) use carsharing for their usual business travel; that 51 percent of them *used to* use their own cars for such travel; that business travel by car declined after members joined a B2B service; and that 15% of the respondents indicate that the B2B program has changed their travel habits by allowing them to commute to work less often in a private car. This last effect is of high significance as it hints towards the potential effects of shared cars available at the workplace. When transportation managers at employers were surveyed there was an inverse relationship between employer size and business travel in carshare vehicles; being public sector organization was associated with a higher proportion of b2b travel; and an organization that prioritizes public transit, cycling, and walking is associated with a higher frequency of B2B carshare usage (Clark et al. 2015).

POLICIES AND REGULATIONS

As has been mentioned throughout the text, carsharing is still meeting several policy and regulation related obstacles. Many of these regulations were simply drafted before carsharing was in place and therefore did not take into account this phenomenon. Now they often pose a barrier to acceptance and/or profitability, and their removal or adaptation could greatly promote carsharing. In the following, an overview of the most important regulatory issues for carsharing in Sweden is provided.

LACKING CARPOOL DEFINITION

There is no legal difference between a rental car and a car belonging to a carpool in Sweden. Both are considered to be rental cars governed by the Swedish car rental law. There is also no legal definition regarding what a carpool is. This is a problem when it comes to parking on publicly owned land. The starting point is that a municipality should treat its residents equally and not give any individual an advantage (i.e. a reserved parking space on the street). But in special cases, the municipality may, through a local traffic ordinance, reserve a parking space for example for the disabled. If there is no legal definition of a carpool the municipality cannot incentivize carsharing by reserving parking space for carpools. This is even a bigger problem for electric carpools that require charging stations. A charging station is of no use if it is occupied by petrol cars. There have been attempts in Sweden to clarify, legally, what a carpool is. But so far, no regulation exists. (Stearn, Goldmann, 2017) However, the current "Betänkande av Bilpoolsutredningen"¹ has made a suggestion how a definition should look like, and it is to be seen when and to which extent this will be converted into guiding law.

PARKING REGULATIONS AFFECTING CARPOOLS

Access to parking space is one of the factors that are most important for transportation mode choice. Changing access to parking is also one way that society can reshape mobility. Many cities lack parking

¹ Motorfordonspooler – på väg mot ökad delning av motorfordon. Stockholm 2020. Online: <https://data.riksdagen.se/fil/4EABF48F-A7CA-43C1-9055-96B3FBCC58A8>

spaces and have problems with congestions of cars. If more individuals share cars instead of driving alone in their own cars, it would relieve congestion on the roads. In Sweden, there are two different regulations for parking. One regulation is about parking on private land (i.e. a parking garage). The other regulation is about parking on land jointly owned by citizens (municipality) (i.e. a street).

New construction of buildings

Building parking space on private land is expensive. It is therefore tempting for a developer to refrain from building parking space. To avoid this from happening there are regulations in Sweden regarding how much parking space a developer must build when a new house is produced. It is the municipality that decides on specific parking requirements for different types of buildings. A common value is somewhere between 0.8-1.1 parking spots per household. Lately there have been some new ideas about how much parking space a building will need in the future if combined with MaaS—which could theoretically lower the demand for parking. Some municipalities have decided to permit houses with no parking space at all provided that the developer guarantees to supply the residents with a MaaS subscription (i.e. for five years). MaaS could, for example, include membership in a carpool. If more and more municipalities decided to follow this trend, real estate developers will have to take an active role in developing sustainable transportation for the future.

SHARING ECONOMY AND P2P CARSHARING

The sharing economy helps people realise value of underused assets such as vehicles. An individual can offer temporary access to a service (e.g. driving) or offer the vehicle itself. Sometimes money is involved in the transaction, sometimes the transaction is about services and return services.

The sharing economy faces regulatory challenges. One of the challenges is taxation. How can society ensure that correct taxes are paid? Another challenge is identifying the boundaries to businesses. When does the individual or their individual actions, for example, become a business?

P2P carsharing is a double-sided business. Borrowing a car faces no legal uncertainty today, but lending a car is more difficult. Sweden has a car rental law for professional carsharing.² The purpose of the law is to make car rental safer for consumers. You need, for example, a permit to do business and there are more stringent safety demands on the rental vehicle compared to a family-owned vehicle. However, the car rental law does not define what is a professional car rental, and there are no legal cases about the definition. This has led to uncertainty in the matter of P2P carsharing. For example, one of the P2P platform operators in Sweden has decided (internally) that an individual may not register more than three cars. In this way, the operator hopes to protect lenders from being considered as commercial entities which would require a permit. If an individual lends their car to someone else and makes a profit on this transaction, they are supposed to pay tax (income from capital). A few years ago, there was uncertainty among users of P2P carsharing platforms about taxation. The Swedish Tax Agency has now published information on how taxes should be calculated on its website, which has made it easier for the users of P2P carsharing to do things right.³

² Lag (1998:492) om biluthyrning

³ <https://www.skatteverket.se/privat/skatter/arbeteochinkomst/inkomster/delningsekonomi/hyrauttillgangarsombilbatmedmera.4.2cf1b5cd163796a5c8bc0b.7.html?q=bildelning>

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