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22th ACEA

SCIENTIFIC ADVISORY GROUP REPORT

Carsharing: Evolution, Challenges and Opportunities

SEPTEMBER 2014

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Acknowledgments

The authors would like to thank Arnd Bätzner, Stephan Herbst, Barbara Lenz, Fuensanta Martinez Sans, Joseph Seal-Driver, and Ivo Wengraf for comments on earlier drafts.

Any remaining errors are the authors' responsibility.

1.

Introduction: rationale and main objectives

Carsharing sits within the emerging class of ‘mobility services’ that draw on modern technology to enable access to car-based mobility without the consumer owning the physical asset (a car). In contrast to the traditional format of selling cars to end users, this requires new value propositions, new organisational structures, and new ways of interacting with the public sector. Taxis and traditional car hire are alternative, older, forms of mobility services that do not require modern information and communication technology to be commercially viable, but that are making use of new technologies to deliver service improvements (see [TEXT BOX ‘A’](#)).

The worldwide carsharing market today encompasses several million¹ customers. The fleet consists of some tens of thousands of vehicles². Though carsharing activity today is heavily concentrated in industrialised countries, there are a growing number of examples of operations in less-developed societies.

This briefing paper is not intended to comprehensively chronicle carsharing activity; rather it identifies and discusses the set of key industry-level issues.

2.

What is carsharing?

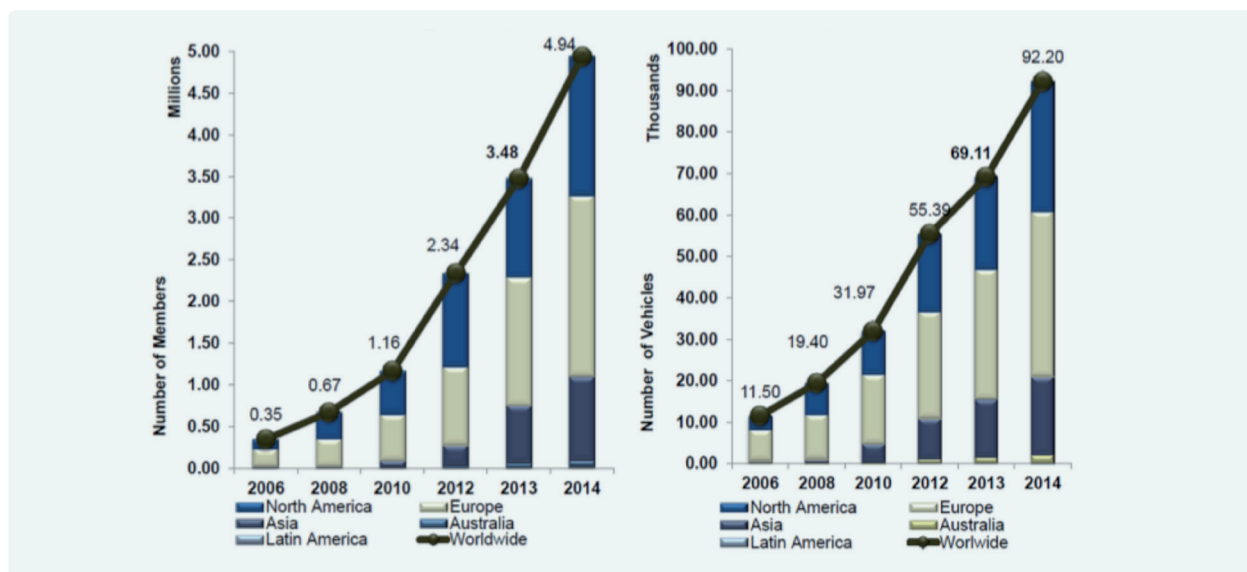
The terminology of carsharing has never been standardised; it is an ongoing source of confusion for both industry professionals and end users. In certain instances clarity can be important, however, such as when a technical definition is used to determine whether a given service is subject to a specific form of taxation. For instance, carsharing activity has occasionally been deemed to be subject to taxes intended for traditional car rental, which in many cases were motivated by a desire to tax a jurisdiction’s visitors rather than its residents.³

Though there is no uniquely-correct definition, carsharing is the term used throughout most of the world to refer to mobility services with the following general characteristics:

- The user must go through a pre-qualification process for verification of identity and driving-record once, and is then able to access the service’s cars in future without interacting with a member of staff each time. Keyless access is typically, though not all carsharing services have the in-vehicle telematics that this requires. For instance, many peer-to-peer carsharing services (see the next section) require the user to manually exchange the car’s keys.
- The vehicle is driven by the end user as in traditional car hire (ie not a paid chauffeur, as in a taxi). The end user may

Figure 1 Carsharing Market, Number of Members and Vehicles, 2006-2014

SOURCE Frost and Sullivan (2014) Strategic Insight of the Global Carsharing Market. Report #ND90-18, June 2014.



be making use of the vehicle on a personal basis, or on behalf of an employer (sometimes called corporate carsharing). The vehicles tend to be models that are uncomplicated for users to operate, as with standard rental cars.

- Usage is billed in time increments of minutes or hours, and sometimes also on the basis of distance travelled. Many operators allow multi-day usage at discounted rates, though daily rates are typically higher than for traditional car hire.
- There may be a one-time sign-up fee or an annual subscription fee, in addition to time-based and/or distance-based charges.
- Usage is in some cases spontaneous and in others reserved in advance (this point is discussed further below).
- The vehicles are typically available from distributed locations across a service area, in contrast to traditional car hire in which vehicles are accessible only from a small number of storefront or airport locations.
- Servicing/cleaning is done by the operator's staff on an occasional basis, rather than after each usage. In many cases collaboration with users facilitates fleet logistics; for instance users may be incentivised to re-fuel a carsharing vehicle through a modest benefit such as an additional increment of time to use the car.

In the UK carsharing refers to multiple people travelling together in a car at the same time; the term car clubs is used in the way that carsharing is elsewhere.

The next section describes the diversity amongst different types of carsharing services.

TEXT BOX A

SHARING VS ACCESSING

The term carsharing is used for historical reasons, but it is debatable whether 'sharing' accurately describes the behaviour. Carsharing generally involves accessing a car owned by another person or entity in exchange for an agreed monetary payment. During the period of time when a person has access to a carsharing car, they are responsible for it and its use is for their exclusive benefit. Rather than carsharing cars being shared between consumers, it is the authors' view that the behaviour is more accurately described as sequential short-term car access. Even in instances in which consumers collectively own a carsharing operator through a cooperative structure (eg Mobility Carsharing in Switzerland), they continue to use the fleet via the sequential-access-in-exchange-for-monetary-payment model.

Many analysts position carsharing within the increasing array of other connectivity-enabled access-based consumer services, such as cloud computing and peer-to-peer accommodation rental (AirBnB⁴). There are counter-examples, however, where the dominant paradigm has shifted in the opposite direction over time, from access to private-ownership. Today, for instance, nearly all adults in high-income countries carry their own personal mobile phone, and the traditional shared form of phone-access (the phone booth) has become irrelevant.

IS 'UBER' A CARSHARING SERVICE?

Media for general audiences frequently use the term carsharing more loosely than it is defined here. For instance, companies that connect car-drivers with fare-paying customers wishing to be driven from point 'A' to 'B', such as Uber and Lyft, are regularly described as 'carsharing services' in the mass media (eg, Bloomberg, Forbes, Wall Street Journal). 'Transport Network Companies' (TNCs) is the term that now seems to be emerging amongst professionals to describe chauffeur-driven (as opposed to the end user driving himself) technology-enabled mobility services. Such services are becoming increasingly prominent, with Uber being valued at \$18 billion (€13 billion) when it raised capital in early June 2014, as compared to a valuation of \$3.5 billion in a previous capital-raising round in August 2013.

In June 2014 the taxi trade in a number of European cities staged public demonstrations against smartphone-app-based TNCs. The question is how such services will be regulated by the public sector; the taxi industry's overriding concern is that app-based systems will be treated preferentially relative to incumbents in the industry.

3.

Variations on a theme

➔ Several forms of carsharing can be found; in some cases a single carsharing operator delivers more than one type of carsharing service model. Understanding the distinctions between different types of carsharing services is important because there is great variability in the customer experience, typical use cases, and in the wider consequences.

ROUND-TRIP CARSHARING

This type of carsharing is the best established commercially, and has been studied most extensively by researchers. Users generally reserve a car ahead of when they wish to use one, in general via smartphone apps or a dedicated website. In most cases, but not all, the user must specify both the time at which they wish to begin their reservation and its duration. Usage is 'round-trip' as the customer must (with few exceptions) return the car to the same place that it was accessed, and pay for the entire time between when they gain access to the car and when they return it at the end of their reservation. The fleet of carsharing cars is centrally owned (or leased) by a professional carsharing operating entity. The vehicles are allocated dedicated parking spaces, which in some cases are on-street (which requires permission from the street network

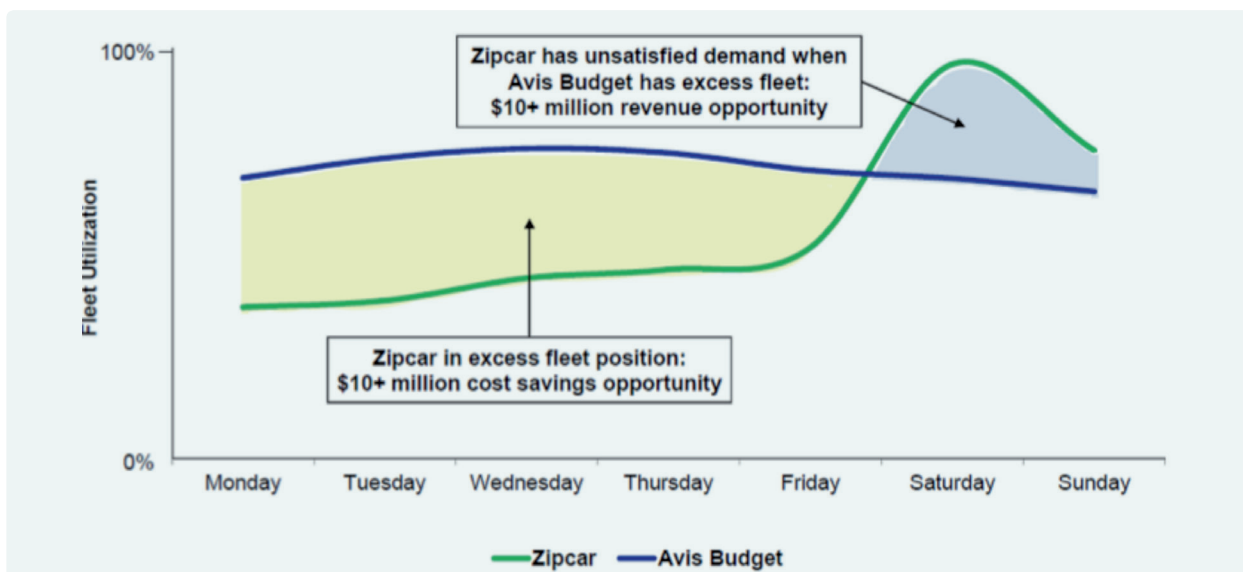
manager) and in others are located off-street. Zipcar is the largest provider of round-trip carsharing services worldwide.

PEER-TO-PEER CARSHARING

This model is also characterised by round-trip usage episodes. The key distinction with the round-trip model described above is that the carsharing fleet is de-centralised – owned by private individuals – not owned by a central operator. People choosing to make their private car available for use by others receive payments when it is rented out. In some cases the vehicles are equipped with telematics devices to provide vehicle-renters with remote access via smartcard, whereas in other systems the vehicle-owner must physically transfer the car's keys to the vehicle-renter at the beginning of the usage episode. Compared to other forms of carsharing, a more diverse selection of vehicles is typically available to users of peer-to-peer carsharing, due to the fleet not being centrally-managed. The principal role of the peer-to-peer carsharing operator is to provide an online marketplace to connect vehicle-owners with prospective vehicle-renters. As part of the business model, the operator typically provides a bespoke insurance product that protects the vehicle-owner, and collects a percentage of each rental transacted through their online marketplace.

Figure 2 **\$20+ Million Opportunity**

Zipcar's parent company Avis Budget Group indicates that fleet utilisation between its traditional car hire and round-trip-carsharing units is complementary, and has therefore begun to pool their fleets (Avis Budget Group Presentation to Investors, May 2014)



POINT-TO-POINT FREE-FLOATING CARSHARING

Point-to-point free-floating carsharing (often referred to as flexible carsharing) enables one-way journeys within a specified geographic zone, in contrast to round-trip carsharing. Usage is typically spontaneous – ie not reserved at all, or only reserved several minutes in advance. The fleets are centrally-owned by the system operator. A contractual arrangement with the entity that manages on-street parking is generally required; typical agreements involve the payment of an agreed sum in exchange for the right for customers to park in any (or nearly any) legal on-street parking space. Though this type of carsharing allows one-way journeys, customers may also use cars for round-trip excursions. The largest operator of point-to-point free-floating carsharing services worldwide is car2go.

POINT-TO-POINT STATION-BASED CARSHARING

Some point-to-point carsharing services are station-based, meaning that the user picks up a car from one parking station and returns it to another. Fixed infrastructure can be located at the parking stations, such as charging points for electric vehicles and kiosks for customer service. France's Autolib' is the largest point-to-point station-based carsharing system (and has plans to expand internationally); the point-to-point system currently being piloted by Zipcar in Boston (USA) is also station-based. The logistics of a point-to-point station-based system are less challenging to manage (in comparison to a point-to-point free-floating system). The trade-off, however, is that users are provided a lower degree of flexibility, and as with round-trip carsharing the stations require the allocation of dedicated space.

Both types of point-to-point carsharing (free-floating and station-based) are subject to tidal flows. Clustering of vehicles is undesirable from the perspective of both users and the service provider. The Autolib' system addresses this problem collaboratively with its customers, by offering free rentals to users willing to re-position vehicles on an ad-hoc basis.

TEXT BOX B

THE CONSUMER PERSPECTIVE

In a memorable exchange (in 2009), a focus group participant described to the authors the view that selling her car to join a carsharing service was akin to "stepping off of a diving board without knowing whether there's any water in the pool".

It is well-established that carsharing services thoroughly restructure the costs of car-based mobility, away from high fixed costs / low marginal costs and towards average costs. The other ways that carsharing differs from owning a car are less well-understood but nevertheless essential to understanding consumers' attraction to carsharing.

Dealing with damage is a drawback for consumers. In principle, users are obligated to check a vehicle for damage prior to each time they use a carsharing car; failing to report it could mean that they are liable for damage caused by a previous user. Any damage deemed to have been caused by a user is subsequently repaired by the operator and billed to the customer, whereas when a person owns a private car they have the choice of whether or not to pay to fix cosmetic damage.

Carsharing addresses some of the classical problems of owning a car – such as arranging permanent parking, vehicle inspection, maintaining insurance cover, and repair costs that can be both uncertain and large. But the consumer must bear new risks. Many carsharing services require that a user indicate the duration of their rental in advance; the customer must therefore either pay for reservation-time that they do not end up using, or run the risk of paying large penalties for not returning the vehicle at the agreed end of the reservation. Also, a private car is (nearly) always available to its owner, whereas carsharing operators make no promises to users that a car will definitely be available when and where desired. Cambio carsharing, for instance, reports that 93% of customers' requests for reservations are accommodated to the customer's satisfaction – this means that 1 in every 15 requests is not satisfactorily accommodated.

In future, larger fleet sizes and fleet-management techniques to better predict patterns of fleet utilisation will help carsharing operators design offers that balance between degree-of-certainty and price-charged in more sophisticated ways. This will allow consumers to better match, on a journey-by-journey basis, between their appetite-for-risk and willingness-to-pay.

In order for carsharing operators to unlock new consumer segments, the operational challenge will be to retain the benefits of the access-based mobility, while in future providing customers a very high degree of assuredness that they will have access to a car when and where they wish (as is the case with private car ownership).

4.

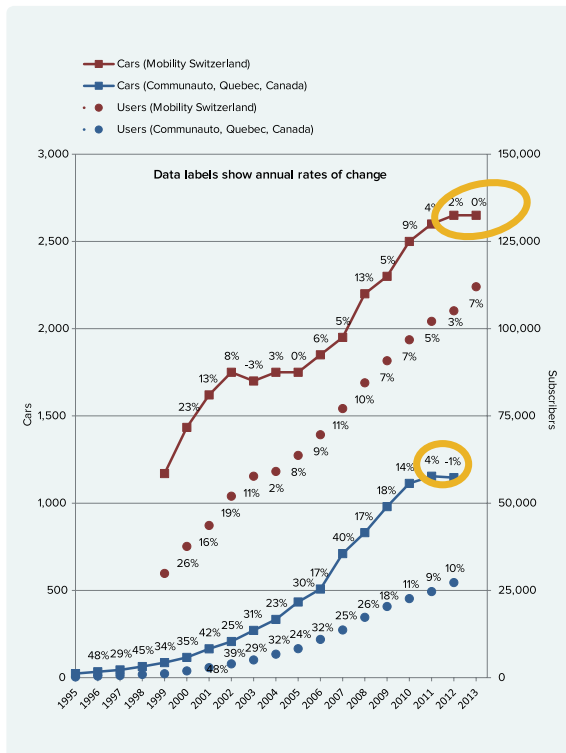
The carsharing ecosystem



Various types of organisations deliver carsharing services. Many operators are for-profit entities, whilst others (typically smaller operators) are not-for-profit. Some are independent entities for whom carsharing is the core business; others are part of a much larger organisation (eg Zipcar, the world's largest carsharing operator, accounted for only 3% of the revenue of its parent company Avis Budget Group in 2013).

The growing interest of incumbent automotive sector firms in the carsharing sector is leading to new types of business relationships. Car hire firms, for instance, are traditionally major purchasers of new cars from vehicle manufacturers, and this well-established relationship continues today. However, carmakers and car hire firms now both deliver carsharing services, and so find themselves in competition with one another. In other instances carmakers and car hire firms are cooperating to jointly deliver carsharing services (eg Europcar and Daimler's car2go service, and BMW and Sixt's DriveNow service).

Figure 3 Total number of users and vehicles
1995-2013



TEXT BOX C

SWITZERLAND'S MOBILITY CARSHARING

Switzerland's Mobility Carsharing traces its origins back to the late 1980s. Today its 180 staff serve 112,000 customers across Switzerland with 2,650 vehicles; 47% of its users are members of the Mobility co-operative, investing a small amount in the service in exchange for discounted rates and taking part in its governance. 1% of its fleet (27 cars) are battery electric vehicles (fully electric).

Mobility operates 1,400 vehicle locations, with service in 65% of Swiss municipalities. 16% of its locations do not cover costs; the co-operative reports that it operates these pods at a loss of CHF 200,000 (approximately €165,000) annually as part of its social commitment. The business as a whole operates at a profit margin of approximately 5%.

Mobility currently operates a round-trip carsharing service model, though a trial of a point-to-point free-floating service is planned for September 2014. Earlier in 2014 it invested in the Sharoo peer-to-peer carsharing platform. It also launched, in 2013, an innovative scheme that makes its cars available for use by learner drivers prior to acquiring their full driving licence.

Mobility reports that their number of customers increased by 7% from 2012 to 2013, though the fleet size remained unchanged (and grew by only 2% from 2011 to 2012) and revenue from core operations decreased by 0.8% (2012 to 2013). There is a parallel with Communauto, another well-established independent carsharing operator (located in Quebec, Canada) that also exhibited evidence of stabilisation in its fleet size for the first time in the early 2010s (see FIGURE 3).⁵ Interestingly, both Mobility and Communauto are among the small set of first-wave operators that have operated round-trip carsharing services for many years and are now beginning to experiment with point-to-point and peer-to-peer offerings (see discussion later in this section).

Carsharing: Evolution, Challenges and Opportunities

Whilst the overall carsharing sector is growing rapidly, there is churn among individual operators. In Britain, for instance, three significant carsharing operators have withdrawn from the marketplace since 2013:

- Whipcar operated a peer-to-peer carsharing service between 2010 and 2013.
- The Dutch firm GreenWheels withdrew its round-trip carsharing service in 2013 (it continues to provide service in continental Europe).
- Car2go withdrew its point-to-point free-floating service in spring 2014 (its operations continue to grow in continental Europe and North America). It was reported that “coordinating 32 separate [local] authorities across different [London] boroughs proved to be more difficult than anticipated”. A car2go spokesman stated that the business was not financially sustainable in Britain because demand from the fewer than 10,000 customers was not sufficient to achieve the required usage level of five to eight bookings per car per day. ⁶

Different organisational forms for providing carsharing services each have distinct strengths and weaknesses. Carsharing is not a traditional core competency for vehicle manufacturers, and therefore requires allocating resources to set up dedicated teams with the specialised skillsets as well as capital investments in information-technology systems. Car-makers are, however, well-positioned in several respects to deliver carsharing services. They have the financial depth to bear risks such as residual values and to self-insure, whereas smaller independent carsharing operators frequently struggle with insurance issues (see **TEXT BOX D**). Vertical integration between vehicle manufacturing and service-provision also allows telematics equipment to be efficiently designed and fitted into a carsharing service’s vehicles in the factory, rather than as after-market add-ons. Finally, car-makers are able to leverage existing organisational strengths (eg back-end IT systems, market research capabilities, brand recognition, optimal vehicle maintenance regimes) in ways that competitors cannot.

Operators of round-trip carsharing services have taken notice of the rapid growth of competing point-to-point carsharing services. At the time of writing, at least three major ‘legacy’ round-trip carsharing operators are experimenting with point-to-point services to complement their existing service offers (Communauto pilot-tested a one-way system in Montreal, Canada in summer 2013, with a larger launch in autumn 2013; Zipcar began a pilot project in Boston, USA in late spring 2014, with plans for wider rollout later this year; and Mobility Carsharing plans a pilot programme in Basel, Switzerland, to be called Catch-a-Car, in September 2014).

TEXT BOX D

CARSHARING AND INSURANCE

Carsharing operators that cannot self-insure must instead purchase insurance in the marketplace. According to Guy Fraker, CEO of risk-mitigation software company get2kno, insurance charges for carsharing services are typically 3-4 times what a comparable private car owner would pay. Innovation in the insurance sector is limited by its high degree of regulation, and designing customised products to address the challenges of a small sector such as carsharing is in general not a priority for insurers.

There is cause for optimism, however. Fraker points out that carsharing services have a relatively rich set of evidence for each of their customers (in comparison to traditional car hire) to contribute to insurers’ underwriting decisions. The data streams from in-vehicle telematics can in principle be exploited in order to better assess risk – encouraging safer drivers, if not actively discouraging unsafe drivers.

Carsharing operators today price insurance to their customers in quite crude ways, in comparison to the sophisticated pricing models used for private motor insurance. The price operators charge for insurance frequently does not vary among different drivers, but is rather embedded in the overall car-usage charges and therefore invisible to the end user.

Insurance issues have proven particularly troublesome for peer-to-peer carsharing services, as vehicle owners who rent their cars out may in some cases expose themselves to financial liability.

A new paper by Dixit and Rashidi ⁷, available online now and to be published in print in September 2014, appears to be the first in the public literature to quantify the impact of various factors associated with carsharing members’ crash risk. Also later in 2014, a global actuarial study of carsharing crash risk will be publicly disseminated; the research is being undertaken by UC-Berkeley’s Transportation Research Sustainability Center, get2kno, Metavera, and sponsored by the insurance company Assurant. Additional information is available by contacting Susan Shaheen at TSRC or Guy Fraker at get2kno.

There are risks as well as opportunities for carmakers in the carsharing marketplace. While serving younger customers (see Section 6) via carsharing services may encourage brand loyalty if and when they purchase cars in future, this is not a foregone conclusion. Delivering the level of service customers expect in a sustained way will be important if brand loyalty is to be positively influenced.

5.

New types of interactions with the public sector



National governments and European-level bodies make decisions, in areas such as emissions and safety, that directly affect car manufacturers. Carsharing services, however, must interact with the public sector in ways that are unfamiliar for carmakers.

Many carsharing services require privileged access to on-street parking space, which is typically managed by municipalities. This can be a critical vulnerability, as in certain cases the inability to attain the required access to on-street space can effectively prevent a carsharing service from operating. The intermediation of local government between supplier and end user is a novel concept for the automotive industry, which is accustomed to interacting primarily with national and Europe-wide public sector bodies.

In contrast to higher levels of government, local governments have a monopoly on on-street space. They also, in general:

- are fragmented, each representing a relatively small geographic area,
- are subject to changes in policy direction (eg following elections),
- are under pressure to deliver a range of desirable outcomes, some of which may conflict with one another (eg a high quality of life for residents, emissions reductions, revenue generation, social inclusion, and a supportive environment for commerce),
- are under no obligation to reach agreements with carsharing operators, and
- take actions at a slower pace than private-sector entities.

The relationship between carsharing operators and local government will always be important for operators, in the same way that local-government actions have historically had strong impacts on the taxi trade.

The asymmetry between local government and carsharing organisations is structural (for the reasons outlined above) and larger than any one individual carsharing operator. How-

ever, there are ways to effectively manage this relationship.

Carsharing services must be represented by competent industry level bodies that, as a trusted third-party, can effectively mediate between individual operators and local governments. Industry level bodies should undertake tasks such as:

1. Proposing a clear and simple set of principles to guide both sides of the local government/carsharing-operator relationship, including transparent formulae for calculating payments and terms-of-access, as well as standards for information-sharing. The principles would of necessity be voluntary; in order to be impactful and sustained over time, they must be drafted in such a way that reasonable people on all sides see them as fair.
2. Preparing (and posting online) standardised sample contracts between carsharing operators and local government.
3. Maintaining an online archive of contract documents between local government and carsharing-operators.
4. Offering a formal mediation service to prevent small-scale misunderstandings or disagreements from escalating.
5. Providing a secure, moderated online forum (perhaps an e-mail listserv) for local government staff from different places to exchange information with each other. This would address the asymmetry whereby carsharing operators active in multiple cities currently have better access to information than local government staff regarding the terms-of-on-street-parking-access in different places.

Examples of current industry bodies with partial representation of carsharing operators include BCS (in Germany, www.carsharing.de), CarPlus (in the UK, www.carplus.org.uk), and the Carsharing Association (primarily in North America, www.carsharing.org). In the USA, the Shared Use Mobility Center was very recently launched (10 June 2014, www.sharedusemobilitycenter.org), with ambitions to “work with industry, cities and other governmental agencies to craft policies, programs and standards that demonstrate the potential of shared-use mobility”.⁸ There are also established organisations that represent the vehicle-rental sector (eg the British Vehicle Rental and Leasing Association in the UK, www.bvrla.co.uk) and the automotive sector more broadly (eg European Automobile Manufacturers Association, www.acea.be). The authors wish to be clear that they do not take a view on which existing body(ies), or new one(s), should take on this role. The important principle is that terms-of-access are best addressed at the industry level rather than each individual carsharing operator; it is better for all concerned for operators to devote their energies towards (and compete with one another on) quality of service provision, rather than terms-of-market-access.

Carsharing: Evolution, Challenges and Opportunities

Even with the best of intentions among all parties, the structural nature of the relationship between carsharing-operators and local-government creates inefficiencies. It injects a layer of uncertainty that constrains the ability of operators to invest, and leads all parties to mis-allocate resources. Respected, independent industry level body(ies) that can undertake tasks such as those listed above would provide net benefits to both carsharing operators and local governments, and ultimately to end users.

6.

Who uses carsharing and how?



Carsharing activity has been studied quite extensively by both academic and private sector researchers. This section describes what is known about carsharing customers and their travel patterns.

Though the publicly available evidence is fragmentary, it is clear that carsharing users have a distinctive socio-economic profile. This section briefly highlights patterns and relationships that are typically observed; readers interested in further particulars are directed to more extensive reviews of the literature.^{9,10,11,12,13}

The evidence base regarding carsharing users and their behaviour is most robust for round-trip carsharing services, though a number of research studies are presently underway investigating other types of carsharing services.

Users of round-trip carsharing services tend to be:^{14,15,16,17,18,19,20}

- well-educated,
- predominantly males (Loose²⁰ reports a range between 53% and 69% male among various services in Europe, but Martin and Shaheen¹⁷ reported a 57% to 43% split in favour of females in North America),
- young adults, predominantly between ages 25 and 45 (70% of British carsharing users are in this age range),
- living as single-person or childless-couple households,
- living in middle or middle/upper income households,
- living in carless or single-car households,
- living in urban neighbourhoods,
- relatively heavy users of non-car forms of urban transport (eg public transport, walking and cycling).

By way of contrast, comparatively little reliable data is available regarding the user profiles of other types of carsharing services. What evidence exists suggests broad similarities in the users' socio-economic profiles, though there appear to be more substantial differences in the ways the services are used and hence their wider impacts (discussed later in this section).

Information about the socio-demographics of peer-to-peer carsharing customers is particularly scarce. In one study, a 2012 survey of customers of the Whipcar peer-to-peer service found that large majorities were under age 45 (73%), and lived in a carless household (58%).¹⁵ A major research project is currently underway in Portland, Oregon; early results show that people who list their cars for rent through a peer-to-peer service are also relatively young, well-educated, and in moderate/upper income households²¹. A majority (58%) indicated that the car they make available for rent through the service is the only car their household owns.

A recent study¹⁹ (May 2014) examined the user profile of the point-to-point station-based service Autolib'. Like customers of round-trip carsharing services, Autolib' users were found to be relatively well-educated and to live in households with above-average income levels. This study also found that customers of both Autolib' and the Mobizen round-trip carsharing service are motivated primarily by economic considerations and convenience, rather than environmental sensitivity. Interestingly, this last point is somewhat in contrast to earlier findings (2006) from Switzerland, where environmental consciousness was found to be a distinguishing feature of round-trip carsharing users.¹⁸

Whereas the discussion of user demographics up to now has focused on personal use of carsharing, the services are also used for commercial purposes, and some operators specifically target the business-to-business market (eg Alphacity and Ubeeqo). A reported 8% of round-trip carsharing journeys in London (which accounts for 83% of Britain's carsharing users) are for business purposes, with higher rates elsewhere in Britain (17% in Scotland and 22% in England and Wales, excluding London).¹⁵ Loose²⁰ reports that "at least 16% of authorised users [in Europe] are business customers".

For carsharing operators, increasing the business travel as a share of overall usage can help increase fleet utilisation during periods when demand for personal use of carsharing services is low (eg daytime hours during weekdays). Employers may also find staff use of carsharing attractive as a substitute for providing company cars or pool cars (for cost and sustainability reasons) or conversely staff use of their own private cars for business travel (due to insurance/liability issues). In some cases an employer provides its staff with access to a carsharing service for their own personal use as an employment benefit (eg the employer may pay their employees' subscription fees) as well as their business use.

TEXT BOX E

'PEAK CAR' AND CARSHARING

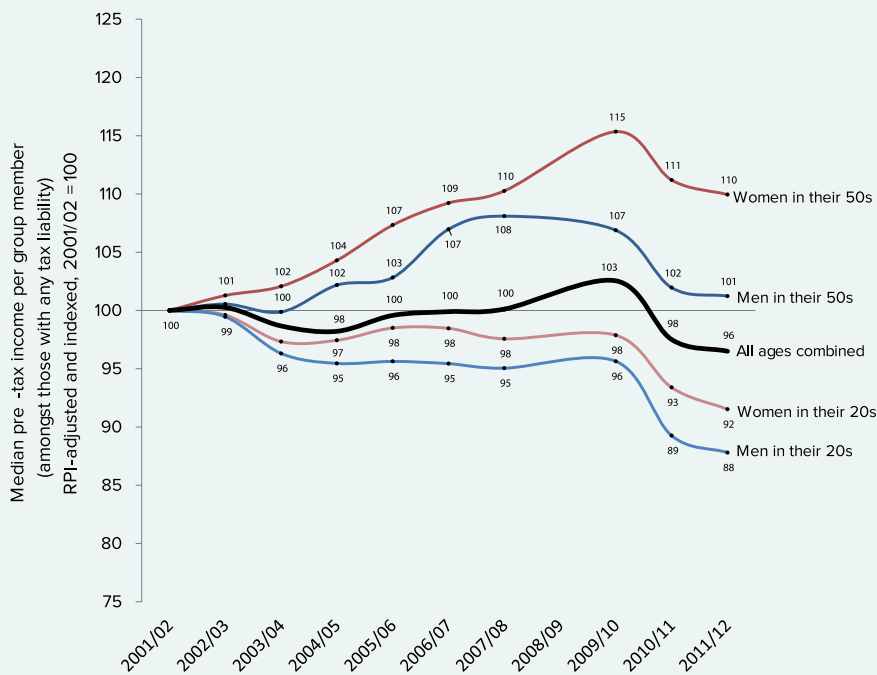
Carsharing customers tend to be young adults, and the growth in carsharing has taken place alongside sharp decreases in young adults' car ownership and use. This structural downward trend in 'auto-mobility' amongst this demographic group is a major component of the overall Peak Car phenomenon.²²

One interpretation is that the current generation of young adults (sometimes referred to as Millennials) are less interested in owning cars and instead prefer to access carsharing cars when needed. This may be true, but the authors are unaware of unambiguous evidence showing shifts in young adults' consumption preferences relating to cars. At the same time structural changes in the constraints on young adults' consumption have taken place, and researchers have yet to quantify the relative contribution of changing preferences as opposed to changing technologies and other external constraints.

FIGURE 4 below shows that real incomes for young British adults trended downwards through the 2000s, beginning well in advance of the 2008 recession. This trend of falling living standards is in contrast to the concurrent growth in older adults' income levels. Kuhnimhof and colleagues report a similar structural downward trend in young German adults' real incomes.²³ For young adults in these countries, falling incomes may have increasingly constrained their use of private cars, at the same time as new technologies have made carsharing services more practical.

In summary, distinguishing between these alternative hypotheses (changing preferences vs changing constraints) to explain young adults' changing car-related consumption patterns is not yet a settled issue. Quantifying their relative explanatory power will have important commercial consequences for the future trajectory of the carsharing sector, and the automotive industry more broadly.

Figure 4 Time-trend in personal income of British adults aged 20-29 and 50-59, by gender
(Authors' analysis of HMRC's Survey of Personal Incomes)



Carsharing: Evolution, Challenges and Opportunities

The impacts of carsharing are complex to calculate, though many efforts have been made. Firnkorn²⁴ points out that correctly-interpreting the impacts of carsharing hinges on the methodology used to elicit the responses. A particularly powerful technique is to enquire about the counterfactual; Martin and Shaheen did so by asking how carsharing customers' behaviour would change if carsharing were to disappear suddenly.¹⁶ (Shaheen and colleagues refer to impacts elicited from this question-wording as the 'full impacts' of carsharing; see Table 1).

There is a consensus that the impacts vary quite strongly between different carsharing service models. It is inappropriate, for instance, to apply the established impacts of round-trip carsharing to predict the prospective impacts of peer-to-peer and point-to-point carsharing systems.

Table 1 below (reproduced from Shaheen and Cohen [2013]) summarises reported carsharing impacts from North America and Europe, showing evidence of reductions in both private car ownership and greenhouse gas emissions (arising from a combination of reduced average driving distance and driving in lower-emitting cars). It should be noted that the average net reduction in driving distance by round-trip carsharing users comes about from an increase in driving by some (eg people who otherwise would not own a car) and a decrease in driving by others (eg those who otherwise would be car owners).

The 2012 survey of British peer-to-peer carsharing customers provides some limited evidence regarding the effect of this service model on the amount of driving. Of the 207 respondents (all of whom were vehicle-renters, as opposed to people listing their car for rent), 29% reported driving more (in terms of distance) than they did before taking part in the service, while 68% said there was no change. No respondents

indicated that they drove less since taking part (3% provided no response). These early findings (suggest that the net effect was an increase in driving mileage associated with this peer-to-peer carsharing service, though to establish this with any certainty will require the accumulation of further evidence.

A body of literature is now beginning to take shape regarding the early impacts of point-to-point carsharing. Car2go in Seattle (USA) reports that 39% of their customers have reconsidered the need for a personal car, and that on average their customers are using private cars, taking public transport, cycling and walking less than they did prior to using car2go.²⁶ These findings are consistent with earlier findings by Firnkorn and colleagues who studied the car2go system in its early stages in Ulm, Germany.^{21, 27} Likewise, 2013 survey results from Munich, Germany show that 30% of users of the Drive-Now point-to-point free-floating system defer, reduce or plan to reduce their private car ownership due to their participation in the service.

In Paris, recent (2014) findings suggest that both round-trip and point-to-point carsharing encourage reductions in car ownership, with the effect being stronger on a per-customer basis for round-trip carsharing (a reduction of 67% for round-trip carsharing, as compared to 23% for point-to-point).¹⁸ Both types of services in Paris are likewise associated with decreased driving distance, again with a larger per-user impact (-127 kilometres per user per month) for customers of round-trip carsharing than point-to-point carsharing users (-43 kilometres per user per month). In Paris it was also found that point-to-point carsharing customers use the service on average more frequently than round-trip carsharing users, with 57% doing so more than twice per week whereas 80% of round-trip carsharing customers reported using it less than 3 times per month.

Table 1 Reported impacts associated with round-trip carsharing

SOURCE reproduced from Shaheen and Cohen [2013]¹³

IMPACT	EUROPE	NORTH AMERICA
Carbon dioxide emission reduction	39 to 54%	27% (observed impact) 56% (full impact) ²⁵
Number of private cars a carsharing vehicle replaces (sold/forgone purchase)	4 to 10 cars	9 to 13 cars
Sold vehicle due to carsharing	16 to 34%	25%
Forgone vehicle purchase due to carsharing	N/A	25%

7.

Policy and governance issues



Carsharing raises a number of policy issues beyond those discussed in Section 5.

Carsharing is, in economics terms, an imperfect substitute for other forms of urban transport. This means that in places with one carsharing operator, the service provider has a degree of pricing power that can result in inefficiently high prices and lower-than-otherwise service levels. There is no simple answer to the question of how much competition is enough²⁸, but it is important that policymakers do nothing to discourage competition between operators and make clear publicly the terms under which new entrants can enter the marketplace. A related issue is whether public transport operators and carsharing services offer joint ticketing products.

A frequent research question is whether carsharing leads to net increases or decreases in greenhouse gas emissions. The answer appears quite clearly to be ‘net decreases’ for round-trip carsharing, though as noted earlier in this paper the evidence base is not presently as robust for other forms of carsharing. Whatever the answer to this question, policymakers must keep in mind that very few consumer products have negative emissions impacts, and that emissions reductions must be one of a number of desirable outcomes (eg supporting economic development, improving residents’ quality of life, and encouraging social inclusion) that they seek to deliver through public policy actions. Impacts such as those on traffic levels and emissions must be taken into account, but as part of a wider assessment. When considering a public-sector transport investment, decision-making is guided by the ‘value for money’ criterion. Likewise, the question to be asked regarding carsharing services is also whether they are net creators of value (taking account of both user benefits/costs and wider impacts, including the full social costs of environmental impacts). The answer to this question is quite likely to be ‘yes’, but it has not yet been comprehensively addressed, particularly for newly-emerging forms of carsharing that have yet to mature commercially. It is therefore an important item for the research agenda.

Carsharing services predominantly use vehicles powered by fossil fuels (petrol or diesel). There are however many examples of a pure-electric vehicles forming a small part of an operator’s fleet, and some instances (eg Autolib’ in Paris, and car2go in Amsterdam) where an operator’s entire fleet is electrically-propelled. In general, however, electric vehicles are more complex to operate and overall less economic from the perspective of the carsharing service operator. Therefore, public policy that encourages the use of electric vehicles in carsharing fleets requires a clear understanding of the

trade-off that the arrangements between the operator and local government will generate less revenue for the public sector than otherwise.

It is likely that carsharing services will continue to be provided mainly by private sector organisations. While the private sector is well-positioned to adapt to the rapid evolution in this market, there is also likely to be continued churn among operators. There are therefore policy questions of how to handle the situation that an operator needs to exit a market; Carplus in Britain, for instance, requires operators that take part in its accreditation scheme to provide their members “two months” notice if this is practical”, and also to “consider offering members the option to transfer to another [carsharing provider] for a nil or nominal charge”.²⁹

In many cases carsharing service providers do not allow young adults to use their services (see [Table 2](#)), primarily due to insurance restrictions. But this is less viable as carsharing scales up commercially and becomes an important part of the

Table 2 Minimum age to use selected carsharing services

OPERATOR	MINIMUM CUSTOMER AGE
Mobility Carsharing (Switzerland)	18
Autolib’ (France)	18
Buzzcar (France)	18
Car2go (in Netherlands)	18 and have held a driving licence for at least one year
Mobizen (France)	20 and have held a driving licence for at least one year
DriveNow (in Germany)	20 (18 if have taken a safe driving course)
RelayRides (USA)	21
Car2go (in UK, prior to withdrawing from market in May 2014)	21
Hertz 24/7 (in UK)	21 (19 if joining through an affiliated university)
Zipcar (in UK)	21 (19 if joining through an affiliated business or university)
Cambio (Germany and Belgium)	25 (or younger, if have held a driving licence for at least two years)

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transport network. An alternative regime would be for carsharing services to price insurance to their users on a more individualised basis than they currently do, and to charge young drivers insurance prices that are actuarially fair (ie neither subsidise other users nor require subsidy from other users). A similar argument applies to drivers with poor driving histories, who in some cases are not allowed to use carsharing services at all. The policy question is whether these characteristics of today's carsharing systems are acceptable as the sector increases in importance.

One of the great strengths of carsharing is that unlike many forms of urban transport it can be profitable, generating a revenue stream for the public purse rather than requiring ongoing subsidy. It is therefore an ideally suited product for the current era of austerity; private-sector carsharing services' main request from the public sector is to be able to operate in a stable investment environment. This places relatively few demands on public sector entities. Another strength is that, from the public sector's perspective, facilitating carsharing is an action that can be modified in due course or even reversed if deemed necessary. This flexibility is in sharp contrast to other types of public sector decisions, such as whether to provide planning permission for a land development or whether to build a new road. Such cases require major one-off decisions that cannot be easily re-visited, rather than the opportunity to learn and adapt over time, as in the case of carsharing.

What, if any, actions are appropriate for national governments to take is an important decision. National government departments often have large fleets of cars that in principle can be reduced through providing staff with access to a carsharing service. National governments may also directly sponsor new forms of carsharing; an example of this is Britain's shared-autonomous-vehicle project in Milton Keynes.³⁰ As with any public funding of industrial activity, there must be very clear public benefits in order to justify this type of participation. Such benefits are more likely to be found in demonstration projects than applications of mature technology. Finally, national governments frequently give policy guidance to local government; it would be appropriate to provide overarching policy guidance that local government should have a presumption to facilitate innovative forms of carsharing services in the first instance, and later revisit the arrangements to optimise the terms once impacts are better understood.

The relationship between public and private sector entities requires careful management, but there are parallels to other industrial sectors. The rail industry, for instance, is characterised by similarly complex functional relationships between different actors. In the UK, for instance, there is a quasi-public owner of rail track, a number of private-sector

train operating companies, ongoing subsidies for individual routes disbursed by the Department for Transport, and a separate public sector regulator that oversee the industry. Drawing on lessons from railways and other regulated markets (eg electricity and water) will be valuable as the carsharing sector matures.

8.

Carsharing's novel system-level properties



This section concludes the paper with a brief discussion of how the properties of large-scale carsharing systems differ from other forms of urban transport, particularly private car ownership.

Connectivity is essential to the operation of all contemporary types of carsharing systems. Carsharing services with centrally-owned fleets rely on uninterrupted wireless communication to reliably provide customers with access to vehicles at the agreed time. However, even services that do not use in-vehicle telematics (eg many peer-to-peer carsharing services) could not operate without buyers and sellers being able to arrange car rentals through an online portal. Carsharing systems are therefore vulnerable to unexpected disruption to communications networks in ways that the traditional regime of private car ownership and use is not.

Urban travellers are quite accustomed to the first-in / first-out nature of congested road traffic. With few exceptions (eg emergency vehicles), all private cars move in relatively orderly queues, meaning that all travellers experience similar level of service. Carsharing operates differently, however – rather than all drivers of private vehicles getting to their destination but at a slow speed, carsharing systems experience congestion at the point of vehicle-access. When demand exceeds capacity, some users are simply unable to gain access to a carsharing vehicle at all, whilst others who have gained access to a carsharing-system car experience no delays due to the congestion in the vehicle-access system. Carsharing systems today allocate vehicle-access on a first-come / first-served basis through fairly blunt tariff structures, though other mechanisms may emerge in future (eg pricing that is dynamic to take spatial and temporal context into account; or mechanisms that enable customers to trade vehicle reservations in secondary markets³¹). Service operators are likely in future to differentiate their service offers to better align with individual customers' willingness-to-pay, such as offering 'premium' services that provide varying degree of priority in the vehicle-access system.

Carsharing systems at large scale will also provide public sector road network managers with new options for optimising network conditions. For instance, if it is deemed important to restrict traffic volumes for a specific event (eg when a city hosts a major sporting event), the road network manager could simply block-book some or all of a carsharing system's fleet, in effect paying the private sector operator to keep their vehicles parked during some period of time. This could be done in a much more straightforward, and politically acceptable way, than blanket restrictions on people using their own cars. In other ways, however, carsharing services may complicate the task of road network management. Peer-to-peer carsharing could, for instance, reduce the effectiveness of number-plate-based driving restrictions, such as those implemented for several days in Paris in response to acute air pollution problems in spring 2014.³²

Road pricing is increasingly seen by transport planners and network operators as a desirable mechanism to manage travel demand. Service operators can point out that the tariff structure of carsharing is a particularly pure form of congestion pricing; a point-to-point carsharing user stuck in traffic for 20 minutes, for instance, would be liable for very roughly €5 of additional charges. This is a strong and direct price signal that penalizes travel in congested conditions much more strongly than a corresponding private car owner would experience.

Car rental is traditionally a low-margin commodity business. For carsharing operators to avoid such an outcome, leveraging their customer relationship will be an important aspect of their business strategy. A credit card issuer facilitates a transaction between a customer and a merchant, and in turn retains a percentage of the value exchanged. Carsharing services similarly are vectors for connecting customers with retailers, and have the advantage of an ongoing physical relationship with the user (the user rides in the service's vehicles, interacts with their in-vehicle user interfaces, and explicitly accepts driving in a telematics-equipped car). Given the socio-economic profile of carsharing users, they are prime target consumers for many retailers. Further, using a carsharing service occasionally (rather than the more-frequent car-usage typical of owning one's own private car) may mean that they spend more on each of their less-frequent shopping journeys than other shoppers do during each of their store visits. Recent exploratory research by the authors³⁴ indeed found that non-car-owners that gain access to a point-to-point carsharing service are likely to consolidate their grocery shopping into less-frequent shopping occasions, but to make longer journeys to shop at different food stores (presumably larger stores). A real-world example is the partnership between DriveNow and German grocery retailer REWE.³⁵ A discount card is stored in the carsharing vehicle; swiping it when paying

for groceries unlocks a 5% discount on the in-store purchase. When the customer returns to the vehicle they enter a unique code printed on their store receipt to make available 10 free minutes of parking, with the vehicle's telematics system verifying that the customer is at a participating store location during opening hours. For the reasons mentioned earlier, increasingly-sophisticated partnerships between carsharing service providers and retailers can be expected in coming years – partnerships that are enabled by the relatively deep and persistent relationship between carsharing operators and their customers.

TEXT BOX E

VEHICLE AUTOMATION AND CARSHARING

Highly-automated driving technology is increasingly available in the new car market, and a number of prominent researchers (eg Adriano Alessandrini of the Sapienza University of Rome, Emilio Frazzoli of the Massachusetts Institute of Technology, Alain Kornhauser of Princeton University) have highlighted the opportunities that fully-automated cars would provide to carsharing operators.

Automation offers many new possibilities for private-car-based mobility; the main advantage unique to carsharing is frequently identified as the ability to re-position carsharing vehicles to where and when demand is likely to be high, without the expense of sending human drivers to re-position them.

Full-automation of carsharing cars to enable re-positioning on public streets without a human inside is not, however, a short-term proposition, notwithstanding the fleet of bespoke test-vehicles without manual steering controls announced publicly by Google in May 2014. Even the recently-agreed changes (April 2014) to the United Nation's 1968 Convention on Road Traffic (ratified by many European countries) that aim to encourage vehicle automation require that a human driver be capable of taking control away from the automation system at any time.³³

In addition to the prospect of full-automation, carsharing fleets are very tightly-managed, so may prove to be ideal test-beds for manufacturers to experiment with highly-automated driving technologies that are short of full-automation (eg collision-avoidance technologies that engage braking in emergency situations).

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