

Personal vehicle sharing services in North America

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ABSTRACT

Over the past three decades, carsharing has grown from a collection of local grassroots organizations into a worldwide industry. Traditional carsharing, though expanding, has a limited network of vehicles and locations. The next generation of shared-use vehicle services could overcome such expansion barriers as capital costs and land use by incorporating new concepts like personal vehicle sharing.

Personal vehicle sharing provides short-term access to privately-owned vehicles. As of May 2012, there were 33 personal vehicle sharing operators worldwide, with 10 active or in pilot phase, three planned, and four defunct in North America. Due to operator non-disclosure, personal vehicle sharing member numbers are currently unknown. The authors investigated personal vehicle sharing in North America by conducting 34 expert interviews. This research explores the development of personal vehicle sharing including business models, market opportunities, and service barriers to assess its early viability as a sustainable transportation mode and to provide a foundation for future research on the topic. Personal vehicle sharing has the potential to impact the transportation sector by increasing the availability and interconnectivity among modes and providing greater alternatives to vehicle ownership in more geographic locations.

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1. Introduction

Although the personal automobile remains the primary transportation mode in North America, recent research supports the view that private vehicle use is in decline in numerous countries (Millard-Ball & Schipper, 2011; Newman & Kenworthy, 2011). Indeed, the U.S. Department of Energy recorded a drop in ownership of four million vehicles in 2009—the first significant decline since it began recordkeeping in 1960 (Mittelstaedt, 2010). This decline coincides with a growing prevalence of alternative modes such as traditional carsharing and the development of new modes such as personal vehicle sharing (short-term access to privately-owned vehicles).

Traditional carsharing provides members access to a vehicle for short-term daily use. Automobiles owned or leased by a carsharing operator are distributed throughout a network; members access the vehicles with a reservation and are charged per time and often per mile. They benefit by obtaining personal automobility without the need to own a private vehicle; this can result in considerable monetary savings and environmental benefits.

Traditional carsharing is intended for short trips and as a supplement public transit. Initial market entry in North America focused on the

neighborhood carsharing model, characterized by a fleet of shared-use vehicles parked in designated areas throughout a neighborhood or municipality. In recent years, business models have advanced and diversified. Variations on the neighborhood model developed in North America include: business; college/university; government/institutional fleet; and public transit (carsharing provided at public transit stations or multi-modal nodes). Despite differences in target markets, these models share a similar organizational structure, capital ownership, and revenue stream.

The next generation of shared-use vehicle services, which provide access to a fleet of shared-use vehicles, incorporates new concepts, technologies, and operational methods. These models represent innovative solutions and notable advances. They include one-way carsharing and personal vehicle sharing. One-way carsharing, also known as “free-floating” carsharing, frees users from the restriction of having to return a vehicle to the same location from which it was accessed. Instead, users leave vehicles parked at any spot within the organization's operating area, allowing for the possibility of one-way trips. The one-way model resembles more traditional forms of carsharing—except for the logistics of vehicle redistribution and the need for expanded vehicle parking.

Personal vehicle sharing, which is the focus of this paper, represents a more distinct model due to differences in organizational structure, capital stock, and liability. Personal vehicle sharing involves short-term access to privately-owned vehicles, enabling a lower operating cost and a wider vehicle distribution. While two versions of personal vehicle sharing first occurred in North America beginning in 2001, the personal

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vehicle sharing model did not begin significant expansion until 2010 when companies began to emerge across the globe. Since then, personal vehicle sharing models have evolved rapidly. As of May 2012, there were 33 personal vehicle sharing operators worldwide, with 10 active or in pilot phase, three planned, and four defunct in North America.

Personal vehicle sharing remains an extremely new concept within the shared-use vehicle spectrum, the potential of which is unknown. This research explores the development of personal vehicle sharing including business models, market opportunities, and service barriers to assess its early viability as a sustainable transportation mode, and to provide a foundation for future research on the topic.

This paper is organized into six sections. First, it presents a background section, which provides an overview of the emergence of personal vehicle sharing. Next, it provides the study methodology. This is followed by the results of 34 expert interviews on personal vehicle sharing—exploring business models, barriers, and opportunities for this market. Next, a continuum framework for understanding shared-use models is presented, followed by a brief discussion of the implications of personal vehicle sharing for managerial practice. Finally, it concludes with a summary of key findings and recommendations for future research.

2. Background

This section focuses on the emergence of personal vehicle sharing as an extension of traditional carsharing, in part resulting from recent shifts in consumption patterns referred to as “collaborative consumption.” Collaborative consumption is an economic model that emphasizes “access” or “sharing” instead of ownership. The discussion of traditional carsharing includes its evolution over time in North America and a review of its social and environmental impacts—key drivers to service growth.

2.1. Collaborative consumption

According to Rachel Botsman, author of *What's Mine is Yours: The Rise of Collaborative Consumption*, the phenomenon of a “sharing economy” has become more prevalent in recent years due to a number of factors: online connectivity, which makes shared access networks ubiquitously accessible; technology; the “living local” movement, which facilitates community focused lifestyle; cost consciousness due to the economic downturn that began in 2008; and environmental consciousness. The sharing of information, photos, and music is widespread and mainstream; thus, it is not surprising that the digital sharing template has been applied to physical goods (N Gorenflo, 2011, pers. comm., 28 July).

Online social networking, such as LinkedIn, Facebook, and Twitter, has allowed people to connect, influence, converse, and share information about new products, companies, and ideas more easily and rapidly than ever before. While people have always exchanged such information, the Internet makes it easier, more wide reaching, and faster. It has also enabled an offline experience, where people can connect with their communities face to face through peer-to-peer or person-to-person (P2P) sharing networks (L Anderson, 2011, pers. comm., 8 August). Social media, both offline and via the web, is an important facet of marketing for most consumer-facing businesses today and perhaps even more so for P2P sharing businesses, including personal vehicle sharing, which must overcome a lack of familiarity with the concept and fear of sharing among users.

The public understanding of “access to shared goods” advanced by the traditional carsharing industry has likely increased consumer acceptance of sharing high-value assets, such as vehicles. Carsharing marketing, education, and experimentation have impacted the way many consumers view their car and perhaps are diminishing the importance of the private vehicle as a status symbol (S Savoure, 2011, pers. comm., 9 June; and M Williams, 2011, pers. comm., 21 June).

The next section provides a discussion of traditional carsharing's evolution in North America.

2.2. Personal vehicle sharing: evolution and growth

Traditional carsharing was first introduced in North America by way of two experiments: Purdue University's Mobility Enterprise (1983–86) and Short-Term Auto Rental (STAR) in San Francisco (1983–85). Carsharing later reemerged in 1994 in Quebec City, Canada, with the founding of the cooperative Auto-Com, which operates today as the for-profit Communauto in Montreal and the Province of Quebec. In 1998, CarSharing Portland in Portland, Oregon was the first successful launch of modern carsharing in the United States (U.S.) (Shaheen, Cohen, & Chung, 2009). In 2000, Zipcar was started in Cambridge, Massachusetts, and Flexcar was established in Seattle, Washington. These organizations expanded rapidly with the help of outside capital and eventually merged to dominate several large cities in the Northeast and Pacific Northwest by the end of the decade.

As of July 2011, 26 U.S. carsharing programs claimed 560,572 members and 10,019 vehicles. In Canada, 78,840 members shared 2605 vehicles among 20 carsharing organizations. At present, carsharing organizations operate in 20 metropolitan regions in the U.S. and Canada. Despite sustained membership growth, traditional carsharing remains geographically limited. Sullivan and Magid (2005) estimated that the profitability of a carsharing business is contingent upon gaining approximately 25 active members living within 0.40 km/0.25 miles of each point of departure (POD) to ensure sufficient use. This estimation is supported by the findings of Cervero et al. (2007), which indicated that 80% of all City CarShare members lived within 0.80 km/0.50 miles of the nearest POD, and more than 50% lived within 0.40 km/0.25 miles of the nearest POD.

As early as 2001, eGO CarShare (formerly Boulder Carshare) of Boulder, Colorado implemented the first personal vehicle sharing model by incorporating private vehicles into their commercial fleet through the transfer of personal vehicle titles to the carsharing organization. In this model, the carsharing operator becomes the temporary owner and maintainer of the transferred vehicles. In the same year, RentMyCar was launched using a marketplace approach (similar to eBay®), whereby vehicle owners pay a small fee to list their automobile on the website. Beginning in 2007, a variety of companies offering personal vehicle sharing were established internationally including: Wombat Car Club (England), Zilok (France), and Drive My Car Rentals (Australia). Since then, the personal vehicle sharing market has continued to expand domestically and internationally.

The next section provides a summary of the social and environmental impacts of traditional carsharing, which may be common to personal vehicle sharing, and have been associated with user adoption and public- and private-sector support.

2.3. Social and environmental impacts

An increasing body of empirical evidence indicates that traditional carsharing can provide numerous transportation, land use, environmental, and social benefits (Dallaire, Lafond, Lanoix, & Viviani, 2007; Econsult Corporation, 2010; Shaheen et al., 2009). Public benefits are generated through reduced vehicle ownership, vehicle miles/kilometers traveled (VMT/VKT), and greenhouse gas (GHG) emissions, as well as through the provision of short-term auto access. Table 1 provides an overview of the changes in auto ownership impacts and VMT/VKT due to carsharing from a range of studies conducted in North America over the last decade.

One of carsharing's notable impacts is vehicle ownership reduction. A 2008 survey of more than 6281 carsharing members in North America found car ownership among the survey population dropped by approximately 50% due to carsharing participation (Martin & Shaheen, 2011a). Data from the same survey indicate that carsharing removed between 9

Table 1
North American carsharing impacts.

North American studies (year)	Location	Sample size	Participants selling owned vehicle (%)	Participants avoiding vehicle purchase (%)	# of privately-owned vehicles removed per carsharing vehicle	Change in average VMT/VKT (%)
Martin and Shaheen (2010)	North America	N/A	25	25	9–13	N/A
Econsult (2010)	Philadelphia, PA	300	25	7	15.3	N/A
Cervero et al. (2007)	San Francisco, CA	N/A	24.2	N/A	N/A	–33
Cervero et al. (2007)	San Francisco, CA	N/A	N/A	N/A	N/A	–67 ^c /24 ^d
Dallaire et al. 2007	Quebec Province, Canada	N/A	24	53	4.6	N/A
Price et al. (2006)	Arlington, VA	369	29 ^a	71 ^b	N/A	–43
Zipcar (2006)	United States	N/A	32	39	20	–79.8
Millard-Ball et al. (2005)	North America	1340	55.2 ^a	70.5 ^b	14.9	–37
Lane (2005)	Philadelphia, PA	502	24.5	29.1	10.8 ^e	–42
Price and Hamilton (2005)	Arlington, VA	403	25	68	N/A	–40
Cervero and Tsai (2004)	San Francisco, CA	516	29.1	67.5	6.8	–47 ^c /–73 ^d
Autoshare (2003)	Toronto, Canada	N/A	15	25	6–8	N/A
Katzev (2003)	Portland, OR	64	26	53	N/A	N/A
Cervero et al. (2002)	San Francisco, CA	404	2.5	60	N/A	–3 ^c /–58 ^d
Jensen (2001)	Quebec Province, Canada	N/A	21–29	55–61	9.1	N/A
Cooper et al. (2000)	Portland, OR	N/A	23	25	N/A	–7.6
Katzev (1999)	Portland, OR	110	26	53	N/A	N/A
Walb and Loudon (1986)	San Francisco, CA	N/A	15.4	43.1	N/A	N/A

Note: N/A denotes data not provided.

^a Percentage that strongly agreed or agreed that they were able to sell one or more cars due to carsharing.

^b Percentage that strongly agreed or agreed that they were able to postpone buying a car due to carsharing.

^c Reflects existing members' reduction in VMT/VKT.

^d Reflects only trial members' reduction in VMT/VKT.

^e Reflects vehicles removed by members who gave up a car.

and 13 automobiles for each carsharing vehicle in North America (Martin, Shaheen, & Lidicker, 2010). While only 40% of all households joining carsharing own one or more vehicles in North America, these households exhibited a dramatic shift toward a carless lifestyle (Lane, 2005). Carsharing promotes alternative travel modes, such as public transit, biking, and walking. These lifestyle shifts not only improve health but also lead to decreased traffic, congestion, and parking demand in urban areas. A study by Martin and Shaheen (2011b) reported the net impacts of carsharing on public transit, walking, and bicycling. The net change in: all public transit was –1%; traditional public transit (rail and bus) was –3%; walking was +3%; and bicycling was +6% (Martin & Shaheen, 2011b).

North American studies also document overall reductions in VMT/VKT and emissions. Carsharing has facilitated significant reductions in some households' annual emissions, which compensate for the collective small increases of other households. Studies of North American carsharing operators found reductions in VMT/VKT ranging from 7.6 to 80% (City CarShare, 2004; Martin & Shaheen, 2011b; Zipcar, 2006). The most recent study demonstrated a reduction of the average VMT/VKT of 68% (Martin & Shaheen, 2011a; Martin et al., 2010). Along with decreased VMT/VKT and vehicle ownership, low-emission fleets contribute to lower GHG emissions.

Carsharing's GHG emission impacts have recently been measured through two distinct metrics in North America: an “observed impact” describing the emission change that actually occurred and the “full impact,” which includes the observed impact but also an additional component of avoided emissions that would have occurred, if carsharing were not available. On balance, net carsharing emissions are negative (i.e., reducing total emissions). Further, in the 2008 North American carsharing survey, the average emission change over 2000 respondents was –0.58 t GHG per household per year for the observed impact, and –0.84 t GHG per household per year for the full impact (Martin et al., 2010). From the same survey data, Martin and Shaheen also estimated a reduction of 27% in GHGs (observed impact) and a reduction of 43% (full impact) (Martin & Shaheen, 2011a).

Finally, carsharing offers an array of individual benefits by providing “pay-as-you-go” automobile without the need for personal vehicle ownership (Martin & Shaheen, 2010; Shaheen, Mollyanne, & Wipyewski, 2003). Due to carsharing membership, average monthly transportation

costs decreased by a range of US \$154 to \$435 for American members (Cervero, Golub, & Nee, 2007; Price, DeMaio, & Hamilton, 2006) and US \$375 to \$471 for Canadian members (Martin & Shaheen, 2011a; Robert, 2000). The next section provides the research methodology.

3. Methodology

Between May and September 2011, researchers conducted 34 expert interviews. Semi-structured questionnaires were selected as the method of data collection. The intent was to enable multiple researchers to conduct interviews and provide comparable qualitative data while maintaining the flexibility to probe respondents on relevant topics. A review of the literature and Internet resources were used to identify potential interview topics and subjects. Subject populations were divided according to respondent expertise so that the perspectives of various industry stakeholders were represented. Interview questionnaires were developed for each subject population and pre-tested with one expert in each field. Subject populations included personal vehicle sharing operators, traditional carsharing operators, insurance providers, and public policy authorities.

Researchers developed questionnaires to address key topics including: business models, market opportunities, barriers to adoption and expansion, technology, insurance, and public policy. Questionnaires were provided prior to administration so that experts could formulate answers before being interviewed. Interviews lasted for approximately 1 to 2 h and were recorded and transcribed for analysis purposes. Subjects reserved the right to non-disclosure of any given topic.

Researchers interviewed five active, two pilot, one planned, and one defunct personal vehicle sharing operators in North America and three active organizations in France. In addition, 17 traditional carsharing operators, one carsharing consultant, three insurance experts, and one public policy expert were interviewed. Questions regarding industry technology were integrated into each interview type.

4. Personal vehicle sharing expert interview results

This section provides an overview of the personal vehicle sharing models identified as part of this research; a discussion of market

opportunities; and a synopsis of barriers to personal vehicle sharing adoption and expansion, as identified by the study's expert interviews.

4.1. Personal vehicle sharing models

Shared-use vehicle services are entering a new phase of development characterized by short-term access to privately-owned vehicles, referred to as personal vehicle sharing. Broadly speaking, personal vehicle sharing companies broker transactions among car owners and renters by providing the organizational resources needed to make the exchange possible (i.e., online platform, customer support, auto insurance, and technology). As of May 2012, there were 33 personal vehicle sharing operators worldwide, with 10 active or in pilot phase, three planned, and four defunct in North America. Researchers identified four distinct models through the business model portion of the personal vehicle sharing operator interviews. Each model is described below.

Fractional ownership

In the fractional ownership model, individuals sub-lease or subscribe to a vehicle owned by a third party. These individuals have "rights" to the shared-use vehicle service in exchange for taking on a portion of the expense. This could be facilitated through a dealership and a partnership with a carsharing operator, where the car is purchased and managed by the carsharing operator. This enables access to vehicles that individuals might otherwise be unable to afford (e.g., higher-end models) and results in income sharing when the vehicle is rented to non-owners.

Hybrid P2P-traditional carsharing model

In the hybrid P2P-traditional carsharing model, individuals access vehicles by joining an organization that maintains its own fleet of vehicles, but also includes private autos, throughout a network of locations. Insurance is provided by the carsharing organization during the access period for both carsharing and P2P vehicles. Members can access vehicles through a direct key transfer from the vehicle owner or through operator installed in-vehicle technology that enables "unattended access." In exchange for providing the P2P service, operators keep a portion of the vehicle usage fee. An example of this approach is Communauto's carsharing service, which started to pilot P2P vehicles in 2011.

This model could also incorporate private vehicles into a commercially-managed fleet through indefinite transfer of title from a private car owner to a carsharing organization. In this case, the private owner receives carsharing access at a reduced cost, while transferring the costs of private vehicle ownership to the carsharing organization. This model was pioneered by eGo CarShare of Boulder Colorado (formerly Boulder Carshare) in 2001, and was adopted in 2011 by Go-Op of Pittsburgh, Pennsylvania (now defunct), during its pilot phase.

P2P carsharing

P2P carsharing employs privately-owned vehicles made temporarily available for shared use by an individual or members of a P2P company. It allows short-term (hourly or daily) or longer-term (multi-day) vehicle access; members pay only for the time they use the auto and the mileage driven. Insurance is generally provided by the P2P carsharing organization during the access period. In exchange for providing the service, operators keep a portion of the usage fee. Members can access vehicles through a direct key transfer from the vehicle owner or through operator installed in-vehicle technology that enables "unattended access." The P2P key exchange method represents a point of debate among carsharing

experts; some feel that an in-person exchange excludes it from car-sharing's definition, which emphasizes unattended access (i.e., a key box or smartcard access). Others contend that any service that facilitates vehicle sharing can be classified as carsharing. RelayRides, launched in June 2010, and Getaround, which launched in May 2011, represent the first two examples of P2P carsharing in North America.

P2P marketplace

P2P marketplace enables direct exchanges between individuals via the Internet. This model can focus exclusively on the shared use of private vehicles or on the buying, selling, and trading of a broader set of products and services, such as autos, tools, and party rentals. Terms are generally decided among parties of a transaction and disputes are subject to private resolution. RentMyCar, which launched in May 2001, represents the first example of a P2P marketplace exclusively offering personal vehicle sharing. Other P2P marketplaces, such as Zilok, focus on the exchange of a wider range of goods and services. This model is distinct from P2P carsharing in that transactions are made between parties versus a third-party provider, which offers insurance coverage and technology, for instance, as part of the service.

Table 2 lists the North American personal vehicle sharing operators chronologically by launch date and operational status; it also includes model type and location. Table 3 lists the personal vehicle sharing operators outside of North America chronologically according to launch date and includes location. Model classifications for operators located outside of North America are beyond the scope of this study.

4.2. Market opportunities

Traditional carsharing is most suited to walkable, high-density, mixed-use urban areas with convenient public transit, allowing for

Table 2
North American personal vehicle sharing operators.

Organization	Launch date	Model	Launch location
<i>Active</i>			
RentMyCar	2001	P2P marketplace	New York, NY; Germany
eGO CarShare	2001	Hybrid P2P-traditional carsharing	Boulder, CO
Jolly Wheels	2009	P2P marketplace	New York, NY
RelayRides	2010	P2P carsharing	Cambridge, MA
Getaround	2011	P2P carsharing	San Francisco, CA
Wheelz	2011	P2P carsharing	Palo Alto, CA
PATS Carshare	2011	Hybrid P2P-traditional carsharing	San Jose, CA
JustShareIt	2011	P2P carsharing	San Francisco Bay Area, Los Angeles, CA
Rent2Buy (formerly HiGear)	2011	P2P Carsharing	Unknown
<i>Pilot phase</i>			
Communauto	2011	Hybrid P2P-traditional carsharing	Quebec, Canada
<i>Planned</i>			
Sprite	Unknown	Unknown	San Francisco, CA
Koolicar	Unknown	P2P carsharing	Unknown
Mesh Motors	Unknown	Fractional ownership	San Francisco, CA
<i>Defunct</i>			
Divvy	2009	P2P marketplace	Seattle, WA
Spagg Network	2009	P2P carsharing	Los Angeles, CA
HiGear	2011	P2P carsharing	San Francisco, CA
Go-op	2011	Hybrid P2P-traditional carsharing	Pittsburgh, PA

Table 3
Personal vehicle sharing operators outside North America.

Organization	Launch date	Location
WOMBAT Car Club	2007	United Kingdom
Zilok	2007	France
DriveMyCar Rentals	2008	Australia
CaFoRe	2009	Japan
E-loue	2009	France
DEways	2010	France
LivOp	2010	France
Tamyca	2010	Germany
Voiturelib'	2010	France
WhipCar	2010	United Kingdom
Autonetzer	2011	Germany
Buzzcar	2011	France
CityZen Car	2011	France
FlexiDrive	2011	Sweden
MyWheels	2011	Netherlands
Nachbarschaftsauto	2011	Germany
Rent-n-roll.de	2012	Germany
Snappcar	2011	Netherlands
Social Car	2011	Spain
Une Voiture a Louer	2011	France
WeGo	2011	Amsterdam
PosodiAvto	2012	Slovenia
Cartribe	Unknown	Switzerland

high vehicle usage rates (Sullivan & Magid, 2005; Cohen et al., 2008). Personal vehicle sharing services have the potential to expand the geographic range of vehicle sharing services by renting underused autos and thus lowering vehicle usage requirements. As of February 2012, there are approximately 1500 autos operating in personal vehicle sharing services in North America. Due to operator non-disclosure, personal vehicle sharing member numbers are currently unknown. This section discusses the geographic viability and market adoption of personal vehicle sharing.

4.2.1. Geographic viability

Hampshire and Gaites (2011) assessed the financial feasibility of personal vehicle sharing relative to supply and demand across the U.S. by adapting Sullivan and Magid's (2005) market penetration threshold for the model. They found that a 10:1 user-to-vehicle ratio would be sufficient to ensure market viability (Hampshire & Gaites, 2011). This ratio is much lower than Sullivan and Magid's 25:1 ratio for traditional carsharing because the organization is not responsible for the vehicle's capital costs.

"Private" vehicle use in personal vehicle sharing enables the potential to expand the range of geographic environments (e.g., suburbs) for shared-use vehicle services. One of the P2P carsharing operators interviewed in this study, RelayRides, referred to their service as "neighbor-to-neighbor carsharing" because it is especially focused on neighborhoods. Private vehicles used in this service are typically parked at or near an owner's residence, creating "walkable" access and the potential for increased community member use. Eight personal vehicle sharing and 13 traditional carsharing expert interview respondents identified the potential for personal vehicle sharing to expand into areas previously considered less viable for traditional carsharing—due to the capital costs and usage requirements needed to support a traditional carsharing model.

4.2.2. Market adoption

Not surprisingly, personal vehicle sharing services benefit from the operational history and marketing of traditional North American carsharing companies, particularly when targeting markets with a deep understanding of shared-use vehicle services. Traditional carsharing operators cited population density related to land use as a primary distinction between early adopters of personal vehicle sharing and traditional carsharing members. The potential to deploy personal vehicle sharing services in low- to mid-density areas may enable the incorporation of

new member demographics. For instance, Getaround stated that their members in San Jose, California were older on average than those in San Francisco. Despite the potential for personal vehicle sharing to expand into lower-density areas, the initial target markets have been in primarily dense urban centers where traditional carsharing companies currently operate, resulting in analogous user populations.

On the vehicle renter side, the demographic and psychographic characteristics of early adopters varied by company. Members of Getaround and RelayRides in the San Francisco Bay Area were representative of an urban population and tended to be cost-conscious, technologically savvy individuals. Hybrid P2P-traditional carsharing services, such as eGo and Communauto, had personal vehicle sharing renters that show similar demographics to members of their traditional carsharing service. Communauto reported that its personal vehicle sharing members were more likely to be partnered than single and had an average age of 41 years.

On the vehicle owner side eight personal vehicle sharing and traditional carsharing experts identified economic incentives and perceived environmental benefits as the primary motivations for early adoption. Vehicle owners receive 60 to 65% of the rental fee. Income from renting a personal vehicle is taxable; however, automobile expenses and depreciation can be deducted from revenue. One expert believed that environmental concern was more important among affluent populations to whom the financial incentive may be less significant (W Knapp, 2011, pers. comm., 27 June). Another noted that households with multiple automobiles might be more likely to dedicate a vehicle to P2P than households relying on a single vehicle (e.g., a household that requires multiple cars during the week but only one on weekends) (K McLaughlin, 2011, pers. comm., 16 May). Further market research is needed to establish the market potential for personal vehicle sharing services.

Revenues from personal vehicle sharing provide an incentive to vehicle owners to market their own vehicles through diverse mechanisms (e.g., friends and family). One operator, Jolly Wheels, noted that it is critical for vehicle "providers" (i.e., vehicle owners) to operate as a small business, publicizing the availability of their vehicles to potential customers (A Maus, 2011, pers. comm., 12 August). Getaround, another P2P carsharing operator, is a proponent of "grassroots" marketing—a strategy that relies primarily on vehicle owners and less on centralized marketing. Personal vehicle sharing companies often rely heavily on the "social graph," relationships among individuals that lack the physical advertisements common to commercial enterprises, such as vehicle and parking signage used in traditional carsharing. However, many successful companies have grown their customer base using word-of-mouth and online social networks. The founders of Zimride, a dynamic ridesharing service, have cited connections with Facebook as the reason their company was able to scale successfully (J Zimmer, 2010, pers. comm., 4 November).

The next section discusses the barriers to the adoption and expansion of personal vehicle sharing including: insurance; public policy; fear of sharing; pricing/revenue and other key issues, such as technology and safety.

4.3. Barriers to adoption and expansion

Researchers asked both personal vehicle sharing and traditional carsharing operators (n=29) to identify the top three barriers to widespread adoption of personal vehicle sharing (with "one" being the most important); the results are shown in Fig. 1. Although it was noted that various barriers were inter-related, the two most common barriers identified included insurance coverage (23/29) and fear of sharing personal vehicles (21/29). The next most prevalent barriers included balancing revenue and pricing (10/29), public policy (9/29), and technology (8/29). These and other barriers are discussed below. Public policy is discussed following insurance due to their close interrelation.

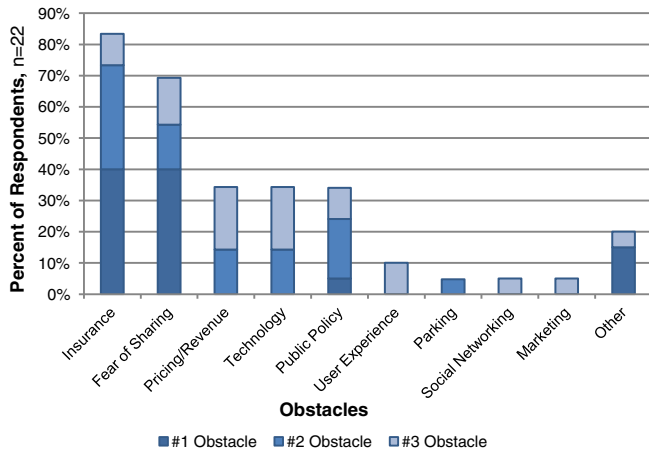


Fig. 1. Barriers to adoption and expansion of personal vehicle sharing.

4.3.1. Insurance

As in the early phase of traditional carsharing, cost and availability of auto insurance in personal vehicle sharing represents one of the most notable barriers to the adoption, implementation, and profitability of this service.

Automotive insurance policies are historically designed to provide a separate coverage of commercial and personal vehicles. Insurance coverage of personal vehicle sharing requires policies designed to provide umbrella coverage in order to cover personal vehicles under high usage rates for any number of vehicles and users. The commercial umbrella coverage developed for traditional carsharing was an enabling factor for the development of insurance policies for personal vehicle sharing. However, significant modifications were required for umbrella coverage of personal vehicles. The creation of a new policy or modification of existing policies is encumbered by development costs and setup/legal fees for filing policies with state-level insurance departments.

A common coverage limit is US\$1 million for general liability; however, such policies sometimes provide *only* secondary coverage to a vehicle owners' primary policy. In February 2012, a serious collision occurred in Boston, Massachusetts involving a vehicle rented through a P2P carsharing company. The accident caused irreparable damage to the vehicle, debilitating injuries to four individuals, and one fatality. If the liabilities in this case exceed insurance coverage limits for the P2P carsharing company, the resulting settlement will likely set a precedent for future cases (Leiber, 2012).

Based on interview response, insurance costs currently represent 20 to 25% of personal vehicle sharing operators' overall costs; one operator cited it as their largest marginal cost. Member and vehicle screening is essential to maintaining manageable premiums. At the time of this writing, the full-time equivalent cost to insure personal vehicle sharing automobiles in the U.S. was US\$2000 to \$2500 per vehicle per year (W Curtis, 2011, pers. comm., 10 June). The cost of physical damage insurance is assessed on a per hour basis. William P. Curtis, Jr. of Porter & Curtis (Media, PA) proposed an alternative model whereby liability is established on a per mile basis to reflect vehicle exposure rates, since vehicles are rarely driven for the full duration of the rental period. Communauto uses a per-mile and per-hour basis to price their insurance. In the province of Quebec, La Capitale charges US\$910 per vehicle per year. The relatively low cost of insurance is a product of Communauto's strict screening requirements and universal health care in the province of Quebec (removing the necessity for personal injury coverage).

While insurance costs reflect one of the largest barriers to profitability for personal vehicle sharing operators, all insurance experts

interviewed agree that improvements in risk assessment could significantly reduce insurance costs. Personal vehicle sharing introduces unique exposure circumstances and a lack of operational experience hinders liability assessment. Accurate insurance pricing requires as much as 10,000 vehicle-years of operating data to determine liability costs and realize industry-standard profit margins (insurance expert on carsharing, 2011, pers. comm., 4 August). The most immediate means of reducing insurance coverage costs, while expanding the providers' interest, is for personal vehicle sharing operators to aggregate non-identifying operational data so that insurance companies can make coverage profitable. One personal vehicle sharing operators' insurance premiums decreased by 30% in the first year alone due to operational data collection (W Curtis, 2011, pers. comm., 10 June). Although disputed among a number of the experts interviewed in this study, technology may affect the development and cost of insurance policies through data collection, vehicle security, and P2P operator control. The next section discusses public policy developments for personal vehicle sharing services.

4.3.2. Public policy

Insurance laws vary state-to-state in the U.S. and province-to-province in Canada. Indeed, insurance coverage may vary somewhat among locations even within a single policy due to state or province requirements. Key elements of personal vehicle sharing legislation include the classification of personal vehicle sharing as non-commercial vehicle use (which allows them to be shared in exchange for a rental rate, if less than the annual vehicle expense), liability determination, the use of information to determine price and coverage, and economic incentives or taxation.

Lobbying in California, Oregon, and Washington has facilitated the operation of personal vehicle sharing services through the passage of AB 1871, HB 3149, and HB 2384 respectively. The enactment of AB 1871 has been the key for personal vehicle sharing in California and serves as the model legislation for other states across the U.S. These bills classify personal vehicle sharing as non-commercial use and limit "the circumstances under which the vehicle owner's automobile liability insurance can be subject to liability" in order to prevent cancellation of primary automobile insurance policies (AB, 1871, 2011). Thus, personal vehicle sharing programs assume liability when the vehicle is rented in a shared-use capacity, and the owner's insurance policy resumes coverage once it is returned. Vehicle owners are indemnified for any loss or injury that occurs through shared-use not resulting from their negligence. The date, time, initial and final locations of a vehicle must be clearly delineated through "verifiable electronic records identifying" when it is being used as part of a personal vehicle sharing program (AB, 1871, 2011). This prevents premium spikes for primary insurance policies resulting from unverified shared use. Vehicle owners that share their autos in states lacking personal vehicle sharing legislation risk non-renewal of primary insurance policies, as well as premium spikes resulting from increased use.

Finally, legal classifications of shared-use vehicle services affect the establishment of taxation rates or financial incentives. In many states, excise taxes are applied to traditional carsharing services. New York State, for instance, classifies car rental and traditional carsharing services as commercial enterprises, which are taxed 6% on transactions. While many carsharing operators perceive this as a financial disadvantage, this classification benefited Zipcar (the largest traditional carsharing operator in the world) in the New York court case, *Minto v. Zipcar*. A personal injury action arose whereby Leslie Minto, the plaintiff, alleged that his vehicle was rear-ended while stopped at a red light by a vehicle owned by Zipcar, which was driven by the defendant. The defendant asserted the claim against Zipcar in an attempt to attach vicarious liability to the company as the vehicle owner. Zipcar successfully refuted the action "precluded by section 14 of the Federal Transportation Equity Act of 2005, better known as the Graves Amendment," which protects commercial vehicle

owners from vicarious liability in cases void of negligence or criminal wrongdoing (Zipcar, 2010). The next section discusses “fear of sharing” as a potential obstacle to the growth and expansion of personal vehicle sharing services.

4.3.3. Fear of sharing

In this study, fear of sharing personal assets was cited as one of the primary barriers to the adoption of P2P sharing services. A combined 21 personal vehicle sharing and carsharing respondents (out of 29) identified this as one of the top three barriers, second only to insurance barriers. Indeed, the private vehicle is among an individual's most valued possessions, and a person may be more likely to rent out their home than their automobile (G Kohli, 2011, pers. comm., 17 June).

In 2010, University of California, Berkeley graduate students conducted an intercept survey of people at the Department of Motor Vehicles to test user response to personal vehicle sharing. This study found that more than half of all participants indicated lack of trust as their main reason for not converting their personal vehicles to shared vehicles. Survey respondents most commonly cited operator screening, user rating, and feedback systems as mechanisms for P2P operators to address trust issues among renters and owners. This research supports the survey findings, with variations attributed to subject population and methodology. Fig. 2 indicates how traditional carsharing and personal vehicle sharing operators believe that the personal vehicle sharing industry can address the trust issue.

When traditional carsharing and personal vehicle sharing experts ($n = 28$, one personal vehicle sharing operator abstained) were asked to identify all the mechanisms that they thought would help to address the trust issue among individuals in personal vehicle sharing, the top three choices included: user rating and feedback system (22/28), operator screening and selection (18/28), and social networking (13/28). Other mechanisms identified included vehicle quality assurance and responsive customer service.

In personal vehicle sharing, user rating and feedback systems provide a critical medium for establishing trust and credibility among members. Feedback systems provide a mechanism for accountability and a way to “blacklist” users in the event of misuse or vehicle damage. There may be instances where damage liability is difficult to determine, which may require operators to investigate. Some personal vehicle sharing operators incorporate vehicle owner control over who can rent. User rental criteria may be established through user feedback and ratings, behavioral analysis of driving data, and social networking (whereby only certain “communities” or “groups” are granted access). Two traditional carsharing operators expressed concern regarding potential liabilities

to service operators and vehicle owners resulting from practices that may be perceived as discriminatory; however, four carsharing operators agreed that the vehicle owner's choice of renters would help to address the trust issue. One respondent believed that vehicle renters would tend to take better care of a personal auto than a traditional car-sharing fleet vehicle (A Quirk, 2011, pers. comm., 20 June). Face-to-face interaction of the vehicle owner with the renter could also play a major role in establishing trust (G Kohli, 2011, pers. comm., 17 June; and J Scorpio, 2011, pers. comm., 24 June).

Screening and selection criteria must be met for individuals to gain membership to shared-use vehicle organizations in exchange for service use, “unattended access” or “skip the counter” services, and/or member rewards incentive programs. Companies commonly screen for and verify age, identity, and driving record, which enable operators to satisfy insurance policy guidelines. In the future, this could also include criminal checks. Some personal vehicle sharing organizations screen vehicles for maintenance issues, age, fuel efficiency, and model specifications.

Seven of 12 personal vehicle sharing operators indicated that increased legitimacy of personal vehicle sharing could be achieved through marketing and social media. Three personal vehicle sharing operators and 10 traditional carsharing experts agreed that media coverage provides education about the service and helps to establish legitimacy. However, it also has the potential to affect the industry negatively through reporting of a major incident.

Airbnb, a P2P lodging service that enables people to rent a room or bed, experienced a widespread media blow in the summer of 2011 after a case involving property damage (Mills, 2011). One expert thought that personal vehicle sharing companies would be less vulnerable to this type of incident for two reasons. First, the majority of personal vehicle sharing services require member screening to meet mandatory auto insurance requirements. Home- or room-sharing, on the other hand, does not require insurance; thus, those companies are not forced to confront this issue up-front. Second, personal vehicle sharing may occur most often within one's own community or local region, thus encouraging a positive connection with neighbors (L Anderson, 2011, pers. comm., 8 August). Conversely, P2P lodging generally occurs when someone is traveling away from home—it could be a one-time transaction, which can eliminate community connection and accountability.

One approach advocated by two operators is to focus exclusively on sharing between affinity groups—peoples' pre-established community networks—instead of the community at large (A Freed, 2012, pers. comm., 20 March). This enables personal vehicle sharing only among trusted community members, as well as increased accountability

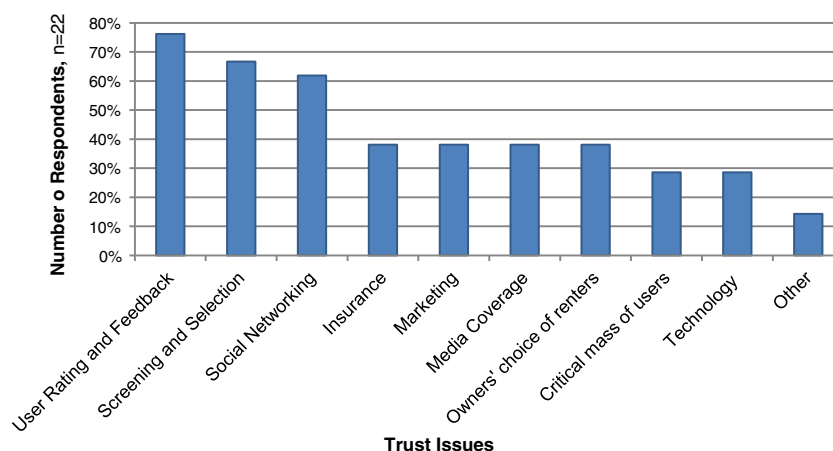


Fig. 2. Personal vehicle sharing trust issues.

through personal interaction. The next section discusses barriers to balancing revenue and pricing for personal vehicle sharing operators.

4.3.4. Balancing revenue and pricing

Barriers to balancing revenue and pricing result from a trade-off between generating operator profit and vehicle owner revenue. Personal vehicle sharing companies must find renters and offer incentives to owners, such as 60 to 65% of the rental fee to match the demand. Too many P2P vehicles could result in owners not receiving enough reservations to make their participation worthwhile (K McLaughlin, 2011, pers. comm., 16 May). In addition, there may be a lag period between when vehicle owners put their auto into a personal vehicle sharing service and begin generating rentals (A. Freed, 2012, pers. comm., 20 March).

In personal vehicle sharing, pricing is dependent on membership fees, technology and insurance costs, hourly or daily use, and mileage. Competitive pricing is critical in areas where traditional carsharing is available to incentivize personal vehicle sharing use. Although P2P services require less capital investment, they also generate a lower return per transaction in contrast to traditional carsharing due to revenue sharing between the operator and vehicle owner. Thus, profitability is contingent on rental volume. Among the personal vehicle sharing operators in North America, membership fees are charged primarily by hybrid P2P-traditional carsharing providers and range from US \$50 to \$345 annually. Technology installation costs are often waived during the start-up period, but they range from US\$250 to \$1000. As of April 2012, the typical hourly fee set by vehicle owners renting their vehicles through Getaround ranged between US\$5 and \$12, with daily rates between US\$25 and \$65—not including fuel. By comparison, Zipcar charges US\$8 to \$14.25 per hour with discounts available through monthly plans, overnight rates of US\$39, and daily rates between US \$72 and \$102 Brook, 2012.

At present, three methods exist to determine pricing and operator revenue. One method, referred to as the “owner-pricing model,” allows owners to set the rental price of their vehicle within the bounds established by the operator. This method enables market mechanisms to dictate the price, from which the operator takes a percentage of typically 35 to 40%. In the second approach, the “vehicle-model pricing model,” operators determine rates on a per-vehicle basis. Go-op used this system and commented that balancing renter fees, car owner revenue, and P2P operator return was difficult to achieve, but it was key to supporting a profitable business model (R Hampshire, 2011, pers. comm., 11 May). In the third method, referred to as the “P2P marketplace pricing model,” operators charge a fee for car owners to post their vehicles to an online marketplace where owners set the price and/or renters bid against each other, setting the usage rate. Since a fractional ownership model has yet to be demonstrated, this model is not described in terms of pricing. Nevertheless, it is presumed that a fractional ownership model could operate much like a traditional carsharing service with respect to renter pricing, and it would most likely involve discounted pricing or inclusive service to individuals that invest in vehicles owned by the operator.

4.3.5. Technology

Technology development costs and per unit expense represent major barriers to profitability, especially during the start-up phase. The development and implementation of a personal vehicle sharing system that addresses software, hardware, and security needs in a universal solution have proven resource-intensive and costly. Stand-alone packages range from US\$500 to \$1000 per unit. Most personal vehicle sharing companies currently waive technology installation fees to boost membership and plan to absorb a portion of future installation costs. Some auto owners prefer not to install aftermarket technology in their vehicles because it may void manufacturer warranties or hurt resale values. Compatibility issues may arise with in-vehicle technology in certain vehicle makes and models, especially for advanced vehicle types (e.g., electric vehicles). Through partnership

with General Motors (GM), RelayRides replaced their aftermarket technological package for use of the OnStar© technology, available in GM vehicles, and a key exchange for non-GM autos. JustShareIt plans to use a single technology platform for multiple vehicle types, including boats and all-terrain vehicles, further complicating technological development. It is important to note that oversight and maintenance costs, as well as user ease-of-use, vary by technology.

The importance of technological applications in personal vehicle sharing schemes was highly contended among experts—ranging from the need for no technology to advanced systems. The majority of interview subjects agreed that rapid technological advances and digital communications could play a key role in establishing a market conducive to personal vehicle sharing, but they disagreed regarding the need for in-vehicle technologies to provide operator control and vehicle security. For instance, some operators claimed that an in-person key exchange between owner and renter facilitates access to personal vehicle sharing and trust among users. Others asserted that unattended access promotes user safety and reduces potential access issues caused by coordination among individuals. The failure of the high-end personal vehicle sharing operator, HiGear, due to vehicle theft reinforces the need for vehicle security, as well as careful member screening to prevent fraud and identity theft.

4.3.6. Vehicle availability

While personal vehicle sharing has the potential to greatly expand the number of shared-use vehicles, nine of the 18 traditional carsharing operators interviewed expressed concern regarding vehicle supply (or availability) meeting demand. In traditional carsharing, vehicles are made available for reservation during all allotted times in contrast to personal vehicle sharing models, which reflect more limited availability. Potential operational issues include: short and limited usage periods, non-availability during peak-use hours, and emergency situations when the owner needs a vehicle unexpectedly. Vehicle availability represents a larger issue for personal vehicle sharing transactions that involve a key exchange due to the lack of operator control over vehicle access.

Personal vehicle sharing services focus highly on customer service to provide fast and adequate response to issues that could arise. For instance, operators plan to address emergencies by honoring pre-existing reservations and assisting the owner in acquiring an alternative vehicle. However, P2P carsharing and P2P marketplace models may prove less able to provide a vehicle in some cases.

4.3.7. Safety

Vehicle safety is a critical issue for personal vehicle sharing services. Traditional carsharing operators actively maintain fleet vehicles to ensure standards of safety and quality. P2P carsharing and P2P marketplace models rely on vehicle owners to upkeep their autos and address maintenance issues. Lack of operator control over vehicle care may result in variable auto conditions vs. condition of autos and create risk for vehicle renters in instances of negligent maintenance practices. P2P carsharing and P2P marketplace operators are advised to conduct regular vehicle maintenance inspections and require vehicle owners to sign agreements that their vehicle is properly maintained in order to reduce safety and liability concerns.

Table 4 identifies the most impactful barriers to the spread of personal vehicle sharing, as well as opportunities for addressing many of them.

5. Shared-use vehicle services: a continuum

This section proposes a continuum framework for understanding the current state of shared-use vehicle services, which includes personal vehicle sharing—spanning from commercial car rental to the P2P marketplace model. This framework has been created to guide local and regional governments, policymakers, researchers, and business practitioners in understanding key differences among the models

Table 4
Opportunities and barriers to personal vehicle sharing in North America.

Personal vehicle sharing	Barriers	Opportunities
Market adoption	<ul style="list-style-type: none"> • Competition among shared-use vehicle models • Availability of personal vehicles for shared-use 	<ul style="list-style-type: none"> • Expansion of shared-use vehicle services to lower-density areas • “Walkable” community access to shared-use vehicles • Increased shared-use vehicle supply • Strict screening requirements • Aggregation of operational data to improve risk assessment
Insurance	<ul style="list-style-type: none"> • Cost and availability of auto insurance • Lack of operational experience to accurately assess risk • Circumstances with indeterminate liability (operator provided insurance liability vs. vehicle owner insurance liability) 	<ul style="list-style-type: none"> • In-vehicle security and control mechanisms that could reduce risk and lower insurance costs • Dynamic insurance pricing based on user demographics and usage rates
Public policy	<ul style="list-style-type: none"> • Indefinite number of users and vehicles • Lack of state-level legislation in the U.S. • Clear delineation of liability • Rental tax 	<ul style="list-style-type: none"> • Lobbying • Classification of personal vehicle sharing as non-commercial vehicle use • Economic incentives (e.g., tax credits)
Fear of sharing	<ul style="list-style-type: none"> • Value of private vehicles • Personal attachment to private vehicles • Lack of trust among members • Personal vehicle sharing legitimacy needs to be established (i.e., reliable business) 	<ul style="list-style-type: none"> • User rating and feedback system • Operator screening of members • Social media and marketing • Vehicle access limited to affinity groups • Insurance to cover all parties in the case of an accident (e.g., driver, owner, and operator) • Vehicle owner screens renters • Critical mass of users • In-vehicle technology facilitates vehicle security
Balancing revenue and pricing	<ul style="list-style-type: none"> • Trade-off between operator profit and vehicle owner revenue • Competitive pricing in areas with competitive shared-use vehicle services 	<ul style="list-style-type: none"> • Reaching a profitable rental volume • Operator selection of pricing model
Technology	<ul style="list-style-type: none"> • Development of a universal software, hardware, and security suite • Cost per unit • Vehicle theft • Compatibility among makes, models, and vehicle types 	<ul style="list-style-type: none"> • In-vehicle technology facilitates operator control and vehicle security • Technology fee waivers boost membership • Fraud and identity theft protection
Safety	<ul style="list-style-type: none"> • Lack of operator control over maintenance 	<ul style="list-style-type: none"> • Regular vehicle maintenance inspections • Vehicle owner agreement to properly maintain vehicle

based on: capital ownership, technology, social and environmental impacts, and industry competition. Fig. 3 illustrates the placement of the models along the shared-use vehicle continuum.

5.1. Capital

Automobile capital is a central determinant of organizational structure and thus a key distinguishing factor along the continuum. Models ranging from commercial car rental to hybrid P2P-traditional carsharing involve company-owned vehicle capital. The costs of purchasing or leasing and maintaining a vehicle fleet are among the highest operational costs for models with company-owned capital. Vehicle capital represents approximately 69% of the total operating expenses of car-sharing companies (Sullivan & Magid, 2005). Company-owned vehicles require reserved parking, which can be an asset for marketing and service users, but this typically requires additional expenditures. The costs of vehicle maintenance and parking reflect geographic location, with costs tending to increase in dense urban areas. Personal ownership of vehicle capital is a central distinguishing factor of personal vehicle sharing, which can greatly reduce operator capital requirements.

5.2. Technology

Technology solutions are rapidly evolving among shared-use vehicle services and vary widely even within a single model. Key elements of shared-use vehicle technology include reservations and billing, access, vehicle control and security, and data recording and transmission. Advances in information and communication technology have enabled reservations and payment through multiple platforms including automated phone systems, web-based user interfaces, and smart phone applications. The use of a manual reservation process has steadily diminished since the mid-1990s, although they are still available through customer service representatives (Shaheen et al., 2009).

Vehicle access may be provided through an in-person key exchange (i.e., no technology), referred to as attended access, or through unattended access mechanisms such as lockboxes, key fobs, smart cards, or smart phone applications. Shared-use vehicle service operators may provide attended access, unattended access, or both. The distinction between attended access and unattended access is considered critical for security and safety by three of the personal vehicle sharing and three of the traditional carsharing operators interviewed. At

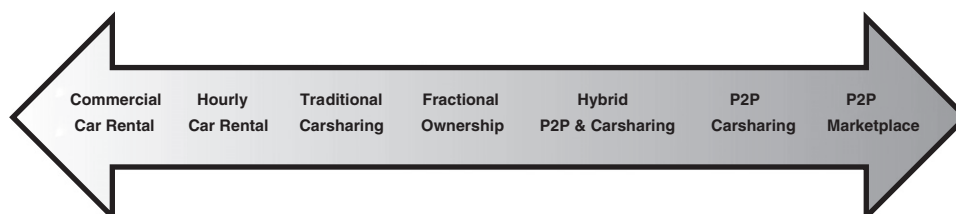


Fig. 3. Continuum of shared-use vehicle services.

present, seven out of ten personal vehicle sharing operators in North America provide unattended access.

Three pre-existing classifications of shared-use vehicle technology have been adapted to reflect the current systems: manual processes, partially-automated systems, and advanced technologies (Shaheen et al., 2009). These classifications are based on reservations and billing as well as access mechanisms, which are common to all shared-use vehicle services. *Manual processes* involve reservations and billing in-person or via telephone with attended access via key exchange or unattended access using a lockbox. *Partially-automated systems* include reservations and billing via automated telephone system, Internet, smart card, or smart phone, with attended access via key exchange or unattended access using a lockbox. *Advanced technologies* involve reservations and billing via automated telephone system, Internet, smart card, or smart phone, and unattended vehicle access using key fobs, smart cards, or smart phone applications.

Shared-use vehicle providers are increasingly integrating additional technologies for vehicle control and security, as well as data recording and transmission. These systems are most commonly used in personal vehicle sharing systems to provide operator control over shared assets and to reduce the risks associated with P2P transactions. Table 5 identifies the mechanisms and purpose of additional technologies used for vehicle control, security, data recording, and transmission.

5.3. Social and environmental impacts

With respect to social and environmental impacts along the continuum, traditional carsharing is the only model that is documented in the literature, at present. While the benefits of traditional carsharing are widely accepted among experts, the social and environmental impacts of personal vehicle sharing are still debated. Most respondents believed that personal vehicle sharing would encourage lifestyle changes that foster modal shifts and ultimately provide environmental benefits analogous to those of traditional carsharing. About half of the traditional carsharing operators expressed concern that personal vehicle sharing has the potential for negative environmental impacts. They argued that personal vehicle sharing would increase VMT/VKT through increased vehicle usage rates and encourage households to keep a personal vehicle they otherwise might sell or even purchase new vehicles to support rentals. Further research is needed to document and understand the social and environmental impacts of personal vehicle sharing.

5.4. Industry competition

Shared-use vehicle services within the continuum have the potential to provide both complementary and competitive services depending on geographic location, density, and company strategy. Some experts cited the private automobile as the primary competitor to mobility alternatives as a whole. However, market competition in

the San Francisco Bay Area illustrates how a wide variety of similar services can compete in the same marketplace. In general, market competition tends to increase in high-density areas with widely available public transit, and shared-use vehicle services tend to complement each other more in low-density areas with fewer alternative transportation modes.

6. Implications for managerial practice

Today, the P2P carsharing business model is receiving a great deal of attention and is the most widely available personal vehicle sharing approach in North America. Traditional carsharing operators that incorporate personal vehicle sharing into their services (i.e., hybrid P2P-traditional carsharing) can have a financial advantage—especially during the initial stages of market development—since they do not depend on venture capital funding or their personal vehicle sharing services to be self-sustaining.

Expert respondents were asked to extrapolate the potential for profitability of personal vehicle sharing over the next 10 years. Five personal vehicle sharing and four carsharing operators thought that personal vehicle sharing would likely become profitable in the next 5 years depending upon: reduced insurance and technology costs, a sustainable balance of rental fees with owner revenues, and well matched supply and demand. Some operators recognized the trade-off between expansion and profitability, although others identified expansion as key to profitability.

In the early phases of personal vehicle sharing market development, organizations offering these services could mutually benefit from cooperation. Communication and information sharing could aid in technological development, reduced insurance costs, supportive public policies, and an expanded marketplace. The establishment of a set of best practices that could provide operational guidelines, which also occurred in traditional carsharing, could facilitate a better understanding of the social and environmental benefits of this approach. In the future, other transportation-related shared access business models—such as ridesharing (Avego, Zimride), public bikesharing (BIXI, Capital Bikeshare), and parking services (parkatmyhouse.com)—will likely interconnect with personal vehicle sharing schemes.

7. Conclusion

In recent years, the concept of personal vehicle sharing has gained momentum in Europe and North America, largely as an outgrowth of traditional carsharing. This evolution has coincided with reduced auto ownership trends and shifting consumption patterns, often referred to as “collaborative consumption” (or a sharing economy). This approach has facilitated a range of new business models that create access to shared resources as an alternative to ownership. This has resulted in privately-owned vehicles being incorporated into shared-use vehicle fleets.

Table 5
Mechanisms and purpose of additional shared-use vehicle technologies.

Technologies	Mechanism	Purpose
Vehicle control and security	Door lock controls	Manage access
	Remotely controlled security system	Prevent theft
	Engine disable	Prevent theft
Data recording and transmission	In-vehicle sensor network	Detect accidents or parts theft
	Global positioning system (GPS) tracking that combines satellite navigation and vehicle tracking (e.g., time, distance traveled, speed)	Record vehicle use to satisfy personal vehicle sharing legislation requirements (e.g., records identifying the date, time, initial and final vehicle locations, and kilometers/miles driven); vehicle tracking to prevent theft; and operational data collection and analysis
	On-board diagnostic parameters (e.g., fuel used, emissions, engine load)	Vehicle operational data collection and analysis (e.g., environmental impact assessment)
	Wireless data transmission	Real-time data recording
	In-vehicle communication	Emergency response and reservation changes

Note: In-vehicle data recording and transmission devices are commonly referred to as telematics (combined computer and wireless communication systems).

As of May 2012, there were 33 personal vehicle sharing operators worldwide, with 10 active or in pilot phase, three planned, and four defunct in North America. Personal vehicle sharing could provide a model that overcomes some of the financial constraints and geographic limitations of fleet ownership and distribution, as in traditional carsharing. Interestingly, all personal vehicle sharing and traditional carsharing experts interviewed in this study agreed that personal vehicle sharing holds the potential to notably expand the shared-use vehicle market. However, a range of issues related to adoption and expansion need to be addressed including: insurance and liability, technology, vehicle availability, maintenance, and trust among auto owners and renters. Experts identified a number of opportunities to address barriers including: lobbying and legislation, screening and data aggregation, user rating and feedback, operator screening and selection, rental volume, pricing model, and technology.

Moving forward, more research into personal vehicle sharing is needed to assess market potential and its social and environmental impacts. Future research opportunities include: understanding geographic and land use opportunities, demographics and psychographics, economic viability, business model evolution, and market growth. While this paper assesses industry developments in its nascent stages, continued tracking and assessment of future developments is recommended.

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References

- Autoshare (2003). About us: In the news/PR. (online) Available at: www.autoshare.com/aboutus_news.html (Accessed July 23, 2008).
- Brook, D. (2012). Portland Carsharing Choices. [online] Available at <http://www.carsharing.us> [Accessed April 20, 2012].
- California Assembly Bill 1871 (2011). An act to add Section 11580.24 to the Insurance Code, relating to motor vehicle insurance coverage. (Online) Available at: http://info.sen.ca.gov/pub/09-10/bill/asm/ab_1851-1900/ab_1871_bill_20100212_introduced.html (Accessed February 2, 2011).
- Cervero, R., Creedman, N., Pohan, M., Pai, M., & Tsai, Y. (2002). *City carshare: Assessment of intermediate-term travel-behavior impacts*. Working Paper 2002-02. Berkeley: Institute of Urban and Regional Development, University of California.
- Cervero, R., Golub, A., & Nee, B. (2007). City carshare: Longer-term travel demand and car ownership impacts. *Transportation Research Record: Journal of the Transportation Research Board*, 1992, 70–80.
- Cervero, R., & Tsai, Y. (2004). City carshare in San Francisco, California: Second-year travel demand and car ownership impacts. *Transportation Research Record: Journal of the Transportation Research Board*, 1887, 117–127.
- City CarShare (2004). First-ever study of car-sharing. (Press release), 12 January 2004, Available at: http://www.citycarshare.org/pressrelease_01-12-04.do (Accessed 18 August 2011).
- Cohen, A., Shaheen, S., & McKenzie, R. (2008). Carsharing: A Guide for Local Planners. [online] American Planning Association. Available at: <http://76.12.4.249/artman2/uploads/1/pasmemo0508.pdf> [Accessed 15 August, 2011].
- Cooper, G., Howe, D., & Mye, P. (2000). *The missing link: An evaluation of CarSharing Portland Inc*. Portland, OR: Oregon Department of Environmental Quality.
- Dallaire, Y., Lafond, N., Lanoix, C., & Viviani, M. (2007). Le projet auto+bus: Évaluation d'initiatives de mobilité combinée dans les villes canadiennes. (Online) Communauto. Available at www.communauto.com/abonnes/PT-CS_RapportFinal_jul06.pdf (Accessed 17 August 2011).
- Econsult Corporation (2010). The economic and environmental impact of PhillyCarShare in the Philadelphia region. (Online) Available at: <http://www.phillycarshare.org/wp-content/uploads/2010/07/pcs-impact-study.pdf> (Accessed 17 August 2011).
- Hampshire, R. C., & Gaites, C. (2011). Peer-to-peer carsharing: Market analysis and potential growth. *Transportation Research Record: Journal of the Transportation Research Board*, 2217, 119–126.
- Jenson, N. (2000–2001). *The co-operative auto network social and environmental report*. Vancouver, British Columbia, Canada: Co-operative Auto Network.
- Katzev, R. (1999). *Carsharing Portland: Review and analysis of its first year*. (Online). Portland, OR: Department of Environmental Quality Available at: www.publicpolicyresearch.net/documents/CSP_first_year_eval.PDF (Accessed 18 August, 2011).
- Katzev, R. (2003). Car sharing: A new approach to urban transportation problems. *Analysis of Social Issues and Public Policy*, 3(1), 65–86.
- Leiber, R. (2012). Fatal Collision Makes Car-Sharing Worries No Longer Theoretical. [Online] The New York Times Available at: <http://www.nytimes.com/2012/04/14/your-money/relayrides-accident-raises-questions-on-liabilities-of-car-sharing.html?pagewanted=all> [Accessed 14 April, 2012].
- Lane, C. (2005). PhillyCarShare: First-year social and mobility impacts of carsharing in Philadelphia, Pennsylvania. *Transportation Research Record: Journal of the Transportation Research Board*, 1927, 158–166.
- Martin, E., & Shaheen, S. A. (2010). *Greenhouse gas emission impacts of carsharing in North America*. (Final report). San Jose, CA: Mineta Transportation Institute Available at: http://76.12.4.249/artman2/uploads/1/Greenhouse_Gas_Emission_Impacts_of_Carsharing_in_North_America.pdf (Accessed 18 August, 2011).
- Martin, E., & Shaheen, S. A. (2011). Greenhouse gas emission impacts of carsharing in North America. *IEEE Transactions on Intelligent Transportation Systems*, 12(4), 1074–1086.
- Martin, E., & Shaheen, S. A. (2011). The impact of carsharing on public transit and non-motorized travel: An exploration of North American carsharing survey data. *Energies*, 4, 2094–2114, <http://dx.doi.org/10.3390/en4112094>.
- Martin, E., Shaheen, S., & Lidicker, J. (2010). The impact of carsharing on household vehicle holdings: Results from a North American shared-use vehicle survey. *Transportation Research Board: Journal of the Transportation Research Board*, 2143, 150–158.
- Millard-Ball, A., Murray, G., ter Schure, J., Fox, C., & Burkhardt, J. (2005). *TCRP report 108: Car-sharing: Where and how it succeeds*. [Online]. Washington, D.C.: Transportation Research Board of the National Academies Available at: http://onlinepubs.trb.org/onlinepubs/tcrp/tcrp_rpt_108.pdf > [Accessed 17 August, 2011].
- Millard-Ball, A., & Schipper, L. (2011). Are we reaching peak travel? Trends in passenger transport in eight industrialized countries. *Transport Reviews*, 31, 357–378.
- Mills, E. (2011). SF police arrest suspect in trashing of Airbnb Rental. CNET News. (Online), 29 July, Available at: http://news.cnet.com/8301-27080_3-20085741-245/sf-police-arrest-suspect-in-trashing-of-airbnb-rental/ (Accessed 1 August, 2011).
- Mittelstaedt, M. (2010). U.S. car ownership shifts into reverse, The Globe and Mail. (online) Available at: <http://www.theglobeandmail.com/news/world/us-car-ownership-shifts-into-reverse/article1418860/> (Accessed 17 August, 2011).
- Newman, P., & Kenworthy, J. (2011). Peak car use: Understanding the demise of automobile dependence. *World Transport, Policy & Practice*, 17, 31–39.
- Price, J., DeMaio, P., & Hamilton, C. (2006). Arlington Carshare Program: 2006 Report. (Online) Available at http://www.commuterpage.com/pdfdocs/ArlCo_CarshareReport_2006.pdf (Accessed 17 August, 2011).
- Price, J., & Hamilton, C. (2005). Arlington Pilot Carshare Program: First-year report. (Online) Available at <http://www.commuterpage.com/pdfdocs/ArlingtonCarshareProgram.pdf> (Accessed 17 August, 2011).
- Robert, B. (2000). Potentiel de L'Auto-Partage Dans Le Cadre d'Une Politique de Gestion de La Demande en Transport. Presented at Forum de L'AQTR, Gaz à Effet de Serre: Transport et Développement, Kyoto: Une Opportunité d'Affaire? Montreal, Canada.
- Shaheen, S. A., Cohen, A. P., & Chung, M. S. (2009). North American carsharing: 10 year retrospective. *Transportation Research Record: Journal of the Transportation Research Board*, 2110, 35–44.
- Shaheen, S. A., Mollyanne, M., & Wipiewski, K. (2003). US shared-use vehicle survey findings on carsharing and station car growth: Obstacles and opportunities. *Transportation Research Record: Journal of the Transportation Research Board*, 1841, 90–98.
- Sullivan, E., & Magid, L. (2005). Bringing carsharing to your community. (Online) City CarShare. Available at: http://www.citycarshare.org/download/CCS_BCCTYC_Long.pdf (Accessed 17 August, 2011).
- Walb, C., & Loudon, W. (1986). *Evaluation of the short-term auto rental service in San Francisco, California*. [Online]. Cambridge, MA: Cambridge Systematics Available at: http://www.communauto.com/images/03.coupures_de_presse/WalbLoudon1986_B.pdf > [Accessed 18 August, 2011].
- Zipcar (2006). Zipcar customer survey shows car-sharing leads to car shedding. (Press release), 16 February 2009, Available at: <http://zipcar.mediaroom.com/index.php?s=43&item=108> (Accessed 17 August, 2011).
- Zipcar Granted Graves Protection (2010). Auto rental news: For the car and truck rental industry. (Online) Available at <http://www.autorentalnews.com/Channel/Legislative/News/Story/2010/06/Zipcar-Granted-Graves-Protection.aspx> (Accessed March, 2011).