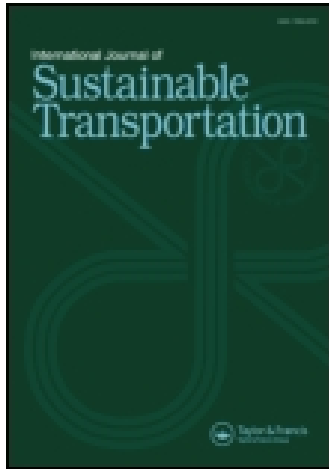


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Carsharing and Personal Vehicle Services: Worldwide Market Developments and Emerging Trends

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ABSTRACT

Carsharing (or short-term auto use) provides a flexible alternative that meets diverse transportation needs across the globe, while reducing the negative impacts of private vehicle ownership. More than 65 years ago, carsharing began appearing in Europe. It has expanded to approximately 1,100 cities worldwide, in 26 nations on five continents. This article provides a global perspective of carsharing growth and future developments from 2006 through 2015, employing data from three surveys conducted in 2006, 2008, and 2010. The authors explore the interview findings of 25 carsharing experts worldwide representing 25 of 26 nations, collected in 2010.

Key Words: carsharing, global, markets, one-way, personal vehicle sharing, survey

According to the United Nations' estimates, the percentage of the world's population living in cities was 49% in 2005 and expected to rise to 59% by 2030 (U.N. Department of Economic and Social Affairs 2001). Many factors, including economic uncertainty, rising energy and private auto ownership costs, and efforts to increase vehicle efficiency and reduce greenhouse gas (GHG) emissions, are encouraging drivers to seek alternatives to vehicle ownership. Moreover, there is a growing trend among younger adults (aged 21 to 30) to employ transportation alternatives, reducing their vehicle kilometers/miles traveled and auto ownership (Botsman and Rogers 2010; Brown 2009). As of October 2010, 26 countries worldwide had adopted carsharing (short-term auto access) as a transportation strategy to reduce personal transportation expenses and mitigate the negative

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environmental impacts of auto use (e.g., congestion, energy consumption, vehicle emissions, and inefficient land use).

Over the past two decades, carsharing has become a mainstream transportation mode for more than a million users worldwide. The principle of carsharing is simple: individuals gain the benefits of a private automobile without the responsibilities and car ownership costs. Carsharing is most common in urban areas where transportation alternatives are easily accessible (Shaheen, Sperling, and Wagner 1998; Shaheen 1999; Shaheen, Cohen, and Roberts 2006; Shaheen and Martin 2010). In some parts of the world, particularly in North America, carsharing has expanded to suburban areas when deployed at major colleges and universities. Worldwide, there has been a proliferation of carsharing business models. The most prominent include: neighborhood residential; business; government and institutional fleets; transit-based; college and university-based; and personal vehicle sharing (use of privately-owned autos employed in shared-use vehicle services). It is important to note that the CarSharing Association does not recognize all forms of personal vehicle services as “carsharing,” given its definition (part of the “Code of Ethics”), which includes access to shared vehicles 24 hours, seven days a week at unattended self-service locations, among other social and environmental criteria (The Carsharing Association 2011).

Worldwide, individuals generally access carsharing vehicles by joining an organization that maintains a vehicle fleet in a network of locations. Vehicles are typically deployed from parking spaces/lots or points of departure (PODs) in neighborhoods, universities, major employment centers, and public transit stations (Shaheen et al 1998; Shaheen 1999). Most carsharing members pay hourly rates and monthly subscription access plans. The vast majority of carsharing operators manage their services with advanced technologies. These technologies can include automated reservations, instant reservations, vehicle class/POD reservations, smartcard vehicle access, real-time vehicle tracking, and equipment that facilitates one-way trips (vehicles can be accessed/returned to a different location) (Shaheen et al. 2006).

As of October 2010, carsharing was operating in more than 1,100 cities, in 26 countries on five continents (Asia, Australia, Europe, North American, and South America) worldwide. (Note that personal vehicle sharing numbers are not included in the worldwide carsharing member and vehicle totals.) This article provides a global perspective of carsharing growth and future developments from 2006 through 2015. The authors employ data from three surveys. Table 1, below, provides an overview of the worldwide longitudinal survey study frame and numbers. The first survey, obtained data from 33 carsharing experts, representing 15 of 18 countries where carsharing operated in 2006 (Shaheen and Cohen 2007). In 2008, the authors conducted another carsharing survey to collect member and vehicle estimates for all 22 carsharing countries. The authors obtained data from 25 carsharing experts from 25 countries, representing 25 of 26 countries where carsharing was operating in 2010. The Netherlands did not participate in the survey; however, member and vehicle data for this nation were obtained through an Internet search. In all three surveys, the authors conducted expert surveys in most countries where carsharing was planned or actively explored. National and regional experts assisted with member and

Table 1. Worldwide carsharing survey.

Year	Experts interviewed	Carsharing countries	Continents	Planned nations	Members worldwide	Vehicles worldwide
2006	33	18 (15 represented)	4	9	346,610	11,501
2008	22	22 (22 represented)	4	7	670,762	19,403
2010	25	26 (25 represented)	5	7	1,251,504	31,665

vehicle totals for Asia and Europe. The authors collected membership and fleet totals for Australia and North America directly from the operators. Operators were asked to provide the number of active members and exclude inactive members who may have used carsharing previously but had discontinued. Data collection involved a combination of operator member/vehicle censuses and surveys and news articles citing operator data.

This article is organized into five sections. First the authors provide an historical overview of carsharing. Next, a comparison of carsharing impacts—primarily from Europe and North America—is provided. In the third section, worldwide growth is reviewed. The authors provide a comparison of worldwide carsharing operations in the fourth section. The article concludes with a summary of emerging and future trends anticipated through 2015.

HISTORICAL OVERVIEW

European experience with carsharing began with a cooperative known as Sefage (Selbstfahrgemeinschaft), which started in Zurich, Switzerland, in 1948 and operated until 1998 (Shaheen and Cohen 2007).

Membership in Sefage was primarily motivated by economics. Individuals who could not afford to purchase a vehicle instead shared one. In Europe, a series of carsharing experiments were attempted but later ceased operations: Procotip (France, 1971 to 1973); Witkar (Amsterdam, Netherlands, 1974 to 1988), Green Cars (Great Britain, 1977 to 1984); Bilpoolen (Lund, Sweden, 1976 to 1979); Vivallabil (Orebro, Sweden, 1983 to 1998); and Bilkooperativ (Gothenburg, Sweden, 1985 to 1990) (Harms and Truffer 1998; Britton 2000; Van Winkel 2002; Cousins 2000).

One of the earliest North American experiences with carsharing began with two experiments: Mobility Enterprise (a Purdue University research program, 1983 to 1986) and the Short-Term Auto Rental (STAR) demonstration (San Francisco, California, 1983 to 1985) (Shaheen et al. 1998). An historical pattern of experimentation and closure has been observed in six nations (Switzerland, Sweden, France, UK, U.S., and Japan). More popularized carsharing operations worldwide began in Switzerland (Lucerne and Zurich) and Germany (Berlin) in 1987 and 1988, respectively (Shaheen et al. 1998).

Although the historic outgrowth of carsharing originated in Europe, a characteristic pattern of worldwide expansion has evolved as shared-vehicle use has become more mainstream. Early carsharing innovations into new markets

frequently consisted of demonstration projects, with sunset dates, which aimed to exhibit carsharing processes and technologies (Shaheen and Cohen 2007). As these markets matured, many of the early demonstrations were replaced with long-term carsharing programs. However, it is not uncommon for carsharing to sometimes disappear for a time before services reemerge. Not surprisingly, as carsharing has become more mainstream, expansion into new markets has coincided with fewer demonstrations (Shaheen and Cohen 2007).

WORLDWIDE CARSHARING IMPACTS

Numerous studies have documented the social and environmental benefits frequently associated with carsharing. However, differences in study methodologies and data collection have often resulted in inconsistent results and limited samples. There have been no independent studies on the quantitative impacts of carsharing in Asia or South America.

Carsharing impacts are categorized as environmental, land use, social effects, and transportation. Lower GHG emissions and reduced vehicle ownership and vehicle kilometers traveled (VKT) [or vehicle miles traveled (VMT)] are environmental benefits frequently associated with carsharing, as trips shift to walking, bicycle, and public transit (Strid 2000; Martin, Shaheen, and Lidicker 2010; Martin and Shaheen 2010; Martin and Shaheen, 2011a; Shaheen, Schwartz, and Wiprywski 2004; Katzev 2003; Shaheen, Meyn, and Wiprywski 2003; Ramirez et al. 2012). See Table 2 below for a summary of documented worldwide social and environmental benefits due to carsharing.

Carsharing studies in Europe indicate that an average carsharing user's carbon dioxide emissions were reduced 39% to 54% (Rydén and Morin 2005). Typically, studies on carsharing's impact measure an "observed impact" (or the actual emission change that occurred) but omit the "full impact," which includes the actual emission change combined with avoided emissions (e.g., forfeited vehicle purchase). On balance, net carsharing emissions are negative. In 2008, Martin and Shaheen conducted a North American survey of 2,088 carsharing members, which revealed an average emission reduction for all respondents of -0.58 t of GHG emissions per household per one year for the observed impact and a reduction of -0.84 t over this same period for the full impact (Martin et al. 2010). Overall,

Table 2. Reported social and environmental impacts due to carsharing.

Impact	Europe	North America	Australia
Carbon dioxide emission reduction	39 to 54%	27% (observed impact) 56% (full impact)	N/A
Number of private cars a carsharing vehicle replaces (sold/forgone purchase)	4 to 10 cars	9 to 13 cars	7 to 10 cars
Sold vehicle due to carsharing	15.6 to 34%	25%	21.3%
Forgone vehicle purchase due to carsharing	N/A	25%	28.1%

household gasoline consumption across all members declined by about 34% (Martin et al. 2010; Martin and Shaheen 2010; Martin and Shaheen, 2011a).

While gasoline vehicles are predominant worldwide (diesel in Europe), many carsharing organizations also include low-emission vehicles, such as gasoline-electric hybrid vehicles, in their fleets. Additionally, electric vehicles have been deployed in nine countries worldwide including: Austria, Denmark, Finland, Japan, Norway, Portugal, Switzerland, the UK, and the U.S. Compressed natural gas, ethanol, and other biofuels also have been deployed in the U.S., Brazil, and Sweden. Not surprisingly, carsharing users frequently report an increased environmental awareness after joining a carsharing program.

In addition, carsharing has a number of beneficial societal impacts. Carsharing offers a “pay-as-you-go” alternative to vehicle ownership for users that may only require periodic vehicle access (Rydén and Morin 2005; Shaheen, Cohen, and Chung 2009). This enables short-term vehicle use without requiring a member to bear the full costs of vehicle ownership. Depending on the carsharing operator and location, the maximum distance up to which carsharing is more cost effective than leasing or owning a personal vehicle is between 10,000 and 16,093 kilometers (Shaheen et al. 2009; Litman 2000; Reynolds and McLaughlin 2001; Duncan 2011; Carsharing 2005). College students and low-income households also benefit from carsharing participation (Duncan 2011).

Other major carsharing impacts on the transportation network include a reduction in vehicle ownership, foregone vehicle purchases, and a reduction in VKT. Carsharing has been documented to reduce the need for 7 to 10 privately owned vehicles in Australia, 4 to 10 cars in Europe, and 9 to 13 cars in North America (Martin et al. 2010). European studies also indicate a large reduction in VKT, ranging from 28% to 45% (Katzev 2003; Shaheen, Meyn, and Wipiewski 2003; Rydén and Morin 2005). In North America, VKT reduction ranged from 7.6% to 80% (Shaheen et al. 2004; Katzev 1999; Autosshare 2005; Lane 2005; Zhou, Kockelman, and Gao 2011; U.S. Department of Transportation 2003; Zipcar 2005). A recent survey by Martin and Shaheen found an average VKT decline/year of 27% (observed impact) and 43% (full impact) in the before and after mean driving distance (Martin et al. 2010; Martin and Shaheen 2010; Martin and Shaheen 2011a; Martin and Shaheen, 2011b). Estimates vary substantially between members that gave up vehicles after joining carsharing and those that gained vehicle access through carsharing in both Europe and North America.”

European studies indicate that between 15.6 and 34% of participants sold a vehicle after joining a carsharing program (Shaheen et al. 2003; Rydén and Morin 2005; Shaheen et al. 2009). Similarly, past North American studies indicate that between 11 and 29% of participants sold a vehicle after joining carsharing, and 12 to 68% had delayed or foregone an automobile purchase (Katzev 2003; U.S. Department of Transportation 2001; Benoit 2000; Jensen 2001; Price and Hamilton 2005; Katzev 1999; Autosshare 2005; Zhou et al. 2001). A recent survey of members of all major North American carsharing organizations (6,281 respondents) found that 25% of respondents shed a vehicle. This study also discovered that roughly another 25% of the total sample would have considered obtaining a vehicle, if carsharing disappeared. These two subgroups were mutually exclusive in that those that shed a vehicle were not counted among those who would consider acquiring

a vehicle. In total, the survey suggested that about 50% of members had either shed or forgone the acquisition of a vehicle as part of their carsharing membership (Martin et al. 2010; Martin and Shaheen 2010; Martin and Shaheen 2011a).

The results of more than two dozen studies have demonstrated that carsharing is a flexible alternative that has been deployed in a variety of contexts to increase mobility, reduce dependence on private vehicle ownership and energy consumption, lower vehicle emissions, and support active lifestyles by encouraging bicycle and pedestrian travel modes.

WORLDWIDE GROWTH: 2006 TO 2010

Member and Vehicle Growth

In the authors' 2010 worldwide carsharing survey, experts from around the world cited three factors contributing to ongoing shared-use vehicle membership growth worldwide: (1) cost savings; (2) convenience of locations, use, and access; and (3) environmental awareness. In 58.3% of carsharing countries (14 of 24 responding nations), cost savings was cited as the most important motivation for members to join carsharing in contrast to 20.8% (5 of 24 responding nations) who noted location, use, and access convenience.

At the time of the authors' first worldwide survey (2006), carsharing was operating in 18 countries on four continents, with planned launches in nine additional nations (Shaheen and Cohen 2007). The planned launches were predominantly in the developing world, including one in the Middle East and three in Africa. Of the nine planned efforts, carsharing programs were initiated in six of the nine countries. All are operational except a pilot program in Malaysia, which is now defunct. In 2010, carsharing was planned in seven countries including: Argentina, Croatia, Iceland, Kenya, Taiwan, Zambia, and South Africa. Three of these nations—Kenya, Zambia, and South Africa—had noted launch plans in the 2006 survey. In 2010, carsharing was operating on five continents including: Asia, Australia, Europe, North America, and South America.

In 2006, Europe was the epicenter of carsharing activity, accounting for 61% of the worldwide carsharing membership and nearly 66% of the vehicles deployed (Shaheen and Cohen 2007). However, stabilized growth in neighborhood residential carsharing and rapid growth in the business and university markets in North America during the period of 2006 to 2011 altered this. In late-2010, North America became the largest carsharing region, with Europe and North America accounting for 44% and 48% of worldwide carsharing membership, respectively. Europe, with its lower member-vehicle ratios, still accounted for the majority of worldwide fleets deployed in 2010: 53% in contrast to 32% in North America.

From 2006 to 2010, growth occurred in all carsharing countries except Austria and Singapore (Shaheen and Cohen 2007). Previously, members of the Austria card of the ÖBB railways were automatically enrolled in Denzel Mobility Carsharing. However, after being acquired as an equity holding of Mobility Switzerland, inactive customers were no longer counted as members; this led to a drop in overall carsharing membership from 2006 through 2010. In Singapore, two carsharing programs ceased operations: CitySpeed and HondaDiracc (ST701 Cars 2011).

Member–Vehicle Ratios

Worldwide, member–vehicle ratios have steadily increased. In 2010, worldwide member–vehicle ratios increased to 40:1 compared to 30:1 in 2006 (Shaheen and Cohen 2007). However, a worldwide regional contrast yields a different perspective. Over this same period, two trends were apparent. They include: (1) declining member-vehicle ratios in Asia between 2006 and 2008 (implying more intensive use of carsharing vehicles by members) and (2) increasing member-vehicle ratios in Australia, Europe, and North America.

In general, member–vehicle ratios tend to be lower in newer markets where operators must position vehicles to gain membership. In more mature markets, higher member–vehicle ratios tend to indicate an increase in membership growth; market diversification (e.g., governmental, business, and university/college fleets); and movement towards outside capital investment. The U.S. was unique in maintaining the highest member–vehicle ratios between 2006 and 2010. The authors attribute this to a greater emphasis on the college/university, business, and governmental fleet carsharing markets where more members have access to shared-use vehicles.

Switzerland and Germany had the second and third highest member–vehicle ratios worldwide in 2006, 38:1 and 33:1, respectively; this is no longer the case (Shaheen and Cohen 2007). In 2010, the UK and France maintained the second and third highest national member–vehicle ratios, averaging 48:1 and 40:1, respectively. The authors attribute this increase in member–vehicle ratios to the expansion of Zipcar and Hertz On Demand into several international cities, as both emphasize business users (Marketwire 2009; Zipcar 2011; Streetcar for Business 2011).

Figure 1 depicts changes in regional and worldwide carsharing membership and member–vehicle ratios from 2006 to 2010.

Worldwide Carsharing Operations: A Comparison

From July to October 2010, the authors collected survey data from 25 carsharing experts from 25 countries, representing 25 of 26 countries where carsharing is currently operating. The Netherlands was the only active carsharing country that was not represented in the survey. Twenty-five experts were surveyed. The views expressed in this and subsequent sections of the article characterize those of national, regional, and global carsharing experts. The majority of carsharing operators from Australia, Austria, Brazil, Canada, China, Ireland, Israel, Italy, Norway, Spain, South Korea, Sweden, Switzerland, Singapore, and the U.S. are represented. Regional carsharing experts and carsharing associations estimated current member and vehicle totals for Asia and Europe—where precise number collection was more challenging due to operator number and proprietary data. The authors collected member and vehicle totals directly from operators in Australia ($n=3$), North America ($n=44$), and South America ($n=1$). This section includes a discussion of market segments, parking, vehicles and fuels, insurance, and technology. A trans-regional summary is included at the end of this discussion, which provides launch dates by region and nation, member-vehicle ratios, markets, vehicle propulsion, and insurance.

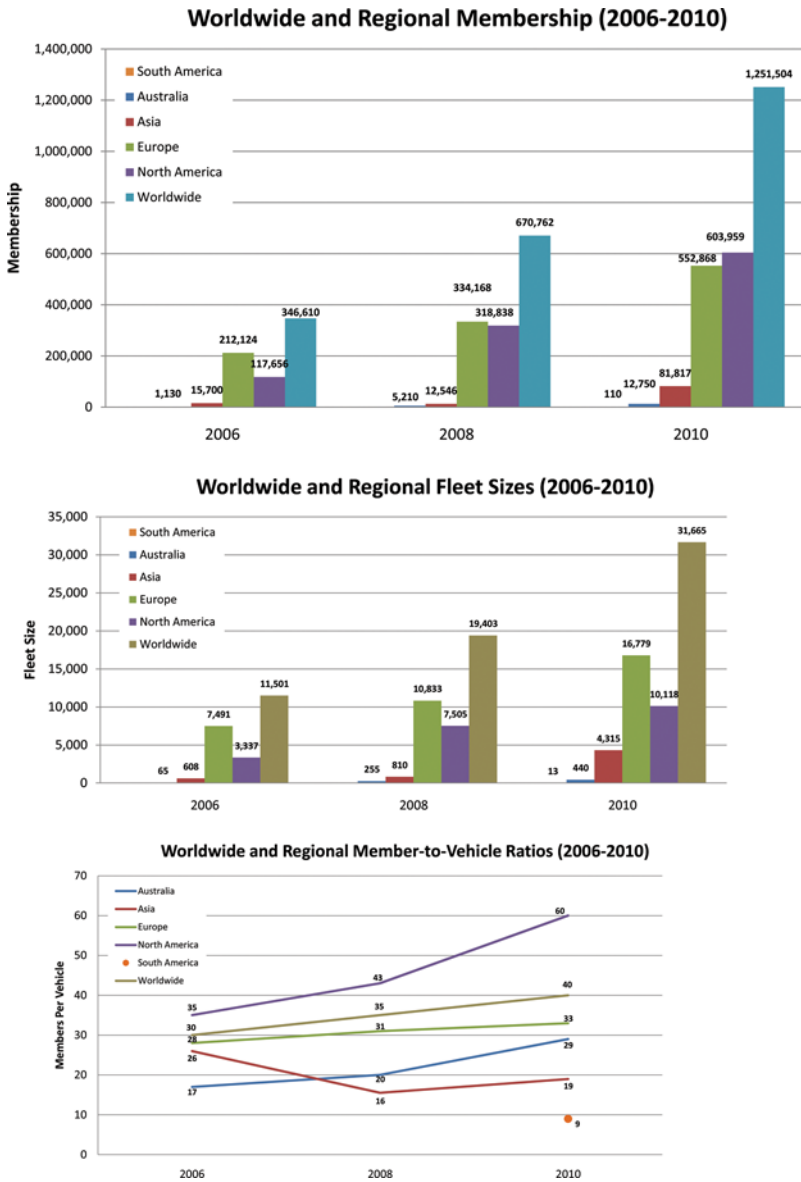


Figure 1. Changes in regional and worldwide carsharing membership, vehicles and member-to-vehicle ratios from 2006 to 2010. (Figure appears in color online).

Market Segments

In recent years, there has been a proliferation of new and diverse shared-use vehicle business models launched worldwide. The most prominent include: neighborhood residential, business, governmental and institutional fleets, and college

and university. Table 3 provides an overview of the most common business and newest business models, along with the regions served.

In the 2010 carsharing survey, the authors asked experts which markets were the most profitable and predominant. Neighborhood residential carsharing represented 54.5% (12 of 22 responding nations) and business 31.8% (7 of 22 responding nations). Interestingly, just four years earlier, 80% of nations stated that neighborhood residential was the most profitable and predominant market, and 20% indicated business (Shaheen and Cohen 2007). Countries noting a shift from neighborhood residential to business markets in 2010 include: Australia, Austria, China, Japan, New Zealand, Switzerland, and the UK. Experts in three nations noted other markets as more prevalent and profitable than neighborhood carsharing: governmental fleets in Ireland, public transit in Sweden, and college/university in the U.S. In most cases, neighborhood residential was still the second most predominant market type followed by college/university and governmental/institutional markets.

The authors also asked experts how they forecast the market to change over the next five to 10 years (2015 to 2020). Of the 17 experts responding to this question, 29% indicated that there would be no change in demographic markets over the next five years, and 18% indicated no change over the next 10 years. The remaining 70.6% (12 of 17 responding nations) all indicated continued market diversification ranging from business, university, public transit, and fleet markets to one-way carsharing and personal vehicle sharing in the next five years. Most experts, when asked about a 10-year forecast, indicated that much of the market changes beyond five years were highly dependent upon public policy and multi-modal integration. Experts in China and Ireland emphasized growth in the neighborhood residential model as auto ownership costs increase (Shaheen and Cohen 2007).

Parking

On-street, public off-street, and free and reduced cost parking are key enablers of carsharing growth worldwide, as parking facilitates exposure and carsharing vehicle access. In addition, parking can be a key operating cost. Thus, free and reduced cost parking can play an important role in supporting business model sustainability (Shaheen, Cohen, and Martin 2010). The availability of on-street carsharing parking has grown since 2006. In 2006, on-street parking was most common in North America and European countries. At that time, on-street parking was available in 67% of carsharing countries ($n = 10/15$) and unavailable in only five (France, Spain, Switzerland, Japan and Singapore; Shaheen and Cohen 2007).

In 2010, on-street parking was available in 76% of carsharing countries (19 of 25 carsharing nations) and unavailable in only 24% or six carsharing countries (Austria, Brazil, Czech Republic, Japan, New Zealand, and South Korea). It is interesting to note that carsharing is relatively new to five of these six markets. Mature carsharing markets, where shared-use vehicle services have been operating for some time, are more likely to have public policy support to enable on-street, free, and reduced cost parking. An overview of worldwide carsharing parking policies in 2010 is included in Table 4.

Table 3. Shared-use vehicle business models.

Business model	Description	Predominant regions served
Neighborhood residential	This is the first and most common type of carsharing worldwide. Carsharing focuses on mixed-use, urban, and residential neighborhoods. This type of service can be either <i>open door</i> or <i>closed door</i> . In an open-door context, a vehicle is placed in an apartment complex or parking garage but is available for use by all carsharing members. In a closed-door environment, a vehicle is placed in a limited-access location, such as a gated apartment complex, and is only available to members of those communities. Operators in this market, typically target large, densely populated areas with high parking costs and robust public transportation networks.	Worldwide
Business	This form of carsharing enables commercial businesses to reduce or eliminate private vehicle fleets typically maintained for business purposes. It may provide <i>exclusive-use</i> vehicles to clients that are shared among employees and departments or it may offer <i>shared-use</i> vehicles where the client accesses the vehicles as part of a larger carsharing fleet (i.e., employees use the same vehicles that are shared by individuals and/or other business members).	Worldwide
College/University	This service provides vehicle access at colleges and universities or is adjacent to campuses. When deployed adjacent to college campuses, vehicles can either be dedicated to the campus or shared in a neighborhood residential and/or business context.	North America and Australia
Government and institutional fleets	A carsharing service that provides vehicles in place of governmental or institutional fleets. This service may provide <i>exclusive-use</i> vehicles to clients that are shared among departments or employees or it may provide <i>shared-use</i> vehicles in which the client accesses the vehicles as part of a larger carsharing fleet (i.e., employees use the same vehicles that are shared by individuals and/or other business members).	Asia, Europe, North America
Public transit	This service is provided at a public transit station or multi-modal node. It is can be associated with providing “first and last mile”	Worldwide

(Continued)

Table 3. Continued.

Business model	Description	Predominant regions served
One-way	connectivity, enabling public transit access to locations that are typically served by private automobiles. One-way carsharing enables a carsharing member to return a shared vehicle to a different location from where the vehicle was picked up.	Europe, North America, Asia
Personal vehicle sharing	This involves privately-owned autos employed in shared-use vehicle services. There are four sub-models of personal vehicle sharing: 1) fractional ownership, 2) hybrid peer-to-peer (P2P)-traditional carsharing, 3) P2P carsharing, and 4) P2P marketplace. 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. In the hybrid P2P-traditional carsharing model, individuals access vehicles by joining an organization that maintains its own fleet of cars and light trucks—but also includes private vehicles—throughout a network of locations. In exchange for providing the P2P service, operators keep a portion of the private vehicle usage fee. P2P carsharing employs privately-owned vehicles made temporarily available for shared use by an individual or members of a P2P company. P2P marketplace enables direct exchanges between individuals via the Internet.	Australia, Europe, North America
Vacation/Resort	This is one of the newest forms of carsharing, which was launched by GreenCar in Hawaii. It provides hourly, shared-vehicle access at vacation resorts and other tourist locations.	North America

Based on results of the authors’ 2010 worldwide survey, most of the countries with on-street parking received it at a reduced cost. However, the methods used for charging parking fees vary considerably across the world. Some of the methods include flat monthly fees; variable rates based on market prices, permit fees, foregone meter revenue; and cost recovery intended to recoup lost revenue due to taking parking out of general use (Shaheen et al. 2010). In some cases, carsharing operators are assessed administrative and conversion fees; the latter involves charging the operator the cost associated with removing meters, striping curbs, removing/installing signage, etc. Free on-street parking was available in some

locations in Belgium, France, Ireland, Switzerland, the UK, and the U.S. Annual permit fees were employed in on-street parking in Australia and Denmark. Dedicated on-street carsharing parking zones were available in Denmark, Italy, Singapore, Sweden, the UK, and the U.S. All but three countries (Czech Republic, Ireland, and Spain) had access to off-street parking.

Vehicles and Fuels

Response to the 2010 survey indicated that smaller compact and hatchback vehicles dominated carsharing fleets across the 26 carsharing countries, except the Czech Republic. The predominant carsharing autos employed in the Czech Republic are mid- and full-size vehicles. In many carsharing countries, mid-size sedans and vans were also available. Luxury vehicles, pick-up trucks, and small sport utility vehicles were only available in a few countries—notably Israel and the U.S.

Fuel and engine technologies differed slightly by region, particularly in Europe. Seventy-six percent (or 19 experts out of 25 represented carsharing countries) indicated that traditional gasoline vehicles were the most prevalent in carsharing fleets. Diesel vehicles were the second most common vehicle type—employed in 11 of 25 (44%) represented carsharing countries. South Korea was the only country outside of Europe with diesel carsharing vehicles.

The greatest change in vehicle propulsion between 2006 and 2010 was toward gasoline-electric hybrid and electric vehicles (EVs). Previously, EVs had been popular in carsharing in Japan and also used in U.S. demonstration projects. By 2006, the vast majority of EV programs had disappeared in favor of hybrids. In 2006, hybrid vehicles were most commonly found in Canada, Singapore, the U.S., and to a lesser extent, Japan (Shaheen and Cohen 2007). By 2010, hybrids were available in Japan, Singapore, Italy, Switzerland, and North America. Unique fuel types identified by experts in the 2010 survey included hybrid-LPG (natural gas) vehicles in South Korea and ethanol in Brazil.

Over the next five years, one of the key emerging trends identified by worldwide experts is the re-emergence of EVs and the integration of plug-in hybrids into carsharing fleets. Historically, Japanese organizations emphasized EVs in their carsharing operations; however, this reliance greatly diminished after initial program deployments (Shaheen and Cohen 2007). In North America, station car demonstration projects and a few research initiatives also focused on EVs (Shaheen and Cohen 2007). Interestingly, EV carsharing has experienced a resurgence in recent years, as automakers have begun launching next generation production EVs. Survey experts in Belgium, Finland, and the U.S. noted an increased use of EVs in carsharing fleets in the near future.

In 2010, EVs were already being deployed in limited applications in Japan, Austria, Denmark, Norway, the UK, and the U.S. One notable application of EVs in carsharing occurred in December 2010 when Hertz On Demand began deploying EVs in its New York City fleet as part of its “Hertz Global EV” initiative. In 2011, the Hertz On Demand initiative expanded its program to other locations in Europe/UK and North America, including London, Los Angeles, San Francisco, and Washington, DC. In total, the company anticipated launching between 500 and 1,000 EVs by the end of 2011; however, they launched approximately 250 vehicles

Carsharing and Personal Vehicle Services

Table 4. Overview of worldwide carsharing parking policies.

	On-street parking	Predominant cost structure	Dedicated on-street parking zones	Off-street parking
Asia				
China	Yes	Monthly Fee	No	Yes
Israel	Yes	Yes (Uncertain of Cost Structure)	No	Yes
Japan	No	No	No	Yes
Singapore	Yes	Full Rate	Yes	Yes
South Korea	No	No	No	Yes
Australia				
Australia	Yes	Full Rate, Annual Permit Fee	No	Yes
New Zealand	No	No	No	Yes
Europe				
Austria	No	No	No	Yes
Belgium	Yes	Free	No	Yes
Czech Republic	No	No	No	No
Denmark	Yes	Reduced Cost, Annual Permit Fee	Yes	Yes
Finland	Yes	Reduced Cost	No	Yes
France	Yes	Free and Reduced Cost	No	Yes
Germany	Yes	Free	No	Yes
Ireland	Yes	Free	No	No
Italy	Yes	Free	Yes	Yes
Netherlands	Yes	Reduced Cost	No	Yes
Norway	Yes	Reduced Cost	No	Yes
Portugal	Yes	Reduced Cost	No	Yes
Spain	Yes	Free and Reduced Cost	No	No
Sweden	Yes	Free and Reduced Cost	Yes	Yes
Switzerland	Yes	Free	No	Yes
United Kingdom	Yes	Free	Yes	Yes
North America				
Canada	Yes	Reduced Cost	No	Yes
United States	Yes	Free and Reduced Cost	Yes	Yes
South America				
Brazil	No	No	No	Yes

due to limited manufacturer availability (Motavalli 2010; Hertz On Demand, unpublished data, January 2012). In October 2011, Paris launched an all-electric carsharing program Autolib', with plans to expand to 5,000 vehicles by 2013 (Worldstreets 2010). In addition, car2go launched an all electric carsharing fleet in San Diego, California in mid-November 2011 (The City of San Diego 2011). Five

global automakers (BMW, Ford, General Motors, Mitsubishi, and Toyota), also in 2011, announced either market entry or a partnership to provide a carsharing service or EVs to new and existing carsharing operators. Prior to the 2011 entries, three additional automakers (Daimler, Honda, and Suzuki) had already provided carsharing services or factory-equipped telematic vehicles for carsharing.

Insurance

Although vehicle insurance remained a substantial carsharing operating cost in 2010, it was no longer considered cost prohibitive in most markets. Finding affordable carsharing insurance was only a challenge in three carsharing countries ($n = 25$). These include South Korea, where carsharing recently launched, and Denmark and the UK where affordability was only noted as a challenge among smaller operators. Similarly, affordability and availability of carsharing insurance for younger drivers—generally under 21 years of age—was only a challenge in Denmark, the UK, and the U.S. Across all represented carsharing countries ($n = 25$), private-sector carriers predominantly provided carsharing insurance. In a few nations, other insurance options were available including governmental (at the provincial or state level) and non-profit insurance, while less popular. Carsharing insurance has been supplemented by governmental policies (usually in particular provinces) in both Australia and Canada, although the overall number of government insurance policies could be higher due to carsharing in governmental fleets (i.e., government users who have replaced vehicle fleets or augmented existing fleets with carsharing).

Technology

In Europe and North America, many carsharing operators have evolved from manual operations to either partially automated (i.e., automated reservations via a touch-tone telephone or Internet) or to fully automated systems (i.e., systems with automated reservations, integrated billing, and advanced vehicle technologies) (Shaheen 1999; Shaheen et al. 2006; Shaheen and Martin 2010). Although Australian operators followed this same technological evolution from manual to partially and fully automated systems, Australian operators implemented fully automated systems faster—since they launched after their European and North American counterparts. Historically, Asian operators have been unique in typically launching with advanced technology and fully automated systems. Asian operations frequently emphasized logistical operations, using telematics to communicate between vehicles, global positioning systems (GPS) for vehicle tracking, smartcards and mobile phones for vehicle access, and reservations via short message services (SMS) (Shaheen et al. 2006; Shaheen and Cohen 2007).

With increasing availability and affordability of advanced technologies, it is more common for carsharing operators to leapfrog directly to partially or fully automated systems when launching in both new and existing regions. Today, carsharing technologies emphasize “advanced services” including open-ended bookings (i.e., no fixed return time); instant access (i.e., no reservation needed); one-way rentals; satellite radio; prepaid usage cards; interoperability; and personal vehicle sharing. In 2010, instant reservations were the most commonly deployed advanced service—available in ten carsharing countries (Australia, Brazil, China, Finland, Italy,

Japan, Norway, South Korea, the UK, and the U.S.). In all but five of the 25 represented carsharing countries (Belgium, Czech Republic, Denmark, Israel, and the UK), a combination of open-ended, one-way, and instant reservations were planned innovations.

Summary

Table 5 provides a global comparison of carsharing operations since 2006 for each of the carsharing regions. Note some data categories for South America have been excluded from this analysis to protect operator-specific proprietary information (only one program launched in Brazil since 2009).

In 2010, three nations (the U.S., the UK, and France) distinguished themselves from their international counterparts with the highest member-vehicle ratios. The authors attribute this to greater market diversification and lower member use per vehicle. Business and neighborhood residential remained the top two market segments for 92% of carsharing countries worldwide (23 of 25 represented nations). On-street parking was available in most countries except Brazil, the Czech Republic, Japan, New Zealand, and South Korea. Worldwide insurance availability was only a challenge in Denmark, Ireland, South Korea, and among smaller operators in the UK. Insurance was also expensive in these markets and among younger drivers in Brazil. Although differences in alternative fuel vehicle use were regional, most worldwide fleets were comprised of conventional gasoline and diesel automobiles. A key trend across the globe was the re-emergence of EVs and integration of plug-in hybrids into carsharing fleets. Worldwide carsharing continued to be technologically driven and frequently placed an emphasis on “advanced services,” such as open-ended bookings, instant access, one-way rentals, satellite radio, prepaid usage cards, interoperability, and personal vehicle sharing.

EMERGING AND FUTURE TRENDS

In this section, the authors examine six emerging and future carsharing trends: (1) multi-nationalization and mainstreaming, (2) growth of traditional car rental companies and automakers into shared-use vehicle services, (3) expansion of one-way carsharing, (4) introduction and growth of personal vehicle sharing, (5) continued growth, and (6) increased competition and industry cooperation.

Multi-Nationalization and Mainstreaming

In recent years, some of the world’s largest carsharing operators have expanded into large multi-national organizations including: (1) Greenwheels in the Netherlands and Germany; (2) Cambio Car in Belgium, Germany, and Ireland; and (3) CityCarClub in Sweden and Finland. NTUC Income Car Co-op in Singapore previously operated a trial program in Malaysia from January through July 2006 (Unpublished Data Lewis Chen). NTUC Income Car Co-op also considered launching operations in Hong Kong. In Singapore, several recent program mergers, buyouts, and consolidations have resulted in the formation of fewer, large nationwide operators; this includes Car Club’s acquisition of NTUC Income Car Cooperative and KahShare’s acquisition of Honda Diracc operations (ST701 2011).

Table 5. Carsharing regional overview: Launch dates, markets, vehicle propulsion, and insurance.

Region	Carsharing activity
Asia	<p>Early program launches in Asia included Singapore in 1997, followed by Japan in 1998. In recent years, another wave of program launches in Asia included Israel in 2008, and China and South Korea in 2009. A pilot program, which operated in Malaysia, from January to July 2006 is now defunct. Asian member-vehicle ratios were estimated at 19:1; this is a substantial decrease from 26:1 in 2006. Although there have been a number of new program launches in Asia, the decline in 2010 regional member-vehicle ratios can be attributed to Japan and Singapore, both of which had approximately 40% fewer members per vehicle on average than in 2006. Experts in China and Japan indicated that the business market was the largest and most profitable, followed by the neighborhood residential model. Experts in Israel, Singapore, and South Korea noted that neighborhood residential was the largest and most profitable market followed by business. For the majority of Asian operators in 2010, insurance availability was not a problem, except for operators in South Korea. Although there was an initial emphasis on EVs in Japan, conventional and low-emission automobiles were the predominant carsharing vehicles in Asia in 2010. Lack of alternative fuels; additional costs (e.g., fuel/batteries, maintenance, vehicles and charging stations); and limited vehicle range were cited as key challenges to the expansion of alternative fuel vehicles in carsharing in every Asian market in 2010. Between 2010 and 2015, growth potential in major metropolitan regions was estimated at 4.2% for individuals over the age of 21 across Asia.</p>
Australia/New Zealand	<p>The first Australian carsharing operator launched in 2003, followed by New Zealand's initial program in 2007. In 2010, Australian operators reported member-vehicle ratios of 29:1, an increase from 17:1 in 2006. Experts also indicated that business was the most profitable market segment followed by neighborhood residential. Australian experts reported market diversification into college, business, and planned community markets in 2010. Although insurance remains expensive, it was less challenging to obtain for younger and international drivers. Australian operators incorporate gasoline-electric and plug-in hybrid vehicles into their fleets and did not plan to introduce other alternative fuel vehicles at the time of the 2010 survey. Between 2010 and 2015, growth potential in metropolitan regions was estimated at 3% of individuals over the age of 21 in Australia.</p>
Europe	<p>Modern carsharing traces its origins to Switzerland and Germany, which launched operations in 1987 and 1988, respectively. Recent European carsharing program startups include Spain in 2005, followed by Portugal, and Ireland in 2008. Interestingly, carsharing launched in Ireland in 1997 but closed due to loss of insurance coverage. In 2010, the UK and France distinguished themselves with higher member-vehicle ratios: 48:1 and 40:1, respectively. Overall, average</p>

(Continued)

Table 5. Continued.

Region	Carsharing activity
North America	<p>European member-vehicle ratios were estimated at 33:1. Most European experts indicated that neighborhood residential was the largest market segment except for business in Austria, Switzerland, and the UK in the authors' 2010 survey. Public transit and governmental fleets were the largest markets in Sweden and Ireland, respectively, in 2010. European experts reported increased market diversification up to 2015. For the majority of Europe, insurance availability was not a problem, except for operators in Denmark and among smaller operators in the UK in 2010. Although diesel and gasoline vehicles dominated European carsharing fleets, experts indicated deployment and/or testing of EVs as part of their fleets—in eight of 15 European carsharing countries. Between 2010 and 2015, growth potential in major European cities was estimated at 2.9% for individuals over the age of 21.</p> <p>The first North American carsharing programs launched in 1994 in Canada and 1998 in the U.S.. In 2010, the U.S. maintained the highest worldwide member-vehicle ratios (67:1). North American average member-vehicle ratios in 2010 were estimated at 60:1—an increase from 35:1 in 2006. North American experts reported neighborhood residential, business, and college/university as the predominant market segments in the U.S. and Canada in the 2010 survey. North American experts also forecast carsharing expanding into lower density locations through personal vehicle sharing over the next five years. Although a few research programs historically used EVs, a number of North American operators planned to deploy EVs to augment their existing gasoline, gasoline-electric hybrid, and plug-in hybrid fleets. While insurance remained expensive in 2010, it was no longer a challenge to obtain for typical and younger drivers among most operators. Between 2010 and 2015, growth potential in major metropolitan regions was estimated at 10% of individuals over the age of 21.</p>
South America	<p>In 2009, the first Latin American carsharing program—Zazcar—launched in Brazil. Zazcar was the first carsharing operator to launch operations in South America. Not surprisingly, 2010 member-vehicle ratios were lower than the rest of the world. Similar to other carsharing regions, the predominant markets were neighborhood residential, followed by the business market. The entire carsharing fleet operates on flex-fuel vehicles that use gasoline and ethanol blends. In 1976, Brazil began requiring an ethanol-gasoline fuel blend. In 2010, insurance was not a challenge to obtain but expensive for younger adults. Between 2010 and 2015, growth potential was estimated at 2% for major metropolitan areas among individuals over the age of 21.</p>

Beginning in October 2007, worldwide carsharing entered a new phase of commercial mainstreaming marked by the merger of Flexcar and Zipcar, which created the world's largest carsharing operator. This was followed by Zipcar's acquisition of the UK-based Streetcar in 2010 and an announcement in January 2011 that enabled Zipcar to increase its share of the Spanish-based Avancar to a majority holding through the end of 2011. As of January 2011, Zipcar operated in the U.S., the UK, and Canada. As of Winter 2010, it was estimated that Zipcar accounted for approximately 46.5% of the worldwide carsharing membership and 27.6% of the vehicles deployed (Streetcar for Business 2011). In April 2011, Zipcar went public with an initial public offering (IPO) (Ovide 2011). In October 2008, Daimler's car2go launched operations in Ulm, Germany followed by launches in Austin, U.S.; Hamburg, Germany; Amsterdam, Netherlands; Vancouver, Canada; and San Diego, U.S. in 2010-11 (The City of San Diego 2011; Goldmark 2011; Chambers 2010). In October 2011, car2go announced expansion plans in up to 50 cities throughout Europe and in a number of U.S. locations (The City of San Diego 2011; Goldmark 2011; Chambers 2010; Loveday 2011). In December 2008, Hertz On Demand launched carsharing operations. By January 2011, Hertz On Demand was operating in six countries (Canada, the U.S., France, Germany, Spain, and the UK). This represents more countries than any other carsharing operator. The authors forecast ongoing multi-national expansion, including mergers and acquisitions. Not surprisingly, growth-oriented operators will continue to account for the majority of members and vehicles deployed worldwide.

Growth of Traditional Rental Car Companies and Automakers into Shared-Use Vehicle Services

Avis-Europe became the first traditional rental car company to launch carsharing services. Their early efforts included a number of independently branded organizations around Europe—one of the most notable being CARvenience, which launched operations in the UK in 2001 (Avis 2000). Earlier efforts were often small in scale, each independently branded and/or operated. In the past few years, however, there has been a proliferation of traditional rental car companies entering the carsharing market through hourly pricing options. More recent efforts have begun on a larger scale with a growth-oriented approach (i.e., multiple cities, nations). Recent initiatives include U'Haul's U Car Share, which launched operations with a fleet of PT Cruisers in North America in 2007, and Enterprise's WeCar and Sixt's Sixti Car Club, both of which launched in 2008 in North America and Europe, respectively. In April 2011, Zipcar announced the launch of a pilot program "Zipvan" aiming to compete with U-Haul and Budget by providing a fleet of Ford E-150 vans for hourly rentals (Van der Pool 2011). In 2011, WeCar announced that it acquired the Philadelphia-based non-profit PhillyCarShare (Enterprise Holdings 2011). In May 2012, WeCar announced its acquisition of Mint Cars On Demand, a carsharing company serving more than 8,000 members in New York City and Boston (Bizjournals 2012). Hertz On Demand launched its service in North America in 2009. In December 2010, Hertz acquired the Australia-based carsharing firm Flexicar (Hertz 2010). In February 2011, Avis

acquired Okigo, which offers self-service car rentals in Paris, France (D'leteren Annual Report 2010).

Based on the authors' analysis, as of January 2011, rental car-based carsharing services accounted for an estimated 4% of the worldwide carsharing membership. An overview of traditional rental car companies and automakers providing carsharing services is included in Table 6. Please note that Suzuki is not included in the table, as they are not providing services directly but developed a factory-equipped telematics vehicle for carsharing.

In Spring 2010, the authors interviewed four of the five largest rental car companies that offered carsharing services worldwide. This research revealed that the business model of traditional car rental companies and their carsharing services were notably different. Several of the rental car providers began carsharing services with "attended access." Typical carsharing services provide "unattended access" (i.e., the user accesses the car with a smartcard where the vehicle is parked). By Summer 2010, all of the rental car companies providing carsharing services employed some type of "virtual branch" (i.e., vehicles are accessed using automated reservations via touchtone telephone or Internet and may have integrated billing and advanced vehicle access systems) (Anonymous operator, unpublished data, June 2010).

The traditional rental car business model focuses on one of three primary markets: (1) home city or off-airport locations, (2) airport-based locations, or (3) truck-based model (i.e., an emphasis on providing moving and storage services) (Anonymous operator, unpublished data, June 2010). Off-airport locations maintain a traditional retail storefront, insurance is required for vehicle rentals, and revenue is measured per vehicle based on vehicle use. In the rental car industry, this is based on the number of days a vehicle is rented. Industry usage rates typically average: 78% to 82%; the expectation is that a vehicle is rented for an average of 24 days out of a 30-day period. In contrast, carsharing usage rates tend to average between 25% to 40% (6 to 9.6 hours a day), varying by operator and location (Anonymous operator, unpublished data, June 2010). In North America, rental operators that represent all three of these models have launched successful carsharing services with varying market emphases (e.g., neighborhood, business, and college/university).

Another notable difference between the rental car model of carsharing and traditional carsharing operations is fleet age. With the exception of truck rentals, passenger vehicle fleets typically average 18 months in a traditional rental setting vs. three years in carsharing. Rental fleets tend to be replaced through purchase buy-back agreements, which are maintained between the rental provider and the manufacturer. The vehicles are bought and sold through auction or bought and then sold to the public. All of the rental carsharing providers interviewed indicated that their carsharing vehicles were not kept as long as those of traditional carsharing service providers (e.g., Zipcar). Further, because their shared-use vehicles are adapted with carsharing technology this results in higher operational costs, as vehicle manufacturers do not want to "buy back" vehicles that have been adapted with third-party telematics.

Another key difference involves insurance. Initially, insurance availability for carsharing members under 21 was not included by most of the rental carsharing

Table 6. Traditional car rental companies and automakers with shared-use vehicle programs.

Operator	Brand name	Countries served	Time frame
Avis-Europe	CARvenience	UK	2001 to present
Avis-Europe	Okigo	France	2011 to present
Enterprise	WeCar/PhillyCarShare	U.S.	2008 to present
Hertz	Hertz On Demand	Canada, France, Germany, Spain, UK, U.S.	2009 to present
Sixt	Sixti Car Club	Germany	2008 to present
U-Haul	U Car Share	U.S.	2007 to present
BMW (partnership with Sixt)	DriveNow	Germany	2011 to present
Daimler (partnership with Europcar in Hamburg)	car2go	Canada, Germany, U.S.	2008 to present
Ford Motor Company	Zipcar GoCar	U.S. Ireland	2011 to present 2008 to present
General Motors	RelayRides/Clic	U.S., Canada	2011 to present
Honda	Honda Diracc	Singapore	2002 to 2008
Mitsubishi Motors	Hertz On Demand	UK	2011 to present
Peugeot	Mu Program and Greenwheels Partnership	France, Netherlands	2009 to present
Toyota Motor Company	Nomura Real Estate Development/Daikyo Incorporated	Japan	2011 to present
Volkswagen	Quicar Streetcar	Germany UK	2011 to present 2007 to unknown

programs. However, insurance is becoming increasingly available to this market due to member coverage through their parents' policies, parental consent, and excess coverage (both collision and liability) to allow vehicle access. Vehicle insurance for carsharing tends to average approximately \$900 to \$1,000 USD a month per vehicle in contrast to approximately \$1.35/hour to \$3/day USD for a rented vehicle.

Automakers Entering into Shared-Use Vehicle Services

In addition to the entry of traditional car rental programs into the carsharing market, a number of automobile manufacturers have also begun entry into this marketplace. This has included: (1) the incorporation carsharing technology (e.g., telematics) into vehicles for carsharing operators; (2) business partnerships as a vehicle supplier to operators; (3) pilot/demonstration projects to showcase carsharing, new vehicle technologies, or both; and (4) automaker owned/operated carsharing programs (either as a 100% owner or a business partnership with another entity). This section is not meant to provide a comprehensive inventory

of automaker involvement in carsharing but rather an overview of key trends involving auto manufacturers in the carsharing marketplace.

There have been a number of efforts by automakers to provide vehicles with features directly marketed towards carsharing operators. The vast majority includes alternative fuel vehicles (either for demonstration projects or long-term use and factory-equipped telematics). Suzuki was one of the earliest automakers to release a vehicle with factory-equipped telematics for carsharing use. The “Suzuki Every” has a factory equipped radio-frequency identification (RFID) reader to identify multiple users and telematics to communicate with fleet management systems (Shaheen and Cohen 2007). More recently, in October 2011, General Motors announced that it was integrating P2P carsharing software into OnStar as part of a partnership with the U.S.-based P2P operator RelayRides (HybridCars 2011).

A number of automakers have also entered into various fleet agreements with carsharing operators. In 2007, Volkswagen partnered with Streetcar in the UK to provide Polo BlueMotion diesel vehicles across London (HybridCars 2011). In April 2011, Mitsubishi Motors signed an agreement with the Hertz Corporation in the UK to add the i-MiEV electric city car to Hertz and Hertz On Demand fleets (Loveday 2011). Mitsubishi delivered its first all-electric “i” model to San Francisco-based City CarShare in Fall 2011 (AutoblogGreen 2011). In August 2011, Ford and Zipcar announced a partnership to supply its vehicles at 250 college and university locations around the U.S. (Zipcar 2010; Vlastic 2011). Additionally, Ford has maintained an ongoing partnership with Ireland’s GoCar since 2008 (GoCar 2011).

A few automakers have also launched pilot carsharing demonstrations. In 2009, Peugeot completed its experimental program (Mu Program) and began expanding elsewhere in Western Europe. Peugeot also maintains an ongoing partnership with Netherlands-based Greenwheels (Frost and Sullivan 2011). Additionally, Daimler has launched a pilot, car2gether aimed at integrating ridesharing with social media—an outgrowth of Daimler’s earlier car2go program (Barry 2010). In Summer 2011, General Motors partnered with the Quebec transportation ministry to pilot an EV carsharing service in Laval, Canada (Barry 2011).

The earliest automaker operated carsharing program was Honda Diracc, which offered a service in Singapore from 2002 to 2008; it was taken over by KahShare in 2008 (ST701 Cars 2011). Another notable program is Daimler’s car2go. It launched as a pilot in Ulm, Germany in 2008 and later expanded to Austin, Texas in the U.S. in 2009 (Daimler 2011a, 2011b). In October 2010, Daimler announced a joint venture to expand car2go with Europcar in Hamburg, Germany followed by expansion into: Amsterdam, Netherlands; Vancouver, Canada; and San Diego, California (Daimler 2011a, 2011b). In March 2011, BMW revealed its plan to begin a carsharing service in Munich and Berlin. Branded as DriveNow, the carsharing program consisted of 800 vehicles at its launch and provide a one-way service (Carsharing.US 2011). They expanded into Düsseldorf in January 2012. DriveNow is a 50-50 partnership between Sixt Car Rental and BMW (Carsharing.US 2011). Additionally, in June 2011, Toyota Motor Company announced that it would partner with Nomura Real Estate Development, Daikyo Incorporated, and the Toyota Housing Corporation to launch a condominium-based carsharing service (Toyota 2011). In November

2011, Volkswagen announced the launch of their Quicar carsharing project, comprised of 200 Golf BlueMotion models located at 50 stations in Hanover Germany (Volkswagen 2011).

Due to close business partnerships among manufacturers and car rental companies and the entry of automakers into carsharing, the authors forecast that factory-equipped carsharing telematics may be an option offered by more automakers in the future.

Expansion of One-Way Carsharing

One-way carsharing enables a carsharing member to return a shared vehicle to a different location from where they started. Although there have been a number of small-scale efforts aimed at providing one-way carsharing, the majority were dependent upon manual labor to physically re-balance fleets to maintain the vehicles across an entire carsharing network. In recent years, there has been a resurgence in one-way carsharing, with a renewed emphasis on using advanced telematics to facilitate both one-way trips and fleet balancing. Daimler's car2go was the first major initiative allowing users to end their vehicle rental anywhere within a city's operating area. According to Daimler, nearly nine out of every ten rentals have been one-way. From March 2009 to October 2010, car2go completed more than 430,000 rentals in Europe and North America (Daimler 2011a, 2011b).

Additionally, in November 2010, Hertz On Demand launched a one-way option, enabling New York City users to pick up a carsharing vehicle and return it one-way and drop it off at any airport location (Shaheen et al. 2010). Hertz plans to expand this program to other rental locations (Motavalli 2010). In Spring 2011, Communauto in Quebec, Canada announced that it would introduce a one-way service (Communauto 2011). In April 2011, BMW's DriveNow program launched with one-way service options in Munich and later expanded into Berlin and Düsseldorf (Fast Company 2011). Paris' Autolib' program, which started in December 2011, anticipates the eventual deployment of up to 3,000 EVs offering one-way service and fully integrated with Vélib—the city's public bikesharing system (Sidawy 2011).

Introduction and Growth of Personal Vehicle Sharing

Within the past few years, there have been increasing developments in personal vehicle sharing. Personal vehicle sharing involves short-term access to privately-owned vehicles. This typically entails an hourly rental fee that includes gas and insurance, similar to traditional carsharing services. In exchange for renting their vehicle, the owner is paid a portion of the usage fee. While it is just emerging, P2P carsharing has expanded to include operators in seven countries around the world (Australia, Canada, France, Germany, the Netherlands, the UK, and the U.S.). As of May 2012, there were 33 personal vehicle sharing organizations worldwide, with ten active or in pilot phase, three planned, and four defunct in North America.

The authors have identified four sub-models of personal vehicle sharing. These include: (1) fractional ownership, (2) hybrid peer-to-peer (P2P)-traditional carsharing, (3) P2P carsharing, and (4) P2P marketplace. 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. It is important to note that fractional ownership occurs in other markets, such as housing and plane sharing. In the hybrid P2P-traditional carsharing model, individuals access vehicles by joining an organization that maintains its own fleet of cars and light trucks, but also includes private vehicles, throughout a network of locations. In exchange for providing the P2P service, operators keep a portion of the private vehicle usage fee. P2P carsharing employs privately-owned vehicles made temporarily available for shared use by an individual or members of a P2P company. P2P marketplace enables direct exchanges between individuals via the Internet.

In P2P carsharing, involving a third-party operator, the organization can: (1) require the vehicle owner install carsharing telematics in their personal auto allowing their vehicle to be accessed at all times (similar to carsharing) and/or (2) involve a transfer of keys from the vehicle owner to the user. The latter service requirement is reminiscent of traditional car rental schemes and lacks “unattended access,” which can sacrifice convenience and accessibility.

Several factors have converged to support personal vehicle sharing’s expansion. Technological advances supporting unattended access and real-time information about vehicle availability via smart phones and “geo-location.” In addition, integration of personal vehicle sharing with the Internet and social networking enables users to spontaneously search and access vehicles in a given area. Still, a number of challenges exist in implementing this service. Vehicle owners accept a certain level of risk renting their private vehicles with respect to damage, traffic enforcement (e.g., parking tickets), and liability. In P2P carsharing, owners pay for private vehicle insurance and augment it with additional insurance from a third-party operator when the vehicle is rented to its members. In some jurisdictions, challenges exist to using a private vehicle for commercial use. In January 2011, California’s state legislature implemented AB 1871, a law that exempts personal carsharing vehicles as commercial vehicles and “limits the circumstances under which the vehicle owner’s automobile liability insurance can be subject to liability” in order to prevent cancelation of primary automobile insurance policies. A key provision of the California legislation is that a vehicle owner cannot earn a profit from their vehicle (the revenue earned from personal carsharing cannot exceed the annual vehicle expense). Oregon and Washington have also passed similar legislation – HB 3149 and HB 2384 respectively (Shaheen et al., 2012).

Continued Growth

Although carsharing growth rates have varied around the globe, the authors forecast continued worldwide growth in both the developed and developing world. According to worldwide experts, growth has occurred in all carsharing countries except Austria and Singapore since 2006. In the authors’ 2010 survey, every national, regional, and global expert surveyed forecast carsharing growth through 2015 ($n=25$). Further, experts in 18 of 25 existing carsharing countries (72%) indicated that carsharing would grow through 2020. Experts in three of 25 countries (Israel, Japan and Norway), or 12%, indicated that carsharing would stabilize. Two experts in the Czech Republic and Denmark were unsure if

carsharing would still be on a growth trajectory in their countries by 2020. None of the experts forecast a decline in any of the countries where carsharing is currently operating.

Results of the 2010 survey indicated carsharing membership growth potential in major global cities at 4.3% of individuals over the age of 21 (18 of 25 carsharing nations reporting) and 3.2% of individuals under the age of 21 (16 of 25 carsharing nations reporting) between 2010 and 2015. Regionally, growth potential for carsharing among individuals over the age of 21 was estimated at 4.2% and 2.5% in Asia and Australia, respectively. Growth potential was also estimated at 4.3% and 10% for Europe and North America, respectively for individuals over the age of 21. The authors largely attribute the higher forecast growth potential in North America to differences in operations and marketing. North American operators tend to have larger member-vehicle ratios and place a greater emphasis on employer-based, university/college, and governmental carsharing fleets. Looking forward, it was estimated that revenue for carsharing programs in North America could grow to \$3.3 billion USD in 2016, up from \$253 million USD in 2009. In Europe, carsharing revenue was forecast to increase to €2.6 billion in 2016, up from €220 million in 2009 (Hybrid Cars 2011). In Japan, it was estimated that carsharing revenues would grow to \$550 million USD by 2016 (Frost and Sullivan 2011).

Increased Competition and Industry Cooperation

By 2015, the authors envision increased competition and industry cooperation. Despite the presence of numerous multi-national carsharing operators, there continues to be an increase in the total number of carsharing operators worldwide. The authors predict continued launches, closures, and mergers and acquisitions worldwide coupled with the launch of new carsharing business models aimed at serving niche markets (e.g., business, university, one-way personal vehicle sharing).

Despite increased competition, the authors also anticipate increased industry cooperation in the areas of insurance, parking, public policy, roaming agreements, technology, and alternative fuels. In 2011, there were three national carsharing associations in Australia, Denmark, and Italy. Experts from every participating carsharing nation indicated that a national carsharing association was needed. Additionally, experts from five countries noted that a worldwide carsharing association was needed in addition to a national one.

In 2011, a European regional association—European Car Sharing (ECS)—had members from Italy, Germany, the Netherlands, Switzerland, and Sweden. The main purpose of ECS is to provide roaming-access to visiting members across member operators, standardize carsharing services, and increase carsharing awareness (European Car Sharing 2011). In January 2011, a new CarSharing Association was announced, which was initially comprised of North American operators. This association is aimed at creating a worldwide industry association (The CarSharing Association 2011). In March 2011, the CarSharing Association had 17 members from four countries, on three continents (including Australia/New Zealand, North America, and South America; The CarSharing Association 2011). Member organizations of the CarSharing Association have adopted a code of ethics

(e.g., standards of practice) and worldwide roaming agreements among the operators, which allow members from one organization to use vehicles and services of another carsharing organization.

Summary

Although carsharing traces its roots to central Europe, this once novel concept has grown into a mainstream transportation mode, operating worldwide in approximately 1,100 cities in 26 nations on five continents. Europe and North America are the two largest epicenters of carsharing activity, with rapid expansion occurring in Australia/New Zealand, Asia, South America, and forecast growth in the other areas of the developing world. Carsharing is being explored in seven countries including: Argentina, Croatia, Iceland, Kenya, South Africa, Taiwan, and Zambia. As of October 2010, an estimated 1.25 million carsharing members worldwide were sharing over 31,660 vehicles.

Current and emerging worldwide developments between 2010 and 2015 include:

- Renewed emphasis on EVs and growing interest in plug-in hybrids, although gasoline (diesel in Europe) and gasoline electric-hybrids were the most common vehicles in 2011;
- Continued multi-nationalization and mainstreaming of carsharing;
- Expansion of traditional rental car providers and automakers into carsharing;
- Advancement in one-way rentals;
- Introduction and growth of personal vehicle sharing;
- Linkages among mobility options, such as carsharing and bikesharing; and
- Continued worldwide carsharing growth and expansion into new nations and regions.

Increased industry cooperation could facilitate technological standards, roaming agreements among carsharing operators, and industry-wide public policy development. As carsharing increasingly becomes a mainstream transportation mode, it is expected that it will be further integrated into metropolitan transportation and land use strategies and multi-modal nodes. Not surprisingly, increased competition worldwide will likely result in greater customer choice, mergers/acquisitions, and closures.

In recent years, a number of transnational carsharing ventures have occurred, including the entry of traditional car rental providers and automakers into the carsharing market. This trend will continue to shape the carsharing industry, as new multinational operators emerge. Looking forward to 2015, growth-oriented operators will continue to account for the majority of members and fleets deployed. In addition, carsharing is anticipated to expand to other nations in Latin America and the Middle East, with possible expansion into other areas of the developing world, including Africa and Central Asia.

The authors envision that carsharing operations that launch in the developing world might evolve differently with respect to technological development and business models. Lower labor costs, differences in technology use and availability, congestion, and road infrastructure could also change the way in which carsharing is

deployed. For example, lower labor costs could further enable one-way trips through vehicle delivery and pickup.

Key forces in carsharing's expansion will likely include: higher energy costs, economic uncertainty, mainstreaming of carsharing, the expansion of multinational carsharing operators, growth in one-way carsharing and personal vehicle sharing, and an increase in traditional car rental providers and automakers into carsharing. This expansion will be driven by increased mainstreaming and competition in shared-use vehicle services, entry into new markets (both geographic and demographic), and new technologies that support carsharing services around the world.

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