

WORLDWIDE CARSHARING GROWTH: AN INTERNATIONAL COMPARISON

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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. Although carsharing appeared in Europe between the 1940s and 1980s, it did not become popularized until the early 1990s. For nearly 20 years, there has been growing worldwide participation in carsharing. Today, carsharing operates in approximately 600 cities around the world, in 18 nations, and on four continents. Malaysia is operating a carsharing pilot, with a planned launch in late-2006. Another eight countries are exploring carsharing. This paper is based on 33 carsharing expert surveys collected internationally. Cost savings, convenient locations, and guaranteed parking were identified as the most common motivations for carsharing use worldwide. The authors provide an international comparison of carsharing operations, including similarities and differences. In the future, continued growth is forecast, particularly among new and emerging market segments, such as businesses and universities. Growth-oriented operators will continue to account for the largest number of members and fleets deployed worldwide. In addition, higher energy costs; limited and expensive parking; ongoing diffusion of operational knowledge, benefits, and supportive technologies; and greater demand for personal vehicle access in developing nations will impact carsharing's future growth and expansion.

KEY WORDS: Carsharing, global, markets, international, comparative analysis

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INTRODUCTION

In recent years, energy prices have become increasingly more expensive and volatile. This trend has added to auto ownership costs and uncertainty about future operating expenses. Moreover, parking in many of the world's largest cities is limited and costly further adding to private vehicle expenditures. Many nations worldwide have adopted carsharing (or short-term auto access) as a means to reduce personal transportation costs and the negative impacts of widespread auto use including: congestion, inefficient land use, energy consumption, and emissions. Knowledge of carsharing and advanced technologies to support its operations has spread throughout Europe and North America and into Asia and Australia. Together, these factors are influencing carsharing growth across the globe in new and mature markets.

The principle of carsharing is simple: individuals gain the benefits of private vehicle use without the costs and responsibilities of ownership. Carsharing is most common in major urban areas where transportation alternatives are easily accessible. Individuals generally access vehicles by joining an organization that maintains a fleet of cars and light trucks in a network of locations (1, 2). Vehicles are most frequently deployed from lots located in neighborhoods, at transit stations, or businesses. Carsharing members typically pay for use through hourly rates and subscription-access plans. The majority of carsharing operators manage their services with advanced technologies, which can include automated reservations, smartcard vehicle access, and real-time vehicle tracking (3).

For almost two decades, there has been growing worldwide participation in carsharing. Today, carsharing operates in approximately 600 cities worldwide (4). Approximately 348,000 individuals share nearly 11,700 vehicles as part of an organized carsharing service (more than 60% are in Europe). Much of these developments began in Switzerland and Germany in the late-1980s and later spread to 13 other countries across Europe and the British Isles. In the 1990s, North America and Asia also started professional carsharing activities. More recently, Australia launched three carsharing initiatives, beginning in 2003.

This paper provides a global perspective of carsharing growth and developments. In mid-2006, the authors obtained survey data from 33 carsharing experts from 21 countries. Twenty-eight national experts participated, representing 15 of 18 countries where carsharing is currently operating. Four experts represented nations where carsharing is being explored, another where it is in a pilot phase, and one where it previously operated. Entrepreneurs in three nations investigating carsharing did not respond to the questionnaire. Regional experts estimated member and vehicle totals for Asia and Europe. The authors collected membership and fleet totals for North America and Australia from each of the existing carsharing operators in those regions in July 2006.

This article is organized into five sections. First, the authors provide an historical overview of carsharing, followed by a comparison of carsharing impacts mainly from Europe and North America. Next, worldwide carsharing growth is examined. The fourth section provides a comparative analysis of carsharing operations worldwide, including similarities and differences among nations/regions. Finally, the authors conclude with a summary of growth trends and anticipated developments.

HISTORICAL OVERVIEW

One of the earliest European experiences with carsharing can be traced to a cooperative, known as “Sefage” (Selbstfahrgemeinschaft), which initiated services in Zurich, Switzerland, in 1948 and remained in operation until 1998 (5). This early effort was mainly motivated by economics. Individuals who could not afford to purchase a car instead shared one. Elsewhere, a series of shared car experiments were attempted but were later discontinued in Europe and the United Kingdom, including “Procotip” (France, 1971 to 1973); “Witkar” (Amsterdam, 1974 to 1988); “Green Cars” (Britain, 1977 to 1984); and Sweden’s “Bilpoolen” (Lund, 1976 to 1979), “Vivallabil” (Orebro, 1983 to 1998), and a “bilkooperativ” (Gothenburg, 1985 to 1990) (6, 7, 8, 9). Experience with carsharing in the U.S. began with two experiments: Mobility Enterprise—a Purdue University research program (1983 to 1986) and the Short-Term Auto Rental (STAR) demonstration in San Francisco (1983 to 1985) (1). The authors observed the historical pattern of experimentation/closure in at least six nations including: Switzerland, Sweden, France, United Kingdom (U.K.), United States (U.S.), and Japan. More successful carsharing operations worldwide began in Switzerland (Lucerne and Zurich) and Germany (Berlin) in 1987 and 1988, respectively (1).

While the historic outgrowth of carsharing originated in Europe, a characteristic pattern of worldwide expansion has evolved as shared-vehicle systems have become more popularized. Early carsharing innovators in new markets frequently consisted of demonstrations projects, with sunset dates, that aimed to exhibit carsharing operations and technologies. As these markets matured, many of these demonstrations were replaced with permanent carsharing services, although in some cases carsharing disappeared for some time before services reemerged. Not surprisingly, as carsharing has become more mainstream, expansion into new markets has consisted of fewer demonstrations.

COMPARISON OF CARSHARING IMPACTS

A number of social and environmental benefits are commonly associated with carsharing, supported by an increasing body of empirical evidence. However, differences in data collection and study methodology frequently produce inconsistent results, often with limited samples. Other possible reasons for these inconsistencies are location-specific variations and whether such studies examine innovators, early adopters, or early majorities. To date, no independent studies have been conducted on the quantitative impacts of carsharing in Asia or Australia.

Carsharing impacts can be categorized into transportation, environmental, land-use, and social effects (10, 11, 12). See Table 1, below, for a summary of reported benefits for Europe and North America from a range of studies. One major impact of carsharing on the transportation system is a reduction in vehicle ownership. According to recent studies, a carsharing vehicle reduces the need for 4 to 10 privately owned cars in continental Europe, between 6 to 23 cars in North America, and 7 to 10 vehicles in Australia (13).

Earlier European carsharing studies indicate a range of 15.6 to 31.5% sold a vehicle after joining carsharing; however, a more conservative range (23 to 26.2%) avoided or postponed a vehicle purchase (14, 15). A more recent study, reporting on

carsharing impacts in Belgium and Bremen, indicates a slightly higher range of 21 to 34% of participants who sold a personal vehicle due to carsharing (13). North American studies and member surveys suggest that between 11 to 29% of carsharing participants sold a vehicle after joining a carsharing program, while 12 to 68% delayed or had forgone a vehicle purchase (16, 17, 18, 19, 20, 21). While the estimates of foregone vehicle purchases in the U.S. appear to be comparatively high in contrast to Europe, it is important to note that they are based on “stated preference” survey responses, which can be overstated and are typically less reliable than “revealed preference” data (such as actual number of cars sold after joining carsharing). Furthermore, auto ownership is much higher in the U.S., so the potential to reduce the number of cars in a household is presumably greater (22).

European studies indicate a large reduction in vehicle kilometers traveled (VKT), between 28 to 45% (13). VKT reduction data range from as little as 7.6 to 80% of a member’s total in Canada and the U.S. (21, 22, 23, 24, 25). Estimates differ substantially between members that gave up vehicles after joining a carsharing program and those that gained vehicle access through carsharing in both Europe and the U.S. (21, 23, 24, 25, 26, 27). The authors calculate an average reduction of 44% in VKT per carsharing user across North American studies.

TABLE 1 Carsharing Benefits by Region

Region	Number of Vehicles Replaced Due to One Carsharing Vehicle	Percent of Participants Who Sold Private Vehicle After Joining Carsharing	Percent of Participants Who Postponed or Avoided Vehicle Purchase Due to Carsharing	Percent of Vehicle Kilometers Reduced Due to Carsharing
Europe	4 to 10	15.6 to 34%	23 to 26.2%	28 to 45%
North America	6 to 23	11 to 29%	12 to 68%	7.6 to 80% (Avg. of 44% across studies)

Furthermore, reduced vehicle ownership and VMT/VKT lower greenhouse gas (GHG) emissions, as trips are shifted to transit, biking, and walking. In Europe, recent carsharing studies estimate the reduction in average user’s carbon dioxide emissions ranged between 39 to 54% (13). In addition, many carsharing organizations include low-emission vehicles, such as gasoline-electric hybrid cars, in their fleets (12, 23, 24). Carsharing members also report a higher degree of environmental awareness after joining a carsharing program (21).

Finally, carsharing shows evidence of beneficial social impacts. Households can gain or maintain vehicle access without bearing the full costs of car ownership (12, 28). Carsharing offers a pay-as-you-go alternative for individuals and families who may require only periodic access to an automobile. Depending on location and organization, the maximum annual mileage up to which carsharing is more cost effective than owning or leasing a personal vehicle lies between 10,000 to 16,093 kilometers (28, 29, 30). Low-income households and college students can also benefit from participating in carsharing (10).

Research in nearly two dozen studies has demonstrated that carsharing is a flexible alternative that can be used in a variety of contexts to assist in increasing mobility by serving as a “missing link,” reducing dependence on private vehicle ownership, lowering vehicle emissions and energy consumption, and encouraging active lifestyles by interfacing with bicycle and pedestrian modes.

WORLDWIDE CARSHARING GROWTH

While modern carsharing traces its evolution to Switzerland and Germany, this once novel concept has expanded to include four continents. While central Europe remains an epicenter of carsharing activity, other growing markets have developed in northern Europe, North America, Asia, and Australia. In this section of the paper, the authors provide a regional comparison of worldwide carsharing growth (members and vehicles) and trends over time.

Today, carsharing has grown to include approximately 600 cities around the world in 18 nations and on four continents (4). These include Austria, Belgium, Denmark, Finland, France, Germany, Italy, the Netherlands, Norway, Spain, Sweden and Switzerland in Europe; the United Kingdom (Scotland, England, and Wales); Canada and the United States in North America; Japan and Singapore in Asia; and Australia. Carsharing is currently in a pilot phase in Malaysia with a scheduled launch in late-2006. At present, there are an estimated 348,000 carsharing members worldwide who share nearly 11,700 vehicles.

Much of these developments began in Switzerland and Germany in the late-1980s. In the 1990s, North America and Asia also started professional carsharing activities. More recently, Australia launched three carsharing initiatives, beginning in 2003. At present, there is one planned launch in Malaysia, and eight additional countries, including: China, Ireland, Israel, Kenya, New Zealand, Portugal, South Africa, and Zambia, are exploring carsharing startups. While carsharing growth has continued since the late-1980s, it has not occurred at a homogeneous pace worldwide. See Figure 1 for a histogram of worldwide growth from 1988 to the present and the current estimated numbers of carsharing members and vehicles by region.

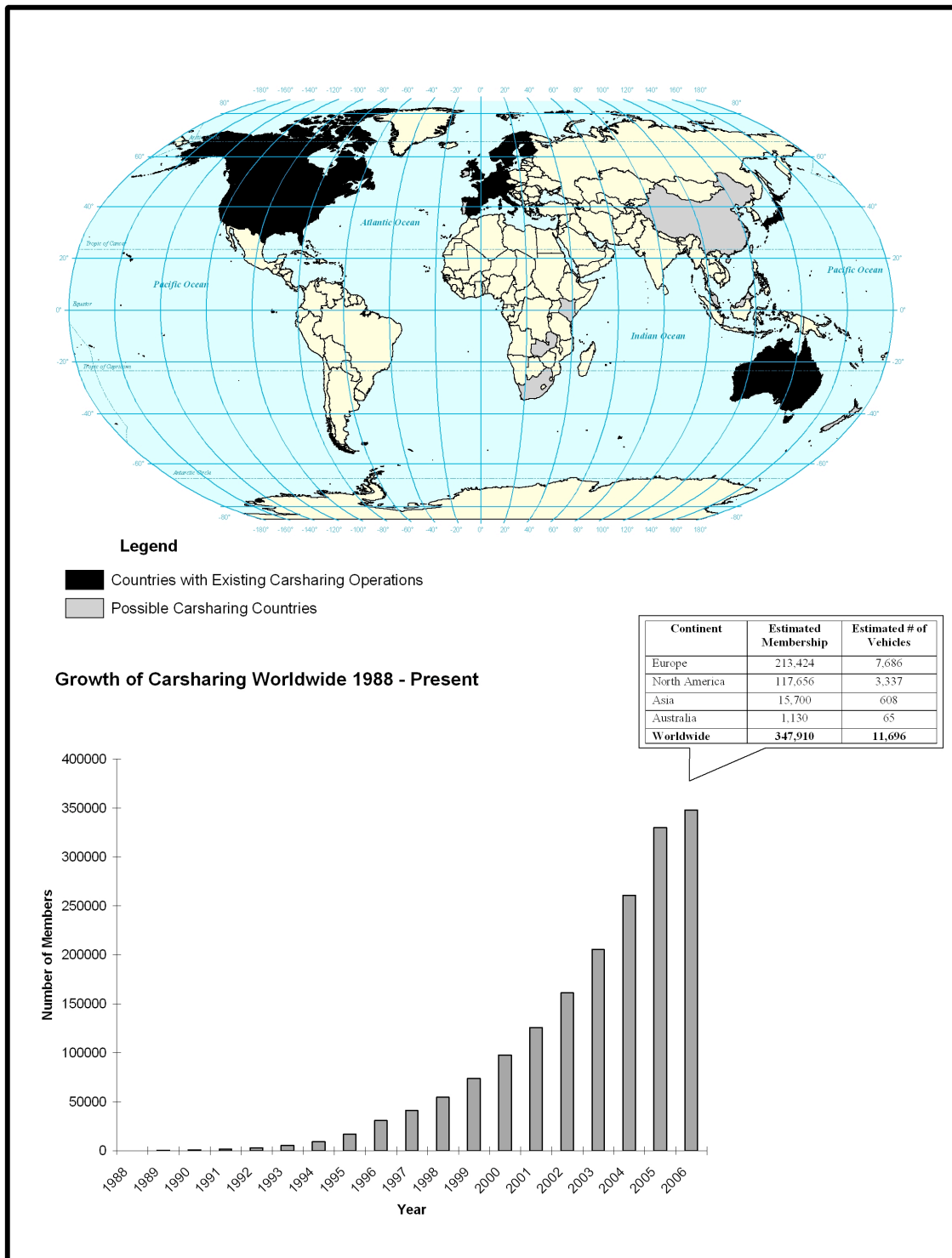


FIGURE 1 State of Carsharing Worldwide.

In Europe, carsharing started in the late-1980s and experienced substantial growth throughout the 1990s. Indeed, the majority of growth for nearly a decade was centralized in Europe, as carsharing operations did not begin in Asia or the U.S. until the late-1990s, with the exception of two Canadian organizations that launched between 1994 and 1995. More notable North American growth activities began around 2000. Today, North America represents nearly 35% of the total worldwide carsharing membership. Expansion in Asia has been slower during this period, attaining an estimated 15,700 members. It is important to note, however, that growth in some markets, such as the U.S., could be overstated due to possible double counting of private and business members. In addition, lower average vehicle use by members in the U.S. has resulted in higher member-vehicle ratios (10), which is less typical in the majority of carsharing nations. Member-vehicle ratios have tended to be higher in the U.S. as a result of: 1) less frequent use among neighborhood users (many have joined carsharing as a form of “mobility insurance” to supplement existing modes) and 2) business memberships where many individuals have access to a vehicle during the day (10). Finally, the growing frequency of competition in carsharing markets, particularly in the U.S. (e.g., Chicago, San Francisco, and Washington, D.C.), yields the possibility of over counting users that maintain memberships in more than one carsharing organization to access a greater network of shared-use vehicles.

In recent years, some of the world’s largest organizations have expanded into multinational operators including: Zipcar in the United States and Canada, Greenwheels in the Netherlands and Germany, Cambio Car in Germany and Belgium, and CityCarClub in Sweden and Finland. NTUC Income Car Co-op in Singapore announced a partnership with KAR Club, which is in the process of launching in Kuala Lumpur, Malaysia. NTUC Income Car Co-op may also expand operations into Hong Kong (31). The authors forecast continued developments among multinational operators. In the future, growth-oriented operators will continue to account for the largest number of members and fleets deployed worldwide.

To summarize, carsharing has witnessed increasing growth since 1988, with the majority of the growth in the 1990s occurring in Europe. More recently, growth has expanded into North America, Asia, and Australia. While the largest organizations continue to account for the majority of members and fleets deployed, many have become increasingly competitive and multinational in character. Three trends appear from the authors’ examination of growth: 1) a transformation from grassroots operations and demonstration projects to more formal organizational structures in several regions; 2) mergers that have led to fewer and larger organizations in several nations; and 3) differing growth rates worldwide among new, developing, and maturing markets.

One notable characteristic of shared-vehicle growth is the transformation from smaller “informal” car clubs to larger more “formal” carsharing operations as new markets grow and mature, particularly in Europe. Indeed, carsharing has grown in Switzerland and Germany in the 1990s through a number of new entrants, followed by a few prominent mergers. To date, mergers have occurred on a more limited basis in Canada, Japan, the U.S., the Netherlands, and Sweden. In summary, historical carsharing growth rates have varied across the world. The majority of this expansion has occurred in both Europe and North America. Shared-vehicle growth, according to study experts, is increasing in all nations except Austria.

COMPARATIVE ANALYSIS: CARSHARING OPERATIONS

From May to July 2006, the authors collected survey data from 33 international carsharing specialists from 21 countries. A total of 53 were contacted with a response rate of 62.3%. One additional expert provided carsharing member and vehicle totals for Denmark. Twenty-eight experts, who represented 15 of 18 active carsharing countries, completed the survey (Australia, Austria, Belgium, Canada, France, Germany, Italy, Japan, the Netherlands, Singapore, Spain, Sweden, Switzerland, U.K., and the U.S.; Denmark, Finland, and Norway are not represented in this analysis). Survey participants also include one expert from Malaysia (also representing Singapore) where carsharing is planned to launch in late-2006; four experts from nations where carsharing is being explored (China, Israel, Portugal and South Africa); and one from Ireland where it previously operated. Entrepreneurs in three nations that are presently investigating carsharing (New Zealand, Kenya, and Zambia) did not contribute to the survey. The authors supplemented survey data with a literature review.

The views expressed in this section reflect opinions of national and regional experts and are intended to provide a worldwide overview. The vast majority of carsharing operators from Australia, Canada, Italy, Spain, Switzerland, and the U.S. are represented in this paper. Regional authorities estimated current member and vehicle totals for Asia and Europe where it is more challenging to collect precise numbers. The authors collected North American (n=28) and Australian (n=3) member and vehicle totals from each existing carsharing operator in these regions.

Experts from across the globe cite three common factors that drive member growth: participant cost savings, convenience (locations and use), and guaranteed parking (particularly in locations where it is limited and costly). While these customer benefits collectively play a strong role in worldwide growth, operational approaches, market opportunities, and existing challenges vary. In this section, the authors provide a transnational comparison of carsharing operations. Table 2 provides a high-level summary by region. A more detailed analysis follows and is organized by topic: member-vehicle ratios, market segments, vehicles and fuels, parking, insurance, and technology.

<p>Asia - Asian member-vehicle ratios are estimated at 26:1. Experts in Singapore reported that the largest market segment is neighborhood residential, linked to rail. Business is the largest market segment in Japan. Asian experts indicated that on-street parking is unavailable, and parking is not offered as a form of non-monetary support. There is an emphasis on electric and gasoline-electric hybrid vehicles in Japan and Singapore, respectively. Since carsharing's inception in Asia, operators have emphasized advanced technology and logistical operations, employing a range of technologies: 1) telematics to communicate between vehicles and shared-vehicle management systems, 2) global positioning system vehicle tracking, 3) vehicle access through smartcards, 4) mobile phone vehicle entry, and 5) reservations via short message services.</p>
<p>Australia - Australian operators estimate member-vehicle ratios at 17:1. Experts indicated that neighborhood residential is the largest market segment followed by business. Australian experts also reported market diversification in college, business, and planned community markets. Australian experts indicated that free on-street parking is a form of non-monetary carsharing support. Operators also have access to dedicated carsharing parking zones. Experts reported that it is difficult to obtain insurance for younger and international drivers. While Australian operators have followed a technological evolution similar to North America and Europe, Australian organizations have quickly adopted fully automated systems (in less than three years).</p>
<p>Europe - Germany and Switzerland distinguish themselves with higher member-vehicle ratios: 33:1 and 36:1, respectively. Average European member-vehicle ratios are estimated at 28:1. European experts indicated that neighborhood residential is the largest market segment followed by business, except for Austria and Sweden. Experts reported increased market diversification over the next five years. While the majority of national experts indicated that free and reduced on-street parking is a form of non-monetary support, on-street parking is not widely available to operators in France, Spain, and Switzerland. Four countries (Austria, Belgium, Italy, and, U.K.) have dedicated carsharing parking zones. Diesel and gasoline vehicles dominate European fleets. Experts in the U.K. indicated that obtaining insurance for younger drivers and older adults is challenging. In Europe, many operators have evolved from manual operations to partially and fully automated systems.</p>
<p>North America - The United States maintains the highest worldwide member-vehicle ratios (40:1). North American average member-vehicle ratios are estimated at 35:1. North American experts reported neighborhood residential as the predominant market segment, followed by business. Experts also indicated ongoing growth in the college and business markets over the next five years. Free and reduced cost on-street parking are forms of non-monetary support. Although a few research programs employ electric vehicles, most operators use gasoline vehicles, with gasoline-electric hybrids representing a growing portion of U.S. fleets. Although it is becoming less challenging, many operators find it difficult to acquire affordable insurance for younger and low-income drivers. In North America, the majority of organizations have evolved from manual operations to partially and fully automated systems. As of 2005, 70% of U.S. organizations employed fully automated systems, and 73% of Canadian operators deployed partially automated systems. For more information, see (3).</p>

TABLE 2 Regional Overview of Carsharing Operations

Member-Vehicle Ratios

While the authors do not have precise member-vehicle ratio data for carsharing organizations worldwide, average national ratios are approximately 20:1 and are lower in newer markets where operators must first position their vehicles to gain membership. In contrast, the Swiss, U.S., and German markets distinguish themselves from the rest of the world with higher member-vehicle ratios. Since 1997, when carsharing services became unified under one provider (Mobility Carsharing Switzerland), Swiss ratios have steadily risen from 23:1 to 36:1 (32). In the U.S., the rise in member-vehicle ratios has been more dramatic, steadily rising from approximately 7:1 in 1998 to 64:1 in mid-2005 (3). Today, German member-vehicle ratios are estimated at 33:1.

Experts ascribe higher member-vehicle ratios in Switzerland to inactive members and a combination of inactive users and growth in corporate memberships in Germany. In the U.S., the authors attribute higher ratios to greater market diversification, resulting in larger groups of business/fleet users with vehicle access throughout the day, and less active members who rely on carsharing as a form of “mobility insurance” (3, 10). Furthermore, double counting of members, who are both individual and business/fleet users, can increase member totals. Finally, individuals who join more than one carsharing service to increase their overall vehicle access in some U.S. cities may also drive higher average ratios.

Since July 2005, U.S. member-vehicle ratios have dropped from 64:1 to 40:1. Today, greater vehicle use among members, growing carsharing awareness, and increased vehicle access (resulting from growth in the number of available lots/vehicles in major cities, particularly those in which multiple providers are operating) appear to be driving usage rates and lowering average member-vehicle ratios. Ratios may also be falling as a result of venture capital investments received by two major carsharing operators in summer 2006. The authors hypothesize that national for-profit carsharing organizations were interested in demonstrating growth to potential investors through increased member totals. Since the infusion of private capital into these operations, average member-vehicle ratios have fallen. This may be indicative of increased operator focus upon profit performance and encouragement of higher and more regular vehicle use among members. Finally, more inactive members, who previously joined carsharing largely as “mobility insurance,” may have discontinued their membership particularly as monthly member fees have become more common.

Market Segments

With a few notable exceptions, the majority of national shared-vehicle experts indicated that neighborhood residential is their predominant carsharing market, followed by business. These nations represent approximately 80% (12 of 15) of respondents in the authors’ worldwide survey including: Australia, Belgium, Canada, France, Germany, Italy, Netherlands, Singapore (primarily residential complexes linked to rail stations), Spain, Switzerland, U.K., and the U.S. (31). In contrast, Austria specified business as its predominant market. While Japan and Sweden both indicated business as their largest segment, Japan specified planned communities, and Sweden listed neighborhood residential as their second largest market.

Specialists in Austria, Japan, the Netherlands, and Singapore indicated no expected change in existing markets over the next five years. Sixty percent of respondent nations (9 of 15) reported increasing market diversification in the next five years. Experts in Australia specified

developing college, planned community, and business markets. North American authorities indicated ongoing growth in the college and business market segments (3). European experts specified a wider array of market diversification, varying by country, including the expansion of older adult and planned community markets in France, a developing low-income market in Sweden, and growth in planned communities and businesses in the U.K.

Based on the authors' survey, worldwide carsharing activities emphasize the neighborhood residential market, with the exception of Austria, Japan, and Sweden. Over the next five years, greater market diversification is predicted in Australia, North America, and most of Europe.

Parking

One of the limiting factors to carsharing expansion is the development of a dense network of lots for carsharing users, such as on-street and transit-based parking (33, 34). Thus, parking typically represents a key area of interest for the majority of carsharing programs around the world.

On-street carsharing parking is generally available in North American and most European countries with a few exceptions. See Table 2 (below) for national comparisons. Approximately 33% of nations (5 of 15) responding to the survey (France, Spain, Switzerland, Japan, and Singapore) indicated that on-street carsharing parking was not available. Additionally, a number of experts reported that operators had access to dedicated carsharing parking zones in 40% of the responding nations (including Australia, Austria, Belgium, Italy, U.K., and the U.S.). While on-street parking is free in a few nations, most frequently it consists of a combination of free and reduced-cost parking. When charged, the methods used for calculating parking costs vary considerably including: 1) a flat monthly fee and 2) variable rates depending upon market prices, such as residential permit rates, foregone meter revenues, and cost recovery for transit station parking (mainly operations and maintenance). In some cases, conversion charges (i.e., costs associated with removing meters, striping curbs, etc.) and fees for administrative overhead are also added.

TABLE 3 Overview of Worldwide Carsharing Parking Policies

	On-Street Parking	Free / Reduced Cost	Dedicated Parking Zones	Parking as Non-Monetary Support
Asia				
Japan	No			No
Singapore	No			No
Australia				
Australia	Yes	Free	Yes	Yes
Europe				
Austria	Yes		Yes	No
Belgium	Yes		Yes	Yes
France	No			No
Germany	Yes	Free and Reduced		Yes
Italy	Yes	Free	Yes	Yes
Netherlands	Yes	Free and Reduced		Yes
Spain	No			
Sweden	Yes	Free and Reduced		Yes
Switzerland	No			Yes
UK	Yes	Free and Reduced	Yes	Yes
North America				
Canada	Yes	Free		Yes
US	Yes	Free and Reduced	Yes	Yes

The vast majority of world experts (93.3%, all nations except Spain) indicated that operators had access to off-street parking in their countries. One European expert indicated that access to off-street parking is very limited, however.

Parking is a common form of non-monetary support of carsharing worldwide. With the exception of Asia, and three European countries (Austria, France and Spain), 66.7% of responding nations (10 of 15) provide economic assistance to carsharing operators in the form of parking. Respondents from Australia indicated that application procedures to apply for parking spaces are often cumbersome. Furthermore, the lack of legal definitions and restrictions for carsharing has created challenges for legal shared-vehicle parking in Italy. Experts from every nation in Asia and North America and from five countries in Europe (Austria, Belgium, France Italy, and the U.K.) indicated that supportive parking policies are a key opportunity for carsharing in their countries.

Vehicles and Fuels

Based on the authors' survey and literature review, smaller compact and hatchback vehicles dominate the world's carsharing fleets. Some fleets in Europe, Singapore, and the U.S. deploy a limited number of sport utility vehicles (SUVs) and luxury cars (31). While there is some difference in the range of total vehicle models offered by carsharing organizations worldwide, there is a notable divergence among fuels and engine technologies used.

Expert respondents in Australia, Europe, North America, and Singapore indicated that carsharing fleets are primarily comprised of conventional gasoline vehicles. Japanese organizations largely use electric vehicles (EVs), but their reliance on them has somewhat

diminished since initial program deployments (31). Gasoline-electric hybrid vehicles are popular among operators in Singapore, although conventional gasoline cars are the predominant vehicle type. While there is a history of EV demonstration projects in the U.S., they have been limited to station car operations and a few carsharing research initiatives (i.e., Intellishare and ZevNet) (31, 35).

The dominant alternative fuel technology incorporated into fleets in North America and Singapore is the gasoline-electric hybrid. Australian operators reported that hybrid and other alternative fuel vehicles were too expensive. While much less common in Europe, hybrids represent a developing fleet segment. Diesel (and to a lesser extent biodiesel) is the leading alternative fuel vehicle deployed in Europe and is unique in this worldwide. Indeed, one shared-vehicle program in Spain, Catalunya Carsharing, only uses diesel and biodiesel fuels.

Outside of Japan, worldwide experts provided similar reasons as to why alternative fuel vehicles represent a smaller percentage of overall carsharing fleets. Experts frequently reported that hybrid vehicles are considerably more expensive and other alternative fuel vehicles (e.g., EVs) pose too many operational barriers including: limited vehicle range, fewer fueling stations, and member inexperience.

Insurance

Vehicle insurance is a major operational cost of carsharing. Twenty-eight experts from countries where carsharing is currently operating indicated that insurance is obtained through private-sector insurance carriers. Additionally, two experts from Australia and Canada reported that carsharing insurance is also obtained through governmental policies. The authors note that the number of nations providing governmental insurance (either directly or indirectly through partnerships or monetary support) is probably larger when government fleets are included.

Only specialists from a few countries (Australia, Canada Italy, and the U.S.) indicated that finding insurance was an ongoing problem. One additional expert from France reported that identifying an insurance provider is no longer a problem; however, it was a significant challenge early on. Experts from four countries provided that securing insurance for younger drivers was an issue (i.e., under 25 in Canada and under 21 in Australia, U.K., and the U.S.) (3). Experts from Australia, the U.K., and the U.S. also reported difficulty obtaining insurance for international, older, and lower-income drivers, respectively.

Technology

Advanced technology continues to play an important role in carsharing worldwide. However, differences in technological evolution exist between Asia and the other three continents. In Europe and North America, many operators have evolved from manual operations to partially automated (i.e., automated reservations via touch-tone telephone/Internet) or fully automated systems (i.e., automated reservations, integrated billing, and advanced vehicle-access technologies). In 2005, only 11.5% of North American operators continued to use manual operations, compared with 37.5% in 2002. Fully automated systems were more predominant in the U.S. (accounting for 70% of operators) compared to 73% of Canadian operators who deployed partially automated systems (3). Organizations still using manual operations in North America and Europe tend to be smaller in size.

Australian operators have followed a technological evolution similar to North America and Europe, advancing from manual and partially automated systems to more sophisticated ones. While Australia has followed a comparable evolution from lower to higher technology levels, they differ from their European and North American counterparts. Within just three years of launching, Australian operators have adopted fully automated systems.

In contrast, Asian operators launched with fully automated systems. Technology among Asian operators has often emphasized logistical operations through telematics to communicate between vehicles and shared-vehicle management systems, global positioning system vehicle tracking, vehicle access through smartcards, mobile phone vehicle entry, and reservations via short message services (29).

The authors forecast continued technological advancement where carsharing currently exists, such as more open-ended bookings (i.e., no fixed reservations), instant access (i.e., no reservations), one-way rentals (i.e., vehicles can be returned to a different lot), satellite radio, pre-paid usage cards, and interoperability. The extent to which automated technologies are deployed in new carsharing markets will vary by region and external factors, such as phone and Internet availability and labor costs. In the developing world, lack of reliable phone or Internet service may encourage manual or partially automated systems or limit potential membership to those who have access to such utilities. Services, such as vehicle delivery and one-way trips, may also be more economical in some of these nations where lower labor costs make fleet management less expensive.

Summary

Key factors that characterize worldwide carsharing operations include: member-vehicle ratios, market segments, parking approaches, vehicles and fuels, insurance, and technology. Germany, Switzerland, and the U.S. distinguish themselves from their international counterparts with higher member-vehicle ratios. This is largely due to market diversification and less active users in the U.S. and Germany and inactive members in Switzerland. The predominant carsharing markets in Australia, Europe, North America, Singapore, and the U.K. are neighborhood residential and business. In contrast, business is the primary market segment in Austria, Japan, and Sweden, followed by planned communities and neighborhood residential in Japan and Sweden, respectively. On-street parking in most carsharing countries (with the exception of Asia, France, and Spain) is a common form of non-monetary operator support. While obtaining insurance is not broadly perceived as a problem worldwide, expensive policies are common in most markets. Insurance can also be difficult to secure for particular market segments, such as younger drivers, in Australia, Canada, the U.K., and the U.S. Although there are distinct regional differences in alternative fuel vehicle use, conventional gasoline automobiles represent the majority of worldwide fleets (except in Japan and Spain). Finally, carsharing operators in Asia tend to be more technologically driven, particularly during their startup phase, in contrast to Australia, Europe, and North America where technology has advanced progressively (i.e., from manual or partially automated to fully automated systems).

CONCLUSION

While modern carsharing traces its roots to Switzerland and Germany, this once novel concept has expanded worldwide and is now operating in 18 nations on four continents. While central

Europe remains a key node of carsharing activity, other growing markets have developed in Europe, North America, Asia, and Australia. Carsharing is also being explored in eight countries, and Malaysia plans to launch a shared-vehicle program in late-2006. At present, there are an estimated 348,000 carsharing members worldwide who share nearly 11,700 vehicles.

Current worldwide developments include: 1) ongoing growth (except in Austria), 2) growing awareness, and 2) entrants into new and existing carsharing regions, such as Australia and Malaysia. Continued growth and market diversification in business, fleet, transit, and university carsharing markets (particularly in North America) is projected. Growth in neighborhood carsharing could also result from emerging standards (e.g., vehicle access technologies) that facilitate linkages or cross-agreements among regional organizations. This could lead to increased cooperation among carsharing operators and other partners, such as public transit (e.g., smartcard ticketing and access technologies), businesses, rental car companies, hotels/resorts, and shopping outlets (e.g., Migros M-Budget in Switzerland). In addition, carsharing is expected to be increasingly integrated into urban transport and land-use strategies in the future (e.g., through zoning variances for developers and supportive parking policies). Competition among operators in the same region will continue to increase, particularly in Germany and the U.S., resulting in enhanced services and customer choice and in some cases mergers and company closures. Recently, several transnational carsharing ventures have occurred: 1) Zipcar is providing services in the U.S. and Canada, 2) Greenwheels in Germany and the Netherlands, 3) Cambio Car in Germany and Belgium, and 4) CityCarClub in Sweden and Finland. This trend is reshaping carsharing as more organizations cross national boundaries.

Growth-oriented organizations will continue to account for the largest number of members and fleets deployed. In the future, carsharing expansion will continue, particularly in newer markets. There will likely be new entrants in Ireland, Israel, Portugal, and New Zealand. The authors anticipate that carsharing will also emerge in developing countries in Asia and Africa, such as: China, Kenya, South Africa, and Zambia. The authors anticipate that carsharing operations may evolve differently in the developing world due to lower labor costs, potential differences in technology use, and organizational structure. Inexpensive labor, for instance, could encourage/facilitate vehicle deliveries to customers' homes/offices and one-way trips.

The authors conclude that unfulfilled market potential in new and existing markets, combined with external forces—such as high energy prices and the demand for innovative solutions to urban parking constraints and roadway congestion—will continue to drive carsharing expansion. This will be fueled by the ongoing diffusion of shared-vehicle awareness, expertise, and technologies, which will continue to support carsharing operations in most new and existing locations across the globe.

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