Carsharing and Station Cars in Asia: An Overview of Japan and Singapore

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Original submission date: July 30, 2005
First revision date: November 15, 2005
Final TRR revision date: April 1, 2006
Word count (excluding abstract, references): 6653; figures and tables: 4*250=1000; total: 7653
Abstract word count: 220

ABSTRACT

In recent years there has been significant worldwide activity in shared-use vehicle systems (i.e., carsharing and station cars). Much of this activity is taking place in Europe and North America; however, there has also been significant activity in Asia, primarily in Japan and Singapore with some planned activity in Malaysia. This paper examines the latest shared-use vehicle system activities in Japan and Singapore, beginning with an historical review followed by an evaluation of their current systems. Overall, there are several well-established systems in both Japan (18 systems with approximately 150 vehicles and 3000 members) and Singapore (4 systems with approximately 432 vehicles and 12,200 members). In Spring 2006, a new program is planned to launch in Kuala Lumpur, Malaysia with 10 vehicles. In contrast to most European and North American cities, Japan and Singapore already have a wide range of viable public transportation modes. Interestingly, the primary carsharing focus in Japan is on business use and on neighborhood residential in Singapore. This is likely due to limited vehicle licensing and high car ownership costs in Singapore. Further, systems in Japan and Singapore have a high degree of advanced technology in their systems, making the systems both easy to use and manage. The member-vehicle ratios in Asia appear to be approximately the same as Europe and Canada and less than the U.S. It is expected that Asian shared-use vehicle systems will continue to have steady growth in terms of number of organizations, vehicles, and users.

Keywords: shared-use vehicle systems, carsharing, station cars, Japan, Singapore, Malaysia

INTRODUCTION

Shared-use vehicle systems (i.e., short-term vehicle rentals) have received a good deal of worldwide attention in recent years as an innovative mobility alternative. Shared-use vehicle systems take on various forms; the most common are referred to as carsharing, car clubs, and station cars (see *(1)*) for definitions of shared-use vehicle system models). There are approximately 300,000 carsharing users worldwide *(2)*. The general principle of shared-use vehicle systems is simple: individuals gain access to a fleet of shared vehicles on an as-needed basis, rather than using personal cars for all their tripmaking. Carsharing offers the convenience of a private automobile and more flexibility than public transportation alone. There are many potential carsharing benefits, such as: 1) promoting alternative transportation modes by enhancing and supporting existing transit systems (resulting in increased fare box revenues and decreased subsidies needed); 2) providing greater mobility at substantial savings for people who do not drive everyday (considering 80% of private vehicle costs are fixed and 20% of a household's expenditures support transportation); 3) increasing incentives for compact growth by reducing parking needs through carsharing in new and existing developments and improving transit services by promoting transit-oriented developments; 4) promoting energy and emission benefits due to modal shifts from private vehicle trips to alternative transportation, as well as use of energy-efficient cars; 5) reducing public parking needs by alleviating pressure for public funding of parking structures; and 6) encouraging more economically efficient use of scarce public roadways and reducing the need for higher taxes to support capacity expansions. In contrast to carsharing, station cars are focused primarily on facilitating transit trips. In general, station cars enable individuals to substitute transit for the middle portion of a journey, providing a critical link between transit and origin or transit and destination *(3)*.

Shared-use vehicle systems in the form of carsharing have their roots in Europe where large-scale services began to emerge in the late-1980s, such as Mobility CarSharing Switzerland. The carsharing concept is relatively newer in North America (launching in Canada in 1994 and the U.S. in 1998), with several major systems now in place in 36 urban areas with approximately 88,000 members and 1,800 vehicles total *(2)*. Station car programs, in contrast, are on the decline in North America. There is just one station car program remaining in the U.S., which is scheduled to close in 2007, down from five initiatives in 2002. Another is planned to launch in Vermont (see *(2, 3)* for more information on U.S. station car programs).

In addition to Europe and North America, shared-use vehicle systems have also caught on in Asia, primarily in Japan and Singapore. One program is planned to launch in Kuala Lumpur, Malaysia in Spring 2006 *(Lewis Chen, unpublished data, March 2006)*. The focus of this paper is on shared-use vehicle system activity in Japan and Singapore, and how they compare to the existing systems in Europe and North America. In the second section of the paper, the authors first provide a brief summary of the well-developed transportation systems already in place in these countries. In the next section, the authors present a brief history of shared-use vehicle systems in Japan and Singapore, followed by a current snapshot of existing systems. This is followed by a description of some of the key characteristics of these systems and how they contrast with Europe and North America. Finally, the authors conclude this paper by identifying key observations regarding shared-use vehicle systems in Japan and Singapore.

TRANSPORTATION SYSTEMS IN JAPAN AND SINGAPORE

Compared to Europe and North America, both Japan and Singapore have very high population densities. Japan has a population of around 128 million, the majority who live in urbanized areas. In fact, 44% of the total national population resides in the three major urban areas of Tokyo, Osaka, and Nagoya with corresponding population densities approximately at 4,600, 3,000, and 2,000 people/km^2 *(4)*. After World War II, Japan had a clear objective of catching up with the U.S. and Europe, resulting in tremendous growth in industry and corresponding growth in the transport sector. As a result, Japan's urban sprawl started in the 1960s and has resulted in huge daily inflows and outflows of commuters traveling from suburban areas to central business districts, as well as many other non-commute trips. To handle these trips, over the years Japan has developed and promoted a wide variety of transportation modes consisting of railroads, subways, buses, private cars, motor bikes, bicycles, and walking. As would be expected, private transportation (e.g., automobiles, taxis) is more expensive than transit (railroads, subways, buses). As shown in Figure 1a, for the major metropolitan areas of Japan, approximately 51% of passenger transport is handled by rail (railroad, monorail, and subway); 39% by automobile; 8% by bus; and 2% by other means (e.g., bicycle or walking) *(4)*. Public transportation plays a major role for a variety of reasons: 1) public transportation modes are of high quality and are highly reliable; they also offer a high degree of advanced technology (e.g., smartcards and advanced traveler information systems); 2) roadways are often congested, causing a high degree of uncertainty in travel times; and 3) car ownership is costly; in particular, parking is very limited and expensive.

Even with Japan's rich set of transportation options, there are still several problems in terms of inter-connectivity. As a result, there has been significant activity in recent years to promote seamless public transport through the application of intelligent transportation system (ITS) technology, such as public transport-based navigation systems, common farecards (smartcards) among different modes, and Internet-based trip planning systems *(5)*. Similar to Japan, Singapore is one of the most densely populated and urbanized countries in the world today. Singapore has approximate 4.2 million people situated on a 650 km^2 island (6,400 people/km^2). Singapore also has had rapid economic growth over the last several decades, and as a result, travel demand has easily outpaced the development of roadways. To address this demand, Singapore has developed four key strategies: 1) tightly integrating land-use and transport planning; 2) providing a variety of high-quality public transportation systems; 3) developing an extensive road network system and maximizing its capacity (e.g., through ITS); and 4) carefully managing demand of road usage through vehicle ownership and use measures *(6)*. Historically, the Singapore government has been quite proactive in managing travel demand and land use. For example, in the 1970s, the government mandated bus consolidation *(7)* and public high-rise construction housing in the 1980s, which now house 86% of the population *(8)*.

Singapore's public transportation system consists primarily of rail systems, buses, and an extensive taxi system (see Figure 1b). The rail system consists of Mass Rapid Transit (MRT) and a complementary Light Rail Transit (LRT) service, operating on 138 km of track (109 stations) and satisfying 1.3 million trips daily. Singapore's bus system consists of 270 bus routes with a fleet size of 3,500 buses, satisfying 3 million trips daily. Taxis also play a major role in Singapore, consisting of 20,400 vehicles and satisfying 0.9 million trips daily. In the 1990s, the taxi industry was deregulated in Singapore, and many taxi services voluntarily adopted Global Positioning System (GPS)-based dispatching technology, including enhanced radiophone services, to better track vehicles and match supply and demand *(9)*.

A high demand for vehicles in Singapore is fueled by cultural factors. Singapore is considering how best to accommodate this demand in the future. While almost 25% of workers commute by car *(10)*, workday congestion is deferred effectively through the Vehicle Quota System, which limits the vehicle population growth to 3% per annum. Further, there are also vehicle use restraints through road and congestion pricing. As a result, it is both expensive to own and operate a private vehicle in Singapore. However, peak demand for vehicles occurs on weekends, evenings, and holidays, emphasizing the need for private cars for recreational purposes that are not well served by public transit.

The Vehicle Quota bidding system, which allocates a limited supply of vehicle certificates, has shown notable demand despite high car ownership costs. For instance, licensing a vehicle costs US$10,937—almost one third of the average vehicle purchase price *(11)*. The artificially high fixed cost of ownership in Singapore is a barrier to entry, however, not vehicle use. Furthermore, this system reinforces status-seeking vehicle acquisition and may encourage liberal use by existing owners. For this reason, and to satisfy popular car ownership demand, the government has been relaxing the Vehicle Quota system since 2003, hoping to manage travel demand more equitably through road pricing *(12)*. For the Singapore government, carsharing fits into their agenda of greater vehicle availability.

SHARED-USE VEHICLE SYSTEMS: AN HISTORICAL PERSPECTIVE

Japan: A Brief Overview

The general concept of having multiple users share a fleet of vehicles (i.e., shared-use vehicle systems) first emerged in Japan in the late 1990s. At that time, several European programs were well underway (e.g., Mobility CarSharing Switzerland *(13)*). One of the first shared-use vehicle concepts to materialize in Japan was Honda Motor Company's Intelligent Community Vehicle System (ICVS, see *(14)*). ICVS was introduced as new mode of comfortable, efficient individual transportation. The overall goal of ICVS is to use resources more effectively and efficiently, benefiting society and the environment. The ICVS concept is not limited to one type of shared-use vehicle system model (e.g., carsharing). Honda researchers recognized that shared-use vehicle systems will take on various forms, such as station cars, depending on the location and application; in addition, the vehicle type will also differ according to the system needs. Honda created a major demonstration of ICVS at their Motegi Twin Ring race facility in 1998. At Motegi, four different transportation modes were demonstrated that included a city-class electric vehicle (CityPal), a single-passenger utility vehicle (StepDeck), a low-speed electric vehicle (MonPal), and an electric bicycle (Racoon) *(14)*. Multiple stations were established to demonstrate the vehicles, which included a high degree of technology, such as driverless vehicle platooning and automatic docking for electric vehicles. It is important to also note that Honda promoted its ICVS concept at other locations including the U.S. CarLink I and Carlink II projects *(15, 16, 17)*, the UCR IntelliShare system *(18)*, the Keihanna system *(14)*, and their latest project, Honda Diracc in Singapore *(19)*.

Also in the late 1990s, Toyota Motor Company launched their carsharing concept with a major demonstration in Toyoda City called the Crayon System, serving many of the Toyota Motor Company facilities *(20)*. The Crayon system consisted mainly of small city-class electric vehicles (Toyota ECom) that could be used for business purposes during the day, with a subset available for commute purposes. As such, the system served as both a carsharing and station car system. Similar to the Honda system, the Crayon demonstration had a very high degree of technology

penetration, including automated reservations, automatic vehicle tracking, and on-board navigation.

In addition to these vehicle manufacturer demonstrations, several government-backed, shared-use vehicle system programs began in 1999. Japan's Ministry of Construction (which later merged with the Ministry of Transportation in 2001) helped sponsor three separate systems:

- ***ITS Mobility System*** was deployed primarily as a commuter carsharing program in Osaka, targeting primarily business use, where participants would arrive by transit (or personal car), then use the shared vehicles throughout the day. Nearly 100 companies participated in this program, which had 28 vehicles and 8 different stations, before it closed in 2002.

- ***Tourist Electric Vehicle System*** was introduced in Kobe as a tourist carsharing program, which operated for approximately one year using a variety of electric and natural-gas powered vehicles, primarily serving tourists in the Kobe area.

- ***Ebina Eco-Park & Ride*** debuted in early 2000 as one of Japan's first hybrid shared-use vehicle system models. The Ebina system served commuters as a station car program (allowing them to travel to/from their home and local train station, as well as office and local station). During the day when the vehicles weren't used for commuting, they were offered for business use.

Also in the 1990s, Japan's Ministry of Trade and Industry (MITI) formed an external organization for promoting ITS called the Japan Association of Electronic Technology for Automobile Traffic and Driving (JSK). (JSK later became part of the Japan Automobile Research Institute (JARI), which conducts research in intelligent transportation systems (ITS), advanced vehicle technology, and energy/environmental issues.) JSK was key in initiating two other major shared-use vehicle systems:

- ***Inagi EV-Car Sharing*** was established for residential use, with the primary target of serving as a "second-car" system, similar to the neighborhood carsharing systems now flourishing in Europe and North America. A total of 242 members used 50 electric vehicles at 5 stations from 1999 through 2002.

- ***MM21*** (Minato-Mirai 21) was initiated in Yokohama; it primarily targeted business use. The system grew with time to include approximately 50 vehicles located at 12 stations in the Yokohama area. In addition to business use, tourists and residents could use the vehicles (e.g., on evenings or weekends). MM21 was one of the few initial demonstration systems that evolved and grew, still operating today as the ITS/CEV (Intelligent Transportation System/Carsharing Electric Vehicle) City Car System.

During the period from 1998 through 2002, many of these initial demonstration programs flourished. There were several key characteristics about these systems that differed from the beginning of carsharing systems in Europe and North America:

1) One interesting characteristic is that many of Japan's initial shared-use vehicle systems used *electric vehicles* exclusively rather than conventionally powered vehicles. This was also true of many early station car programs in the U.S. *(21)*. During the late 1990s and

early 2000s, electric vehicles were being heavily promoted worldwide as an alternative vehicle choice, providing a significant environmental benefit as well as a means to use sustainable energy sources. Significant EV penetration into the overall vehicle population never materialized, primarily due to the limited range on a single battery charge, and the amount of time it took to recharge the batteries. However, many shared-use vehicle system advocates recognized a good match between EVs and shared-use vehicle systems, primarily since many shared-use trips were generally short; further, the vehicles could take advantage of "opportunity" charging while sitting idle at their stations. In Japan, the national electric vehicle association was involved in many of the shared-use vehicle system programs, resulting in the use of many Japanese-manufactured electric vehicles. In contrast, many of the early European and North American systems had fewer electric vehicles as part of their shared fleets (with the exception of station car programs in the U.S.).

2) During the pioneering stage of shared-use vehicle systems in Japan, rather than focusing on the traditional neighborhood carsharing models of Europe and North America, many alternative approaches were investigated and implemented (for a detailed list of shared-use vehicle system models, please refer to *(1)*). These models included targeting business use in central business districts (MM21), investigating the use of a second-car system in residential neighborhoods (Inagi), attracting visitors to use shared-use vehicles in tourist areas (Kobe Tourist System), and using multiple stations located at areas of interest in large communities (e.g., Crayon and Motegi). Further, hybrid shared-use vehicle system models (i.e., combining station cars and carsharing) were also investigated (Ebina).

After 2001, many of the initial demonstration systems were terminated, primarily because they were not able to recover enough user fees to cover expenditures without being subsidized. Several systems did go on and continue to operate with more sustainable business models, such as the ITS/CEV system. Since 2002, a number of more conservative shared-use vehicle system operations have begun, described in the next section.

Figure 2 (below) illustrates a timeline of the number of systems, vehicles, and shared-use vehicle system members in Japan. It can be seen that due to the pioneering programs sponsored by the automobile manufacturers and governmental agencies, shared-use vehicle systems experienced rapid growth from 1998 through 2002 in Japan. After 2002, many of these programs were terminated. However since 2002, many smaller systems have emerged, and there is steady growth in the number of systems and members.

Singapore: A Brief Overview

Given Singapore's high private vehicle costs, limited access, and dense land use, it is not surprising that carsharing programs were initiated there. Mah Bow Tan, the former Communications Minister, first raised the concept as a possible alternative transportation solution for Singapore in the mid-1990s. He recognized that communal cars were more efficient and affordable than private ones, which are parked a majority of the day. In May 1997, NTUC Income, an insurance company that operates high-rise residential complexes, launched the first carsharing company in Singapore—modeled after European carsharing. Approximately US$902,500 was allocated to NTUC Income's program launch in the estates of Toh Yi Drive and Serangoon North *(22)*. Since this initial launch of Car Co-Op (described in detail later) by NTUC Income, three subsequent programs have opened. These include CitySpeed and Honda DIRect ACCess (Diracc),

who both started operations in 2002 *(23)*. WhizzCar followed these two programs in 2003. Three of the companies focus on the neighborhood carsharing model (i.e., two-way rentals—vehicles are rented and returned from the same lot—from residential complexes and rail stations, primarily on evenings and weekends). Honda's Diracc program, which started as a three-year research project with support from the Singapore government, is focused mainly on business carsharing (i.e., short business and personal trips throughout the workweek). An overview of each company is provided in the following section.

CURRENT SHARED-USE VEHICLE SYSTEMS IN JAPAN AND SINGAPORE

Japan

A list of shared-use vehicle systems (carsharing, station car, hybrids) operating in Japan is provided in Table 1, below, as of March 2006. In Spring 2006, there were approximately 18 different programs with nearly 3,000 members, covering many parts of the country.

As described in the previous section, one of the largest systems that continues to operate since its inception is the ITS/CEV City Car system in the Yokohama, Kawasaki, and Tokyo areas. This system began as the government-sponsored MM21 demonstration project and has since been spun off as a separate company. The key shareholders for this company are Orix Rent-A-Car Corporation, Suzuki Motor Corporation, and NEC Corporation. There are a total of 12 stations with 27 vehicles and approximately 550 members. The primary target for this system is business use. Although one-way trips (i.e., a vehicle is taken from one lot and left at another lot) between stations are allowed, these types of trips rarely occur (i.e., two-way trips are more common, which occur when a user accesses and returns a vehicle from the same lot). This system employs multiple vehicle types including the Hypermini EV, a larger wagon EV, and gasoline-powered sedans. Each of the stations averages approximately four trips per day, where approximately 50% of the trips are business related, and 50% are personal use. In the ITS/CEV system, reservations can be made over the phone, cellular phone, and the Internet. In addition, users can use the system without reservations in an on-demand fashion.

In contrast, a more traditional carsharing network non-profit group was formed in 2002, in Fukuoka Japan. This system was developed as a grass roots citizens' organization and has expanded to four stations, with twelve vehicles and approximately 300 users. This system operates very similarly to carsharing organizations in Europe and North America (i.e., neighborhood vehicle rentals involving two-way trips). Several other systems are operating throughout Japan, many of them are fairly small at present and hope to grow larger. Since the pioneering phase of shared-use vehicle systems in Japan in the late-1990s and early-2000s, newer systems have embraced a more conservative business plan and rely less on government subsidies. Many of the systems are deployed very similarly to the European and North American carsharing organizations, with a mixture of personal and business use (see *(2, 21))* for more information on carsharing markets and business models). In terms of vehicles, many of the organizations have recognized that multiple vehicle types are an important factor, and the use of electric vehicles has diminished compared to the initial Japanese shared-use vehicle systems.

Singapore

There are four carsharing companies operating in Singapore in a market of one million licensed drivers *(10)*. They include: Car Co-Op, Honda Diracc, CitySpeed, and WhizzCar. In

March 2006, there were approximately 432 vehicles and 12,200 carsharing users *(Lewis Chen, unpublished data, March 2006)*. Characteristics of these systems are provided in Table 2, below. The authors describe each of these programs briefly.

NTUC Income Car Co-Op (Car Co-Op)

Launched in 1997 by an insurance conglomerate, Car Co-Op is the oldest and largest carsharing operator in Singapore and the only cooperative (non-profit). In March 2006, Car Co-Op served approximately 5,800 members and managed about 200 vehicles *(Lewis Chen, unpublished data, March 2006)*. In 2004, NTUC Income acquired another carsharing program, WhizzCar, which it continues to operate as a distinct brand, although cross-usage between the two programs is permitted for a one-time administration fee of US$36.10. Both locate vehicles primarily at heavy-rail stations in residential areas. Finally, Car Co-Op provides a wide range of vehicles, including: four door sedans, mini vans, gasoline electric-hybrid vehicles, and a sports car. The minimum driving age is 23 years of age. Car Co-Op plans to expand to 69 locations and potentially into Hong Kong *(22)*. In January 2006, Car Co-Op announced its partnership with KAR Club in Kuala Lumpur, which plans to launch in Spring 2006, with a fleet of 10 cars. Vehicles will be placed at rail stations, an air terminal, the city center, and Cyberjaya *(Lewis Chen, unpublished data, March 2006 and (25))*.

CitySpeed

Launched in 2002, CitySpeed was the second carsharing program to enter the market, and the first for-profit initiative in Singapore. Its parent company is Delgro, one the largest passenger transport companies in the world. Delgro also operates taxi fleets. Similar to Car Co-Op, CitySpeed is focused on two-way, neighborhood rentals. In July 2005, CitySpeed had 39 lots located at residential high rises and heavy-rail stations *(26)*. As of March 2006, CitySpeed had approximately 3,000 members and 100 vehicles *(Lewis Chen, unpublished data, March 2006)*. CitySpeed differentiates itself in the market by: 1) streamlining vehicle access/entry by mobile phone and 2) providing the lowest minimum membership age of 19 *(26)*. Despite a relatively recent entrance in 2002, CitySpeed has achieved high penetration for residential customers with over 100 vehicles. CitySpeed provides a wide range of vehicles, including compacts, four-door sedans, and minivans.

Honda Diracc

The Honda Diracc program (an abbreviation for “Direct Access”) has stationed 13 one-way lots in locations that support high trip generation, such as shopping malls, employments centers, and transit stations. The Diracc system is part of Honda’s ICVS program and has many similarities to the UCR IntelliShare program *(18)*. Diracc served 1,600 members with 62 vehicles in March 2006 *(Lewis Chen, unpublished data, March 2006)*. This for-profit operation began as an experiment led by Honda ICVS in March 2002, with support from the Singapore government. In May 2005, the experimental phase of Diracc ended, and the program is now being run as a commercial enterprise *(Ruey Long Cheu, unpublished data, July 2005)*. Honda Diracc is still fully owned and managed by Honda. The relationship that Diracc had with the government during this experiment was unique. This initial partnership was largely motivated by a joint interest in investigating a new potential market for mobility services and technology development in Singapore, which perhaps could be exported to Hong Kong and Bangkok, for instance. The Diracc program is also novel in

its use of only one vehicle class and state-of-the-art wireless technologies—over 50 Honda Civic gasoline-electric hybrids are outfitted with in-vehicle devices allowing one-way trips and instant car access without prior reservation. In April 2004, Honda Diracc revealed that 70% of their Civic hybrid fleet was used on weekends; 40% was rented for overnight use; and 18% was used during the day for business and personal trips *(19)*.

WhizzCar

WhizzCar launched in 2003, the last of the three for-profit operators to enter the carsharing market in Singapore. It is focused on two-way, neighborhood carsharing outside the central business district. In March 2006, the program supported about 1,800 members and 70 vehicles *(Lewis Chen, unpublished data, March 2006)*. Over 20 of its stations are located at residential high-rise estates and at heavy-rail stations *(27)*. NTUC Income acquired WhizzCar in 2004, which has its roots in the rental car industry. However, this latest enterprise continues to operate as a distinct brand from Car Co-Op. While Car Co-Op is a cooperative, WhizzCar is a for-profit company. Both companies support cross-agreements (i.e., enabling members of both programs to access both WhizzCar and Car Co-Op vehicles). "This win-win partnership allows both WhizzCar to tap on existing infrastructure provided by NTUC, and NTUC to tap on Whizzcar's pool of members" *(23)*. Similar to Car Co-Op, WhizzCar is supported by the INVERS carsharing system, employing electronic key boxes and smartcards to access vehicles. The minimum driving age for WhizzCar membership is 21. The program's website appears to be marketing toward younger adults and families (e.g., college students, parents of young adults, and young families). The fleet variety appears be the most extensive of the four programs with nearly 20 different makes/models, categorized by super economy, economy, executive, and van.

THE ROLE OF ADVANCED TECHNOLOGY

In Japan, nearly all of the initial shared-use vehicle systems began with a high degree of advanced ITS technology. Both initial vehicle manufacturer systems (Honda ICVS-Motegi and Toyota Crayon) employed telematics to communicate between the vehicles and system management, tracked their vehicles using GPS technology, and provided vehicle access through smartcards. The Honda system even demonstrated autonomous vehicle relocation through platooning and automatic vehicle docking. The government-sponsored programs also had a high degree of technology as part of their systems. In addition to vehicle tracking, smartcards, and telematics, these systems had advanced reservation systems that were accessible via the Internet or phone. Many of the current systems operating in Japan continue to use advanced technology since much of it was developed (under government sponsorship) during Japan's pioneering stage of shared-use vehicle systems.

Similarly, the Singapore systems also have a large degree of advanced technology in each of their four carsharing programs. Car Co-op and WhizzCar each use the INVERS system *(28)*. INVERS allows vehicle access through a two-stage process in which an onsite keybox identifies individuals by a unique smartcard/PIN and dispenses a physical car key to authorized users. Reservations are made via Internet or automated telephone system. CitySpeed uses a proprietary software system. This technology allows members to unlock a vehicle by cellphone (wirelessly) by entering a PIN received at the time of an Internet or automated phone reservation. Finally, Honda's ICVS technology, which is employed by Diracc, is more technically advanced, accommodating one-way trips among stations. Very much like the UCR IntelliShare multiple-station system in the U.S. *(18)*, users are not required to reserve a vehicle in advance (i.e., instant

rentals) nor return it at a specified time. It is important to note, however, that one-way rentals create additional costs (i.e., vehicle relocation by Diracc staff, so that the fleet does not become imbalanced with too many or too few vehicles at a particular lot). Also, members can check vehicle availability via short message services (SMS) with a mobile phone. Users can make reservations by Internet or SMS. Vehicles are accessed via a smartcard/PIN and a pop-up, ignition-based key (after the PIN is verified). This penetration of advanced technology in both Japan and Singapore is in sharp contrast to the shared-use vehicle systems that developed in Europe and North America, where systems began mostly with low technology penetration and slowly evolved towards higher technology *(21, 29)*. It is important to realize that during the Japanese pioneering stages of development, a large fraction of the program budgets were dedicated towards technology development.

MARKET ANALYSIS

As described in previous sections, shared-use vehicle systems in Japan can be characterized into two separate periods: 1) a pioneering phase where vehicle manufacturers and governmental agencies financed/promoted the launch of a wide variety of systems in the late-1990s and early-2000s; and 2) a more traditional carsharing trend (i.e., neighborhood model, little to no government funding, two-way rentals) that began in 2002, consisting of many smaller systems that are in a nascent growth phase. In general, carsharing systems in Japan have been largely promoted by corporations with a for-profit focus. These carsharing organizations continue to increase in number every year; however, the number of members and vehicles remains somewhat small among most Asian systems. In this section, we briefly touch on member-vehicle ratios, market segments, finances, organizational structure, and impacts.

Member-Vehicle Ratios

In Japan, member-vehicle ratios vary according to the target application and range from approximately 10 to 50 users per vehicle, with 20 to 25 being the common average. This is similar to Europe and Canada, overall *(2)*. Many of the Japanese systems are still relatively young and are trying to increase their member-vehicle ratios with additional users. In Singapore, carsharing has continued to expand since June 2004. Based on the aggregate member and vehicle data, the member-vehicle ratio for carsharing in Singapore is estimated at 28 members to one vehicle. Note this is the same range projected by estimates of member and vehicle numbers in Table 2 above. This ratio is similar to those reported in Europe (~ 25:1) and Canada (~20:1). This implies a more intensive use of the vehicles per member than in the U.S., where member vehicle ratios were 45:1 in June 2004, and 53:1 in December 2005.

Key Market Segments

During the initial pioneering period in Japan, a wide variety of markets were targeted by different systems, including business use, residential second-car systems (i.e., to supplement a household's privately owned vehicle), station car commute systems, university campus systems, and tourist transportation. The systems that have continued and emerged from the pioneering stage are now targeting several markets, such as business and neighborhood carsharing, typically in high-density urbanized areas. In many systems, the dominant market segment is business use. Many companies in central business districts make use of carsharing to have the convenience of a

car. For example, approximately 50% of the ITS/CEV-sharing market is business based. For the Carsharing Network Non-Profit Organization in Fukuoka, approximately 80% of the use is for business purposes; the rest is individual residents and tourists. Another trend seen in large downtown apartment buildings is the use of carsharing as a second-car system.

In contrast, many of the carsharing systems in Europe and North America are used for more individual, personal trips rather than business use. Many of the carsharing organizations in North America are attempting to tap the business-use market *(2)*, where in Japan, this is the norm. The primary reason that personal individual use is less in Japan is that there are already many other available public transportation modes. It is relatively simple for an individual (or family) to use a subway, a train, or some other means of transportation to get around whereas in the U.S. a car is often necessary.

In Singapore, there are two main markets for carsharing: neighborhood rentals and business carsharing. The predominant model is focused on serving residential complexes/rail stations outside of the central business district (CBD) (i.e., three carsharing programs focus on this market). This is likely due to high vehicle ownership costs and demand for private vehicles on evenings and weekends but not to a lack of a flourishing public transit system. These operators largely accommodate evening/weekend trips and allow tripmaking to Malaysia, which Diracc does not. Diracc, in contrast to the other providers, concentrates on the business market (i.e., short business or personal trips during the workweek). Locations served include the CBD and airport. However, Diracc has experienced increasing demand for their vehicles on evenings/weekends among its users. So, this program may modify its focus in the future to accommodate this demand, which is quite complementary to business carsharing (i.e., when vehicles are not in use by business customers revenues can be generated by neighborhood rentals).

Financial Structure

Transportation in general is fairly expensive in Japan; however, there are many different options to move about the country. To make shared-use vehicle systems appear attractive, many operators have priced vehicle use at or lower than other transportation modes (with a particular emphasis on taxis and rental cars). For example, the ITS/CEV-City Car system has an initial membership cost of approximately US$200, a monthly membership cost of US$30 to $60 depending on the plan, and vehicle use costs approximately from US$8 to $12 per hour (again depending on the plan used). This is quite competitive with a train, bus, or subway, particularly when a car is more convenient for special trips. It is interesting to note that many companies in Japan subsidize transportation costs for their employees, if they use public transportation to commute. Companies are now slowly buying into business-related carsharing to allow their employees to make business trips when a car is needed. Currently, there are no personal tax benefits or other financial provisions to those who give up driving their own cars and shift to carsharing.

The rate structures for all four carsharing programs in Singapore are quite similar—approximately US$5.70 per hour. This is not surprising in a competitive market. Interestingly, Honda Diracc charges by the minute; they have an in-vehicle navigation display screen, which calculates a fare by the minute (similar to a taxi). Presumably this is to equate Diracc to a taxi service. The cost per kilometer charge is US$0.24/km for the three neighborhood programs, and US$0.21/km for Diracc, so these rates are also quite comparable. Differences appear in registration fees and surcharges to enter Malaysia. Car Co-Op and WhizzCar (affiliated) have a higher registration fee than the other two programs. The Malaysia surcharge is higher for shorter

trips for CitySpeed (e.g., six hours) than Car Co-Op and WhizzCar. This could be interpreted as an incentive to return the vehicle at the end of the day (rather than keeping it out over an entire weekend).

Organizational Structure

It can be seen in Table 1 and Figure 2, above, that the number of shared-use vehicle systems in Japan continues to grow; however, the majority of these systems are quite small compared to other systems around the world. Although there has been some attempt at organizing carsharing efforts across Japan (e.g., in November 2003, a Japan Carsharing Workshop was held in Tokyo where many carsharing advocates gathered to discuss key issues of carsharing and its future in Japan *(24)*, there do not appear to be any larger cooperative systems evolving in the near future. However, the ITS/CEV City Car system has recently made an attempt to unify system operations by providing an Application Service Provider (ASP) package that other systems can use in terms of reservations, local area management, and vehicle use. In Singapore, there is cooperation between two of the four existing systems (i.e., WhizzCar and Car Co-Op). Joint membership activities between Diracc and Car Co-Op were attempted, starting in November 2003; however, they were later discontinued. As part of this partnership, members who joined either company were granted a discounted membership rate if they joined the other program *(30)*..

Impacts

Recently the ITS/CEV Corporation in Japan conducted surveys and public hearings with its corporate users and found that the City Car System has had a “strong impact” on their businesses in terms of better corporate efficiency when using City Car Sharing rather than using buses or train *(31)*. It was found that carsharing business use continues to grow because companies see it as a means to save on transportation expenses (e.g., car lease/rental). In addition, many companies want to promote an environmentally-friendly public image that can be gained by promoting carsharing. Many of the other carsharing organizations in Japan often reference how environmentally beneficial carsharing can be, calculating the number of kilograms of pollutant emissions saved through the use of cleaner vehicles in a carsharing fleet. To date, no independent studies have been conducted in Japan on the quantitative impacts of carsharing (e.g., vehicle-kilometers-traveled saved, pollutant emissions reduction, increased transportation efficiency, etc.). Carsharing in Singapore is focused largely on providing more individuals with access to private vehicles (i.e., mobility). This objective appears to be met, at least in part, by the market’s growth since 1997—both in terms of members and number of programs. Based on the authors’ review of the literature, social and environmental impact data are not available to date.

SUMMARY AND CONCLUSIONS

In Asia, the majority of shared-use vehicle system activity has been primarily in Japan and Singapore. Similar to North America, the majority of these systems began in the late-1990s and early-2000s. Japan had a distinct pioneering phase of activity where several government-supported systems were established and vehicle manufacturers launched demonstration systems in the late-1990s. Many of these original systems have been terminated and now a number of newer, smaller systems (approximately 18) are beginning to flourish with more conservative business models. In Singapore, carsharing shows promise as a cost-effective transportation alternative,

given the high cost of private vehicle ownership and dense land-use patterns. Four carsharing organizations have evolved, focusing on neighborhood (primarily) and business-use carsharing (approximately 432 vehicles and 12,200 members as of March 2006). It appears that carsharing activity will continue to grow at a steady pace in both Japan and Singapore. Furthermore, KAR Club plans to launch in Spring 2006 in Kuala Lumpur, Malaysia.

There are several interesting characteristics of these systems, summarized below:

- Both Japan and Singapore have a very high level of technology penetration in most of their systems. In Japan and Singapore, much of this came about with their governments promoting the use of ITS technology including smartcards, automated reservation systems, and vehicle tracking and management. This high penetration of advanced technology was established early in the development of these systems, in contrast to the systems that have developed in Europe and North America.
- The primary carsharing focus in Japan is on business use and on neighborhood residential in Singapore. This is likely due to limited vehicle licensing and high car ownership costs in Singapore.
- In Japan, there is currently a lack of larger carsharing organizations that handle multiple locations (with the exception of the ITS/CEV City Car System). Instead, there are many smaller systems with little cooperation between them. Singapore has four systems with some limited cooperation. As with Europe and North America, the authors expect that larger organizations will evolve in the future through growth and mergers.
- In Japan, shared-use vehicle system use will continue to grow at a slow, steady pace. The main barrier to carsharing in Japan is likely the large number of available transportation modes that are offered at a reasonable price. Another barrier that existed in the past was that the government classified carsharing as a “rental-car” business and required that management operations be within 2 kilometers of the “rented” vehicle. This has recently been relaxed for carsharing organizations, promoting carsharing development at multiple, distant locations.
- Systems in Japan cite a positive environmental impact, though few have been quantitatively evaluated. Many carsharing advocates in Japan and Singapore are looking forward to receiving some type of governmental support through transportation measures associated with the Kyoto Protocol. In Singapore, carsharing was launched largely to provide private vehicle access to more individuals (due to high vehicle costs associated with the voucher system). Carsharing in Malaysia offers an alternative to a second or third auto and rising private vehicle ownership costs *(25)*.
- While North America is faced with the challenge of insuring younger drivers (i.e., individuals 25 years of age or younger in Canada or 21 years or younger in the U.S.), this does not appear to be the case in Singapore. The minimum membership age among the four carsharing companies in Singapore ranges from 19 to 23 years of age.

ACKNOWLEDGEMENTS

The authors would like to acknowledge and thank the many shared-use vehicle system organizations and experts in both Japan and Singapore for providing information on their systems. The authors also acknowledge J. Darius Roberts of California PATH/University of California, Davis campus for his invaluable assistance in gathering data on Singapore for this paper. Thanks also go to Professor Ruey Long Cheu and Alvina Kek of the National University of Singapore and

Lewis Chen of NTUC Income Car Co-Op for their expertise on carsharing developments in Singapore. This research was funded in part by various sources including the University of California, the Japan Society for the Promotion of Science, and Honda Motor Company (through their endowment for new mobility studies at UC Davis). The contents of this paper reflect the views of the authors and do not necessarily indicate acceptance by the sponsors.

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LIST OF TABLES AND FIGURES

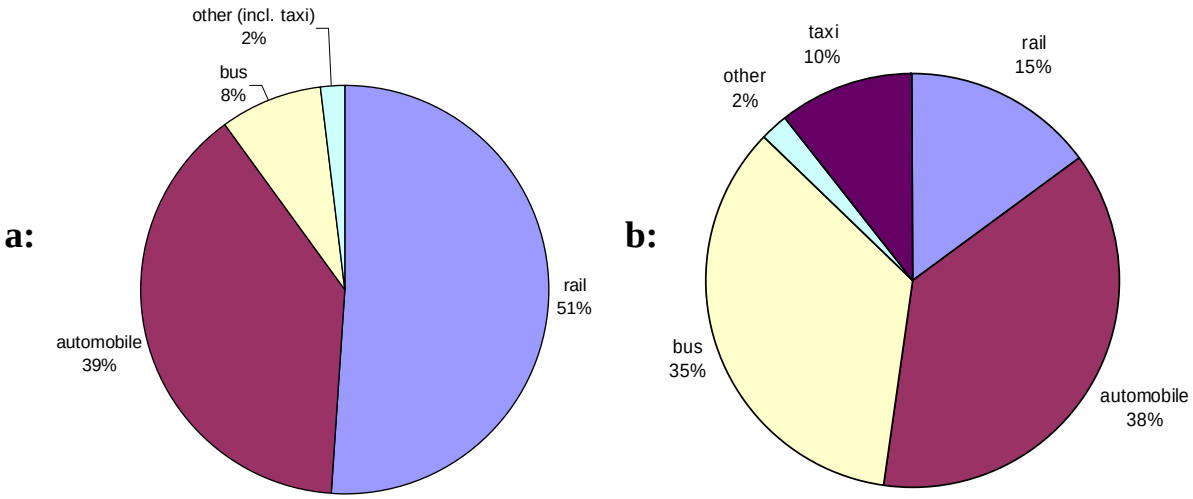

FIGURE 1 Modal share of passenger transport for a: the major metropolitan areas of Japan; and b: Singapore.

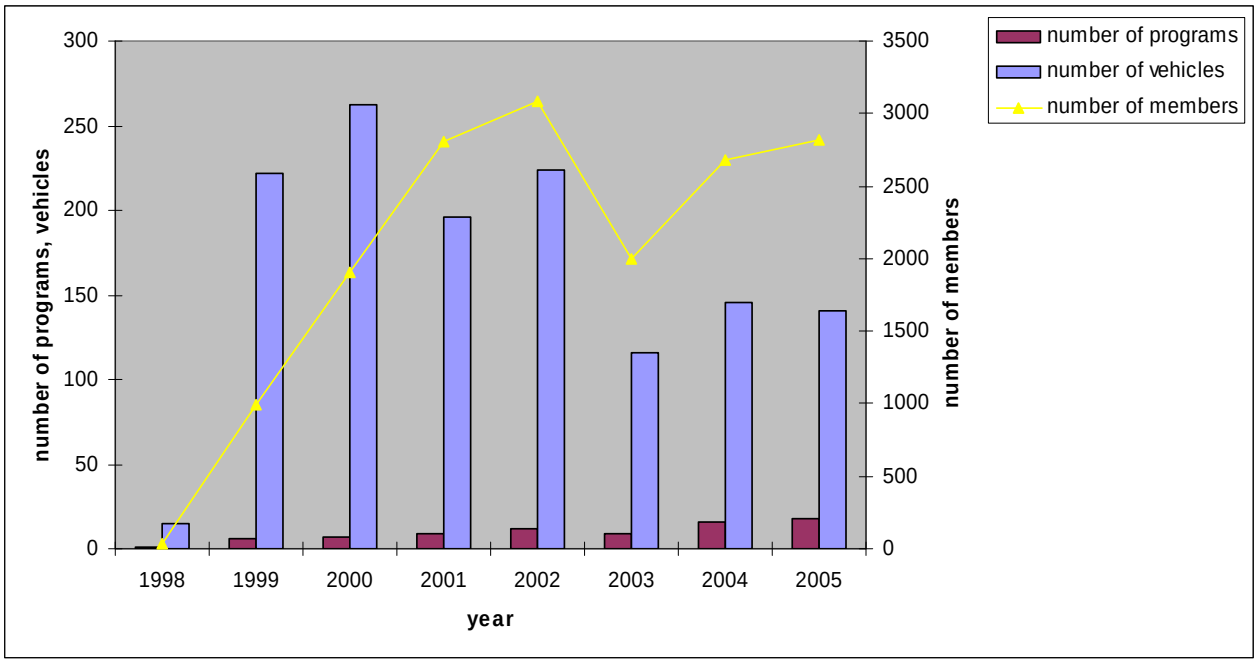

FIGURE 2 Timeline of shared-use vehicle system programs in Japan, compiled from multiple sources.

TABLE 1 Current Shared-Use Vehicle System Operations in Japan (multiple sources: *(24)* and others, updated March 2006)

Project Name	Organization	Start Date	Area of Operations	No. of Stations	No, of Vehicles	No. of Members
ITS/CEV City Car System (previously MM21)	ITS/CEV Sharing Co., Ltd.	9/1999 -	Yokohama City/Kanagawa Pref., Kawasaki City/Kanagawa Pref., Chiyoda Ward/the Metropolis of Tokyo	19	37	around 550 individuals
Toyota City Small Electric Vehicle Sharing Experiment	Toyota City	3/2001 -	Toyota City/Aichi Pref.	5	17	approximately 1700 individuals
Carshare 24 (formerly Car Sharing Network Non Profit Organization)	West Japan Recycle Movement Citizens' Group (Kyushu Electric	10/2002 -	Fukuoka City/Fukuoka Pref.	4	12	303 individuals
OUR CAR	Ido Support Ltd. Transportation Planning Asano Lab./Waseda University	2/2003 -	Mitaka City/the Metropolis of Tokyo	1	2	20 individuals
Business Use Vehicle Sharing System (mobi-system)	Nishio Rent All Co., Ltd., Sacos Co., Ltd.	11/2003 -	Edogawa Ward/the Metropolis of Tokyo and Vicinity	4	25	in the firm
Park City Tokyo Bay Shinurayasu Car Sharing System	Orix Rent-a-car Co., Ltd.	3/2004 -	Urayasu City/Chiba Pref.	3	6	150 individuals
"Orizon-mare" carsharing system	Orix Rent-a-car Co., Ltd.	12/2004 -	Koto Ward/ Metropolis of Tokyo	1	2	120 individuals
"Omori-prosuto city resident" car sharing survice	Orix Rent-a-car Co., Ltd.	3/2005 -	Ota Ward/Metropolis of Tokyo	1	2	80 individuals
Saito Car Sharing System	Hankyu Saito Development Co., Ltd.	4/2004 -	Ibaraki City/Osaka Pref.	1	3	35 individuals
Car Sharing "Choinori Club"	Station Rent-a-car Kansai Co., Ltd., Japan Railway West	4/2004 -	Shin-Osaka Station, Shin Kobe Station	2	6	no information
Shiki "Handmade Car Sharing"	User, Shiki-no-wa Non Profitable Organization	5/2004 -	Shiki City/Saitama Pref.	1	1	15 individuals
Kyoto University Campus Car Experiment for Practical use	Kyoto University Campus Car (C-Car) Operation Committee	8/2004 -	Kyoto City/Kyoto Pref., Uji City/Kyoto Pref.	3	10	15 Lab.
Linkul Car Sharing	Tokai Kyujin Service Co., Ltd.	10/2004 -	Nagoya City/Aichi Pref.	5	12	101 individuals
Windcar	Windcar Company (Sugahara Automobile Industry Co., Ltd.)	11/2004 -	Sapporo City/Hokkaido Pref.	3	3	42 individuals
UPR Car Sharing System	Ube Pallet Rental Leasing Co., Ltd.	12/2004 -	Minato Ward/the Metropolice of Tokyo	3	3	20 individuals
Town Mobile Network Kitakyushu	Town Mobile Network Kitakyushu	1/2005 -	Kitakyushu City/Fukuoka Pref.	1	2	98 individuals
Carshare 24 (Hiroshima)	Mazda Rental Car	2/2005 -	Hiroshima City/Hiroshima Pref.	8	22	300 individuals

TABLE 2 Overview of Four Carsharing Companies in Singapore

PROGRAM DETAILS	NTUC Car Co-Op	CITYSPEED	Honda Diracc	Whizzcar
LAUNCH DATE	1997	2002	2002	2003
BUSINESS MODEL	Cooperative	For-Profit	Experiment and Now For-Profit	For-Profit
CORPORATE AFFILIATION	NTUC Income (insurance conglomerate)	Delgro (worldwide passenger transportation company)	Honda Intelligent Community Vehicle System (ICVS)	Popular Rent-A-Car, which is owned by NTUC Income
MARKET EMPHASIS	Neighborhood Residential	Neighborhood Residential	Business & Neighborhood Residential	Neighborhood Residential
MINIMUM AGE	23	19	23	21
MEMBERS	5800	3000	1600	1800
VEHICLES	200	100	62	70
MEMBER-VEHICLE RATIO	29:1	30:1	26:1	26:1
VEHICLE TYPES	Wide Range (12 Makes/Models)	Wide Range (11 Makes Models)	1 Vehicle Type (Honda Civic Hybrid)	Wide Range (18 Makes)
ACCESS/RETURN MODEL	Two-Way	Two-Way	One-Way	Two-Way
RESEVATION METHOD	Online, Automated Phone System	Online, Automated Phone System	Online, Automated Phone System, or Text Messaging	Online, Automated Phone System
VEHICLE ACCESS METHOD	Smartcard/PIN and Keybox	Smartcard/PIN	Cellphone, PIN, and Smartcard	Smartcard/PIN and Keybox