

Integrative Sustainable Concepts for Individual Mobility in Asia - A Qualitative Analysis of Carsharing and Taxi Services in Singapore

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Abstract:

Singapore has a unique and proactive approach towards managing the national transport system. This article explores the integrative approach of carsharing into the overall transport system from an individual sustainable mobility perspective. The authors argue that for Singapore, taxi services are the strongest competitor for the establishment of free-floating carsharing systems. Low taxi fares and a high distribution rate provide easy access for consumers and show great advantages in correspondence with the prevalent transport measures. Furthermore, the Singaporean government considers taxi services as part of public transport that helps bridging public transportation gaps in door-to-door travel. The article draws on literature review and expert interviews to evaluate the current market conditions and analyse the pros and cons of carsharing systems and taxi services as integrated part of the public transport system. The authors conclude by stating that from a sustainable perspective, the goal is to replace private car ownership. Provision of multi modal choices and therefore co-existence of different individual transport opportunities is indispensable.

Key words: carsharing, taxi, Singapore, mobility, sustainability, transport

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1. Introduction

Recent discussions on environmental and climate impacts of rising vehicle population foster the on-going search for sustainable mobility concepts. Consequently, it is interesting to look at cities that already have a well-developed transport system as well as a proactive approach towards handling individual mobility. Concerning Asia, Singapore is a good example when looking for role models of sustainable transport management.

Recent growth of alternative models related to the enhancement of individual mobility, such as carsharing, show the efforts for promoting development towards greater sustainable mobility. Singapore serves as the example for this research paper as it is the first Asian city that is able to report about carsharing schemes from 1997 onwards, closely followed by Japan with initial starts of demonstration projects in 1998 (Barth, 2005, p.5 et sequ.). The recent increase of carsharing schemes around the world directs attention to the question on how this growth is reflected in Asian countries where the taxi business mostly serves the purpose of closing public transportation gaps. As Singapore is very advanced in terms of integrative public transportation solutions, it serves as focus of this research. As taxis are considerably cheap and stronger integrated into individual transportation solutions, prior research raised the question whether the taxi in Asia is not already serving a similar purpose as carsharing now does in European and Northern American countries where e.g. cost per taxi ride is significantly higher (Weithmann, 2013).

This research is divided into three parts. The paper first introduces relevant key-terms to establish a clearer understanding of carsharing and sustainable transportation. The article then gives a brief synopsis of the Singaporean carsharing development in relation to local traffic management measures. The third part establishes the discussion in context of the prevailing taxi businesses. The follow-on assessment highlights major flaws and possible solutions.

1.1. Definitions of Key Terms: Sustainable Mobility and Carsharing

Sustainability of transportation systems became important when increasing concerns on climate change and environmental pollution gained public awareness. In the Mobility 2030 report published by the World Business Council for Sustainable Development (WBCSD, 2004), sustainable mobility is defined as “the ability to meet society's desires and needs to move freely, gain access, communicate, trade and establish relationships without sacrificing other essential human or ecological values, today or in the future”. This involves all affordable forms of mobility with low impact on the society and the environment, thus the modes walking, cycling, public urban transit but also green mobility and logistic concepts. It leads to building or protecting urban transport systems that are fuel-efficient, space saving and promote healthy lifestyles. Moreover, a sustainable transport system is accessible, safe and affordable (ECMT, 2004). These concepts often integrate different transport modes with minor attention on private transport approaches.

Carsharing systems are usually defined as a fleet of vehicles shared by a certain group of users. If demanding access to such fleets, users typically need to join a user group and pay

membership fee. The user will then pay upon usage, which is charged by time, by distance or a combination of the two factors. Operators of such carsharing systems usually provide fuel, vehicle maintenance and insurance for the cars. Thus, carsharing can also be described as a transportation mode between conventional car rental and taxi (Kek et al., 2009, p.150). As customers can drive between two or more locations, they are less depended compared to general public transport. Users can still drive on their own and bridge public transportation gaps especially when door-to-door transport is needed, such as for transporting larger baggage or heavy goods, without having to own a car.

In terms of business relevancy, there is a difference between non-profit and for-profit carsharing schemes. Non-profit carsharing schemes are mostly referred to as “car clubs”.¹ These have the primary aim of adding convenience to the daily mobility. This characteristic can also be found for carsharing schemes related to condominiums where large housing operators offer a car club to tenants in order to provide an additional service. Opposed to this, there are for-profit business models that mostly include larger user groups. Anyone who is fulfilling basic ground rules such as minimum age is then obliged to attain membership.

As the carsharing market is growing at rapid speed, several different business models emerge simultaneously: First, there are conventional carsharing models that require users to pick up and return their vehicle at the same parking station: two-way carsharing. One rather exotic form of this type is peer-to-peer exchange, meaning that someone provides his personal car for usage by other members of the same community. Moreover, as competition increases within conventional schemes, carsharing providers try to offer greater flexibility regarding additional stations where users can return the cars after usage, the one-way carsharing within a certain area. This can be further expanded by offering flexible return-times, which often leads to disproportionate distribution among stations and causes the necessity for periodic relocation processes to ensure that vehicles are spread evenly and in accordance with demand among stations (Kek et al., 2009, p.150). Another business model is the operation with free-floating vehicle fleets. Instead of picking-up and returning cars at fixed stations, this allows hiring a car and leaving it at any point within a restricted area: Flexible one-way travel (Firnkorner & Mueller, 2011, p.1519). Enterprises offering such carsharing systems are joint businesses between car manufacturers and car rental companies such as ‘car2go’ (Heuer, 2013, p.102) or ‘DriveNow’. These systems mostly operate without previous booking arrangements. A disadvantage of free-floating systems is certainly that unless there are dedicated parking spots, customers have to find spots by themselves. This is especially difficult in larger cities. In Germany for instance, the average duration for finding a parking spot is ten minutes whilst driving 4.5 km (n-tv, 2013).

In summary, there is no common definition of carsharing. As there are several categories such as station-based, free-floating and others, it is very hard to draw a clear line between carsharing and conventional car rental. Especially as car rental companies nowadays offer more flexibility, for example as cars can be returned at another station for little surcharge, the two types share similar characteristics. Honda used the definition of a ‘vehicle-on-demand system that provides its members the freedom to pick up and use its cars from any of its ports - designated car parks at various strategic locations’ (Honda Diracc, year n/a). Based on the

¹ The term ‘Car club’ mostly refers to communities that share same interests in automotive transport or vehicle brands. It can therefore be assumed that the term also established for non-profit carsharing schemes. In this case, the term ‘car club’ also reflects a community that shares same interests, here it is sharing cars. As this is a personal proposition for explanation, further research is required.

review of the different concepts, the most significant aspects that separate carsharing from car rental are the following three buzzwords used in the previous definition: (1) ‘on-demand’ as this signifies flexibility and short-term usage, (2) ‘freedom to pick up’ which signifies spontaneity and last but not least (3) ‘strategic locations’ which indicates the availability of cars within reach. If conventional car rental companies fulfil all these keywords, they also deserve the label ‘carsharing’. This implies the assumption that the wording as well as definition is partly impacted by linguistic marketing tools that intend to give current concepts a trendier image. However, the usage of the carsharing term for this paper is defined as one-way station-based and free-floating scheme, if not pointed out otherwise. From the author’s understanding, carsharing as an integrative part of new mobility concepts in urban areas targets the ultimate purpose of challenging and finally replacing private car ownership by large stakes as a contribution to a higher level of sustainability.

1.2. Carsharing - A Sustainable Mobility Concept?

The question whether carsharing can be considered as a sustainable mode of transport is prevalent in the on-going discourse. Main arguments pro or contra the perception of carsharing schemes focus on the set-up of public transport infrastructure in cities, which enable more or less sustainable and integrative solutions. This debate is closely linked to the respective type of carsharing. While there is proven evidence that station-based carsharing systems with about 23.5% of users minimizes the number of vehicles per household, free-floating systems on the other hand are mostly considered as being less sustainable (Brüninghaus, 2013).

According to Firnkorn (2011, p.1521) free-floating carsharing systems only show positive environmental impact if integrated in mobility systems that enable large-scale effect and therefore reduction in vehicle usage. However, the impact on vehicle ownership in metropolitan areas is still insufficiently investigated. Firnkorn further outlines that carsharing schemes have influence on static land consumption as less cars are needed in case that an increasing number of people make use of the carsharing scheme. However, research on dynamic land consumption² is not yet complete. A study on corporate carsharing in Bremen and Stockholm even showed that offering corporate carsharing decreased the number of people commuting to work by their own car but increased the total mileage driven by the employees due to the better access to cars (Rydén & Morinet, 2005, p. 29 et sequ.).

Long-term studies on free-floating systems have just recently started and need further time to show results on long-term changes that affect for instance the use of public transport systems. A study on free-floating systems in Germany (Project Share, 2014) has shown no significant behavioural changes or impact on public transport usage for the first three months of usage. That initial research period was conducted until mid-May 2014. However, as the systems are still new to the market and the pre-investigation period lasted for one year, reliable outcomes are not expected before the fourth round of investigation that takes place 24 months after the application of study participants (Project Share, 2014).

² Static land consumption: Total surface required for vehicles such as for parking; in case of decrease, more space becomes available for e.g. public transportation, buildings, parks, etc.

Dynamic land consumption: Number of vehicles moving simultaneously; in case of decrease, it causes less congestion, emissions, change of composition between private and public transport (Firnkorn & Mueller, 2011).

Concerning further research on the consumer groups of free-floating carsharing systems, most users of station-based carsharing systems are between the age of 17 and 39 while those of free-floating systems are even younger, with every second user being below 30. Those users perceive free-floating systems as trendy and emphasize their preference for a distinct variety of different car models. Furthermore, about 90% use the cars for less than an hour (Brüninghaus, 2013). This matches the results of another study on usage motives, which highlights that those consumers who are environmental conscious need to be addressed by carsharing concepts that are based on fuel-efficient vehicles, while those consumers who are rather convenience-oriented can be attracted through provision of dedicated parking spots or free-floating systems (Schaefers, 2013, p. 75). We can therefore assume that most free-floating users are young urban citizens that are less dependent on regular car use.

Regarding the sustainability definition, also certain vehicle types, such as electric cars, need to be considered. When integrating electric cars into the overall electricity grid or by powering them by renewable energy sources, electric cars contribute significantly to sustainable approaches. As a side effect, electric cars reduce particulate and noise pollution. Several cities such as Amsterdam or Berlin provide first examples for electric carsharing. Another factor should not be underestimated: The positive demonstration effect. Carsharing allows people to experiment with new technologies such as hydrogen or electric cars. This might affect proceeding car purchases. Thus, the most positive effect of carsharing trials by customers would mean the decision against private car ownership; or at least second car ownership.

1.3. Research Method

The literature on the Singaporean carsharing market is sparse. Detailed material can be found for the period between 1996 and 2005 (Barth & Shaheen, 2005; Seik, 2000) while thereafter, research literature is rather limited. Starting from 2010 onwards, carsharing literature became again more elaborate but focuses less on the Singaporean carsharing market but rather on Europe and North America as the topic of carsharing has become more and more popular in these regions, especially in respect of climate and environmental discourse. Major publications concern the development of carsharing schemes such as car2go by Firnkorn and Mueller (2011).

This research is based on literature review while further research for this paper has been conducted through media and newspaper analysis of larger Singaporean daily and weekly newspapers. Furthermore, carsharing is a popular topic in Singapore that is frequently discussed on blogs with opinions about the schemes often going astray. Nevertheless, the analysis of the different schemes, when handled objectively, is perceived valuable. Moreover, the authors conducted semi-structured interviews with industry experts to investigate further recent developments. The research was continued as early findings questioned the necessity of carsharing in opposition to established taxi schemes. Further contact was established to taxi companies as well as taxi drivers to gather additional information. This paper therefore aims at getting a clearer definition on current developments and activities of the Singaporean individual mobility solutions while giving respective suggestions and recommendations concerning the further development.

The main two main sections on carsharing and taxi businesses concentrate on potential of free-floating schemes, which are still non-existing in Singapore, in comparison to established taxi services from a sustainability perspective. The focus on free-floating schemes was chosen as these schemes are currently popularized in several countries. Conventional car rental companies are not considered throughout the research as most of them focus on renting cars for entire days and therefore offer less flexibility as opposed to free-floating and taxi.

2. Transport in Singapore

Singapore is a city island-state with 650 km² in area and a population of 5.4 million (CIA World Factbook, 2013) resulting in a density of approximately 6400 people/km² (Barth, 2005, p.4). Throughout the last thirty years, Singapore's population has grown by 90%, which reflects in an annual population growth rate of 2%. In order to plan future mobility requirements, the anticipated growth rate until 2020 is less than 1% per annum which will result in a population of 5 million people (May, 2004, p.80). If researching Singapore, it is also necessary to be aware of the geography as well as the ethnic and cultural background that further increases interest in Singapore regarding concept trials of transport measures.

The transportation system of Singapore has been analysed by various researchers, as it is unique in many respects. Therefore, it can be seen as 'test bed' for developing various transport management measures. After proving its feasibility and economic viability in Singapore, these measures have been transferred or copied by several cities all over the world. A famous example is the urban congestion charge scheme, which became a model for other urban regions such as London and Shanghai. Therefore, in terms of practical purposes, Singapore's transport system developments have been internationally observed and elaborately investigated.

2.1. Local Transportation Market in Singapore

Most impact for the growing transportation market seems to be created through the combination of rapid population and economic growth in Singapore as travel demand has outpaced the development of roads. To catch up with demand, Singapore has introduced several strategies to improve the management of the transportation system. These include integrating land-use and transportation planning, providing a high-quality public transportation system, developing an improved road network and extend its capacity while restricting vehicle ownership and road usage.

The responsible agency for management and administration within the transportation sector is the Land Transport Authority (LTA). The LTA is responsible for land transport strategies, which include decisions on land use, transportation planning, improvement of the public transportation system such as traffic management systems and effective transport demand management (Seik, 2000, p.76). The authority act as a central bus network planner, policy maker and regulator (LTA 2014). The LTA leases operating licences to private public transportation service operators. Two companies share the operation of bus services and the rail system, the SMRT Corporation Ltd., which was found in 1987 for the operation of the first mass rapid transit (MRT) system (SMRT, 2014a). In addition to SMRT, the SBS Transit Ltd., is responsible for one MRT line, one underground heavy rail system and two local Light Rail

Transit (LRT) systems (SBS transit, 2014). The public transportation in Singapore currently counts 8.9 million journeys a day and is expected to grow to about 14.3 million journeys a day by 2020 (LTA 2013 (d)). The public transportation systems therefore serve as important backbone for the overall transportation planning in Singapore.

2.2. Traffic Management Systems in Singapore

The growing motor vehicle population for private cars can be derived from figure 1, which shows a continuous increase between 2008 and 2013. The private vehicle population covers an overall 55.2% of the total vehicle population at 969,910 in 2012 (LTA 2009-2012e). In order to keep up with the continuous increase in vehicle population, the expansion program for road vehicles was implemented accordingly but vehicle population growth was slowed down to 0.5% per annum. The LTA also targets to further slowdown growth of road expansion to about 0.5% over the next 15 years (LTA, 2013d).

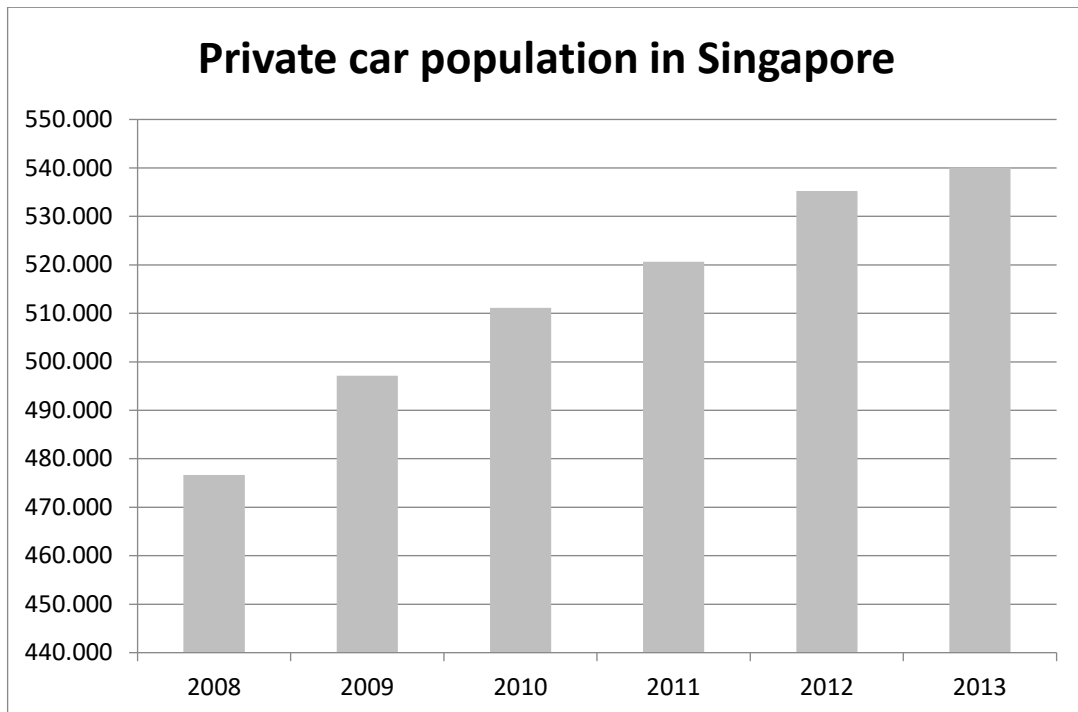


Figure 1: Increase in private car population between 2008 and 2013 (LTA 2009-2013e).³

So far, Singapore has proven a very proactive approach in regulating and managing individual transport (Barth, 2005, p.4). One major tool is the Electronic Road Pricing (ERP) that enables automated deduction of charges for road usage from the vehicle owner (LTA, 2014b). Due to strong increase in vehicle purchases, the government also uses the Vehicle Quota System (VQS) as steering tool.⁴ This enables the government to plan growth rates

³ The figure only highlights the private vehicle population, excludes company cars, tuition cars, rental cars, and off peak cars. Furthermore, taxis, buses, goods and other vehicles, motorcycles and scooters also account for the entire motor vehicle population.

⁴ Prior to 2009, the growth rate was 3% per annum. From 2009, the growth rate was at 1.5% per annum. From August 2012, the growth rate is 1% per annum. From February 2013 to January 2015, the growth rate will be set at 0.5% per annum.

according to the current traffic condition as well as road capacity. The LTA then translates this into a number of vehicles that can be added to the overall sum within the specific year. While this manner creates the possible supply quota, all those who would like to purchase a car need to bid for a license called the Certificate of Entitlement (COE). The price for COE skyrocketed from 2009 on (up to 50,000€ for a car in category B⁵) which is the effect of further policy adjustments. In terms of sustainability (see chapter 1.1), the affordability of private car ownership has outreached equality issues due to increased cost of ownership that limits private mobility to upper class citizens. A possible solution to solve this would be a license plate lottery instead of an auction. Beijing for instance implements such a policy by handing out a limited number of plates to the lucky winner for a minimum price coverage. In unison with such a policy, carsharing operators could also apply for the lottery and then offer services to a larger number of people. The argument of increase in mileage per vehicle for carsharing vehicles can then be restricted again with a respective VQS decrease.

3. Carsharing in Singapore

The earliest car sharing systems in Europe were 'StattAuto', introduced in 1988 in Berlin and 'Mobility CarSharing Switzerland'⁶ (SZ, 2008; Mobility car sharing, year n/a). After a period of carsharing as low profit niche only for alternative, ecologically aware people, carsharing schemes meanwhile began to spread around the globe. At present, the worldwide annual carsharing growth rate is measured at 20% for 2010 - 2012. There are 33 carsharing operators in 27 countries with 1.8 million members using 43,554 private cars (Heuer, 2013, p.101 et sequ). Europe counts for more than 60% of worldwide usage, closely followed by North America (Shaheen & Cohen, 2005). Four reasons act as main contributors to recent growth: Firstly, it became easier to manage car fleets due to improved technology. Secondly, social networks make it easier to address potential customers and to conduct credit assessment of clients. Thirdly, consumer behaviour of younger generations changed and car ownership became less important. Finally, people watch their money more closely that is a direct result of the recent financial crisis. However, Shaheen and Cohen (2007) suggest that carsharing trends will develop rather differently in industrialized and developing countries. This is due to differences in labour costs, organizational structure but also technology that becomes available. In addition, supplementary service such as vehicle deliveries to homes and offices are more likely in developing countries.

Asia has also introduced a variety of carsharing concepts. Looking at Singapore, the first carsharing concept derived from the idea that individual mobility should be equally accessible to all citizens. The government started thinking about carsharing alternatives when car licensing and road pricing systems increased the cost of car ownership and use. The concept, which has been developed in cooperation with the National Trade Union Congress Income (NTUC Income),⁷ aimed at improving the management of the increase of vehicle demand and satisfy demand for individual mobility (Seik, 2000, p.76). After the initial set-up

⁵ The category refers to the engine size and split into two different categories: category A (Cars \leq 1600cc & Taxis) and category B (Cars $>$ 1600cc)

⁶ A result of the 1997 merger of ATG Auto Teilet and ShareCom, both founded in 1987.

⁷ 'NTUC Income was established in 1970 to provide affordable insurance for workers in Singapore. As a social enterprise, it has the mission to provide value for customers above maximising profits for shareholders. NTUC Income is today the leading composite insurer serving over 2 million customers with about 3.8 million policies.' (<http://www.income.com.sg/>)

in 1997, carsharing mainly prevailed from 2004 onwards. Currently there are four carsharing operators in business in Singapore: Car Club, WhizzCar, iCarsClub and Smove. For more detail, see appendix 1. Hourly rates of carsharing companies are at 7-10 SGD per hour (4.10-5.80 €/per hour), while distance fee is mostly added to this cost, varying between the providers (Lin, 2012); iCarsClub charges 0.37 SGD/km (0.22 €/km). Still, the carsharing community increased by 33% between 2012 and 2013 to 8,000 users. The LTA mirrors this growth as a success of COE increase as carsharing enables people to “gain access to cars without having to own one” (Yew, 2013). Compared to the overall privately owned cars numbering 530,000 (2012), carsharing is still low in market share.

Singapore has two main markets for carsharing purposes which are business carsharing and recreational or neighbourhood carsharing, the latter being the larger part and is in focus of this study. As cost of vehicle ownership usually does not allow owning a private car for infrequent use, the demand of private use for recreational trips on weekends and evenings is high. Carsharing therefore focuses on residential living areas and rail stations outside the CBD. (Barth, 2005, p. 12). While most of the neighbourhood carsharing started by providing only one station for pick up and return, it has now spread and enables one-way carsharing.

3.1 Governmental Targets for Transport: Improvement of Existing Infrastructure

The latest transport development plan, the ‘Land Transport Master Plan 2013’ (LTMP) was issued by the LTA and serves as guidance for identifying transport initiatives that suit the need of Singaporeans and address emerging issues (LTA, 2013d). The interconnected and harmonized transport system is one of the main aims of LTA and several initiatives for improving the transport infrastructure are underway. It includes the improvement of waiting time and frequency at public transport lines, especially during peak-times. For buses there are specific programs implemented such as the ‘Bus Service Enhancement Program’ that targets the introduction of new buses services such as flexible routing to avoid traffic congestions and expansion of bus stops. Private cars are also part of changes in current transport planning initiatives. One of them concerns tax charges, increasing taxes for owners of luxury cars as opposed to budget car owners.⁸ Carsharing is also considered as contributing part to interconnect the overall transportation scheme although it is not considered as a green or sustainable solution.⁹

Additionally, the LTMP includes close cooperation with taxi companies and taxi drivers associations to fill public transportation gaps. An important improvement is certainly the plan to enhance the integration and efficiency of the public transport service through mapping the ‘total journey’ experience of customers to identify transportation leaks and improve the merger between several transport modes (LTA, 2013d). Regarding integrated land-use and transportation planning minister Lui Tuck Yew outlined that on one hand, the expansion of roads brings more convenience to public and private transport, while on the other hand it also burdens the respective residencies who live close to expressways (Cheong, 2013). Apart from these plans, carsharing has received increasing governmental attention.

⁸ LTA, 2013d.

⁹ Interview on 23 September, 2013: Government representative

3.3. Major Flaws and Possible Solutions for Carsharing in Singapore

In order to improve road capacity and accessibility of cars, the transport ministry is working together with the Housing and Development Board (HDB) in order to make carsharing more accessible in remote areas. Both parties consider liberalization of the current private car rental schemes and facilitating peer-to-peer carsharing as one solution (Yew 2013). Under jurisdiction, it is not allowed for private car owners in Singapore to rent out their cars through car rental companies (LTA, year n/a, b). However, as already practiced, it is allowed to use platforms to interchange private cars through networks (see appendix 1: iCarsClub).

A major obstacle for entering the carsharing market from a company's perspective is the high cost of COE, which in the end increases usage prices for customers. Therefore, even if strict transport measures might prevent personal car ownership, COE drives up costs for starting carsharing businesses significantly. While taxis are listed in the less costly category A¹⁰, a special category would be needed for carsharing fleets to offer their service at similar conditions as taxi businesses, enabling lower cost per ride. Taxis are considered as a major mode for interconnecting public transportation gaps in Singapore while carsharing is considered as private transport.¹¹

Whether advantageous treatment of carsharing fleets would increase the affordability of mobility in accordance with low impact on the society and the environment needs to be handled with caution. Giving the choice between two options – taxi and carsharing – certainly would add value to the discussion of inequality issues concerning ownership options. However, further studies are needed on the customer motives of free-floating users as an increase in consumers and vehicle mileage travelled would be less beneficial to the overall urban population.

Regarding further governmental support, the inherent advantages of carsharing as a sustainable mode of transport need to be challenged in terms of overall gain for the transport system. However, the only provable environmental advantage caused by carsharing is the reduction of static land consumption. Nevertheless, static land consumption is of less concern in Singapore where on-road parking is mostly forbidden. But in case that carsharing is associated with an overall decrease of VQS, it would be possible to decrease space needed for parking spots and turn them into places for recreational use and societal interaction.

In contrast, the dynamic land consumption, caused by the traffic is a more important issue, which requires further research. Additional investigation is also required regarding behaviour change of vehicle owners. It would be of great interest whether the provision of free-floating carsharing schemes would have a long-term impact on vehicle purchase decision of current vehicle owners (as known for users of conventional carsharing schemes). Furthermore, there is still discourse missing on specifying from which user sections the users of free-floating carsharing systems come from over the long run. Especially as shifting users from public transport to carsharing would rather cause a negative and unsustainable impact. The provision of cheap individual transport options such as free-floating schemes are propagated to foster such shifts from public to private transport.

¹⁰ Categories relate to tax affiliation, which are less for taxis than for private cars of the same engine capacity.

¹¹Additional information received on February 6, 2014 by a government representative.

4. The Taxi in Singapore

Similar to the carsharing business, NTUC started its taxi-cooperative in the 1970s. This was required in order to provide a legal basis to taxi drivers. Usual practice until 1970 was that taxi drivers started their own business by purchasing old vehicles and operating without official license, so-called ‘pirate taxis’ (Ibrahim, 2003). From 1970 on, legally established taxi companies started their service. Since the liberalization of the taxi industry, the government does no longer regulate fares or supply of taxis (LTMP, 2008, p.38).

Singapore has a taxi population of 5,129 taxis/m habitants which is, compared to other major cities that are investigated in the LTMP 2008 such as London (3,285 taxis/m), New York (1,522 taxis/m) or Hong Kong (1,522 taxis/m), the highest number of taxis in relation to the population size. Further, additional services such as limousine taxis and taxi tourist guides are in place (LTMP, 2008, p.16). Local taxi fleet operators therefore cover most market demand for individual public transport. Currently, there are seven different taxi businesses in operation; these are Comfort Taxi, City Cab, SMRT Taxi, Trans-Cab, Premier Taxis, Prime Taxi and Yellow-Top Taxi (Taxi Singapore, n/a). The license of the eighth company ‘Smart Cab’ was not renewed in 2013, as they did not fulfil the “Quality of Service Standards” (QoS) (LTA, 2013g).

4.1. Governmental Involvement Related to the Taxi Business

As the demand for transportation grows, the taxi population also grows (figure 2). When comparing the numbers, the taxis population is a lot higher than that of carsharing vehicles. Still, as private vehicle ownership is limited due to the VQS, the taxi growth rate is limited to 2% per annum, according to the historical growth rate of taxi ridership. However, growth is only granted to those companies that fulfil the required ‘taxi availability standards’ (LTA, 2012f).

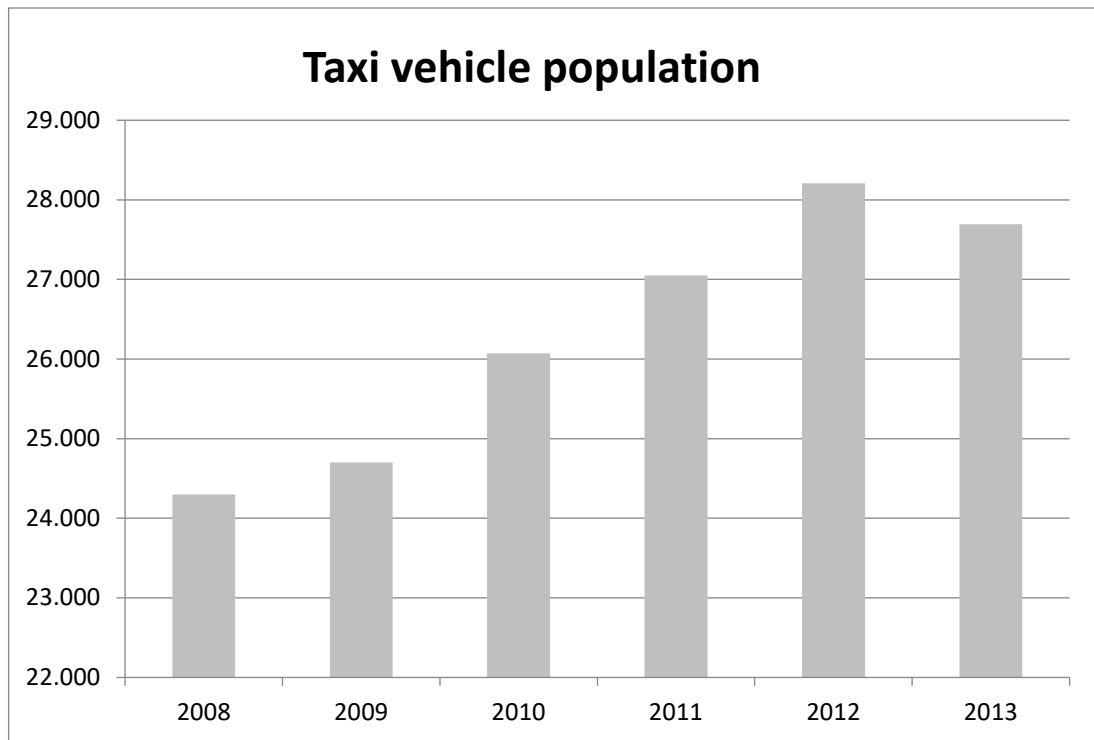


Figure 2: Increase in taxi vehicle population between 2008 and 2013.¹²

Low cost per ride as well as efficient taxi fleet-management that is adjusted to customers' travel patterns creates a strong position if compared to non-established free-floating carsharing schemes. Depending on the taxi company and the type of car, the taxi ride starts at about 3 SGD (1.75 €) and then charges about 0.22 SGD (0.13 €) per 400m, waiting time is charged with 0.22 SGD (0.13 €) for 45 seconds (SMRT, 2014b).

One interviewee¹³ mentioned that he witnessed several foreign carsharing operators investigating the market but so far none of them has come back to start their business in Singapore. Therefore, he assumes that free-floating schemes simply do not fit the current market situation, as not conventional carsharing companies but taxi companies cover this segment. The LTMP (2013, p.32) mentions the target to improve both schemes taxi and carsharing. Nevertheless, it is about the establishment of further carsharing ports in HDB estates, not free-floating schemes. So far, the allocation of HDB ports is split between CarClub and WhizzCar that approach the HDB to obtain parking space in case they spot business potential.¹⁴

4.2. Major Flaws and Possible Solutions

One important fact is that hiring a taxi is relatively cheap in Singapore and most other Asian countries. In addition, going by taxi is easy as they are usually well distributed. The government strongly supports taxis as major transportation mode to bridge public transportation gaps. One measure is the provision of additional taxi stands in the CBD,

¹² LTA 2009-2012.

¹³ From interview on June 13, 2013: Singaporean carsharing operator

¹⁴ Additional information received on February 6, 2014 by a government representative.

enabling commuters to reach taxis stands within the maximum of a 5-minute walk (LTMP, 2008, p.37).

As usage prices for taxis are low, the consumer considers taxi use as convenient. However, a major problem still concerns the availability of taxis when taxi demand surges such as during rainstorms and peak travel time. During peak-hours, taxi surcharges of 25% of the metered fare have to be paid by the customer (SMRT, 2014b). Further availability problems are the result of the fact that mostly two drivers share one taxi. As earnings are better during peak-hours, drivers usually have an agreement to allocate either the morning or the evening peak-hour to one or the other driver. As the morning shift starts at around 5 am and lasts for about 12 hours, the driver need to shift between 4.30 and 5 pm (Frois, 2013). This also impacts the availability of taxis within the early evening period. The government tries to improve the availability of taxis by introducing the 'taxi availability scheme', which forces taxis to drive 250 km per day that equals about 30 trips per day (Frois, 2013). It is therefore argued that 30 trips per day is a much higher ratio than that of most carsharing providers.¹⁵ This means higher usage and therefore greater profitability. According to the 2013 published LTMP, the target was even increased from 65-70% of taxis on roads during peak hours to 80-85% until 2015 (LTMP, 2015, p.32).

Carsharing companies usually argue that free-floating carsharing systems are more sustainable, since taxis spend lots of time on the road in order to find a customer. Free-floating carsharing fleets on the other hand stand still while not in use¹⁶ However, at the current stage of technological development, this argument can no longer sustain. Mobile phone applications and short message correspondence with taxi service stations that allow customers to search for the nearest taxi and call the taxis via one click on a mobile phone application. Singaporean taxi companies nowadays rely on wireless and GPS satellite tracking in order to trace passenger calls or pick-up locations and further advance their service. This also allows the development of customers' travel patterns and therefore a suitable distribution and availability of taxis (Tan, 2006, p. 8).

5. Conclusion and Outlook

This paper outlined how the integration of carsharing into the daily life of individuals could help building urban transport systems that are fuel-efficient, space saving and promote healthy lifestyles. It also explained how taxis already cover most clusters of society's daily demand in a way that is comparable to carsharing. The investigation of these concepts derives from the prevailing situation that personal car ownership in Singapore is extremely costly due to high taxes and tariffs. New mobility concepts need to be investigated and test-bedded to provide and secure long-term and sustainable solutions of private transportation solutions for both, individuals as well as the society as a whole.

The government favours an improved integration of taxi services and further expansion of public transport as this show most potential in Singapore. Apart from conventional carsharing and car rental concepts, free-floating carsharing schemes have the highest potential to serve as an alternative to the taxi business. Nevertheless, they currently do not play a significant role in Singapore and the contribution of free-floating, in contrast to conventional

¹⁵ Interview on September 23, 2013: Governmental representative.

¹⁶ Interview on June 8, 2013: Project lead carsharing operator (not in SIN market).

carsharing schemes, requires clarification. While free-floating carsharing might create an interesting transport alternative for European or American customers where taxi fares are high, the strong focus on affordability of the taxi service and integration of taxis in the public transportation network in Singapore creates an entirely different environment.

As carsharing is becoming more popular nowadays, it is most certain that it will also move to the centre of interest when referring or working on diverse transport schemes. The authors assume that further research on country specifications will follow through a wide range of consulting companies. As there is already prevalent interest in advanced discourse on modern transport schemes and new ways of creating individual mobility, it is most likely that carsharing will move more and more towards the centre of attention for business expansion ideas. Further studies on dynamic land consumption, the major cause of interest in Singapore, are necessary.

Finally, the authors stress that in order to achieve the goal of replacing private car ownership; all diverging needs of consumers need to be covered by providing multi modal choices. The co-existence of free-floating carsharing as well as taxi services to ensure coverage of private individual mobility purposes therefore requires further investigation. While taxi use will remain in place and cover the larger stake of demand in Singapore, free-floating carsharing is an additional instrument to satisfy consumer demand. However, as there is currently little research, testing as well as implementing large-scale schemes is required to measure scientifically the impact of such a co-existence. Speaking of sustainable mobility, the overall goal should always be to create efficient and convenient public transportation solutions, as a backbone in order to reduce private transport. From the sustainable perspective, it does not matter whether the need for private transport is covered through taxi services with technically efficient steering elements or integration of carsharing solutions in the public transport network. In the end, only the impact of motorised vehicles is important, determined by their number and their vehicle miles travelled.

The findings of this investigation encourage subsequent research on diverse carsharing related topics, as there are plenty of further aspects to investigate in this new field of research.

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Appendix 1:

Company	Comment	Foundation	Market phase-out	Members
Car Co-op / Car Club	<p>Car Co-Op was launched by the insurance conglomerate NTUC (National Trade Union Congress) Income in 1997. Car Co-Op was the first and became the largest carsharing co-operative in Singapore, and for long, also the only non-profit carsharing scheme (Barth 2005: p. 9).</p> <p>Car Club (former Car Co-Op) was separated from NUTC Income in early 2010. The interviewed Singaporean carsharing operator¹⁷ explained that this was due to the government's requirement for banks and insurance companies to focus on the core competencies. Based on the earlier Car Co-Op fleet, Car Club is now partly owned by a Japanese corporate conglomerate called Mitsui Group with 58%¹⁸ in stake and the rest belonging to employees due to management buy-out by staff in 2010.</p>	1997	Operating	2,510 (2001) 11,000 (expected growth until mid-2013, not yet confirmed)
CitySpeed	<p>While Car Co-Op was a non-profit enterprise, CitySpeed was the first for-profit carsharing scheme. City Speed was owned by ComfortDelGro which is a large transport company that also manages taxi operating fleets. In 2006, CitySpeed was mainly operating from rail stations and residential areas based on a two-way operation mode. CitySpeed had about 3,000 members in March 2006 and managed 100 vehicles (Barth 2005: p. 9).</p>	2002	2007	3000 (2006)
Honda Diracc	<p>The system is operated by Honda via its Intelligent Community Vehicle System (ICVS) program. Diracc is the abbreviation for Direct Access. Honda Diracc was started in 2002 (experimental stage) with support from the Singaporean government. The intention of joint effort from Honda and the government was to experiment with technology solutions and to investigate the new mobility system's potential, also with orientation towards export possibilities to comparable urban centers in Asia such as Hong Kong and Bangkok (Barth 2005: p. 9). Apart from the initial start in the CBD, the operation area was extended to residential household areas. However, Honda</p>	2002	2008	n/a

¹⁷ Interview on June 13, 2013.

¹⁸ Interview on June 13, 2013.

Company	Comment	Foundation	Market phase-out	Members
	Diracc stopped its operation in Singapore in 2008. In an interview with the Strait Times, the Managing Director Toshio Iwamoto said, "As membership grew... we couldn't maintain the service quality which we set initially, [...] everybody expected cars to be available. But in reality, we could not guarantee. There would sometimes be hiccups, and dissatisfaction and complaints from members would arise" (Carsharing US: 2008). ¹⁹			
WhizzCar	The company behind WhizzCar is 'Popular Rent A Car', a conventional car rental company. WhizzCar profited from the know-how and facilities offered by Car Co-Op and NTUC Income. For instance, WhizzCar made use of the 24-hour call center of NTUC Income (CSAS 2003).	2003	Operating	n/a
iCarsClub	iCarsClub uses peer-to-peer carsharing: Car owners can list their cars and offer it to other users while they are not driving their cars themselves (iCarsClub, year n/a). According to an interviewee, ²⁰ this was possible after restrictions on private car rental were weakened due to limited number of cars on offer for rental during public holidays and weekends. Until now, peer-to-peer carsharing in Singapore is only allowed on weekends and public holiday, given that the insurance covers such rentals.	2012	Operating	n/a
Smove	The owner of smove is Clean Mobility Singapore Pte Ltd (smove, year n/a). Apart bicycle services, smove entered the carsharing business with five electric vehicles and a testing phase that included about 200 members. The business case for smove is an exemption though as they are leasing their electric cars from another company, which is under a governmental scheme that is exempted from taxation. ²¹	2013 (in 2011 as bikesharing system)	Operating	n/a

¹⁹ The primary source of the interview in the Strait Times cannot be accessed anymore.

²⁰ Interview on September 23, 2013.

²¹ Interview on September 23, 2013.