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A Case Study on the Socio-Technical Configuration of Car-Sharing in the City of Malmö.

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Abstract: Previous research has found car-sharing schemes to have great potential, internationally and locally, to reduce greenhouse gas emissions from the personal transport sector, and contain significant locally bounded advantages with implications for improved urban sustainable mobility and more efficient land-use. The aim of the paper is to explore how and why shared mobility services, specifically car-sharing, have emerged and grown as a niche-innovation in the context of Malmö, Sweden, and to look at how the presence of car-sharing has impacted the reproduction of mobility patterns among households in the residential area of Fullriggaren. To accommodate the two areas of exploration, two theoretical frameworks are employed, that of socio-technical systems and social practice theory. Empirical findings suggest local population and urban growth as pressures instigating a municipal agenda with focus on sustainable mobility, where efficient urban land-use, politics of densification, property developers, automobile producers, and the City of Malmö play an important role in establishing the growth and socio-technical configuration of the car-sharing niche in Malmö. Qualitative data findings indicate the impact of car-sharing on some households' mobility patterns appear to be relatively limited, although there are suggestions that some changes occur.

Keywords: Innovation, car-sharing, energy, sustainable personal mobility. transition studies, socio-technical systems, socio-technical transitions, social practice theory, multi-level perspective, Malmö, Västra Hamnen, Fullriggaren.

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It is change, continuing change, inevitable change, that is the dominant factor in society today. No sensible decision can be made any longer without taking into account not only the world as it is, but the world as it will be.

- Isaac Asimov

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List of abbreviations

CIVITAS	City-Vitality-Sustainability [EU initiative]
ICT	Information Communication Technology
IoT	Internet of Things
ITU	International Telecommunication Union
MLP	Multi-Level Perspective
SMILE	Sustainable Mobility Initiative for Local Environment
UN DESA	United Nations Department of Economic and Social Affairs

Chapter 1

Introduction

Observing estimates from the United Nations (UN-DESA 2014), the world is projected to have an urbanisation level of 66%-70% by 2050, compared to 54% in 2014. The rapid urbanisation rate is expected to add further pressure to urban resources relating to increased demand for energy, water, sanitation, public services, education, healthcare, and sustainable personal mobility (UN DESA 2013; UN DESA 2014). Energy systems worldwide are currently facing significant pressures to transform into more sustainable consumption and production systems (Raven, Kern, Smith, Jacobsson, Verhees, 2016; Smil 2000; Hodson and Marvin, 2010). Furthermore, it may likely entail rising energy and private automobile ownership costs, which could encourage drivers to seek alternatives to vehicle ownership (Shaheen & Cohen 2013). Facing these macro- and micro pressures with consequences such as climate-change, and land-scarcity, we see significant increase in energy demand from developing and emerging economies, as well as depletion of resources. The topic of energy systems research has been increasingly explored in-detail in many sectors, among them transportation and mobility studies (Raven et al 2016; Van Audenhove, Korniiichuk, Daby, & Pourbaix 2014; Nykvist & Whitmarsh 2008; Berger, Feindt, Holden & Rubik, 2014).

In terms of economic and environmental decoupling, transportation is a particularly important subsystem, responsible for more than 20% of world energy and roughly one third of energy consumption in Europe (the largest two being international aviation and road-based transport) (Randolph and Masters, 2008, p.513; Eurostat 2014, p.84). In Sweden one-third of national greenhouse gas emissions originate from transportation (Plepys & Mont, 2015; Naturvårdsverket, 2008) and 94% of energy use in domestic transportation, largely petrol and diesel-based, was attributed to road transport in 2014 (Energimyndigheten, 2014).

In addition, our current land transport systems, in particular road-based forms, suffer from a wide variety of problems. These issues include congestion, noise, accidents, emissions of greenhouse gases and other air pollutants, urban land scarcity (traffic congestion and lack of parking space or green areas), inaccessibility of services and amenities, as well as challenges to pedestrian and non-motorised modes of transport (Zijlstra & Avelino, 2012; Nykvist & Whitmarsh, 2008). The transport sector is a locked-in energy intensive sector facing more difficulty than other sectors in transitioning away from fossil fuel resources, in large part due

to sunk investments costs and its trajectory of technological development (Geels, 2012; Unruh, 2000). Finally, the optimisation through higher resource efficiency not only has potentially large impacts for matters of sustainability, but also entails long-term structural change in an economy (Stahel 1997; Mont, 2004). This merits reflection, despite not being the focal point of interest in the thesis, since large-scale change in socio-technical systems tend to have an impact on the structural change of economies (see automotive vehicles, information communication technologies, and changing energy systems).

This paper presents a case study looking at how for-profit car-sharing has emerged in the City of Malmö, Sweden, and specifically investigates the impact an embedded cost-free car-sharing *membership* in a residential neighbourhood has had on changing households' mobility patterns. The paper employs two different theoretical frameworks, 1) socio-technical systems and 2) social practice theory. Through the socio-technical systems framework, the Multi-Level Perspective (MLP) is used to identify three levels within societal systems, e.g. the mobility system: the niche (micro) level, where radical innovations emerge; the regime (meso) level, which constitutes dominant technologies, institutions and actors; and the landscape (macro) level, representing macro-level trends, it is understood to comprise both exogenous and endogenous environmental, socio-economic, and cultural contexts within which institutions and actors are situated, slowly shaping trajectories of development one way or another (Whitmarsh, 2012; Geels, 2012). Social practice theory on the other hand, allows for a more in-depth micro-level perspective analysing routinized practices. Shove & Pantzar (2005) define social practice as something which actively integrates material, meaning, and types of competencies, which together join the material and social aspects of change. It is a theory which can bring about understanding of how and why habits and practices change, e.g. at the household level. It becomes a valuable complementary theory for analysis alongside the systematic approach of the MLP. A conceptual discussion and the deployment of the theories and their respective opportunities and limitations is discussed more in-detail in section 3.

1.1. Previous Research and Knowledge Gaps

Given the issues and challenges posed by land transport, which are associated with environmental, social and economic impacts, further research is warranted in the potential changes of user mobility practices for a transition to a more sustainable low-carbon system. One such subaltern segment in the sustainable mobility system is the concept of shared mobility

of traditionally private transport modes, such as cars and bicycles (Geels, Dudley & Kemp, 2012; Lane, Zeng, Dhingra & Carrigan 2015, p.4-5). Recent research has indicated the potential impact car-sharing has on automobile ownership, travel modes, and reducing pollutant emissions, discussed more in-detail in section 2 (Loose, 2010; Baptista, Melo & Rolim, 2014; Musso, Corazza, & Tozzi, 2012).

Previous studies have generally highlighted environmental impacts, economic and technical data on car-sharing schemes, the worldwide car-sharing market and the structure of car-sharing business models (Shaheen & Cohen 2013; Baptista, Silva, Farias & Heywood, 2012). However, there is still a knowledge gap relating to how car-sharing has emerged and developed in the context of the City of Malmö, Sweden, taking into account spatial and temporal aspects. Further, research on what induced mobility changes is less reflected upon in car-sharing mobility research, although some recent research has been heading that direction (Kim, Ko & Park, 2015). This research attempts to bridge a small piece of that knowledge gap in the larger socio-technical systems debate, as well as in the context of the residential neighbourhood area of Fullriggaren in Västra Hamnen, Malmö. Further, this piece of research may give new insights to local policy makers in Malmö from the learning experiences observed from the car-sharing pilot project.

1.2. Objective of the Study

The principal objective of this study is to gain a deeper understanding of socio-technical transitions at the meso- and micro scale, in part by looking at the transformation of household mobility practices, with an emphasis on shared consumption of traditionally private means of transportation, car-sharing in this case. The socio-technical systems approach is used to present a larger understanding of the context at hand, specifically relating to mobility regimes and the car-sharing niche. Within this context, social practice theory is employed at the household level in one residential neighbourhood to derive what influences access to an embedded car-sharing scheme has had on mobility patterns. Attention is primarily directed to the social and institutional aspects of transitions, without disregarding the important role factored in from technological innovations. Consequently, the overarching research question is: *Taking into account technological development, innovations in mobility services, and social awareness, what role have local and international actors played in paving the way for experimentation and development of car-sharing in Malmö since 2006, and how has it impacted on some households' mobility patterns?*

In order to approach this research question, three specific sub-questions need to be analysed:

- 1) What technical, social, and political factors have been most relevant in expanding car-sharing activities in Malmö?
- 2) To what extent are car-sharing schemes utilised by households in Fullriggaren?
- 3) What changes have occurred in households' mobility patterns since moving to Fullriggaren?

1.3. Selection of City for the Case

The selection of Malmö City in this case study was guided by the location, in close proximity to the author for feasibility in collecting primary data through interviews for empirical research, and due to the steady growth of the car-sharing business Sunfleet since its establishment in Malmö in 2006, and accessibility to secondary data. Furthermore, negotiations between the City of Malmö, involved property developers, and Sunfleet led to an agreement including “free” car-sharing memberships for all tenants for the first five years from moving in, lasting from the fall of 2011 until the fall of 2016. Now is a good time to evaluate how this partnership between different stakeholders has impacted the development of the car-sharing niche and the households' attitude towards car-sharing and their own mobility patterns.

Malmö has been a pioneering city with sustainability solutions in Sweden in many ways since the early and mid-2000s. Initially through the sustainable housing expo Bo01 in Västra Hamnen, an old refurbished industrial area close to the city centre, with a variegated emphasis on sustainability and reduced environmental impact (Austin, 2013; Foletta & Field, 2011; Plepys & Mont, 2004; Malmö, 2002). The area has since been growing rapidly with various neighbourhoods including different environmental and experimental niches, relating to sustainable housing, parking-free neighbourhoods and mobility innovations (Malmö Stad 2014a; Malmö Stad 2003). Given that Malmö is participating as an Urban Living Lab as a live incubator for innovation and experiments in buildings, transport and energy systems (Reimer, McCormick, Nilsson, & Arsenault 2012), it is clearly an experimental ground for various mobility innovations and therefore of interest to investigate further. Another, relatively recent “green niche” area, and *the focus of this thesis*, is the “Fullriggaren” residential neighbourhood (completed in late 2011) which has a lower than average parking standard, down to 0.7 instead of 1 parking unit per household which is standard.

1.4. Limitations

The relative short time span for-profit car-sharing has existed in Malmö should be denoted: 10 years, and the fact that Fullriggaren neighbourhood residents moved in late 2011, gives us a rough time span of 10 and 5 years, respectively to consider and observe. This is important for various reasons. First, transition studies of socio-technical systems are typically done retrospectively, looking at long-term unfolding of developments through various decades (Geels 2012). This case is much more short-term focused, given that it is new and part of an on-going experimental innovation environment, thus deviating from traditional transition studies. Arguably, a socio-technical systems framework can still be used, as it helps conceptualise, with the help of MLP, the current socio-technical configuration of mobility regimes in Malmö.

In order to address the fact that transition entails *change over time*, observations are made through qualitative interviews to find out households' mobility patterns prior to, and after, moving into Fullriggaren. The primary objective here is not to ascertain if in fact a full-fledged transition has occurred, but rather to observe its current progress through the theoretical lenses of socio-technical systems and social practice theory. Because this research is carried out in the study field of economics of innovation and spatial dynamics, the interest here is on observing niche- and regime groups interactions in Malmö's mobility system pertaining to car-sharing, which have occurred within the bounded geographical context of Malmö and Västra Hamnen.

Both top-down and bottom-up mobility schemes exist for these car-sharing schemes, that may be organised by either for-profit companies or non-profit organisations, usually at the local level. However, the scope of the transition investigated at hand is delimited to changes effected from top-down approaches. In this case study car-sharing services provided by Sunfleet to Fullriggaren will be focused on, as it is the only commercial car-sharing company active in Malmö.

1.5. Outline of the Thesis

The remainder of this paper is organised as follows: section 2 covers a literature review of previous research on car-sharing case studies and the state of car-sharing in the world, Sweden and in Malmö. Section 3 describes relevant theoretical concepts used to frame the research (e.g. defining transition, niche, regime, areas of innovation, multi-level perspective etcetera.). Section 4 presents the methodological approach and summarises the data collected. Section 5 presents the case study context, key actors and stakeholders, and some initial results, while Section 6 presents and analyses the current Malmö mobility regime, actor networks and emerging changes in more detail, using primary and secondary data. Finally, section 7 discusses and concludes the analysis, and providing a discussion on implications the findings have on theory and policy, and suggests areas for future research.

Chapter 2

Literature Review

2.1. Conceptualisation, History, and Current State of Car-Sharing in the World

The concept of car-sharing has been around for a long time (dating back to late 1940s in Switzerland) although it has taken until the 2000s for its growth to take off more rapidly with modern car-sharing schemes, particularly in Europe and North America (Shaheen & Cohen 2013 and 2014; Lane et al, 2015, p.22-23). From a transition studies perspective such niches take long time to develop before they mature, break through, and reach the mainstream. It occurs from a process of co-evolution between user and technology relating to increased awareness, user acceptability and improved socio-technical alignment which embeds more innovation technologies in e.g. a single technology “unit” such as a bike or car, which the user can learn to use (Geels 2012; Raven, Kern, Verhees & Smith, 2016). A more thorough account of these processes can be found in section 3, and can be seen empirically applied in the analysis.

The terminology of car-sharing has never been standardised and suffers from different conceptualisations among professionals in different fields (Le Vine, Zolfaghari, & Polak, 2014). For the purpose of this study car-sharing is defined as a mobility service comprising for-profit activities by a business for a local community of ‘qualified’ users, for a relatively low duration of time, by minutes, hours, and sometimes days (Shaheen & Cohen 2013). General characteristics include **a)** a pre-qualification process to ascertain identity of an individual, typically done through registering as a member, **b)** increasingly keyless accessibility through embedded telematics in cars through smartcards, **c)** vehicle is driven by the end-user and not a paid chauffeur, **d)** usage is billed on the basis of distance travelled as well as in time increments of minutes or hours, **e)** vehicles are distributed across a service area, optimising catchment area of users, **f)** fuelling, servicing/cleaning, and insurance is covered by the car-sharing operator, **g)** station-based and free-floating systems, the former requiring users to pick-up and leave car in the same place, while the latter allows for one-way travels (Le Vine et al, 2014).

Furthermore, car-sharing can be *open* (meaning any private person, company or organisation can become a member at any time), *half-open* (limited to specific companies or

organisations) and *closed* (only accessible by employees of a single company or organisation) (Trafikverket, 2012 in Plepys & Mont, 2015). The basic principle of car-sharing is straightforward: users gain the benefit of a private car but without the responsibilities and costs of car ownership. Individuals generally access car-sharing vehicles by signing up as members with car-sharing organisation that maintains a vehicle fleet, in a network of locations which all members have access to. The larger the organisation, the more locations are likely available, whereas the smallest ones usually only have one location (Shaheen & Cohen 2013). With technological improvements and the high degree of Information Communication Technology (ICT) embedded in modern automobiles, most car-sharing services today are managed with mixture of advanced telematics technologies including smartcard vehicle access (to unlock door), smartphone app or online instant reservation, and real-time vehicle tracking (Living; 2012; Shaheen & Cohen 2013; Berg Insights AB, n.d.)

There is a growing trend observed among younger adults (aged 21 to 30) to employ alternative transportation modes, reducing vehicle kilometres travelled (by car) and automobile ownership (Shaheen & Cohen 2013; Brown, Vergragt, Green, and Berchicci 2003). By 2010, 26 countries had officially adopted car-sharing as a strategy to reduce personal transportation and to ameliorate the negative environmental impacts tied to traditional automobile use. In these 26 countries, spanning 5 continents (Asia, Australia, Europe, North America, and South America), car-sharing schemes are operational in over 1,100 cities, with an estimated 1.25 million car-sharing members worldwide, sharing more than 31,660 vehicles (Shaheen & Cohen 2013). Car-sharing is still a recent phenomenon in emerging economies but growing very rapidly, from 2009 to 2015, the growth of cities with car-sharing in emerging economies increased from 6 to 41 (Lane et al, 2015). Figure 1 presents the historical growth of car-sharing worldwide from 1988 to 2007, seen to have started growing significantly per annum since the late 1990s.

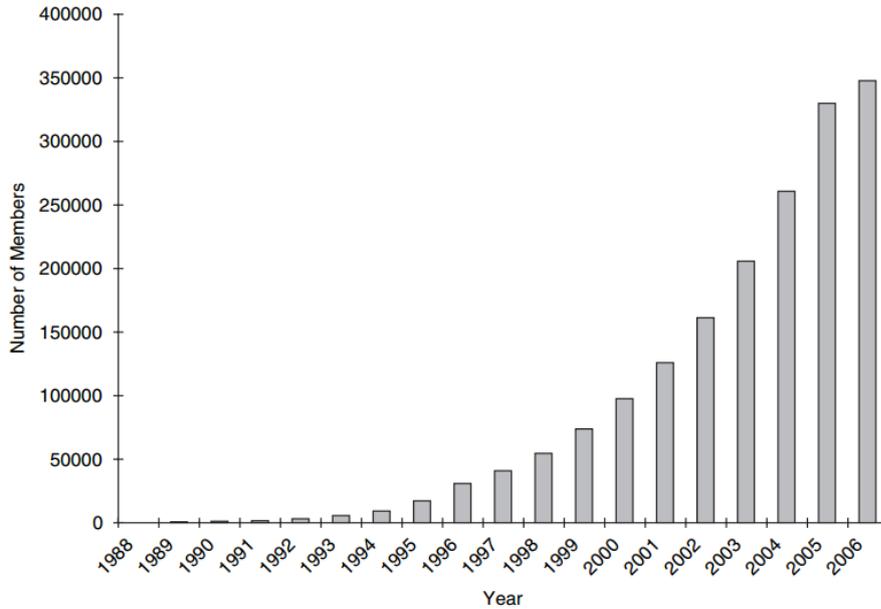


Figure 1: Growth of car-sharing worldwide 1988 to 2006 (Shaheen & Cohen, 2007).

According to Shaheen and Cohen (2013), car-sharing has become a mainstream transportation mode in the last two decades, with over a million users worldwide. Although I argue it is a matter of debate on whether or not it is *mainstream*, as it is still practiced by a relatively small portion of people, with regards to the entirety of users in the automobile regime. While over 1.25 million car-sharing members were found worldwide by 2010, in 26 car-sharing countries across 5 continents, with a total vehicle fleet of 31,665, as seen on table 1, it is still a small number relative to total car ownership. The world recently surpassed 1 billion cars in the total size of the “global car parc”, which clearly indicates the small share car-sharing has in the overall automobile market structure (Living 2012). Car-sharing growth should not be underestimated, as observed from the recent rapid growth in car-sharing members worldwide, from 346,610 in 2006 to 1,251,504 in 2010, table 1. However, it should be noted the survey in 2006 vis á vis 2010 included 18 and 26 countries, respectively, which may present a misdirection in the “growth” of members in the time span of four years. Forecasts made by Berg Insights (n.d.) estimate a growth to 26 million car-sharing members worldwide by 2020

Table 1: Worldwide car-sharing survey, growth from 2006 to 2010

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

Source: Shaheen and Cohen 2013

Further findings from the worldwide car-sharing survey conducted 2010 by Shaheen and Cohen (2013) with car-sharing experts indicate three contributing factors to the rapid growth of car-sharing organisations around the world in last decade: “(1) cost savings; (2) convenience of locations, use, and access; (3) environmental awareness.”. It finds cost-savings to be the strongest incentive (58%) for joining a car-sharing organisation, while convenience and environmental awareness only ranked as the most important factor for approximately 20% each of the survey respondents (Shaheen & Cohen 2013). In 2006, Europe was the epicentre of car-sharing activities, comprising 61% of worldwide car-sharing membership and 66% of car-sharing vehicles deployed. While growth has occurred worldwide since then, Europe now lags behind North America in absolute numbers of car-sharing members, although Europe still retains the largest share of car-sharing vehicle fleets (Shaheen & Cohen 2007).

2.2 Car-Sharing Market Overview in Sweden and Malmö

There are few commercial car-sharing organisations in Sweden, it is a small market in terms of members/customers and turnover relative to Germany or the UK. Currently, the market of *commercial* car-sharing enterprises in Sweden is largely dominated by four companies (listed in order of size from largest to smallest): Sunfleet, City Car Club, Bilpoolen and MoveAbout. While car-sharing is still relatively underdeveloped in Sweden it is developing at a rapid pace (Plepys & Mont, 2015; Trafikverket 2011). In Malmö the dominant car-sharing company is Sunfleet, as it is the single professional car-sharing business in the area. It comprises car fleet parks distributed around Västra Hamnen and other high-desired access- and parking nodal points in the city. The car-sharing service from Sunfleet is a station-based system (pick-up and leave car in the same location), comprising a mix between an open and half-open system, with different degrees of availability to specific car models, as the service

caters to both private persons as well as private companies and municipal organisations (www.sunfleet.se; Van Audenhove et al, 2014, p.13).

Studies on the market and business feasibility of car sharing companies in Sweden indicate the larger clientele, 50-60%, of car-sharing companies tend to be non-private sector consumers, such as public sector organisations (e.g. municipalities) and private companies, as operating costs (invoices etcetera.) incurred are lower “per rental” compared to private users. An optimal mix of clients and efficient exploitation of car-sharing vehicles seem to be important components to achieve profitability. This may be an important insight that can inform further policy guidance in promoting sustainable mobility alternatives (Trafikverket, 2012 in Plepys & Mont 2015). Table 2 gives an indication of the national growth of Sunfleet from 2008 to 2012, showing more than a tripling in the number of car-sharing rentals in 2012 compared to 2008, and a similar growth in distribution of car-sharing locations (Hertz, 2012). A distribution map of Sunfleet vehicles in Västra Hamnen can be found in appendix 1.

Table 2: Growth of Sunfleet’s car-sharing activities

	2008	2009	2010	2011	2012
No. of car-sharing locations	97	118	140	236	292
No. of car-sharing rentals	42 174	64 111	81 023	106 171	158 270

Source: Authors own elaboration based on (Hertz, 2012).

Additionally, smaller community-level car-sharing schemes are also present in Malmö and surrounding cities such as Lund and Malmö, however these are relatively small in size, low number of vehicles and members. While outside the scope of this thesis, it would be useful to know the presence of other car-sharing organisational models, and their exact size. Gathering information on this has been difficult due to the informal structure (Plepys & Mont, 2015).

In Sweden vehicles in car-sharing schemes typically have the same conditions for parking as regular cars, thus no special treatment. Although there are accounts where environmentally friendly vehicles such as EV (electric vehicles), PHEV (plug-in hybrid electric vehicles), and biogas vehicles receive benefits in forms of free parking fees, or using segregated bus lanes (Plepys & Mont, 2015).

2.3 Average Private Sunfleet User

In a recent case-study on the mobility sector in Sweden and car-sharing in Plepys and Mont (2015) findings indicate a nation-wide average Sunfleet client uses the car-sharing service 2-3 times per month. The remaining mobility needs of the household is presumed to be

satisfied with reliance on public transportation, bicycling and walking. It appears consumers needing car-sharing cars use them only occasionally. This appears to be the case in Malmö as well, indicated in a survey conducted by Trivektor (2014) which got 261 respondents out of 778 asked members, with a response rate of 34%. About 57% of Malmö members use a car-sharing car once a month or less, while 41% uses them a few times a month, with only 2% using it several times a week (Trivektor 2014). However, it should be taken into account that these users may either own or borrow a private car from a family or friends circle, which is something that has been largely overlooked in most studies, including in Plepys and Mont (2015). This risks overestimating the change car sharing schemes have on mobility patterns, in certain contexts.

Taking into account the cost-structure and the average degree of service usage amongst members, it is worth looking at what type of mobility mode is most suitable for different users, as it may help understanding mobility decisions and habits of households in the analysis later on. Trivektor (2014) has made an estimation on when it makes economic sense for a user to engage in a car sharing activity, or if owning or renting a car is more economically sensible depending on the travel pattern in terms of frequency and distance. This can be seen below on figure 2. Estimates from the Swedish Transport Administration suggest a total travel distance under 11,000 km/year as a threshold of driving distance where it makes economic sense to shift from car ownership to car-sharing. The most optimal car-sharing user group are those travelling relative short distances approximating 20 uses a year. The same study also identified the primary reasons for participating in car-sharing activities to be economic (30%), environmental consideration (27%), functionality-related reasons (21%), access to different sizes of cars (9%), and access to new cars (7%) (Trivektor 2014).

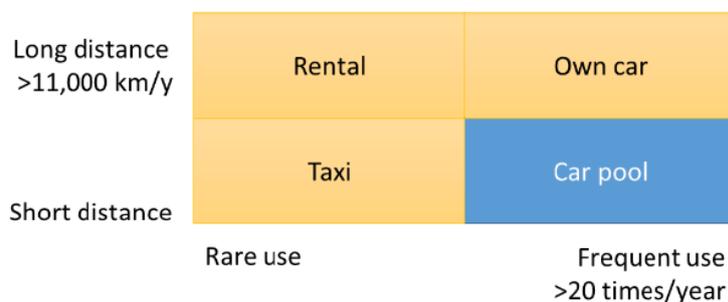


Figure 2: Suggested generic mobility behaviour and relevant mobility scenarios (Plepys & Mont, 2015).

2.4 Benefits of Car-Sharing

Recent literature supports, with empirical evidence, the positive impact car-sharing has had on a more efficient and rational configuration of mobility (resulting in lower number of vehicle per capita among members, lower fixed costs and demand for parking space). Consequently, the reduction of individual automobile ownership lowers the consumption of both physical and economic resources, as well as contributes to a reduction of energy and environmental impacts. e.g. a case study assessing car-sharing impact in Lisbon, Portugal (Baptista et al, 2014), indicates car sharing to have major benefits in reducing energy consumption by 35 or 47% and CO2 emissions by 35 and 65%, presupposing a shift to either hybrid or electric vehicles, respectively.

Table 3: Reported social and environmental impacts due to car-sharing

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

Source: Shaheen & Cohen 2013

Further, car-sharing research has found a general consensus in the shared mobility literature that after joining a car-sharing service households drive less and start using alternative modes of transport such as bicycling and public transportation more frequently than automobile owners (Katzev, 2003; Shaheen et al 1998, Meijkamp 1998; Prettenthaler and Steininger, 1999, all found in Baptista et al 2014). Previous research on car-sharing systems influence on vehicle ownership and usage patterns include findings that one car sharing-vehicle replaces between four to eight individually-owned vehicles in Europe, indicating a significant reduction in private car needs by users selling their car or foregoing vehicle purchase (table 3). Empirical cases included Bremen and Belgium where one car-sharing vehicle replaces 7-10 and 4-6 private cars, respectively (Baptista et al, 2014; Loose, 2010; IBI Group, 2009, Cervero & Tsai, 2003).

In an empirical quantitative survey study by Trivector (2014) on Sunfleet's car-sharing impacts on car ownership and parking spaces in Malmö, findings present one car-sharing car replaces 3,9 privately owned cars. While each car-sharing car also frees up 2,5 parking spaces in Malmö, compared to 3,6 in Gothenburg and Stockholm, thus indicating significant improvements in freeing up urban land space from parking lots.

2.5 Costs of Car Ownership

It is important to explore and understand the context for what induces households to either own a car or engage in car-sharing, or both. One way to do so is considering the cost-structure of both mobility modes and how it aligns with users' mobility needs and routines. For example, a study conducted by IBI Group (2009) in San Diego estimates the *average* car expense for car-sharing individuals to be 50 USD per month, compared to roughly 600-700 USD for car-owning individuals. In the case of Sweden, the average monthly cost of owning a car, with depreciation and additional costs included (parking, gas, insurance, etcetera.), ranges between 630-880 USD (or 5,200-7,300 SEK), according to calculations made by Swedbank (2012).¹

Although large discrepancies in these estimates are expected between the savings in different countries for users, depending on a number of variables relating to taxes, insurances, fuel costs, car-sharing membership fees and rates etcetera. This is of course relative to each individual user that may have a very specific need and routinized mobility, where the cost of the car-sharing user may be higher or lower than the former average cost seen above. This requires further consideration about how costly each individual trip becomes in the time-span of a month for example, thus it may influence members to drive considerably less after joining a car-sharing service (Baptista et al 2014).

¹ Calculations are made on the assumption that the car is driven 15,000 km per year, with gasoline price set at 1,75 USD (or 14,50 SEK)

Chapter 3

Theoretical Framework

This study will employ two theoretical frameworks, as referenced earlier. The first theoretical framework employed is used to research societal changes or transitions through the understanding of *socio-technical systems* (section 3.1), while the second framework utilised is *social practice theory* (section 3.2), with the purpose that they will complement each other where each is limited in its analysis.

The emerging body of transition studies literature is used in this paper to frame the research of innovation in sustainable mobility systems in the case of the City of Malmö, specifically in the neighbourhood of “Fullriggaren” located in Västra Hamnen. The concepts are used to explore stability and change in the mobility regime by investigating the development of niche mobility innovations, specifically car-sharing. Emphasis is given to the way consumers respond to these mobility innovations that have emerged from top-bottom approaches in car-sharing services.

3.1. Socio-Technical Systems

It is important to define the theoretical lens through which the case is to be analysed and its accompanying limitations. The first theoretical framework employed in this thesis is that of socio-technical systems, conceptualising transitions in socio-technical systems, in this case the personal mobility system (which can be viewed as a sub-set of the land-based transport system). These socio-technical systems comprise elements which are reproduced, maintained and changed by various actor groups (e.g. policy makers and politicians, firms and industries, civil society, consumers, engineers and researchers) (Geels, 2012). The approach of operationalising these elements as a set of interconnected factors lends it to become a “socio-technical system”, and it is the occurrence of major systemic shifts that is conceptualised as “socio-technical transitions”, which include both a technological and societal shift. The systemic transition, theoretically considered above, is co-evolutionary and multi-dimensional in nature, meaning a developed toolset is required to manage and operationalise analyses of the multitude of possible variables to look at (Geels, 2012). Many such tools have been developed

in the recent decade, this thesis uses the multi-level perspective (MLP), which is one way to observe socio-technical systems.

In the area of conceptualising transport systems, Geels (2012) argues for a configuration of elements including technology, consumer practices, policy, markets, infrastructure, scientific knowledge and cultural meaning. These elements will be alluded to different degrees in the analysis, guided by the research questions.

Since many heterogeneous elements are changed during system innovation, this can be considered a co-evolutionary process. Changes involve both technical innovations as well as social innovations on part of the user and provider side. A co-evolutionary analysis is a broader perspective which looks at the wider process of system innovation with the alignment of ongoing processes in a socio-technical regime comprising a disaggregation of regimes such as; policy regime, science regime, technological regime, socio-cultural, regime, and user and market regime (Geels, 2005b, p.10, 23). This will be taken into account in the analysis as it helps answering the first sub-research question, to understand how the niche mobility socio-technical configuration (car-sharing) came about in the context of Malmö, and its subsequent development until today.

The socio-technical analysis relates to a specific analytic narrative and perspective, working with several assumptions and conceptualisations of human action, social structure, and technology. The first step here is to conceptualise these core aspects of socio-technical analysis, looking at technology and societal interactions.

3.1.1 Social Groups Related to Socio-Technical Systems

The components of socio-technical systems do not function by themselves, instead they are actively constructed and cultivated by human actors, embedded in social groups. In today's modern society many specialised social groups can be identified to belong to specific elements of socio-technical systems. Figure 3 presents a schematic representation.

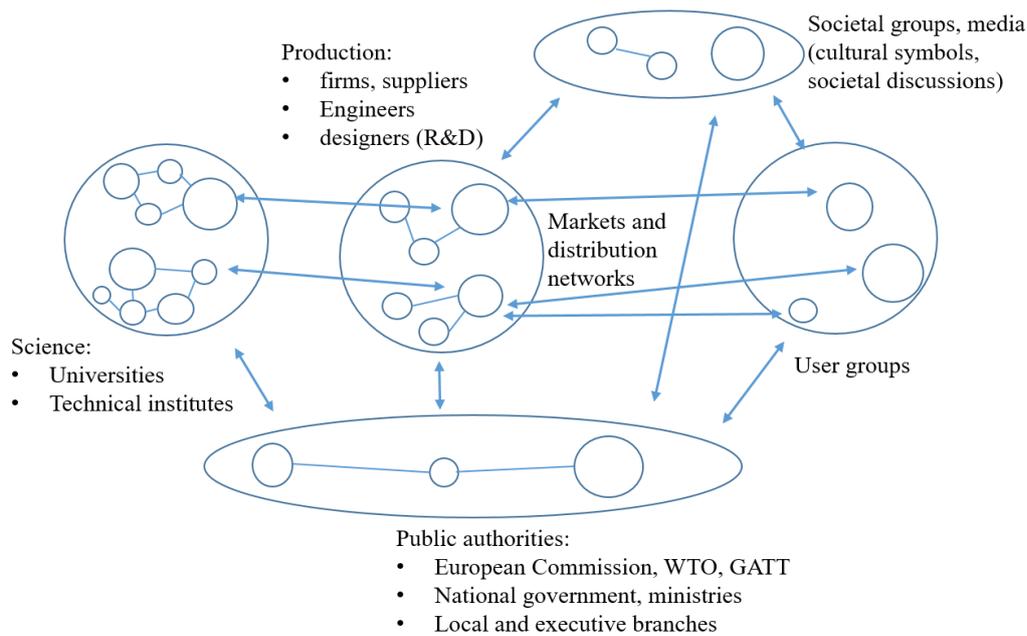


Figure 3: Social groups related to socio-technical systems (Geels 2002, p.1260; Geels, 2005b, p.15). Adapted by author.

The relationships between these groups changes over time, some fall apart and new groups emerge. Further, the configuration of social groups varies between sectors where, for instance, the social network in electricity systems may look and function differently from that in transport systems. This has implications for boundary definitions to be more of an empirical issue rather than theoretical one (Geels, 2005b, p.15). The social groups identified in figure 3 have relative autonomy, and distinctive features in each regime-group. It conceptualises a variety of co-existing regimes in different social domains such as policy regimes, technological regimes, science regimes, user/market regimes and socio-cultural regimes. Within each group, they share “cognitive, formal and normative rules” through which they coordinate. Examples of rules pertaining to policy regimes are regulations, laws and policy goals, while rules in socio-cultural regimes are beliefs and cultural values (technological progress, enlightenment). Rules in the user and market regime relate to preferences and user-practices, selection criteria, user competencies and market institutions (Geels, 2005b, p.15-16).

However, groups do not only interact within their own regime, but also interact with one another, creating networks with interdependent relationships. Because of this interdependence, the activities of social groups are aligned with each other, meaning there is an inter-group coordination, which is represented by linkages between different regimes. Together these create different configurations of socio-technical regimes.

3.1.2 Multi-Level Perspective

The Multi-level perspective was created in the field of innovation studies, borrowing insights from evolutionary economics (regimes, niches, technological trajectories), neo-institutional theory (on the constraint of actors through shared norms, beliefs and regulations), and sociology of technology (innovations are socially constructed through actor groups interactions such as consumers, firms, policy makers and engineers). The value of the MLP lies in its ability to address and analyse stability and change, which lies at the analytical core of transition studies (Geels, 2012).

One on side, current systems are characterised by stability, lock-in, and path dependence, resulting in incremental changes along anticipated trajectories. On the other, radical alternatives emerge (car-sharing for example) and are experimented with by entrepreneurs, pioneers and social movements, and other outsider actors away from the incumbent regime. These alternatives generally face an uphill struggle against incumbent systems, as they tend to be more expensive (not yet benefitting from economies of scale, and with longer learning curves), require *changes in user practices*, are not properly aligned with existing regulations, or lacking appropriate infrastructure. Thus, the core puzzle in transitions centres around understanding and being able to analyse stability and change through interactions between relevant actor groups across multiple dimensions. The MLP enables a way of researching these issues by looking at the interplay of multiple developments along three analytical levels: niches (micro-level), socio-technical regimes (meso-level), and an exogenous socio-technical landscape (macro-level), as seen on figure 4.

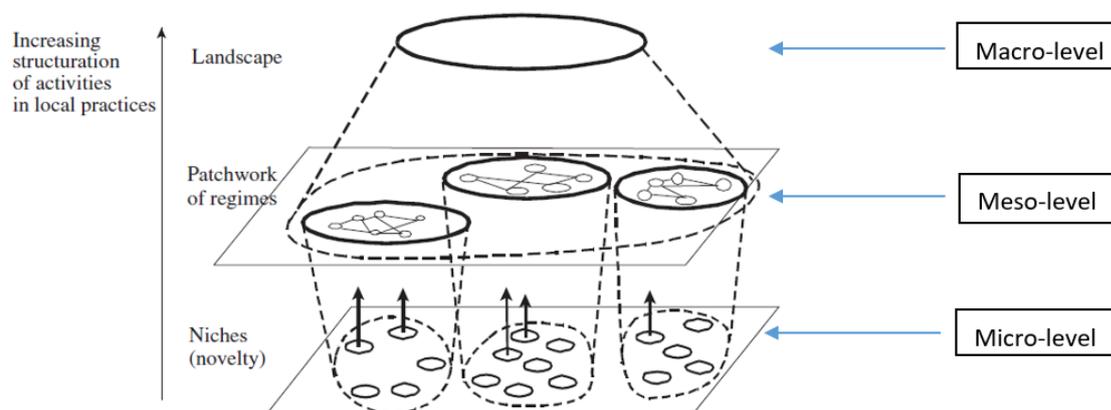


Figure 4: Multiple levels as a nested hierarchy (adapted from Geels, 2002, 2012).

3.1.2.1 Niches

Niches are the locus for radical innovations, it is where novelties emerge in protected spaces e.g. through subsidised demonstration projects, R&D laboratories, or in small market niches where some users have specific demands and may be willing to support emerging innovations. Niche actors engage in radical innovation areas that deviate from incumbent regimes, with the hope that they either replace the existing regime, or are adopted into it (if possible). However, this is not an easy process, and fails more often than not, where niches try to take-off without success. At the same time, they are crucial for transitions as they provide the seeds for larger systemic change in the long-term (Geels, 2012).

It is important to denote three particular social processes occurring within niches:

- The construction of *social networks* and recruiting more actors, which sets the ground for expanding the resources and social base of niche-innovation.
- *Learning processes* across dimensions relate to; constant change and adaptation in order to overcome obstacles such technological as well as organisational, user behaviour, policy instruments, symbolic meaning and market demand.
- The articulation of *visions or expectations* guides the direction of innovation activities, and also attracts attention and funding from external actors

Niches are generally carried out in demonstration projects, as a form of experimental ground where niche actors are allowed to learn from their innovations in real-life circumstances (Geels, 2012). Such pilot projects provide a good ground for various stakeholders to evaluate project performance (in different areas depending on stakeholders' interests) and on its subsequent value to learn from initial experiences and possibility of expansion. If niches are precise in their articulation and become largely accepted by fulfilling their expectations, they may gain enough momentum to see changes in regulation and learning processes resulting in a stable configuration. If social networks grow stronger among the niche actors it may bring about more legitimacy and resources into it for further growth (Geels, 2012). To give a concrete example, looking at engine technologies, for the past century combustion engines have dominated in the car-manufacturing industry, while fuel cells and battery-electric driven vehicles have been pioneered by small start-ups and outsiders. Now those small start-ups have either grown large (e.g. Tesla), or in most cases they have been acquired by large manufacturers who are moving into the area of alternative engine technologies (Dyerson & Pilkington, 2005). This is one type of interplay that can be observed between the niche- and regime level, which

shows an increasing trend in increased R&D moving away from fossil-fuel dependent engines/vehicles in the transport system.

3.1.2.2 Socio-Technical Regime

The socio-technical regime has been described by the literature as the “dominating practices, rules and shared assumptions” (Loorbach 2007, in Nykvist & Whitmarsh 2008), while Geels and Shot (2007) have described the regime as “adaptations of lifestyles to technical systems, sunk investments in machines, infrastructure and competences.” Considering the interdisciplinary nature of innovation studies, there may be no precise definition of a regime that is clear-cut across the board, however the essence of the regime concept remains the same: Rules which are embedded in the elements mentioned above provide coordination and orientation, generating cohesion and stability of societal systems. Further, incumbent regimes steer actors along the trajectory of incremental changes to optimise the current system, using the resources and capabilities of dominant players. Radical change, or system innovation, is limited to occur as structures, rules, and culture are slow in changing at this level. Changes in prevailing norms, practices, and regulation move slowly and at this level draw on “existing competencies and past investment”. These conditions are what create the effects of lock-in and path dependency for social and technological development (Nykvist & Whitmarsh, 2008).

The idea of socio-technical regime does not just comprise activities of engineers and firms, but also other relevant social groups such as policy makers, users, civil society actors and special-interest groups. Thus this concept helps counteract a prominent tendency in innovation studies, which is to view the firms and manufacturers, e.g. car industry, as the single most important actors in a regime (e.g. automobility). Granted, while they are important actors, the regime is not, and could not be sustained just by them. The automobility regime is maintained through habits of use, practices which are created and reproduced, prevailing normality and established practices of professionals such as transport planners who help to reproduce the regime (actions which may be influenced from political agendas) (Geels, 2012; Urry 2004).

3.1.2.3. Socio-Technical Landscape

The socio-technical landscape is the broader context, influencing niche- and regime dynamics alike. It is a landscape in both a physical and metaphorical sense, where urban layouts may be considered, as well as political ideologies, societal values and macro-economic trends.

Situated at the macro-level, it comprises an exogenous landscape of changing ecological, cultural and economic conditions, within which incumbent regimes are more or less well-suited to fulfil their functions. Landscape pressures may reinforce regimes or exert strain on incumbent regimes if they cannot appropriately adapt to changes required from cultural, economic or ecological reasons, which opens a window of opportunity for niches to establish and consolidate themselves (Geels, 2012; Nykvist & Whitmarsh 2008). Landscape pressures may be global challenges, such as climate change, but also locally oriented at a national or even urban level relating to specific contextual challenges such as rapid population growth and the difficulty to accommodate all urban systems to this growth (e.g. housing, mobility/transport, employment etcetera.)

The socio-technical landscape level has the greatest degree of structuration, meaning it is beyond the control of any single individual actors, it is rather the aggregate of societal beliefs, challenges, and other largely encompassing societal backdrops.

3.1.3 Critiques, Limitations and Downsides with MLP

Criticism pointed out by Berkhout et al (2004, p.54 cited in Geels & Schot 2007) is stated by arguing that “it is unclear how these conceptual levels should be applied empirically”, as there is no standard procedure, making it both difficult for someone else to reproduce the same findings in the same context, as well as creates discrepancies between case studies studying the same phenomena utilising the MLP but at different operational levels. This may require further theoretical refinement.

Further awareness should be brought to the boundaries that may be set when studying socio-technical systems, such as when studying a single regime, or sub-system, in an urban context. This proposes two challenges; first, urban systems are inherently much more complex than looking at the evolutionary process of a single regime based on technology and innovation processes at a national or international scale, such as the automobile regime. Secondly, any particular urban sub-system can differ greatly from other urban contexts, rendering strict comparisons more difficult as there are a lot of extraneous variables where it might be difficult to account for their influence on the analytical object. Geography, scale and spatial dimensions are other areas that have arguably not received proper attention which could bring valuable insights to more “localised” case studies on innovation (Carvalho, Mingardo & van Haaren

2012, Coenen, Benneworth, & Truffer, 2012; Coenen & Truffer 2012; Raven, Shot, & Berkhout 2012).

The strength and weakness in the MLP approach is derived on the base that it requires both a theoretical sensitivity (requiring interpretive creativity), which guides the lens of the researcher to notice mechanisms and patterns of interest. The high degree of freedom with multitude units of observation and analysis, may be overwhelming, rendering difficulties in clearly defining the units of analysis (Smith, Voß, & Grin, 2010). Finally, transitions are complex processes, which naturally occur over a long time period. Thus a strong temporal orientation is present, which renders it a more suitable tool to investigate processes in hindsight, and is thus less used as a tool for prediction (Geels 2012).

3.2 Applying the Multi-Level Perspective

Applying the MLP to a sustainable urban transition context is not without complications. The complexity, scale and context-dependency of cities, the permanence of urban built environments, and strong vested interests in lifestyles and cultural norms that is associated with present urban development poses huge challenges to finding the best fit for analysis of transitions towards sustainability (Naess & Vogel 2012; Hodson & Marvin 2010). Cities may differ largely in shape, sizes, and composition of trades, affluence levels, access to international or national transport infrastructure, etcetera. and varies in climate, land-use, and mobility systems (Naess & Vogel, 2012; Bulkeley, Broto & Marvin 2011). This is why the focus here lies only on a small segment of the mobility regime, car-sharing, rather than investigating the overall urban sustainability system and all modes of transport, it becomes too complex and too large a topic to handle within the boundaries of a student thesis. In this thesis the MLP is applied as an analytically descriptive framework and a tool for structuring a narrative about the emergence and transition processes of the car-sharing niche (Naess & Vogel, 2012).

3.2.1 The Current Automobility Regime

Currently much of the transition literature on the automobility regime highlights its stability, resulting from lock-in mechanisms related to sunk investments such as infrastructure, mobility culture, vested interest by incumbent regime actors, factory plants and specialised technologies (Docherty & Shaw 2012; Sheller 2012; Zijlstra & Avelino 2012). On the other

hand, an emerging literature highlights a surge of change initiatives such as socio-spatial innovation, car- and bike sharing schemes, car-free city centres, clean propulsion technologies, intelligent transportation systems and public transport, emerging as a response to different landscape pressures (Goodwin 2012; Dudley & Chatterjee 2012; Zijlstra & Avelino 2012; Sheller 2012). In a way car-sharing does not directly challenge automobility regime to destabilise it, but it rather forms a subaltern mobility regime which takes on a set of new conditions and cultural values that may challenge peoples' traditional perception on private automobile ownership. This is indicated by Dudley and Chatterjee (2012, p.98-99), who argue an inter-generational cultural shift in perception on the importance of individual car ownership is under process, where the older generation view it with greater dependency as a consumer good and with greater symbolic meaning. While the younger generation perceive the car in a more practical way, by being "a means to get from A to B" instead of having the status connotation typically associated with automobiles (Geels, Dudley & Kemp, 2012, p.354). the dominance of the car regime has created strong path dependencies and vested interests among users and producers of the system alike. Further, there is no one-answer solution to sustainable mobility as mobility needs may look very different within and between different locations, requiring an amalgam of complex and differentiated strategies and public policies sensitive to the local context (Berger et al, 2014).

3.3 Social Practice Theory

This section looks to understand how the concept of social practice can carry an importance in analysing systemic change. We must first define it, then discuss how it can become operationalised within a systems-perspective. Following the conceptual development by practice theory scholars, an "ideal" practice can be identified as a "routinized type of behaviour which consists of several elements, interconnected to one another: forms of bodily activities, forms of mental activities, "things" and their use, a background knowledge in the form of understanding, know-how, states of emotion and motivational knowledge" (Reckwitz, 2002, p. 249 in Watson 2012). For this thesis, the elements of routinized behaviour are simplified in three groups and explained in the two following paragraphs.

Through the perspective of practice, everyday tasks such as mobility practices (driving, bicycling, walking, commuting) can be understood as a complex construct of interconnected and interdependent "elements". These elements have been conceptualised differently

throughout the literature, as seen above (See Watson, 2012; Reckwitz 2002, p.249 in Dowling & Kent 2015; Pantzar & Shove 2010, p.450 in Dowling & Kent 2015). This thesis uses the elements in social practice suggested by Dowling and Kent (2015) referring to *materials*, *meanings*, and *skills*.

Relating social practice to car sharing, these elements take on the following meanings: *Materials* can relate to technologies and novel innovations implemented in the supporting infrastructure around the new generation of automobiles with highly embedded ICT, such as the smart card system used to lock/unlock the car (Dowling & Kent, 2015). But it may also relate to the built surrounding environment, and its ability to support a car sharing network system (e.g. on-street parking, high residential and commercial densities and active transport networks); *Meanings* here refers to the change in perception automobile ownership may have on people, or practitioners. While traditionally thought of, and still dominantly so, automobile ownership symbolises freedom through autonomous mobility and is strongly embedded in most cultures (Sheller, 2012; Marletto 2011). However, there are those who argue (Bardhi & Eckhardt, 2012) that for an increasing number of people, freedom is derived from the absence of ownership and commitment, which is reflective of a more functional economy type of thinking; Finally, many *skills* required for the successful functioning of car sharing schemes may be easily transferred to practitioners from other areas in life, meaning there are rapid learning curves. Such skills may include knowing how to drive, and the use of online interface through a mobile or computer platform to reserve a car, which resembles other online consumer experiences. The same idea relates to the practicality of using the car, the mode of operating a car is highly standardised, thus it can be seamlessly replicated from users' past experiences (Dowling & and Kent 2015). Building on previous arguments, it is suggested that car-sharing can purposively be understood as a social practice, characterised by a distinctive assemblage of meaning, skills, and materials (Dowling & Kent, 2015)

As Frank Geels (2002, 2005a,) and other transition scholars have shown, socio-technical systems comprise a multi-scalar and heterogeneous complexity, with transitions occurring through the dynamic relations between technologies, social practices, infrastructures, markets, norms, and regulations over temporal and spatial scales (Watson, 2012; Geels & Schot 2010 in Watson 2012). Watson (2012) discusses the overlapping concepts of social practice theory and socio-technical transitions, arguing that a transition, or change, in the latter must first be constituted by a change in the former. Thus it can be understood that practice theory analysis works in-detail at the micro-level, whereas socio-technical transitions instead apply a

systems-perspective through a given macro-level context. As Watson (2012) aptly puts it: "Changes in socio-technical systems only happen if the practices which embed those systems in the routines and rhythms of life change; and if those practices change, then so will the socio-technical system."

As consumption of mobility services and travel behaviour are social practices embedded in different social contexts - including work situation, family, spatial location, and social norms - there is a clear overlapping between the two frameworks, focused on different conceptual layers. Socio-technical systems take an overarching approach looking at the interaction of different actor groups that enable or disable a regime, while practice theory leads to understanding the rationality of mobility routine choices, and how they are shaped by their tangible and intangible surroundings. Watson (2012) further argues "When placed in accounts of historical, societal level shifts in socio- technical systems, it becomes clear how practices are intrinsically and actively part of those systems". In discussing socio-technical shifts as the systems-level, e.g. through MLP, Watson (2012) argues the agency of the individual human is obscured. Here it becomes important to take into account mobility practitioners. Households (or rather the individuals within the household) are the individual units of observation as mobility practitioners. The households and their mobility patterns at the aggregate level provides the unit of analysis, which serves to describes the general change in mobility patterns at their residential area in Fullriggaren.

It is argued (Watson 2012) that the population of "carriers" of a practice - the people who perform it - can change. Practitioners may, for example, be either recruited by a different mobility practice, or abandon an old practice for specific reasons. Occurring at a large-scale of practitioners, this entails a fundamental change to a practice which from the socio-technical systems perspective can be viewed as a regime-change. It is important to understand how this regime-change comes about from the reproduction of practices of individuals which manage to recruit further practitioners. Considering how practices persist through their performance, the success of sustaining a practice hinges on its ability to recruit practitioner's willingness and ability to repeat and integrate the practice into everyday life.

In their paper, Pooley, Horton, Scheldeman, Tight, Jones, Chisholm, Harwatt and Jopson (2011) argue household practice to be of a complex and contingent nature, emerging from a general coordination of everyday life. Thus, a practice can change as neighbouring practices change. From practice theory it is also important to understand the interdependencies of an individual's, or a group's, activities and the pattern of daily or weekly travel. A practice approach enables analysis on the co-evolution of mobility practices with other exogenous

factors, such as the development of de-centralised locations of supermarkets. In this example, the spatial development and allocation of supermarkets follow the co-evolving patterns with personal car, indicating a user's increased mobility. Such a co-evolution between store location and car travel makes it more difficult for alternative mobility modes such as cycling, walking or public transport to retain practitioners. From a systems-perspective this could be considered to create a lock-in and path dependency of a specific mobility practice, the automobile in this case. Furthermore, technological changes and changing communication practices have also continued to reshape practice of mobility, sometimes even referring to not actually physically changing location (e.g. telecommuting) (Watson 2012; Line 2011 in Watson 2012).

Understanding the relations between practices - meaning not only interdependent but also competitive relations - is necessary in order to understand dynamics occurring within practices. Processes of change (regardless of it being focused on the elements of a practice or on patterns of recruitment/defection of practitioners in a practice) are rarely just endogenous to a practice. They are rather subjected to exogenous factors which shift the "relative location of a practice within broader systems of practice" (Watson, 2012). Here it is possible to establish a bridge between theories of practice and approaches to socio-technical systems transitions. By understanding how practices transform we may be able to explore how social practice theory may enable analysis across systemic levels (Watson 2012). These complementary frameworks make it possible to investigate in-depth the reproduction and consolidation (or lack thereof) of niche innovations at the micro-level, and their potential to break into the dominant regime level.

Chapter 4

Methodology and Data Collection

4.1 Methodology

This thesis uses a single case study as its research strategy. It does so because changes in socio-technical systems are complex and multi-causal, unfolding over long periods of time. Considering the relatively short time-span under investigation in this case, a full change cannot be argued to be observed here, but rather the initial phase and its current development and stabilisation, which may indicate the trajectory of this socio-technical change in the future. Thus the study is dependent on a retrospective approach in order to evaluate the process of change since the inception of professionally organised car-sharing in Malmö in 2006. Moreover, this type of phenomena under investigation requires a research strategy that is both rich in context and can track developments over time (Geels, 2005b, p.24-25). Thus theory and method are properly aligned with the purpose of the thesis. It is argued by Yin (1994 in Geels, 2005b, p.24) that case studies are the best suited methodology to study a specific phenomenon set in relations to its real-life context, in order to understand “causal links in complex contexts where many variables interact”. And as Geels (2005b, p.24) puts it “the focus is on the interlocking of multiple processes and activities, not on linear cause-and-effect relationships”

Given that the analysis is combined through the theoretical lens of socio-technical systems and social practice theory, an explanatory case study with a retrospective design is employed. Thus the method of collection and analysing data has been informed by theory and the given research questions. An explanatory design is used as it seeks to achieve a more complex and complete explanation of a specific phenomenon (de Vaus, 2001, p.221). Taking into account the analytical approach of MLP and social practices, there is not one single causal/independent or dependent variable to look at, but rather a multitude of variables, as the MLP is non-linear in its analysis (Geels, 2012).

While the case study itself is the ‘object’ of study, the unit of analysis is what we collect information on and analytically scrutinise. The unit of analysis here is placed on two different levels: 1) city-wide level, and 2) residential community level. At the city-wide level relevant actor groups (regimes and niches) interactions and relationships are analysed, while at the residential community level we look at households’ mobility patterns.

Further, de Vaus (2001, p.227-228) argues “case studies can provide a good way of carefully mapping the sequence of events which is the basis of causal explanation...”. However, this study does not try to find a single causal explanation for investigating the phenomenon at hand, the applied theories do not work this way. The possibility to map the sequence of events in an exploratory fashion lends a hand in a multi-level analysis by being able to see how actor groups and networks have grown around car-sharing since the inception of the niche-innovation in this case. Considering this thesis looks into developments since 2006, this study comprises a temporal dimension in its analysis, fitting with the retrospective design, with data collected during a “single occasion” (in this case, a time period of 2 months) relating to data covering a period of 10 years. Data collection pertaining to a retrospective design can be conducted through the use of official documents, archival records, and interviews with people who either participated in or observed past events. With the exception of archival records, these are some of the data collected. Of course, a flaw in retrospective design is the loss of evidence, e.g. through attempts of interviewees to recall and reconstruct the past in the light of the present, possibly mistaking sequence of events or other key aspects. Other issues may be inaccessibility to key figures during this time period due to no available contact information or having deceased.

4.2 Data Collection

In order to answer the research questions stated in section 1.2 this thesis draws on a combination of context-relevant desktop literature with complementary household interviews, and expert interviews with policy and industry experts where information has been lacking/poorly documented. It uses both primary and secondary data analysis of relevant sources detailing the development of car-sharing and household mobility patterns and preferences.

4.2.1 Primary Data

Ten semi-structured interviews were conducted in total, with 6 experts in industry/policy/politics, and four households. Expert interviews include sustainable mobility experts and city planners in the City of Malmö, a councilwoman’s political adviser on Malmö’s political mobility agenda, a business and project developer at Sunfleet, caretaker/residential manager of one of Fullriggaren’s residential areas, and a project coordinator for sustainable

mobility projects in Scania. Finally, four interviews were conducted with households that had used, and not used, Sunfleet's car-sharing service. All expert interviews were conducted face-to-face.

Expert interviews:

- Olof Holmgren, business development and construction projects, Sunfleet, 2016-05-30
- Anna Stjärnkvist, Traffic Planner, city planning office, Malmö Stad 2016-05-30
- Siri Lindersköld. Mobility Management, street office, Malmö Stad 2016-05-26
- Kami Petersen, political secretary to councilwoman Karolina Skog (now Environment minister of Sweden), Malmö Stad. 2016-05-26
- Jonas Hedlund, strategist in sustainable mobility, HMSkåne [Sustainable Mobility Skåne], 2015-05-19
- Kjell Ehrlin, residential manager, Byggvesta, Malmö, 2016-05-26

The initial two household interviews were conducted *randomly* and spontaneously in the sense that I visited the Fullriggaren neighbourhood and found residents by a playground whom I approached to interview. The rationale for doing this were aspects of inaccessibility to households due to requirement of access codes to get into the apartment complex. Aspects in common for both interviewees was that they were women (and mothers), representing a “nuclear” family household. The subsequent household interviews were conducted later by phone with a contact list of 8 people, provided by Kjell Ehrlin the residential manager who served as a gatekeeper, enabling access to the remaining households, out of which two agreed to an interview.

4.2.2 Secondary Data

Secondary data sources are based on surveying local context literature. Data was gathered on recent studies reporting on the status of car-sharing schemes in different municipalities, Malmö amongst those (Trivector, 2009; Trivector, 2014; Malmö Stad 2014a; Malmö Stad 2014b). Other relevant secondary data gathered has been on policy documents relating to the city's transport and mobility plan (Malmö Stad, 2016), and parking policies (Malmö Stad 2010; Malmö Stad 2013a).

4.3. Limitations

There have been various limitations in terms of data collection. First, given time and resource constraints it was not viable to conduct a survey of all households' mobility patterns in Fullriggaren, although it would be desirable to do so in order to have proper representativeness and stronger confidence in quantitative data. Second, the longer time has passed since participants have joined the car-sharing scheme, interviewees may have more difficulty recalling their typical mobility patterns and needs from 5-10 years ago compared to new users who have used it for some time, but not too long, e.g. more than 3 months but less than 2 years, or the family situation may have changed markedly. This may affect reliability on data, and is not subject to complete confidence in data reliability. However, while considering the limited behaviour data from the four qualitative interviews, this data can be triangulated with secondary quantitative survey data on Sunfleet car-sharing services gathered by Trivector (2014), to ascertain a stronger confidence in the analysis of the data.

Chapter 5

Introduction to the Malmö Case

5.1 The City of Malmö

Malmö is Sweden's third largest city with approximately 320 000 residents, situated in the South-west of Sweden (Malmö Stad 2015a). It is a city that has in the last 20 years undergone significant economic and social transformation with a shift from heavy industry to a knowledge-city with an emphasis on multimedia and urban sustainability issues at the forefront (Luong & Mattson 2015). Alongside the socio-economic change, a demographic change can be observed as well, as seen in figure 6, clearly demarcating a relatively rapid (by Swedish standards) urban population growth since early 2000s, with estimations for a population of 400 000 by 2030 (Malmö Stad 2015b; Stjärnkvist interview, May 30, 2016). This on-going development is putting further pressure on urban resources and sustainable mobility patterns, as the city grows through densification (steered by city politics), rather than an urban sprawl, resulting in "less public space per person".

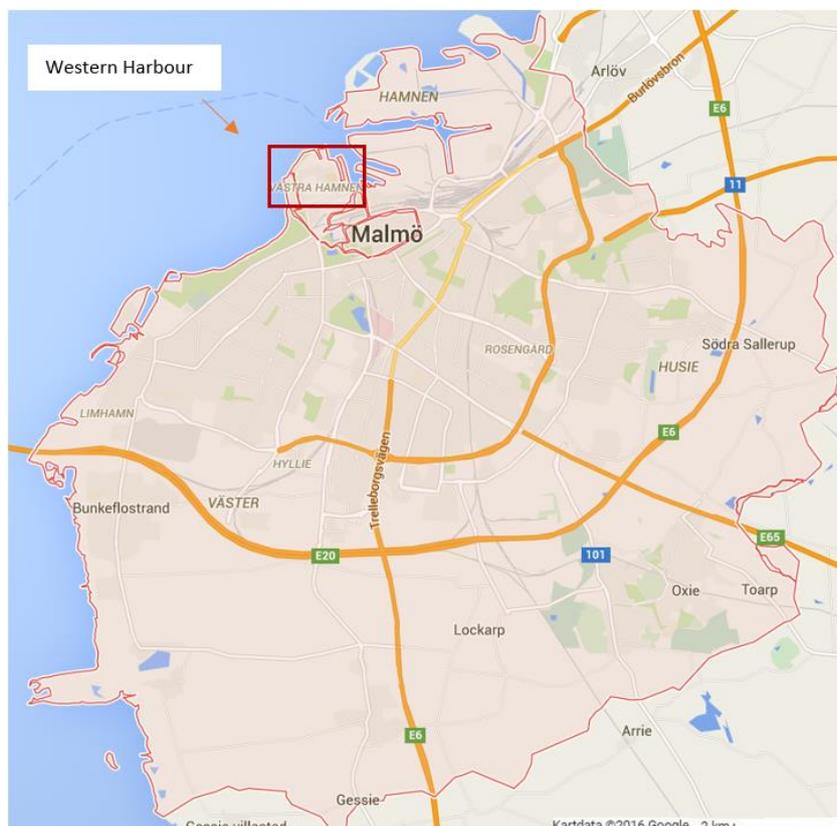


Figure 5: Malmö city boundaries and Västra Hamnen location (Google maps, 15 June 2016).

A range of initiatives have been conducted to increasing modes of sustainable mobility, foremost by attempts to reduce automobile travel by local residents through promotion of public transportation, walking and bicycling. Another venue in vogue right now in Malmö City is Mobility Management, which is the concept of increasing the effectiveness of infrastructure and transportation before travel has begun. It includes improving sustainable transport availabilities for personal mobility, reducing motorised traffic, and increasing effectiveness of land-use and transports (Lindersköld interview, May 26, 2016; Foletta & Field, 2011). The City of Malmö has set a target of reducing car journeys by Malmö residents down to 30%, from today's 40%. Mobility plans are more ambitious for Västra Hamnen, targeted at reaching 75% of journeys by either walking, cycling or public transport, and 70% of these modes to be used for work commute by 2031 (Malmö Stad, 2016). Currently the modal share of transport/mobility in Malmö is comprised by 40% from cars, 40% from bicycling and walking, and 20% from public transportation (Malmö Stad, 2014b).

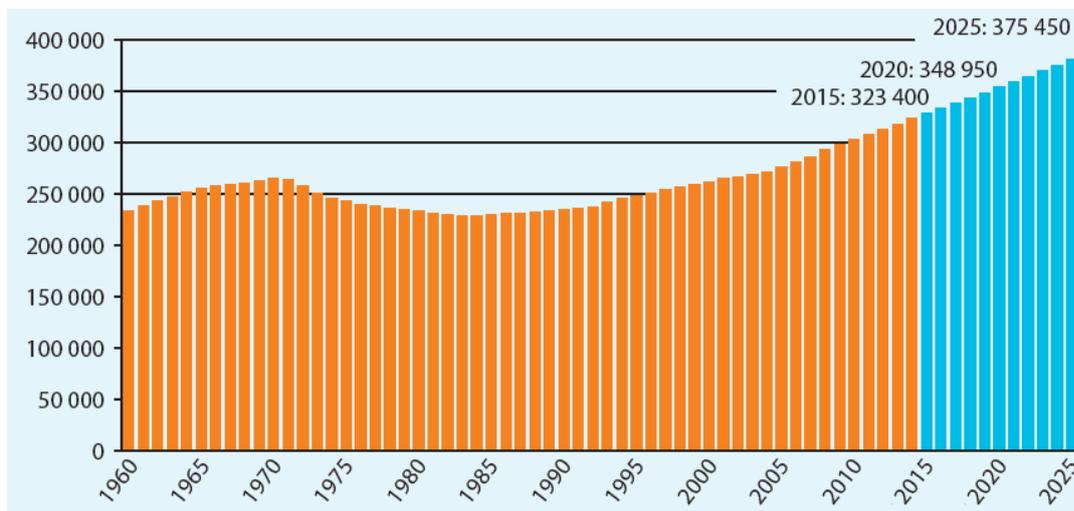


Figure 6: Malmö population 1960-2014, with projections to 2025 (Malmö Stad, 2015b).

5.2 Västra Hamnen & Fullriggaren

Fullriggaren is located close to the central district of Malmö and is well served by paths dedicated to promote pedestrian and bicycle more of transportation. This follows the city's emphasis on promoting non-motorised modes of transportation (e.g. construction of 500 kilometres of bike paths in the city). It is also well connected with public transportation, as no household is further away than 300 metres from a bus stop with frequent bus intervals (7 minutes during weekdays) (Austin, 2013; Foletta & Field, 2011), while the central station is only 2 km away, which connects residents to rail transportation enabling work commutes to

nearby cities such as Copenhagen (Denmark), Lund, and Helsingborg. Automobile ownership in Västra Hamnen remains lower than the average of the city, with residents from the area walking and bicycling significantly more than the average Malmö Resident (Austin, 2013; Foletta & Field, 2011). Sunfleet has a total car fleet of 135 in Malmö, of which 40 are located in Västra Hamnen, across 13 different locations (see appendix 1), with seven vehicles in the Fullriggaren parking garage (Sunfleet.se; Holmgren interview, May 30, 2016).

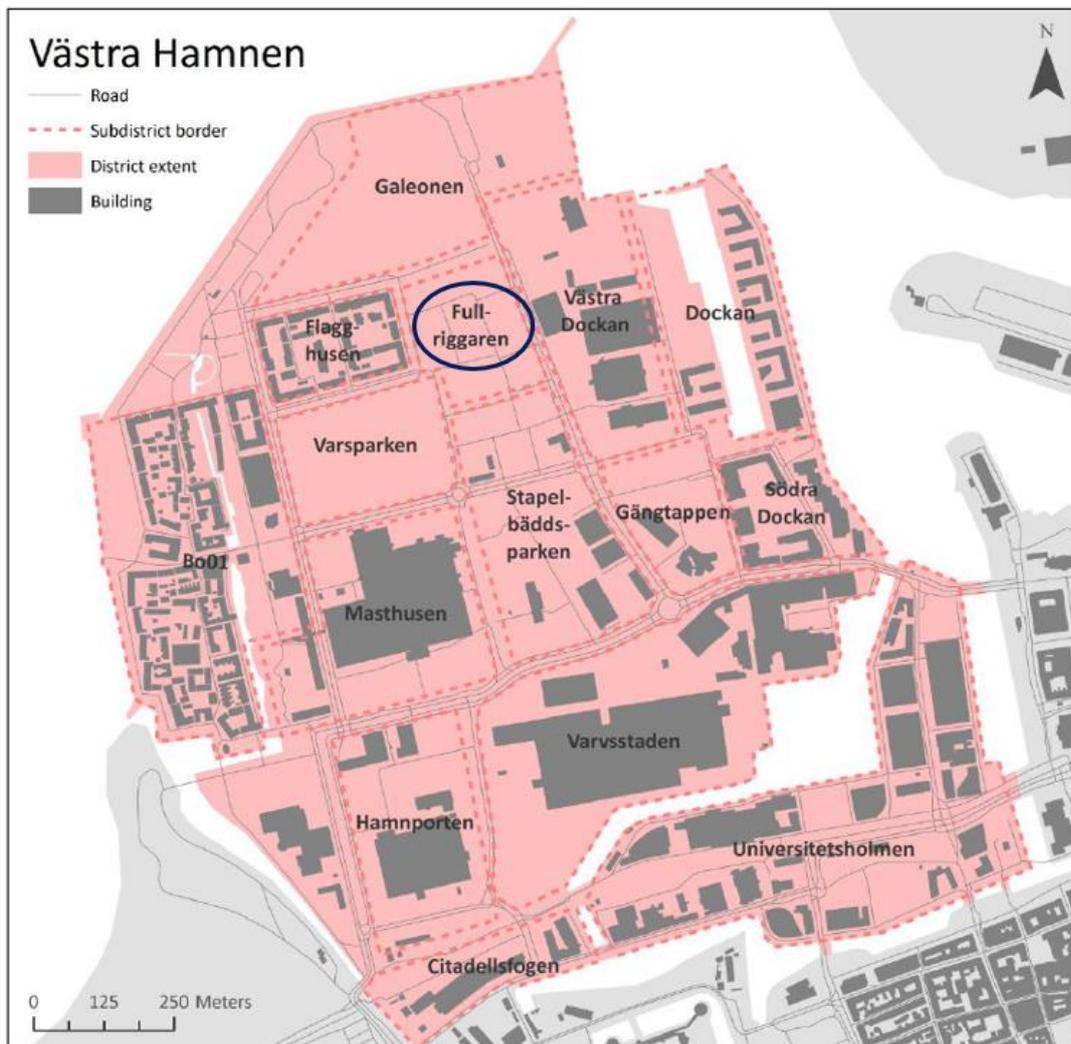


Figure 7: Västra Hamnen in detail, with enclosed circle on Fullriggaren neighbourhood (Elaborated from Hsiung, 2013)

In order to promote car-sharing schemes and decrease dependency on (personal) automobile transport, several mobility alternatives were presented for it to be realistically feasible. In Malmö there is a strong supporting bicycle and pedestrian infrastructure, alongside public transportation (bus and rail systems) (Foletta & Field 2011). E.g. through 8.2 km of newly constructed cycle paths in Västra Hamnen, including a long interconnected cycling route to the southern city centre.

Thirteen different property developers were contracted to build the residential area of Fullriggaren comprising 650 apartments (Lindström 2013; Stjärnkvist interview, May 30, 2016; Ehrlin interview, May 26, 2016; Malmö Stad 2015a). The focus here lies on residents in the apartment complex belonging to Byggvesta, which was previously also known as Fullriggaren, however during the thesis writing period the apartment complex changed name to “Kvarteret Bilén” due overlapping the name with the neighbourhood (Ehrlin interview, May 26, 2016).

Kvarteret Bilén comprises 78 apartments, sizes ranging from one to four bedroom apartments, with a mixture of residents, both young professionals, nuclear-families and elderly. Data regarding demographics and total number of residents was not accessible.

Västra Hamnen is demographically distinguished from the average age distribution in Malmö, with a higher number of economically active people than average of Malmö, seen below on table 4. 70% of the Västra Hamnen population are aged between 20-64, compared to Malmö average of 62%. Moreover, Västra Hamnen residents deviate from the average income classes, as 62% of the residents earn 240 000 SEK and upwards in disposable income, compared to 45% earning similar figures in remaining Malmö, seen on table 5. Understanding this setup gives an idea of the typical average household expected to be analysed in this study. In other words, “young- and medium age professionals and families”. With 70% of the population in Västra Hamnen aged 20-64, there is a clear indication that the majority of its residents are economically active citizens, and a relatively small proportion, 21%, below the age of 20 highlights that not all of these working adults yet have children (Malmö Stad 2015a). This may be an important factor to take into account when investigating household mobility patterns, which may differ due to different daily necessities and routines.

Table 4: Population: Number of residents and age distribution for Malmö and Västra Hamnen as of December 2014

Age	0	1-5	6-9	10-12	13-15	16-19	20-29	30-39	40-64	65-79	80-	Total
Malmö	5 123 (2 %)	22 502 (7 %)	14 044 (4 %)	8 698 (3 %)	8 130 (3 %)	12 105 (4 %)	53 915 (17 %)	54 311 (17 %)	90 128 (28 %)	34 450 (11 %)	14 523 (5 %)	317 930 (100 %)
Västra Hamnen	191 (3 %)	580 (8 %)	250 (3 %)	124 (2 %)	99 (1 %)	131 (2 %)	1 199 (16 %)	1 815 (25 %)	2 146 (29 %)	608 (8 %)	104 (1 %)	7 301 (100 %)

Source: Malmö Stad, 2015a

Table 5: Disposable income for families, ages 20 years or over, in classes as of December 2013

	VÄSTRA HAMNEN Number of families	%	MALMÖ	%
0 kr	258	6	9 967	5
1 kr - 119,9 tkr	387	9	25 698	15
120,0 - 239,9 tkr	907	22	61 960	35
240,0 - 359,9 tkr	903	22	36 467	21
360,0 - 479,9 tkr	541	13	16 486	9
480,0 - tkr	1 108	27	25 680	15

Source: Malmö Stad 2015a

5.3 Current and Past Travel Habits in Malmö

Data regarding Malmö residents presents a high share (89%) of people with a driver's license is found in the age group 40-64, while the share amongst youth aged 19-25 is lower, at 66%. Out of these, more than half can access a car when they need to, while 15% do not have accessibility to a car (a reduction since last Malmö travel habit survey in 2008). Further, a majority of respondents have constant access to bicycles, with only 15% stating they do not have accessibility to a bike. Finally, regarding public transport, a clear majority (61%) have constant access to an electric card for utilising public transport services, while only 10% of respondents state they never have access to these cards (Malmö Stad 2014b; Malmö Stad 2016).

Although this is secondary quantitative data on the travel behaviour of an average Malmö resident, it must be recognised that Västra Hamnen can be considered a “green niche” neighbourhood that may differ from city averages as it focuses on promoting sustainability multi-functionally to a higher degree there than in other areas of the city. This may also attract a specific set of people with a mind-set already inclined towards more sustainable consumption and living.

Chapter 6

Results and Analysis

6.1. The Socio-Technical Configuration

6.1.1. Stakeholders' Interaction at the Regime Level

The Civitas SMILE project was a EU funded program between 2005 and 2009, in which the City of Malmö participated with other European cities with the aim to halt the trend of increased car use, improve urban air quality, quality of life, health and safety by promoting bio-fuels, clean vehicles and smart 'door-to-door' travel choices. Civitas projects primarily focus on urban transport. One of the SMILE subprojects in Malmö was to establish a commercial car-sharing organisation in Malmö, which was done with one of the project's partners: Sunfleet, at the time already established in Gothenburg and Stockholm (McDonald, Hall, & Beecroft, 2010; Malmö Stad, n.d.). Moreover, Sunfleet is a subsidiary of Volvo and Hertz, meaning the product developer and service provider is indirectly the same (Loose, 2010; Hertz 2012). Outputs identified by Civitas' own evaluation report indicate a strengthening of stakeholder engagement through coordination between relevant actors, campaigns and publicity increased public awareness of car-sharing, in which their data reports that 65% of people were aware of car-sharing as a concept. It also found (1) car access without ownership and (2) cost savings were primary reasons cited for joining the car-sharing scheme (McDonald et al, 2010). However, earlier conducted research on evaluation of car-sharing effects on travel behaviours has been recognised to be weak in quantitative terms due to low response rates, thus an insufficient amount of data has been a problem for proper evaluation on the impacts car-sharing has on travel behaviours in the context of Malmö (McDonald et al, 2010).

Basing their rationale on previous international studies of how car-sharing schemes can reduce necessity of parking space as one car-sharing car can replace between 4-10 cars (and thus parking spaces), politicians and city officials at the city planning office have found an interest for embedding car-sharing schemes at the construction of new residential areas (Stjärnkvist interview, May 30, 2016; Petersen interview, May 26, 2016). Fullriggaren is the first residential area in Malmö to change parking standards, with close and frequent discussions between City of Malmö with the 13 property developers regarding how to achieve a 30% decrease in parking space relative to the standard of one parking space per apartment. In 2009

a new parking policy standard was being developed, although not yet accepted by city council. Despite these challenges and the previous rigid policy, by embedding the car-sharing scheme into the neighbourhood the city planning office granted building permits for all property developers that would otherwise have had to commit to building one parking lot per apartment (Stjärnkvist interview, May 30, 2016). New housing developments since 2010, when the new parking policy was accepted, have more easily been able to lower the number of parking spaces, while it has also become the norm and wish of property developers to include car-sharing schemes for economic reasons. The role of parking policy will be explained more in detail in section 6.3 below.

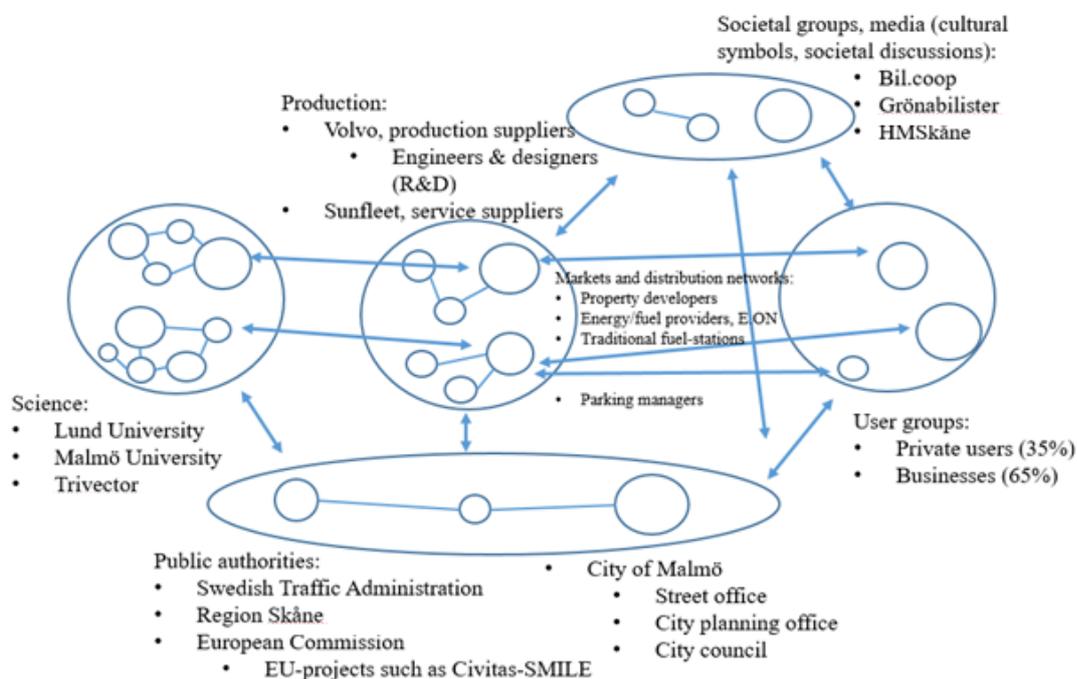


Figure 8: Social groups related to the niche socio-technical system surrounding Sunfleet (Elaborated by author, based on Geels, 2005b, p.15).

Figure 8 presents a schematic representation of relevant social groups and actors in the niche socio-technical system of car-sharing in Malmö, with an emphasis on what type of groups surround the activities of Sunfleet in a variety of regards; Scientific groups, societal groups, user groups, and public authorities (local, national and international). The scientific and societal groups are at the periphery of this study, and does not receive due focus here, but they are important actors to recognise in the overall system of relevant groups. Trivector and Lund/Malmö university serve as the platform for investigating and evaluating the development and potential impact of car-sharing through studies, such as this one. While societal groups, (Bil.Coop, Gröna Bilister, HMSkåne) relating to sustainable mobility alternatives, play an

important role in diffusing knowledge about car-sharing and sustainable modes of mobility, through media, workshops and other societal discussions, familiarising target groups that may be previously unaware of concepts such as car-sharing, and the possibility to utilise such services.

A rare trait and of significant importance of the production groups, Volvo and Sunfleet, is recognised as they are strongly intertwined. Volvo provides its own vehicles to Sunfleet's car fleet comprising a mix of environmental cars, "biodiesel", biogas, and plug-in hybrid electric vehicles, which are used by Sunfleet up to 18 months, before they are returned to Volvo. It is rare that car manufacturers are closely connected to car-sharing services. While not a common practice, other manufacturers such as BMW, Volkswagen, and Daimler, have begun involvement in car-sharing activities (The Independent, 13 May 2011). This has rendered a cost-effective scheme for both individual businesses – Volvo and Sunfleet – as the cars are "leased" for 18 months before being returned to Volvo, which also creates marketing value for both companies. However, this also indicates a significant barrier of entry for other players willing to engage in car-sharing activities in Malmö or other cities where Sunfleet is already strongly established. As such, in the Swedish (and Malmö) market of car-sharing, Sunfleet could arguably be considered the incumbent regime actor, nationally and in Malmö, as has been covered by the literature (Plepys & Mont, 2015). It covers over 44 cities in Sweden, with over 30 000 members and a vehicle fleet of over 1 000 cars (Mynewsdesk, 12 May 2015). However, with the City of Malmö comprising 320 000 inhabitants, and 115 598 personal passenger cars in use in Malmö at the end of 2015, vis á vis 2 500 private Sunfleet members in Malmö sharing a fleet of 135 vehicles, it clearly remains as a niche-innovation subaltern regime to the dominant personal automobile regime (Trafikanalys, 2016; Holmgren interview, May 30, 2016; Malmö Stad, 2015b).

While the role of public authorities such as public officials at The City of Malmö's offices, city council, the European Commission, and market and distribution networks through property developers has been given an analytically descriptive narrative above (tying actors together), a condensed analysis follows in the section 6.5 and 6.6, distilling the drivers and barriers of car-sharing growth. Table 6 below recaps a timeline through the development of events related to Sunfleet activities in Malmö.

Table 6: Timeline of events related to Sunfleet activities

2006-2016	Events related to Sunfleet activities
2006-2009	Civitas SMILE project
2009	First attempted discussions to embed car-sharing for planned neighbourhood construction
2010	City Council accepts a new flexible parking policy
2011-2012	Residents move into Fullriggaren. 5-year contract to cover residents Sunfleet membership cost
2014	E. ON and Sunfleet arrange summer display of car-sharing biogas cars.
2016	Inauguration of public bike-sharing scheme in Malmö
2016	European Mobility week, Sunfleet participating in Lund & Malmö

Source: Elaborated by author

6.2. Landscape Pressures and Multi-Level Interaction

Two landscape pressures have been identified through interviews and desktop studies, one international, the other local. International pressure comes from climate change processes and an international effort by countries to de-carbonise their energy systems, including their transport sectors (Petersen interview, May 26, 2016). Locally, Malmö faces landscape pressures related to a projected rapid population growth the coming 15 years, indicating further pressure on urban resources and land-use, following a political agenda of urban growth through densification. The new urban development direction through densification began in 2006-7 (Petersen interview, May 26, 2016). Additionally, Malmö comprises the geographic prerequisite (flat landscape and relatively short distances) and a historical cultural inclination towards a biking culture, which is already well-established, although in recent decades the automobile sector has grown more dominant as the largest single mode of transportation. In the past few years this trend seems to be reversing (Trivector, 2009; Karlsson & Johansson, 2012).

Figure 9 depicts the multi-level perspective on interactions between the landscape, regime and niche levels, with a contextually concrete mapping at each level of key regime-niche interactions, and how landscape pressures have directed influences at how regime-level

actors interact to resolve the landscape pressures. The most locally pressing landscape pressure is urban population growth and politics of densification and modal shift. The experiences and developments described in section 6.1 and here show that at the regime-level three actors are identified as strongly intertwined with the growth of Sunfleet car-sharing; Volvo Cars, the City of Malmö, and property developers. There is not yet a strictly developed regime behind it of providers, spokespersons, knowledge, and community experts. These are currently emerging as the niche evolves and grows. Furthermore, a limited technical and professional cohesion is evident from public documents from City of Malmö, mentioning car-sharing very briefly with vague implications, as well as the absence of any specific car-sharing expert (Malmö Stad, 2016; Malmö Stad, 2012; Malmö Stad, 2010). Finally, it would appear that rather than displacing the incumbent regime of private automobile ownership, the car-sharing niche is co-opted and made a smaller subaltern regime existing alongside the private automobility regime, rather than in conflict with it. This can be observed through the consolidated partnership between Volvo Cars and Sunfleet.

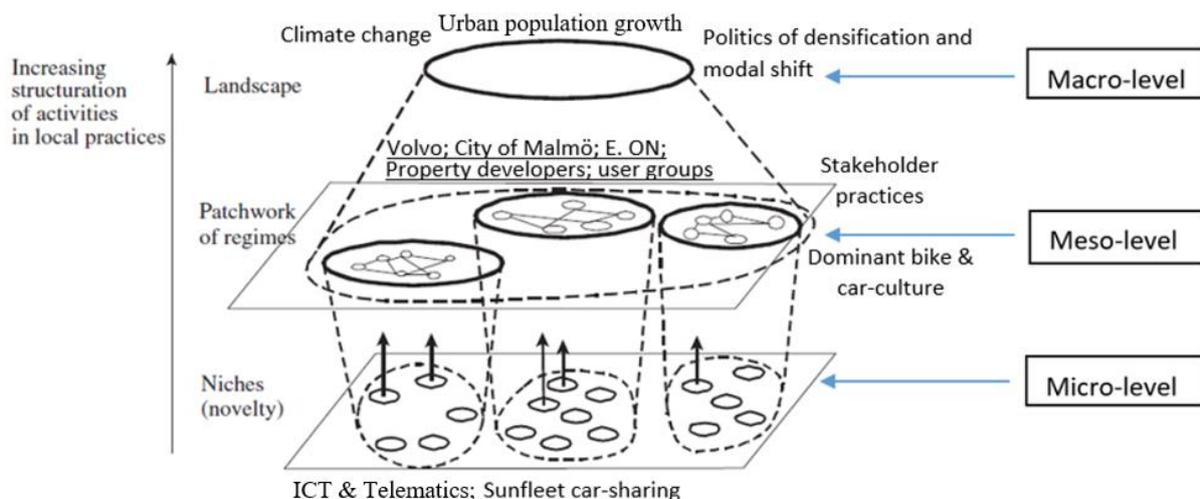


Figure 9: Conceptualised structure driving car-sharing mobility in Malmö (Elaborated by author, based on Geels, 2002, 2012).

6.3. Parking Policy

What is a parking policy? Among other things, a parking policy sets the legal minimum requirement for the number of car parking spaces necessary to provide in a new construction area. It is a guiding and decisive factor when granting building permits (Malmö Stad, 2010). The new parking policy accepted in 2010 in Malmö changed the parking policy requirement from the previous rigid rule of one parking space per apartment to a more flexible policy,

context sensitive to a variety of factors. It now ranges between 0,5-1 parking space per apartment depending on factors seen in table 8.

Table 7: Factors affecting parking norm flexibility

• Location of building
• Accessibility to services nearby
• Accessibility to public transportation
• Apartment size and composition
• Target group (type of residents)
• Housing density and expected car ownership

Source: Elaborated by author, based on Malmö Stad 2010; Malmö Stad 2013a

Under the section of “effective land use” in the parking policy handbook, it is stated car-sharing schemes should be supported as an effort to reduce the need of additional parking spaces (Malmö Stad, 2010). Embedding car-sharing in new construction is an absolute requirement in the regulation in order to achieve the 0,5 car parking space per apartment. As such it can be understood that the city planning office is steering the development and growth of car-sharing schemes rather strongly through policy management by engaging private actors such as property developers and Sunfleet car-sharing towards a new mobility standard for new residential areas.

In 2009, 13 property developers, among them Byggvesta, began dialogue with the City of Malmö to embed car-sharing schemes in their construction plans in order to reduce the parking standard of parking lots produced for residents, aimed to be reduced by 30% from 1 parking lot per apartment to 0.7 per apartment. A regular ground-level parking lot costs about 5 000 SEK, while parking houses and underground levels costs 100 000 and 200 000 SEK per parking lot, respectively (Hedlund interview, May 19, 2016; Malmö Stad, 2013b). According to a report on “Parking for Sustainable Urban Development” (Sveriges kommuner och Landsting, 2013) each 0,1 parking space per apartment reduction, implies a cost reduction of 25 000 SEK. Thus a reduction of 0,3 parking space in the case of Fullriggaren implies a cost-reduction of approximately 75 000 SEK per apartment, for each of the 650 Fullriggaren apartments, signifying a significant economic incentive for property developers to partner up with car-sharing schemes.

6.4. Mobility Management

Telephone counselling was conducted for all 650 Fullriggaren households by the City of Malmö through its mobility management approach, serving as a top-bottom intervention to evaluate and change mobility patterns in order to promote the agenda regarding the modal split of mobility options to reduce personal car travels within Malmö (Lindersköld interview, May 26, 2016; Malmö 2013a). The interview with mobility management expert Siri Lindersköld indicated phone discussions included suggestions for improved travel habits, and provision of bike maps, public transport timetables and free-cards, as well as information regarding possibility to join a car-sharing scheme, in order to forego the purchase of a car (Lindersköld interview, May 26, 2016).

6.5. Drivers for Car-Sharing Growth in Malmö

Two current primary drivers are identified, 1) a political agenda to reduce motorised transportation, car ownership and reduce demand for parking spaces, and 2) an economic incentive for property developers to build less car-parking space to achieve significant savings. The two drivers are largely interconnected, as the political driver has allowed for changes in the parking policy to be more flexible making it possible for property developers to build less than one parking space per apartment (ranging from 0,5 to 1 parking lot per apartment depending on contextual factors). Thus there are different incentives guiding cooperation and coordination between these actors with the only car-sharing organisation in the local market, Sunfleet (Stjärnkvist interview, May 30, 2016; Holmgren interview, May 30, 2016; Petersen interview, May 26, 2016; Ehrlin interview, May 26, 2016).

6.6. Barriers for Car-Sharing Growth in Malmö

Despite strong growth factors, there are certain barriers for growth as well. Firstly, there are no legal regulations exempting car-sharing vehicles from parking fees or prioritised parking in public spaces. In cities where such measures have been attempted as part of municipal policy, national rule of law has impinged on local decisions and efforts which have been benevolent to car-sharing schemes, such as in the case of Gotland (Tjänstebilsfakta, 2014). This has prompted a current debate on new policy discussions and amendment of parking laws (Tjänstebilsfakta, 2014; Stjärnkvist interview, May 30, 2016; Lindersköld interview, May 26, 2016). This is an important consideration as a consensus is held by car-sharing companies that

car parking fee exemptions could be an instrumental success factor for spreading this mobility solution to larger masses (Plepys & Mont, 2015; Holmgren interview, May 30, 2016).

The same barrier applies in Malmö. Secondly, there is certain difficulty in purchasing or leasing long-term (sometimes 25 years) from parking companies, which makes expansion to high user demand areas more difficult, argued by Sunfleet's Holmgren (interview, May 30, 2016). This limitation renders the cooperation/partnership between property developers and the Sunfleet business as an even more critical and conducive factor for growth. Thirdly, a lack of market competition may in fact be detrimental to Sunfleet growth due to procurement laws creating legal barriers for Sunfleet to access/attain public procurement deals with actors such as the City of Malmö, or government agencies (Holmgren interview, May 30, 2016).

Finally, regarding technological aspects and a surrounding support infrastructure of charging/fuelling stations for a car fleet based on clean or renewable energies, there is a limitation of such infrastructure compared to regular gasoline stations. Such a factor may inhibit a larger rollout of improved clean-tech cars that could also be imperative for a select target group of environmentally aware people (Kim et al, 2015). Implications for rolling out such a car fleet implies a reconfiguration of energy providers, demonstrating an increasing importance of alternative energy providers such as E. ON, to keep up with energy demands from changing fuel-vehicles, both for private and shared cars.

6.7. The Importance of Embedded ICT in Car-Sharing

The great leap of information communication technology (ICT) and telematics in the past decade has been attributed by many authors on car-sharing as being a key-factor for user growth of car-sharing systems, as embedded ICT in car-sharing fleets facilitate accessibility to the car in terms of unlocking/locking the car, automated log-files calculating distance driven and time-used to facilitate billing for customers and service providers. These developments with increased software in automotive vehicles are increasingly becoming an integrative part of "the Internet of Things" (IoT), which is the concept of a network of physical devices such as mobile phones, vehicles, computers, sensors, etcetera. connected to each other through the internet, enabling collection and exchange of data (International Telecommunication Union n.d.)

In the case of Sunfleet, such concepts are applied through the telematics system in their vehicles, with integrated GPS and screens, smartcard (sensors) to unlock/lock the car, and online phone apps to make reservations. These niche technological developments can be linked back to social practice theory considering how they facilitate the use of car-sharing services today compared to 20 years ago, when a user had to reserve by visiting a physical location or making a phone call and subsequently go back to pick up the keys for the vehicle. Therefore, today it is arguably easier to recruit new practitioners of car-sharing, following the ease and familiarity of steps taken from finding, reserving, and accessing the vehicle, most users today are already familiar with electronic smartcards which are embedded in many workplaces and public transportation systems (Brink 2015). This argument is supported by seeing the explosive growth of the international car-sharing market, in section 2.1. Likewise, a majority of mobile phone users utilise smartphones, and are therefore familiar with the use of phone applications, there is no new learning curve. By extension this technological configuration forms significant growth capacities of car-sharing markets in Malmö (and internationally) to recruit more practitioners, which may lead to a transition from niche-innovation to become a strong regime actor in transport services.

6.8. Household Analysis

6.8.1. Geography Matters

Clearly both main factor driving the growth of car-sharing are spatially sensitive. First with the political agenda of reducing motorised vehicle ownership and transportation on the streets of Malmö, and secondly the reduction of car-parking space required to be produced on behalf of property developers. While extending a deep spatial analysis is beyond the scope of this thesis, a basic consideration is necessary as the analysis takes places in a bounded geographical context. Primarily this will be understood in conjunction with the analysis of mobility patterns alongside household segments as individuals' mobility is subject to specific needs. Depending on the frequency of these needs, specific mobility patterns emerge through reproduction of daily, weekly, or monthly, mobility practices (Watson, 2012). Subsequently mobility preference is likely to be influenced by household composition, indicating different needs and accessibilities shaped by young single-person households, family households (with young children), or retired residents. Some studies have demarcated different mobility needs through different phases in life (Courgeau 1985; Clark & Onaka, 1983).

The geographic matter of neighbourhood location is taken into account in relation to locations for “every-day” household activities, such as grocery stores, public transportation services, schools and kindergartens (see figure 10). Even if understanding the analysis from a social practice theory and MLP perspective, it is clear that household mobility patterns are influenced by location. Closer proximity to the city centre and a household’s necessary amenities indicates a higher use of alternative mobility modes other than automobile travelling. On the other hand, outer-rim residential neighbourhoods in Malmö have a higher level of commuting with personal cars for local travels compared to more centrally located neighbourhoods, e.g. comparing Västra Hamnen (SUMP² area 3, centrally located) with Oxie (SUMP area 14, located in outskirts) car travels in 2013 account for 30% and 64% of all travels, respectively (Malmö Stad, 2016; Malmö Stad, 2014c). This entails that whatever findings indicated by Fullriggaren household interviews, it is not likely to shed any insight on mobility patterns in other areas, thus conclusions and the insight of mobility behaviour are limited in that regard. Below follows a picture of the Västra Hamnen area presenting some selected areas of services and leisure activities.

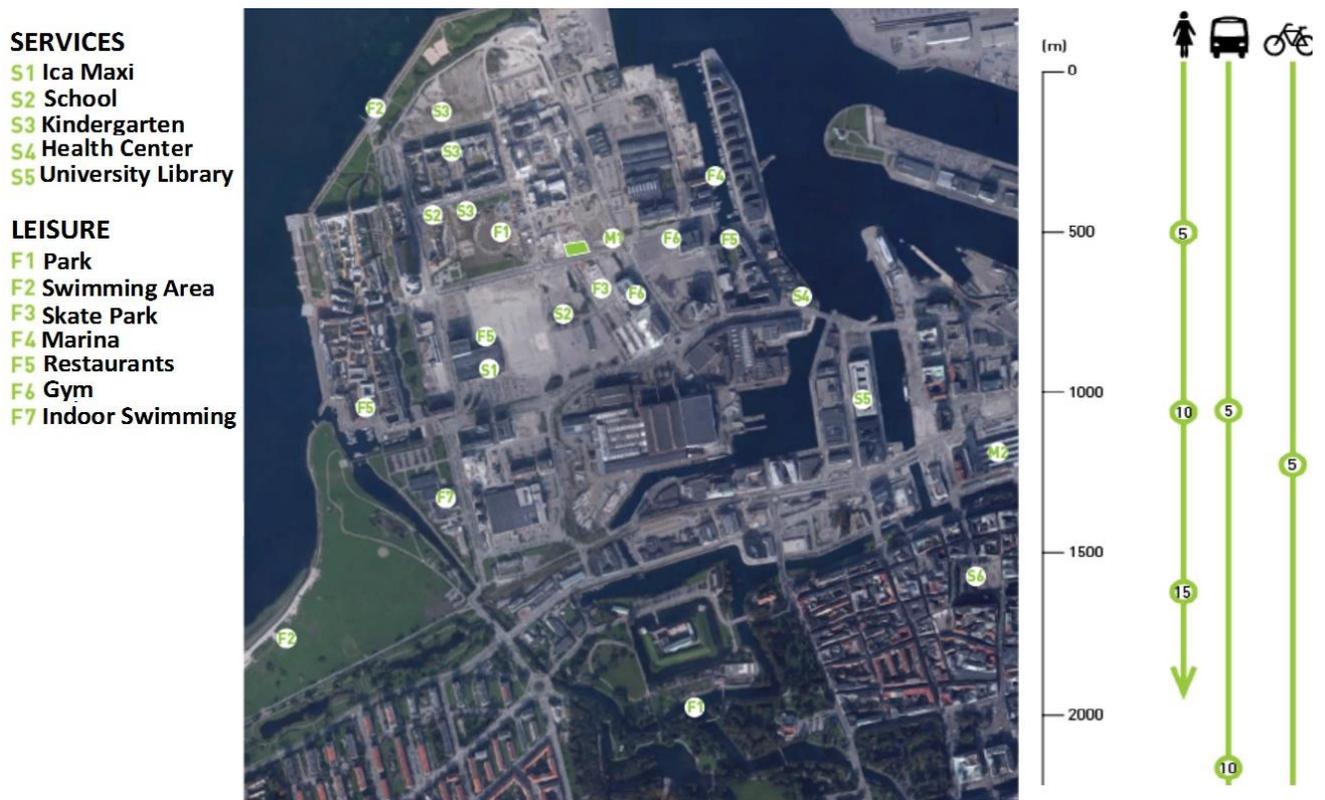


Figure 10: Map layout of services and leisure areas in Västra Hamnen (Elaborated by author, based on: www.Ohboy.se).

² Sustainable Urban Mobility Plan. There are 15 divided SUMP sub areas in Malmö, following geographic, mobility and socio-economic characteristic. For more, see Malmö Stad, 2016.

6.8.2. Household Typology

The four interviewees comprise two car-sharing users, two non-users, three young-family households, and one elderly couple, not retired, with no children in the household. One of the households (no. 1) with children, and the elderly household (no. 3) have not participated in car-sharing, with the former borrowing car from close family, while the latter own their own car. Amongst the remaining two households, no. 4 is currently a member (since 2012) using car-sharing the average frequency, 1-2 times a month, while household no. 2 was a Sunfleet member between 2008 and 2013, until purchasing their own car, also utilising car-sharing 1-2 times a month while an active Sunfleet member. Below tables 8-11 present individual household characteristics, composition, and rankings by most used transport mode before and after moving to Fullriggaren.

Table 8: Typology of household characteristics

	HH no.1	HH no.2	HH no.3	HH no.4
Sunfleet Member:	Yes	Not anymore	No	Yes
Has used car-sharing:	No	Yes	No	Yes
Has lived in Fullriggaren for:	3.5 years	4 years	5 years	5 years
Reason(s) for moving to Fullriggaren:	Environmental/Safety	Close to train station for commuting	Proximity to sea	Proximity to sea
Consider there is good accessibility to services:	Yes	Yes	Yes	Yes
Average frequency of car-sharing use:	N/a	1-2 times a month*	N/a	1-2 times a month

Source: Elaborated by author, based on household interviews.

* While still using the cars-sharing scheme

Table 9: Household composition

	HH no.1	HH no.2	HH no.3	HH no.4
Children in the household*	3	2	None	2
Adult age groups	32 & 36	30 & 35	50 & 53	30-39**
Family size	5	4	2	4

Source: Elaborated by author, based on household interviews.

* Defined as children under the age of 18

** Age not specified

Table 10: Ranking by most used transport mode **before** moving to Fullriggaren

	HH no.1	HH no.2	HH no.3	HH no.4
Bicycling	1	1	1	1
Walking	2	3	4	3
Public transportation	3	2	3	2
Private car	4	N/a	2	N/a
car-sharing car	N/a	4	N/a	N/a

Source: Elaborated by author, based on household interviews.

Table 11: Ranking by most used transport mode **after** moving to Fullriggaren

	HH no.1	HH no.2	HH no.3	HH no.4
Bicycling	1	1	2	1
Walking	3	4	4	3
Public transportation	2	2	1	2
Private car	4	3	3	N/a
car-sharing car	N/a	5	N/a	4

Source: Elaborated by author, based on household interviews.

6.8.3. Changing Mobility Patterns

Mobility behaviour and decision making amongst the households interviewed appear to be based on a variety of needs, although primarily relating to the most common types of mobility activities, such as work commute, kindergarten/school drop-off, grocery shopping, and other occasional services and leisure activities. However, needs are not the only factor to take into account, aspects such as environmental or economic consideration also play a significant role in choosing one's mode of mobility. E.g. household no.1 indicated a strong environmental emphasis for moving to Fullriggaren (table 8) due to its sustainability profile, as well for close proximity to kindergarten (2-minute walk) and good public transportation connection. While household no.2 chose the location for close proximity to Malmö Central station to facilitate work commute to Copenhagen, Denmark, by train. Household no.3 and 4 instead chose the area for its proximity to the sea rather than for any other concrete services or mobility rationale (Household interviews 1-4, May 19 & June 26, 2016).

Table 10 and 11 indicate that there have not been significant changes in the households' mobility patterns, or rather the modal choice, since moving to Fullriggaren. Household no.4 (interview, June 26, 2016) has kept the same frequency ranking on transport mode before and after moving to Fullriggaren, with the exception of adding car-sharing activities since moving in. When asked how the households mobility pattern has changed since moving to Fullriggaren answered:

“We have come closer to Malmö Central [station], so our amount of movement has probably gone down a bit since moving, as Västra Hamnen has access to most things. Public transportation works very smoothly, especially when there are long car queues. Limhamn [household's previous residential area] is located farther away so it always took longer coming into town.”

Instead, looking at what type of mobility is preferred depending on the activity or location, household no.4 answered bicycling or public transportation is used for work commute, while walking to kindergarten is most common. Grocery shopping is done by either walking, using a cargo bike, or ordering large volumes online, while after-work and weekend leisure activities combine public transportation and bicycling, only using car-sharing for an activity outside of the city, such as visiting family members or a national park, or for big bulky buy-ins from IKEA or other furniture stores. On average, household no.4 uses car-sharing 1-2 times a month, and is most usually planned, rather than spontaneous. Despite using the car-

sharing relatively little in comparison to other alternatives, the rationale for doing so is that only one adult has a driver's license, and using Sunfleet services 1-2 times a month equals the monthly cost of a parking space. Furthermore, the household considers car-sharing is more flexible than owning a car in the sense that one does not have to spend money or time on maintenance. However, there are indications that once both adults have a driver's license a car-purchase might be possibility, although this would not directly mean opting out of car-sharing. Considering the perception held by the household there is an indication that car-sharing is a more preferential practice than owning their own car, as car-sharing is in many ways easier to manage due to the absence of pre- or post-maintenance.

Looking at household no.1 (interview, May 19, 2016) the only clear indication of mobility changes is that the relocation has prompted an increased use of public transportation and a slight decrease in walking, having moved from a more central location in Malmö. Biking and public transportation (used for work commute and grocery shopping) is emphasised by the strong environmental awareness of the household, while occasional car travels are conducted by borrowing a car from the immediate family. Despite being a Sunfleet member, the household has opted not to use their services due to complications with child seats, in terms of accessing a car that has them available and installing them. Drawing on social practice theory, such a factor complicating the smooth usage of such a service would likely not be able to recruit a practitioner, rather reject them, which can be observed in this case. The issue of recruiting new practitioners among households with young children may another impediment/barrier for Sunfleet, as only 3-4 cars out of the 135 car fleet have available car seats for children (Holmgren interview, May 30, 2016). Again, household no.1 argues there is no need for owning a car while living in Västra Hamnen as it is relatively centrally located, and would only consider purchasing a vehicle if living outside of the city and in the absence of a decent public transportation network.

Household no.2 and 3 (interviews, May 19 & June 26, 2016) have had the most significant changes in mobility patterns since moving to Fullriggaren, both are households with a private car. Household no.2 (interview, May 19, 2016) is an ex-Sunfleet member, from 2008 to 2013. The average use of car-sharing in household no.2 used to be the same as for no.4, 1-2 times a month. Biking and public transportation remain fixed as the most common mobility types, characterised by work commute primarily, kindergarten and after-work activities, while grocery shopping was an activity that raised the need for car-sharing as the household has indicated a preference for large-scale shopping located at the outskirts of Malmö. However,

after moving to Fullriggaren and purchasing their own car, the households' mobility pattern has indicated an increased use of the car for both work commute, and leisure activities, such as visiting family. Unlike the other households, all with jobs located in Malmö, one of the adults in household no.2 require a work commute to Lund, a nearby city, emphasising the necessity of owning a car. The reverse pattern could be observed for household no.3 (interview, June 26, 2016) where one of the adults changed from car commute to bike/public transport commute to work after moving to Fullriggaren. However, rather than being an induced change by location or car-sharing accessibility, this mobility routine change emerged as a response to the lack of close-by parking spaces to the work place, as well as costly parking spaces in the city.

Looking to materials, meanings, and skills. It can be identified that in household no.1 a strong reason for not utilising the car-sharing service, other than access to close-family car, appears to be general lack of car seats for children. Further, when asked why the household had not used Sunfleet's services the interviewee answered "You know, I think because we have kids mostly. Because it is a little bit more complicated with car seats and that stuff. Easier for us to take the train and bus, you can get anywhere you need from here." First off, this quote implies that materials, in this case children's car seats, implies less practicality with car-sharing as a mobility option vis á vis other alternatives, such as public transportation or biking, at least in the case of a local journey. Skills are also implied here in the sense, should installing and dismantling of car seats be easily transferred to all practitioners (or users), it could imply a swifter use for all, and thus strengthen the reproduction of car-sharing use. However, the economic cost should not be forgotten as a certain deterrent which makes the user think twice before using the service, as is argued by interviewee no. 4 "... it makes us think twice before if we need anything when doing large-scale shopping". Furthermore, interviewee no.4 stands out from the other interviewees from the symbolic meaning derived by the car-sharing, emphasising a certain freedom of responsibility of keeping up with the maintenance of the car, rather than as a loss of freedom from not owning your own car, as implied strongly by household no. 2 and 3.

To conclude, it appears that there are more, and often stronger, factors other than car-sharing that appears to be steering the change in sustainable mobility behaviour of the Fullriggaren residents that have been interviewed. A concrete generalisation is not possible to make from four interviews, although it does provide some insights in the case specific context as to what may steer changes. Further it finds that the reproduction and specific styles of mobility found seem to be coherent with previous research on household mobility patterns

based in part on household segmentation and life-cycle mobility patterns of people (Dowling & Kent 2015; Clark & Onaka 1983; Courgeau 1985). Interviews with both Holmgren and households imply the average usage of a Sunfleet member is 2-3 times a month, which is consistent with findings from earlier research as well (Plepys & Mont, 2015).

It is however made clear both in section 2 and here that the type of car-sharing service found in Malmö is not one to compete with other quotidian mobility practices, and is rather reserved for specific needs and occasions with certain foresight. However, while extrapolating and leaning back on other studies to support this claim, it also appears the mere presence of car-sharing accessibilities may increase a households use of public transportation and biking, as cars may be readily available should then need arise, thus making it possible for households to forego a purchase of a personal vehicle (Hampshire & Gaites 2011).

Chapter 7

Conclusions and Discussion

This explorative and narrative analysis has led to a general understanding of the inception and subsequent growth of Sunfleet car-sharing activities in the City of Malmö by looking at how key actors have formed the niche socio-technical system of professional car-sharing. Relating back to the research questions set up at the beginning of this paper, in answering research question 1 it appears that the predominant set of factors driving the development of the car-sharing niche in Malmö relate to the agency and cooperation of five particular actors, the Civitas initiative (initially, from 2005-2009), the City of Malmö, Sunfleet, Volvo, and property developers. With less direct impact, and auxiliary support from actors such as E. ON, HMSkåne, Bil-coop, and Gröna bilister, acting as social groups for the diffusion of sustainable mobility awareness. Empirical data points towards importance of the EU Civitas initiative to kick-start car-sharing in the City of Malmö with Sunfleet in 2006, due to a previously absent professional car-sharing market in Malmö. Subsequent developments have largely been steered by locations where Sunfleet vehicles can be parked, an emphasis from city planning office to change mobility behaviour through mobility management, and most importantly from local urban development agenda prompting a collaboration between property developers and Sunfleet in order to embed car-sharing schemes in residential areas.

Barriers hindering the growth or consolidation of car-sharing appear to be less strong, though they do exist. There are still legal obstacles preventing cities or municipalities to give preferential treatment of car-sharing in public spaces as a way to promote the use of car-sharing. Further, purchasing or leasing high-in-demand parking spaces may be both costly, and require very long-term contracts. Finally, there is an insufficient charging infrastructure for the development of a vehicle fleet based on clean or renewable energies, although this is no direct impediment for growing with regular internal combustion engine vehicles.

In terms of usage, it appears car-sharing does not significantly impact the mobility behaviour of residents in Fullriggaren, as the average use-frequency of car-sharing lies on 1-3 rentals a month, among users. This can be considered to be quite a limited use. While it implies a limited reproduction of a specific mobility mode, the presence, and occasional use of it can arguably lead users to forego the purchase of a personal car. Furthermore, car-sharing uses have been shown to be steered by after-work activities in the case of private users. Therefore,

the extent of car-sharing usage among households appears to be relatively limited, given the data analysed. Finally, there are no significant changes in mobility patterns from the households observed, some using public transportation and biking more than before, while the other use it less than before.

Evidently four semi-structured interviews do not achieve statistical significance or representation of the entire neighbourhood, however that has not been the purpose. Instead it does provide some valuable insights into the rationale of mobility choices these household make, and how much they are guided by the variety of factors presented in the analysis above; proximity to services, household composition and special needs, weekend and leisure time activities, work commute, quotidian activities. Regarding users and the elements of materials, meanings, and skills it appears the reproduction of car-sharing activities are relatively limited, despite technological improvements to ease accessibility with seamless efforts, with certain barriers remaining, such as the absence or difficulty of installing children's car seats. Further, drawing on these initial experiences it may help in laying ground work for future studies guiding the content of future interviews and surveys, to give a more conclusive and analytical rigour through quantitative methods.

A generalizable take-away beyond this study could be to take into account the physical and geographical landscape of the urban context studied, as such variations may implicate different mobility needs and preferences. This then also relates to applying spatial sensitivity in the analysis. This study area may also benefit from further studies, for example from the behavioural economics perspective, which could possibly more accurately find *how much more* a consumer is willing (or not) to pay for automobile ownership, if their mobility needs and pattern is economically more sound through car-sharing practice.

The international transition of car-sharing is a slow one, a typical characteristic of transition studies, developing slowly in the past decades, only taking up momentum since early 2000s. As has been stated by Geels, Zijlstra and Avelino, and Sheller, referenced earlier, the automobile culture has proven to be one of the most resilient and locked-in cultures to change due to its practical and symbolical meaning to hundreds of millions of users. It appears to be no different in the local case of Malmö. It is an interesting transition in the sense that it is not directly envisioned to completely replace the dominant regime of personal automobile ownership. Rather it forms as a subaltern regime that can exist parallel to dominant regime at the meso-level, suitable for a different type of users. The complementary nature and benefits

of the car-sharing system for sustainable mobility alleviates issues of congestion and pollution, while also promoting increase use of public transport, bicycling and pedestrian modes of mobility. Thus it is both a direct and indirect approach to changing mobility routines.

Other venues for exploration in shared mobility consumption research could be on the environmental impact and frequency of car-sharing uses - depending on car-sharing type – vis á vis private consumers and businesses. Policy implications drawn from this study focus on the insights gained on the politics of parking, new property constructions, and how reconciliation between private and public actors may bring about a purposive growth in car-sharing markets in urban areas where there may be a need for it, with positive impacts for reduced car ownership, congestion, and more efficient urban land-use.

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Interviewees:

Olof Holmgren, business development and construction projects, Sunfleet, 30th of May 2016

Anna Stjärnkvist, Traffic Planner, city planning office, Malmö Stad, 30th of May 2016

Siri Lindersköld. Mobility Management, street office, Malmö Stad 26th of May 2016

Kami Petersen, political secretary to councilwoman Karolina Skog (now Environment minister of Sweden), Malmö Stad. 26th of May 2016

Jonas Hedlund, strategist in sustainable mobility, HMSkåne, 19th of May 2016

Kjell Ehrlin, Manager/Steward, Byggvesta, Malmö, 26th of May 2016

Household no.1 female, 32, Fullriggaren resident, 19th of May 2016

Household no.2 female, 30, Fullriggaren resident, 19th of May 2016

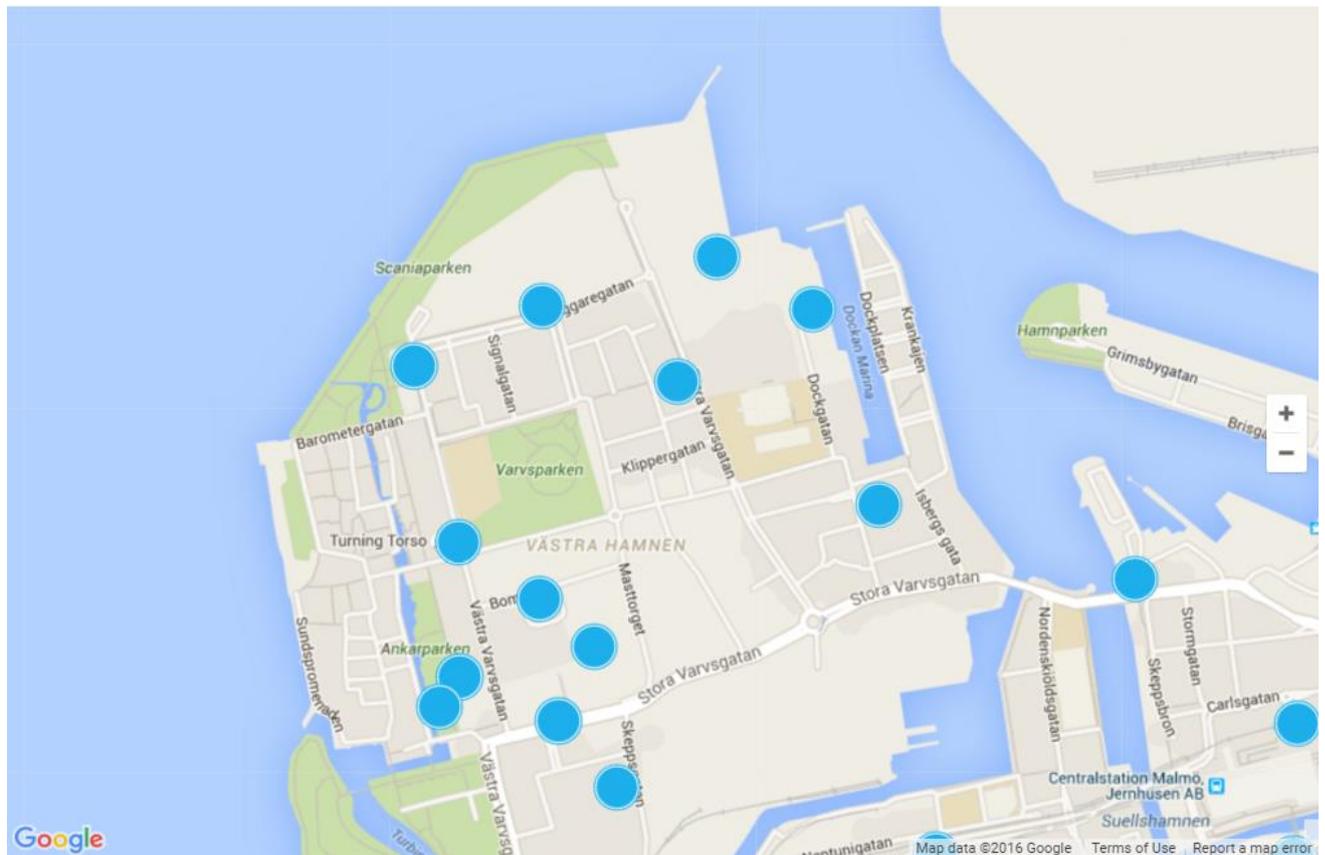
Household no.3 female, 50, Fullriggaren resident 26th of June 2016

Household no.4 male, 30s, Fullriggaren resident, 26th of June 2016

Transcripts of interviews can be produced on request.

Appendices

Appendix 1: Parking Locations of Sunfleet Cars in Västra Hamnen.



Source: Sunfleet.se

Appendix 2: Standard Set of Questions for Households

1. How long have you lived in Fullriggaren?
2. How long have you lived in Malmö?
3. Where did you live before moving to Fullriggaren?
4. Why did you move to Fullriggaren?
5. How many live in the household, and how old are they?
6. Who has a drivers' license in the household?
7. Do you own a car?
8. Did you own a car before moving to Fullriggaren?
9. Do you use anyone else's car?
10. What proximity is there from your households to other services in Västra Hamnen or Malmö that you require frequently?
11. Where do you work, are you close or far away?
12. How do you normally travel to work?
13. How do you normally travel for grocery shopping?
14. What is the greatest need you have for using a car?
15. How did your mobility patterns look like in general before moving to Fullriggaren?
16. What does your mobility pattern look like, living in Fullriggaren today?
17. Are you a Sunfleet member?
18. Have you used the Sunfleet service at some point?
19. How often on average do you use it?
20. For what type of travels do you use a Sunfleet car?
21. Do you know anyone else using Sunfleet?
22. What is your preferred mode of transport, now that you live in Fullriggaren?
23. What does it mean for you to have a car?
24. Do you have any specific attachment or association to the idea of a car/your own car?
25. For what main purpose did you buy a car?
26. How much of a necessity is a car where you live?