

Car Sharing and Urban Mobility in Malmö and San Francisco

A Niche Dynamic Perspective

Brayton Noll

Supervisors

Dr. Tareq Emtairah

Dr. Peter Arnfalk

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Tel: +46 – 46 222 02 00, Fax: +46 – 46 222 02 10, e-mail: iiiiee@iiiiee.lu.se.

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Abstract

Car sharing as an idea challenges the prevailing mobility regime in the global north that has been built around private vehicle ownership. Well established regimes such as this, over time generate norms and collect actors that become dependent on the private car as the dominant form of mobility. These norms and actors, whose very existence is at times contingent on upholding the current socio-technical system of mobility, support the current system and suppress any regime challenging concepts. Thus, for car sharing to grow to a scale where it can challenge private vehicle ownership, initially it requires protection from these aggressive forces. These protected spaces or *niches*, emerge from other actors promoting the use of and shielding car sharing until it can, in conjunction with other mobility actors, challenge or replace the socio-technical regime.

This thesis explores the urban niche dynamics of car sharing in two case study locations: Malmö, Sweden and San Francisco, California. In both urban environments the numerous social and technical components of car sharing render thorough analysis a difficult task. Two theoretical frameworks are utilized in the analysis: the evolutionary/multi-level perspective and the relational perspective. This paper suggests that the institutional regulation and taxation relating to car sharing in Sweden has necessitated the greater number of relationships with other actors and has framed the concept as a *complementary* alternative within a system of alternative mobility actors. In San Francisco however, the demand from residents for a dramatic change to the current mobility regime, paired with favorable institutional enablers, frames car sharing as having greater potential to be a more independent, *promising* alternative. Both cities aim to significantly reduce the dependence on private vehicles in their downtown by 2030. To accomplish this goal, mutually beneficial partnerships within alternative mobility actors' networks play a critical role in growing car sharing and attracting users from the existing mobility regime.

Keywords: Car sharing, Niche dynamics, Socio-technical theory, San Francisco, Malmö

Executive Summary

Background and Problem Definition

As the world becomes increasingly urban, many cities in the global north are working to preference non-private vehicle forms of mobility in their downtowns. Private vehicles have dramatically shaped cities, lives, and boarder expectations from mobility for almost the last century (Patterson, 2000; Freudendal-Pedersen, 2009). The associations with and dependence on the private vehicle that many actors and institutions have, means that out of self-preservation, these outside actors work to ensure the continued success of the private vehicle in part by suppressing any concepts that challenge it. This group of actors, or actor network, all supporting a common means of mobility, constitutes a socio-technical regime, upholding the social and technical aspects of private vehicle ownership.

Challenging a well-established socio-technical regime, can often not be done in an open market setting without external support or protection. The suppressive forces from the actor networks kill emerging concepts before they reach a scale where they can be competitive with the established regime. Thus, for a system/regime challenging concept to grow, it needs protection from these forces. Outside actors or institutions that support the incumbent concept can shield or provide a protective space for the concept to grow and garner a support network until it is large enough to challenge the concept on its own. These protective spaces are called *niches* (Smith and Raven, 2012).

Car sharing as an idea challenges the prevailing mobility regime in the global north, which has been built around private vehicle ownership. In many areas, user percentages are very small and the concept is still in its nascence, still requiring some niche protection. Studying the urban niche dynamics of car sharing in multiple cities, assists not only in understanding the regime challenging concepts' emergence, but also allows analysis on how the niche dynamics play out in different urban contexts. Two case study cites were chosen to analyze the niche dynamics and mobility actor networks surrounding car sharing: Malmö Sweden, and San Francisco, California.

Statement of Purpose and Research Questions

This thesis, utilizing socio-technical theory, is intended to advance the understanding of car sharing as a regime challenger through exploration and analysis of the concept in the two case study locations: San Francisco and Malmö. To do so, this thesis answered the following research questions:

1. What are the social, governance, and technology/ infrastructure factors that have shaped the niche dynamics of car sharing in Malmö and San Francisco?
2. How is car sharing framed by the mobility actors network within different urban contexts and what implications might this have on the transition pathways?

Theoretical Frameworks and Methods of Analysis

To unpack and analyze car sharing's emergence and assess the current mobility environments in both cities, two frameworks, utilizing two complimentary methods of analysis were chosen. To answer the first research question, the evolutionary, or multi-level perspective was selected for its retrospective analysis and focus on factors that shaped the car sharing environment in

both locations. After it was adequately contextualized, the current mobility environments in both cities were mapped to explore the difference in framing and how different mobility actor networks affected car sharing's role in each urban environment. Differences in arrangements and framing of the networks have implications not just for car sharing, but for the entire regime alternative mobility actors.

Case studies were ultimately decided upon due to the richness in detail that in-depth study of a small sample size allows. A literature review was conducted on car sharing in both cities and larger governing bodies affecting the cities. After a baseline of knowledge was established, semi-structured interviews of mobility related actors were conducted to facilitate more in-depth analysis through the inclusion of additional perspectives.

Research question 1: What are the social, governance, and technology/ infrastructure factors that have shaped the niche dynamics of car sharing in Malmö and San Francisco?

In combining data from literature analysis and expert interviews, a multi-level perspective was used to help analyze the niche dynamics in both contexts and to measure car sharing's progression through the different stages of niche protection. Niche factors were selected from Smith and Raven's (2012) definitions and through a thorough review of past car sharing studies. Analysis suggests that the car sharing environment in both cities is still in need of niches. While no longer in need of *shielding* from market forces, car sharing in San Francisco and Malmö still requires different means of *nurturing* and *empowerment* if any larger scale shifts toward broader utilization of car sharing are to be observed.

San Francisco's car sharing environment has benefited from more protective actions than Malmö; particularly with institutional enablers such as legislation and taxes pertaining to the concept. Additionally, the parking ceiling, horrific traffic, and over capacity public transportation in San Francisco are indicators of a struggling existing mobility regime. Conversely, in Malmö, public transportation is generally perceived as acceptable and car sharing has benefited from a close relationship with the government. Thus, the principle question generated from evolutionary perspective analysis was how do these aforementioned factors influence differences in the current framing of car sharing in the mobility actors network in each city? Research question two evolved out of this, and the relational perspective was utilized to answer the question.

Research question 2: How is car sharing framed by the mobility actors network within different urban contexts and what implications might this have on the transition pathways?

From careful analysis of the history of car sharing in both locations and in discussing connections between different mobility actors, the mobility actors network in both cities was mapped using the relational perspective. In Malmö, the alternative mobility actors network clusters around the problems of private vehicles. In this context, car-sharing is framed as an actor in an integrated alternative network of mobility that could assist in the transition to a regime less dependent on the private vehicle. Thus car-sharing in Malmö can be seen more as a *complementary* alternative. The nucleus of the alternative mobility actors web in San Francisco on the other hand, seems to be centered around the problems in San Francisco relating to mobility in more general terms (congestion, bad public transport, conflicts between alternative transport options, etc.). In this context car-sharing was actually given more institutional impetus as an independent *promising* alternative.

Conclusion

The retrospective analysis of the evolutionary/multi-level perspective illuminated the key differences between the two cities. Most notably, institutional regulation in Malmö still lags behind that of San Francisco. The consequences of this were observed when the current alternative mobility environment was mapped out for both cities using the relational perspective. In San Francisco, more favorable regulation and taxation resulted in car sharing's noticeable independence on the web and framed the concept as a *promising* alternative. In Malmö institutional hindrances to car sharing have necessitated the formation of more partnerships and framed the concept as a *complimentary* alternative within a system of interconnected alternative mobility actors.

Utilization of the two frameworks allowed analysis of how the development of the niche dynamics in both cities influenced and framed the current mobility environment. Neither framework has the capacity to incorporate all of these factors on their own. Thus, when looking at socio-technical regimes, using multiple frameworks or methods of analysis that frame the current environment through historical analysis, allows for more place specific, contextualized analysis and better informed conclusions.

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Abbreviations

P.C. – Personal Communication

MLP – Multi-Level Perspective

B2C – Business to Consumer

P2P – Peer to Peer

VMT – Vehicle Miles Traveled

MAAS – Mobility as a Service

TDM – Traffic Demand Management

SFMTA – San Francisco’s municipal transit agency

1 Introduction

1.1 Urban Mobility

Mobility is an important part of any environment – so critical that Urry, (2004) argues it is the lens through which societies should be analyzed. It directly shapes how we define our space-time relationships, and the sentiments tied to different forms are bound to class, ethnicity, gender, and societal ideals (Freudendal-Pedersen, 2009; Hagman 2010). It is linked to happiness (Montgomery, 2013), to identity (Hagman, 2010), and freedom (Freudendal-Pedersen, 2009). For an aspect of human life with such awesome power, the modus operandi of transportation has remained relatively stable in the past century (Patterson, 2000). Cities and daily life in much of the global north are organized with the private vehicle setting the standard for mobility. As such, many other actors and social norm have organized themselves around it, growing to depend on the private vehicle.

With more than half of the world now residing in an “urban area,” sustainable mobility options that can efficiently service the growing demand are increasingly needed (WBCSD, 2016). Yet, despite the majority of the world living in urban areas, for the last twenty years, cities have been growing in size and not in density and this trend is expected to continue through 2050 (Gunalp et. al 2016; Cox, 2011). This means less people are cramming into cities, and instead urbanizing what was once considered suburbs surrounding the urban hearth.

Within urban environments, in an effort to reduce traffic and foster a more “livable” environment, many cities are trying to preference walking, biking, and alternative means of transport as more viable mobility options through design and different programs (MacKenzie, 2015; Malmö Stad, 2016; SFCTA, 2016). While biking, walking, and improved public transportation infrastructure are often the primary approaches taken by cities when trying to reduce the number of cars; car sharing has become such a widespread concept, that many cities now include it in their urban plans.

1.2 Car Sharing - Problem Definition

Despite inclusion in many city urban planning documents and widespread recognition in the global north, car sharing is still an emerging concept in the early stages of formation in most locations. While there are exceptions, car sharing is utilized by less than 3 percent of the population in most urban areas and the number drops when including the entire population, thus the idea is still operating on a small scale (Cornet, et. al., 2012; Naughton, 2014; Shaheen, Cohen, and Roberts 2006; TCRP, 2005). Car sharing as an idea challenges the prevailing norm of private car ownership and directly threatens the systems and actors, norms and socially constructed expectations which have evolved to depend on private vehicle ownership. These norms and actors whose existence is at times contingent on private vehicles setting the standard form the dominant socio-technical system. These dependencies from outside actors stabilize “private car ownership through many lock in mechanisms” and try to ensure its continued success (Geels, 2012, 472). In this context, car sharing represents a socio-technical challenging concept in contrast with the existing regime.

Thus, for car sharing to grow to a scale where it can challenge private vehicle ownership, initially it requires protection from these aggressive forces. These protected spaces or *niches*, emerge from other actors promoting the use of, and shielding car sharing until it can, in conjunction with other mobility actors, challenge or replace the socio-technical regime (Smith and Raven, 2012). Car sharing like other concepts such as public transport or biking challenges the idea that

one needs to own a car to be mobile and questions the idea of what urban mobility looks like. In order to examine how the car sharing emerges in these niches, this paper take two case studies, San Francisco and Malmö and examines the evolution of the regime challenging concept in these areas from conception.

1.3 Modern Car Sharing as a Concept

The term car sharing does not have an internationally agreed upon “standard definition,” and in some cases there is not even a national definition. Often, companies are concerned with the definition for tax or legal reasons and while there are numerous types of car sharing, LeVine, Zolfaghari, and Polak (2014) believe, that generally even with different models, car sharing companies often share these characteristics:

- User must sign up and provide driver license information
- The user is not driven by a chauffeur
- Usage is typically billed in time or distance or a combination of both
- (In almost all modern examples) there is a company app or online platform for booking and/or unlocking, and/or locating

While car sharing companies share the above mentioned criteria, there are two primary business models: Peer to Peer (P2P) and Business to Consumer (B2C). P2P sharing is where a car owner temporarily suspends ownership of their vehicle, entrusts insurance and schedule arrangements to an asset-light car sharing company (generally through a mobile app), and allows another person access to the vehicle with the length of minimum rental time allowed varying in different areas. Some companies install devices that enable the vehicle to be opened through a smartphone app or card while others still require a person to person key exchange. The legal specifics of P2P sharing vary between states in the US and different countries in Europe, however, many places have passed legislation that completely absolves the owner of the car from any legal responsibility in the case of an accident caused by the temporary user.

The second model, B2C has three different variations that are widely recognized. The first is the most widespread and most similar to car rental: round-trip, lot based vehicle sharing. In this model, the user, after pre-registering, generally has to reserve a vehicle, and can then access it through an automated system devoid of human interaction. When the user is done with the vehicle they have to return it to the same location they acquired it. The second variation, is identical to above, but allows for one way trips, so instead of having to return to the same lot, the user can drive to another approved lot, and end their trip there.

The final main-stream type of business to consumer car sharing is free floating. How this variation typically works is that there is a selected area within the city that a person can unlock a car with their phone, with or without reservations drive anywhere (including out of the city) so long as when they are finished with their trip they leave the vehicle within the designated area. There are technical variations with this model such as how (and if) parking is arranged, however, the concept is relatively constant among different cities. There are other options not listed here such as Audi’s new “Audiunite” program, where a limited, predetermined number of people share a vehicle on a month to month basis. However, the four models presented P2P and the three B2C (round-trip and one-way lot based, and free floating) are the most predominant models of car sharing.

Despite car sharing’s steady growth in many locations, general public awareness, ease of access due to widespread smartphone use and improved app technology, in the United States, research

has predicted by the year 2020, a mere one percent of the population will be using a car sharing service (Naughton, 2014). In Germany, the most popular car sharing country in Europe, with over 140 car sharing organizations, only between 2-3 percent of the population utilizes it (Cornet, et. al., 2012).

The large disparity between those with access to car sharing and the number of users evokes questions of concept acceptance/understanding and what hurdles are working in competition to the success of car sharing. While it is documented that radical concepts take time, to be accepted (Loose, 2010) the gap between users and the percentage of the population that lives in urban areas suggests that car sharing is a not large scale challenger to the socio-technical system of private car ownership (Hannon, Mckerracher, Orlandi, and Ramkumar, 2016; Cornet, et. al., 2012). Car sharing, in an incumbent system with other alternative mobility actors could grow its user base and play a much more central role than it does in the present.

1.4 Car Sharing and Urban Sustainability

Many cities have included car sharing in their mobility plans. Car sharing vehicles have been shown to replace multiple privately owned vehicles where their services are offered (Schillander, 2010; TCRP, 2005). While reductions in traffic and “improving” the downtown are often used as general selling points, the environmental impact it can have is often promoted to cities as well. Car sharing has received significant praise from environmental advocates (Belotti, 2015; Edbring and Kessler, 2015; Wilhelms, Merfeld, and Henkel, 2016). Especially in urban areas, research has shown that car sharing leads to an overall reduction in miles/km driven, even when one considers the rebound effects of people who previously did not have access to a private vehicle, now driving (Maritn and Shaheen 2011; Shaheen, Mallery, and Kingsley, 2012; Meijkamp, 1998).

The average vehicle sits idle for more than 90% of the day (Hampshire and Sinha, 2011). While this is an obvious inefficient use of resources, it also means, that when parked in urban centers, there is are enormous and expensive space required to accommodate these generally inactive means of transport. When people forgo their private vehicle, as would be expected, public transportation use increases dramatically (Hampshire and Sinha, 2011; Wendle, et. al., 2016; Schillander, 2010). Thus car sharing advocates often point out that it can act as a catalyst to increased use of more efficient transport and save the city significant space when it comes to parking.

Not all studies on car sharing completely support these solely positive claims. One study conducted in Portland, Oregon found that overall, users of the service did not decrease the km/miles that users drove (Katzev, 2003). The increase in number of km/miles driven is most likely attributed to the population that previously did not have access to a car, utilizing the service at a rate that overcompensated for the reduction in km/ miles from users who previously owned a vehicle. However, public transportation usage did increase overall in the study. Some members of the study sold their private vehicle, while an even larger proportion avoided new purchases. Thus, while not generating a decrease in emissions due to driving, there is a link to resource conservation.

1.5 San Francisco and Malmö: Case Study Cities

While sustainability results vary in other urban settings, in the two case study cities selected for this study, prior research has shown that car sharing in San Francisco and Malmö does lead to an overall reduction in the vehicle miles traveled (VMT) (Shaheen, Mallery, and Kingsley, 2012; Plepys and Mont, 2015). In selecting the two case studies, a number of factors were considered. Their size differential was important as it allows comparisons across urban areas of different

scale however, not so much so that comparisons would be impractical. Analysis at the city level, as opposed to the neighborhood or region level was chosen because it is specific enough to allow rich, detailed analysis, yet general enough to ensure that the findings would be useful to other areas. As purpose of this thesis is to explore the urban niche dynamics of car sharing; the many gaps in the academic literature pertaining to the topic at this level made the city level a logical scale. Finally, the international differences between the two cities allow for the development of theories not contingent on an individual nation's specific legislation or culture.

San Francisco was the testing sites of one of the first car sharing programs in the United States. It is the second most popular city for car sharing in the U.S. and has a variety of different programs and models; with many companies basing their headquarters in the city. However, despite the diversity of options, there are presently no one way or free floating car sharing options, despite DriveNow - a free floating car sharing company - being in San Francisco between 2012 and 2015. Located just north of Silicon Valley where many alternative forms of mobility are tested it is one of the most expensive cities in the United States. While not a huge city in terms of population, at the center of the Bay Area, it is home to some of the worst traffic in the world and the vast majority of residents agree that it has reached a crisis level (Siu, 2017).

Malmö, a smaller city comparatively, is the third largest in Sweden. Located on the southern tip of the nation, it acts as the gateway to Europe. Its smaller scale allows for a slightly more focused look into the more limited number of mobility options. Like San Francisco, Malmö has a large private vehicle commuter population and a number of emerging tech companies that are attracting a younger more affluent population (Zinkernagel, 2017, P.C.; Reimer, McCormick, Nilsson, & Arsenaault 2012). All of the public transportation in the city and the region is coordinated by a single company, Skånetrafiken.

Both countries' cultures and infrastructures are heavily reliant on vehicles, translating to roughly one car for every two people in Sweden and an even higher proportion in the United States. Sweden and California both share progressive leanings in terms of environmentalism and recently signed an agreement to combat climate change together (Press Release, 2017). In exploring the two places using data from existing literature and conducting interviews with individuals representing a number of different perspectives; two questions were posed to explore factors affecting car sharing, and to analyze the present mobility environment in both cities.

2 Research Questions

In the interviews and research conducted for this project, car sharing was discussed from a number of different perspectives. However, even more diverse than the opinions on the future of car sharing, are the number of factors that affect it. This paper seeks to identify the most important factors that influence car sharing. Below are the two questions that served as a guide for the research.

Research Question	Method of Analysis
1. What are the social, governance, and technology/ infrastructure factors that have shaped the niche dynamics of car sharing in Malmö and San Francisco?	<p><u>Evolutionary/Multi-level Perspective</u></p> <p>-Literature Review</p> <p>-Content Analysis</p> <p><i>Literature review on car sharing as a phenomenon, literature review of car sharing in Sweden/Malmö and California/San Francisco, interviews with government employees and researchers</i></p>
2. How is car sharing framed by the mobility actors network within different urban contexts and what implications might this have on the potential transition pathways?	<p><u>Relational Perspective</u></p> <p>-Content Analysis</p> <p><i>City documents, interviews with city officials, researchers, actors in the industry</i></p>

2.1 Limitations in Scope of Research

While there are several limitations to this thesis, they do not undermine the validity of the general findings. Principally, it should be noted that the analysis is based on data from two case study locations and should not be considered representative of every urban environment. Instead, the discussion and analysis of car sharing is intended to identify critical protective actions that shielded car sharing from the current regime in these two locations, and critique the two frameworks used in the analysis.

An additional limitation, is access to car sharing companies. In part due to the fact that the concept is still evolving, companies are secretive with their procedures and company specific statistics. Thus, many of the car sharing companies (some more so than others) are hesitant to, or simply do not speak to researchers. While somewhat limiting, this thesis still was able to analyze the agency exercised by the car sharing companies within the marketplace through interviews with researchers, news articles, and speaking directly with city officials.

Finally, the author does not speak Swedish, making access to some official documents slightly more challenging. However, with assistance from the author's thesis advisors and the fact many of the modern city and federal documents are published in English in parallel with Swedish, the author feels that the information accessed was sufficient.

2.2 Ethical Considerations

I have received no outside compensation for this work. The interviews conducted and data collected was done solely to satisfy academic interests.

2.3 Theoretical Framework

In examining the urban niche dynamics of car sharing, there are a number of theoretical frameworks that satisfy the necessary criteria to serve as a lens through which to analyze the concept. This thesis found social technical theory to be the most appropriate as there are very few studies that examine car sharing from this angle. Socio-technical regimes are made up of a number of actors and norms, that overtime grow dependent on and reinforce one another. These dependencies between actors for a web that, by design supports and “lock in” other actors in the regime (Geels, 2012).

In employing this viewpoint, the evolutionary perspective (also known as multilevel perspective or MLP) is often used to analyze the shift from one socio-technical regime to another. MLP theorists look at how shifts or developments in the landscape, trends and practices in society, have influenced the existing dominant socio-technical regime - but always in the past as this perspective demands a retrospective approach.

As existing socio-technical regimes are difficult to disrupt and often suppress new regime challenging concepts, MLP suggests that these incumbent concepts require protective spaces where they can grow independently, shielded from the existing regime. These protective spaces or *niches* are depicted as three levels through which the concept evolves: shielding, nurturing, and empowering. The incumbent regime challenging concept is pushed up through the levels until it is resilient enough - through general recognition and the establishment of enough interdependencies with other actors - to compete with or replace the existing social technical regime (Smith and Raven, 2012). In each level, the socio-technical challenger (car sharing) gains more support and strengthens its influence. The evolutionary perspective looks at outside actors that shield the incumbent concept. Car sharing is not afforded agency in this analytical perspective. The lack of agency awarded to the regime challenging concept, and its solely retrospective approach are the two most severe limitations of the evolutionary/multi-level perspective. While MLP provides excellent context to the current environment and the evolution of involved actors, its limitations inhibit a holistic depiction (Garud and Gehman, 2012).

Unsatisfied with the limitations of the MLP’s retrospective lens and lack of agency awarded to the actors, scholars have proposed the “relational perspective” as an alternative. The relational perspective uses a flat web to represent the connections in socio-technical systems. The advantage of the relational perspective, is that by ridding itself of the layers, it is adequately able to depict the active role that all actors, including the regime challenging concept, play in shaping and being influenced in their current environment. This perspective has been a popular portal through which to view issues of sustainable journeys (such as the transition to a more sustainable mobility system) because of their complexity. This framework is best described as a complex web of changing actors that have fluctuating degrees of influence and association with the system altering concept.

This thesis will first utilize the MLP to depict and analyze car sharing’s evolution in both urban settings and set the context for the current mobility environment. The three stages of protective actions or the niches that Smith and Raven (2012) discuss have been further broken down to provide additional context for car sharing. In each protective level (shielding, nurturing, and empowering) three internal categories have been created: social, governance, and

infrastructural/ technology. These three categories within each level allow more focused analysis on the sources of the different protective actions that were applied to car sharing. Building off the foundation the MLP provided, this thesis then switches lenses to the relational perspective to present and analyze the alternative mobility actors network in each urban setting.

2.4 Method of Analysis

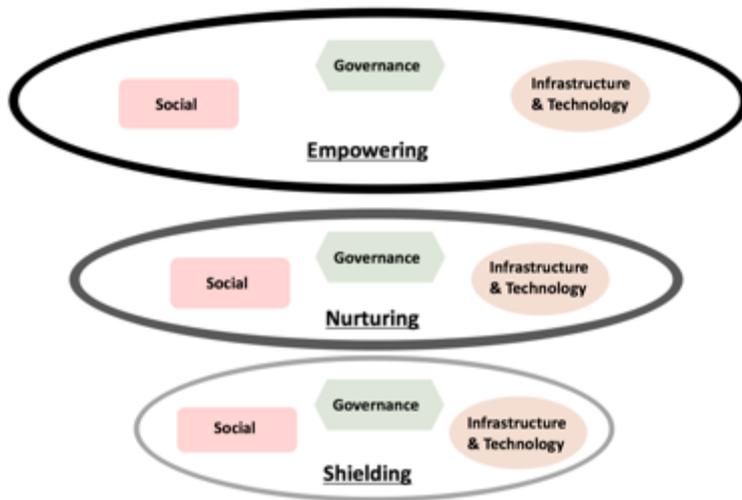
As previously rationalized, socio-technical theory's multilevel/evolutionary perspective paired with the relational perspective were deemed the best tools to analyze the urban niche dynamics of car sharing. Case studies were chosen to be the scale of analysis due to the richness in detail that a focused number of studies can foster. They allow the in depth study and analysis of a variety of variables and can illuminate connections and contributing factors that would be overlooked in more superficial, widespread analysis. The objective of examining specific cities is to provide site specific examples and analysis that can further inform a broader discussion of how car sharing nodes develop and assist in the concepts growth.

Malmö and San Francisco were selected due to the factors discussed earlier. The highly complex nature of socio-technical systems only allowed the examination of the two case study locations during the available time frame. First, a literature review was conducted about the concept of car sharing. Academic articles and studies were reviewed representing cases from around the world, but North America and Europe, were of special focus as the two continents are home to the vast majority of privately owned vehicles as well as car sharing organizations (ACEA, 2016). Then, country, state and city specific literature, both peer reviewed and grey literature was collected, specific to the two case study locations. Statistics, political structure and preferences, as well as other information that tangentially affects car sharing was all analyzed. From the information acquired in this research, the author reached out to relevant persons that interacted with, or influenced car sharing in each location: researchers, consultants, city officials, car sharing operators, etc.

Due to the varying nature of the interviews, semi-structured, exploratory interviews were conducted. Upon scheduling an interview, preparation for the interview was done by researching the person's professional experience (either published articles, projects, or initiatives) and asking the respondents about mobility, car sharing and other relevant factors relating to their work and car sharing. The persons interviewed can be seen in the Appendix. Considering the number of factors that affect car sharing and niche development, it was decided that structured questions would be limiting, and not permitted the interviewees to bring up or discuss new topics that the author had not considered. Thus, the questions posed by the author to each interviewee were informed by the relevant literature previously reviewed, paired with their area of expertise.

Many interviewees suggested additional literature or topics to review relevant to either a local aspect of car sharing or a particular subset of what they discussed. Thus following the interviews, additional research was conducted to gain a better understanding of specific aspects affecting niches. The interviews and the suggested additional reading were the two components that primarily guided the narrowing of the niche dynamics along with previously conducted research on car sharing's success. In analyzing all the factors mentioned in the interviews, and the majority of covered topics in the literature, it became evident that the vast majority of the factors fit into one of three categories: social, governance, and technological/ infrastructure. These are the three categories that the authors fit within each of the different levels of Smith and Ravens (2012) framework. An example of the categories and levels are shown in (Figure 2-1).

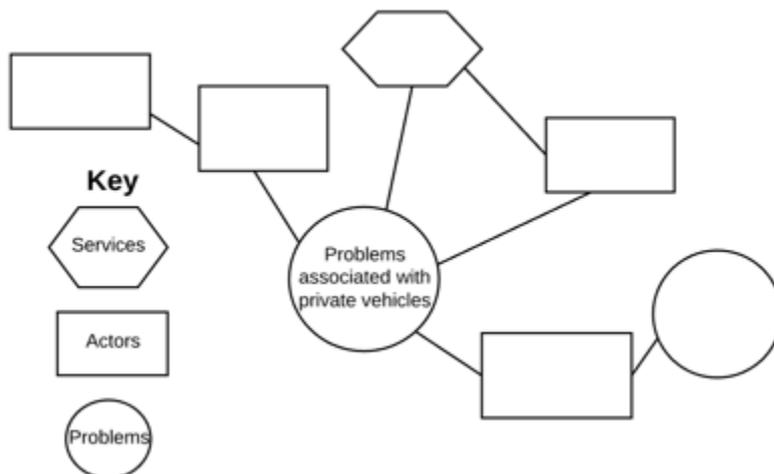
Figure 2-1 The Multi-Level Perspective



Source: Made by author, levels suggested by (Smith and Raven, 2012).

In each of the categories, the aspects and actors that influenced niche's for car sharing were analyzed to understand their role in protecting the concept. As would be expected in two independent locations, the impact of select dynamics varied depending on the city. However, overall ranking was avoided in the case studies due to the very interconnected nature of the factors that influence mobility. The interconnectedness was depicted through a second framework, the relational perspective where the main alternative mobility actors were mapped out on a web. The process began with the primary problems associated with private vehicles in each of the urban contexts and worked outwards, including all of the alternative mobility actors and pertinent problems and services as they relate to car sharing. The beginning of the process can be seen in (Figure 2-2). The objective was to decipher meaning and allow analysis through the visual representation of the framing of car sharing in the alternative mobility actors network in each urban setting (Garud and Gehman, 2012).

Figure 2-2 The Relational Perspective



Source: Made by author, framework inspired from (Garud and Gehman, 2012; Pinch and Bijker, 1984)

3 Case Study 1: Malmö

3.1 Background on Mobility and Car Sharing in Sweden

Car ownership in Sweden is generally increasing. In 2017 there is almost one private car for every two Swedes; translating to just under five million cars in Sweden. However, despite the rise in ownership, vehicle km driven per individual is decreasing (Kågeson, 2014). Additionally, younger people in their early-to-mid 20's are purchasing vehicles at a lower rate (Statistics Sweden, 2017). Sweden is a spread out country whose infrastructure is designed around the private automobile. For non-urban residents, cars are considered “almost indispensable” (Pyddoke and Creutzer, 2014). Sweden household car ownership status is very resilient to change. An urban dwelling Swede owning a car in the previous year, is 91 percent likely to continue to own a car (Pyddoke and Creutzer, 2014). Households with higher income are more likely to maintain or increase car ownership, higher education however has the slight opposite effect (Pyddoke and Creutzer, 2014; TRCP, 2005). Sentiments of cars as status symbols are still very prevalent, especially in the older generation (Schillander, 2017, P.C.). The older generations sentiments can be seen as helping to uphold the status quo and certainly influencing their younger country(wo)men (Koglin, 2017 P.C.; Hagman, 2009). Evidence of this can be seen in the traditional logic of Trafikan (the Swedish highway planner); if there is consistent traffic in a location, the solution they often propose is to add an additional driving lane, does not address the longer-term issue of offering different mobility solutions (Koglin, 2017 P.C.). Sweden has transitioned to a post-industrial society, yet car manufacturing still remains influential in the Swedish economy; 10.5 percent of jobs in Sweden relate to the auto industry and it makes up 2 percent of the nation's GDP (Ward and Loire, 2008). Thus changes surrounding car ownership cost receive pushback both from manufacturers and unions.

3.2 Car Sharing in Sweden

Sweden has a culture of working together, supporting local initiatives, and proclivity towards trying new things. Car sharing has in turn has reflected these values (Stride, 2000). The story of car sharing begins in the mid 1970's when a number of different neighborhoods collectively purchased vehicles to share. A few years later in 1978, the government saw promise in these types of initiatives and allocated roughly one hundred and fifty thousand euro at the time to support these small collectives. In 1976, the first *private* car sharing company, Bilpoolen, was established in the town of Lund. The company “Bilpoolen,” which translates to “car sharing” in Swedish, was actually a, peer-to-peer car sharing (P2P) business model and did not own any cars. Bilpoolen collected information of cars owners and users who wanted to rent them. People interested in using a car would call the company and Bilpoolen would arrange the logistics of connecting the two parties that had meshing schedules. While this business venture ended just three years later, another company using the same model was established in 1980 in Stockholm, Sambil, and is still functioning today on a neighborhood scale (~150 users); making it the oldest car sharing organization in Europe (Stride, 2000).

The first business to consumer B2C car sharing company, Vivallabil, was established in 1983 thanks to funding from the Swedish Transportation Communications and Research Board. Run in Örebro, the cooperative limited membership to thirty households, and was successful until, in 1998, two “critical” members left the cooperative for “private reasons” (Stride, 2000). By 1999 car sharing was expanding rapidly around Sweden in clusters. When one business or cooperative would move to a city, this would raise awareness/interest locally and multiple others would pop up. Around thirty car sharing organizations existed in Sweden at that time. The growth was thanks in part to a “how to” car sharing document produced by EKOBIL, a private car sharing company, sponsored by multiple cities and published by two non-profits in 1995.

Additionally, a number of car sharing related businesses emerging during this time: a non-profit focused on “green” mobility options named Gröna Bilister (est. 1994), and the country’s first car sharing-specialized consultant, in 1998 (Stride, 2000).

Around the turn of the century was a pivotal point for car sharing in Sweden. Sunfleet was established in 1998 in Gothenburg by a man named Per Lanevik as a car sharing company for those traveling on business. In the early 2000’s it quickly began to expand from just being a business traveler company and also moved to other cities. In 2003, City Car Club, expanded to Sweden from Finland by purchasing Statoil’s Swedish holdings in Gothenburg and Stockholm. In 2009, despite Sweden being home to almost 15000 registered car sharing users, and there being over 500 shared cars available to use in the country, these two companies were the only ones that spanned multiple cities. In 2009 there were roughly forty-five car sharing providers in Sweden, but only seven had more than one hundred members (Loose, 2010). Many were small city based or even neighborhood based operations and had no intention of expanding; leaving the market wide open for someone to command control of multi-city car sharing in Sweden. Sunfleet, took advantage of EU initiatives that supported sustainable mobility and expanded the company. It now has a dominant lead in the overall Swedish market, but faces significant competition on the city level in Stockholm. Sunfleet was purchased in 2011 by Hertz and Volvo, and around this time City Car Club, passed along their members to Bilpoolen.nu and returned to operating solely in Finland (Schillander, P.C., 2017).

Car sharing in Sweden today is an underutilized asset, characterized by a significant gap between the market potential and the knowledge/utilization of car sharing by individuals (Schillander, 2017, P.C.; Schillander, 2010). Car sharing organizations in Sweden have maintained throughout their existence that the industry does not and will not require subsidies to be profitable, however, car sharing organizations face, what many in the industry deem as an “unfair” disadvantage (Schillander, 2017, P.C.). When using leased cars and taxis, customers may deduct all Value Added Taxes (VAT) for shared cars however, customers can only deduct half (Schillander, 2017, P.C.; Schillander, 2010). Additionally, the tax on car sharing is 25 percent, on taxis, it is 6 percent. An additional barrier for car sharing in Sweden is that no legal definition of the concept exists. Thus, neither national nor municipal governments can exempt car sharing vehicles from parking fees or be awarded prioritized parking as is the case in numerous other cities globally. Parking allowances are considered instrumental for success (Plepys and Mont, 2015).

While Sunfleet has begun to move to other slightly less dense locations all other commercial companies are located in Stockholm or Gothenburg. Sunfleet’s ability to operate in areas of lesser density is thanks in large part to Arbetsförmedlingen (the Swedish Public Employment Service). In 2009, Arbetsförmedlingen decided to use car-sharing vehicles in lieu of owning their own vehicles. They now use nearly 100 Sunfleet cars in 28 locations in Sweden during standard working hours, allowing other Sunfleet members access to the increased number of vehicles the rest of the of the time. This has allowed Sunfleet to operate in cities that otherwise would not have sufficient size to support it. Finally, asset light car sharing companies such as Snappcar and GoMore (both Peer to Peer car sharing companies) can exist in any city since it’s the members, not the company that own the vehicles. However, there is little data or research on the distribution of members of these organizations in Sweden.

3.3 Mobility in Malmö

Malmö, Sweden’s third largest city, located on the south western end of the country is home to around 330,000 residents. The Oresund bridge, connects Malmö to Copenhagen since the turn of the century serves as a gateway to the rest of Europe. With almost 16,000 people crossing the bridge each day, primarily by train, the influence from rest of Europe can be seen both in

both Malmö's vision for the future and culture. It is ranked the 7th happiest city in the EU and is the 6th most bike friendly city in the world according to the Copenhagen Bike Index (Martin, 2016). With a young population, active participation as an "Urban Living Lab", and a city government that heavily promotes the arts and social engagement, Malmö has become one of Sweden's hotbeds for culture, social, and entrepreneurial projects (Reimer, McCormick, Nilsson, & Arsenault 2012; Malmö stad A, 2017).

One of these entrepreneurial projects was completed in early 2017 and deemed "the bike house." The residential development did not include any vehicle parking and instead opted for extensive bike storage – including non-traditional cargo bikes. The bike house, is a testament to the city of Malmö's willingness to accommodate experimentation when it comes to mobility development; holding true the city's future mobility goals adopted in 2016 (Malmö stad, 2016). Malmö legislation has a 'parking floor' requirement, meaning that for every apartment built, there needs to be .7 of a parking space included in the development (Andersson, et. al., 2015). The bike house is unique in that the city allowed an exception to this policy. It is serving as test piece for experimental developments and if it goes well, there is a good chance the city will be open to more projects with similar alternative mobility form (Zinkernagel, 2017 P.C.). While the cost for parking construction and maintenance varies depending on numerous factors, it can save the developer between 10-18 percent if parking requirements are lifted (Andersson, et. al., 2015). Thus, if the bike house proves successful, the reduced cost in construction could sufficiently lower the cost of development to motivate construction in less financially affluent neighborhoods where development had previously not made market sense.

Another project the city has been involved with is EC2B - a mobility project generated from a local consultancy firm, Trivector that is still in the conceptual stages. This project aims to lessen resident's dependence on private vehicles and in turn the parking requirements, by connecting an array of mobility providers including Skånetrafiken, Sunfleet, (maybe in the future a P2P service), with the City of Malmö, and residential developers (Wendle, 2017, P.C.; Wendle, 2016). The idea is that residential developers, hire this service to link these more sustainable means of transportation to the residents in the building and in turn, the parking floor is lowered or removed. This link includes different forms of transport such as car sharing membership or public transportation card for all residents. Despite the developer paying for these amenities, EC2B would overall save the developer money because the city would lower the parking requirement. These mobility options would be communicated to the residents of the building(s) via a smartphone application that is in the process of being designed.

An ironic barrier that EC2B presently faces is lack of competition. The city, due to public procurement policy cannot use its land for car sharing spaces, nor write mobility ordinances into legislation, where there is only one company on the market that can meet these demands (Koglin, 2017, P.C.; Schillander, 2017, P.C.). Thus before EC2B can manifest into a functioning, mobility provider, some details need to be sorted out. Numerous car sharing reports cite the importance of car sharing organization integration with transit, thus EC2B or a similar mobility linking service, greatly increases the potential for car sharing to continue to expand in the Malmö urban area (Stride, 2000; TCRP, 2005; Pleyps and Mont 2015).

In 2015, 72 percent of interviewed city residents responded favorably when asked if they were satisfied with the state of the city's public transportation system (European Commission, 2016). This percentage placed Malmö roughly in the middle of the group of the 79 European cities measured. While 72 percent leaves room for improvement, it is an indication that people are generally satisfied with the flexibility allotted to them by public transportation. The city has a new tram system that is on schedule to become operational next year and in order to accommodate this, Skånetrafiken has invested heavily in long busses with frequent and

adjustable time schedules to easily accommodate the new tram lines (Malmö Stad, 2016), presumably increasing the population's satisfaction further.

In addition to motorized transport, Malmö's relatively flat and expansive biking infrastructure has created an enormous biking subculture. Propagated through the city's pro biking campaigns and proximity both culturally and geographically to Copenhagen, Malmö is currently seeking to further expanding its cycle corridors and create more favorable conditions while riding with cars on the road (Zinkernagel, 2017 P.C.). Additionally, the city recently opened up its own bike sharing program with more than fifty stations spread across the city. Malmö has put enormous effort, as part of their 2014 plan to eliminate unnecessary car trips, successfully eliminating a large proportion of shorter trips (Zinkernagel, 2017 P.C., Malmö stad, 2014). Much of the issue with vehicle traffic in Malmö is a result of residents from other municipalities commuting to Malmö for work. This issue will be discussed later on. (Zinkernagel, 2017 P.C.).

When it comes to using public transportation, and sharing cars, trust and safety are central issues. There is an intriguing difference between how people feel about their neighborhood vs. the city. 71 percent of respondents respond favorably when asked if most people in their city could be trusted. However, when asked about their neighborhood, 92 percent responded that most of the people there could be trusted. A slightly smaller gap can be seen when it comes to safety: 82 percent of the residents in Malmö responded favorably when asked if they felt safe in their city, but 93 percent said they felt safe in their neighborhood. The gap seen between the neighborhood and the city is a disparity that needs to be addressed if the city wishes to meet its goal of lowering the percentage resident drivers by 10 percent, as both these factors are tied to public transportation use (Malmö Stad, 2016; Melis, Prandini, Sartori, and Callegati, 2016).

In addition to the goal of lowering car use for residents, Malmö's mobility plan, politically adopted in March of 2016, strives to transform the city's downtown, by 2030, into an environment prioritized primarily suited for pedestrians and bikers. In a survey conducted by the city, more than 80 percent of respondents favored a city that was more restrictive towards cars and parking with the condition that the space it utilized to increase efficacy of alternative mobility options such as walking, biking, and public transport (Malmö Stad, 2016).

According to a different survey conducted in 2011, 71.1 percent of the population in Malmö has access to a private car "always" (59.4 percent) or "several times a week" (11.7 percent) (Olsson, Et. Al. 2011). While this information is slightly dated, research from Pyddoke and Creutzer (2014) has shown that the largest indicator of present car ownership is past car ownership; thus these numbers still offer valuable insight into the present car situation in Malmö. Thus, with car ownership and access being an established status quo in Malmö, the city will need to foster all alternative mobility actors to ensure access is maintained if Malmö wishes to alter its resident's travel habits.

However, when dealing with traffic in the downtown, Malmö needs to consider more than just its residents, but the commuting habits of the individuals who commute to work in the city as well. As previously mentioned, commuters are one of the biggest challenges that Malmö is facing in terms of congestion and infrastructure stress (Zinkernagel, 2017, P.C.). Through surveys, research, and partnering with universities, the city of Malmö has integrated several strategies to attempt significantly reduce the almost 2/3rds of commuters who use a personal vehicle to commute to work in Malmö. Strategizing select developments and services on main thoroughways, increase in public transportation with intentionally placed mobility nodes, improving the biking infrastructure entering and leaving the city, and promoting car sharing amongst people needing to drive around the city are all being developed to bring the percentage of driving commuters from 62 percent down to 50 percent by 2030 (Malmö Stad, 2016).

3.4 Car Sharing in Malmö

Table 3-1 Car sharing in Malmö

Sunfleet	Snappcar	GoMore
Owned by Volvo and Hertz	Independent	Independent
Founded in 1998 Gothenburg, came to Malmö in 2006.	Founded in 2011 in the Netherlands, came to Malmö, Sweden in 2016.	Founded in 2005 as non-profit in Denmark, in 2011 became a for profit company. Came to Malmö, Sweden in 2014.
Charge by hour/day – price varies depending on membership – gas included	Charge by day/week – gas not included. Rates dependent on car.	Charge by day – gas not included. Rates dependent on car.
No Km cap – charge additional per Km	Km decided upon by owner and renter	150 km per day
Automated card opens car	Key had off by owner	Key hand by owner

Source: Information was retrieved from each companies' respective website.

Malmö is pursuing a number of different mobility strategies to award residents an array of mobility options, challenging the need for private vehicle ownership. An important component of convincing people to do this however, is providing convenient vehicle access in the case public transport does not satisfy the mobility needs. Prior to 2006, there were no commercial car sharing companies in Malmö and only one private car club, offering two vehicles (Civitas, 2009). Civitas Smile was an EU funded project that focused on five case study cities, one being Malmö, with the objective of developing “sustainable and intermodal urban transport systems” that allowed citizens of the urban environments mobility without private car ownership (Civitas Smile, 2013). In 2006 Smile Civitas brought the first Sunfleet vehicle to Malmö, and more importantly hired a project manager, whose sole responsibility was to advocate and work with Sunfleet and Malmö (Table 5-1). This is exceptionally important and considered one of the most important factors in determining the success of car sharing in an urban environment (TCRP, 2005).

3.4.1 Business to Consumer

From 2006 and on Sunfleet continued to grow with the support of the city thanks in large part to the appointed project manager, Civitas funded educational trainings, and cooperation from Malmö. In April of 2008, Sunfleet had five parking sites, all located in the north western part of the city, containing 15 vehicles, with over 200 private and company users (Civitas, 2009). One decade later, in Spring of 2017, Sunfleet has grown to over 40,000 users and has 80 vehicles now spread out over 60 parking stalls in the city of Malmö (Wendle, et. al., 2016). While Sunfleet has expanded out from its area of inception in Western Harbor, one of the most affluent neighborhoods in Malmö), many of the Sunfleet vehicle parking lots are still located in areas of new development (Zinkernagel, 2017 P.C.). This is primarily due to the city lowering the developments parking requirement, with the inclusion of parking for car sharing, greatly assisting in the company's expansion in Malmö (Alguren, 2017, P.C.).

The newer developments, in recent years in Malmö, have occurred primarily in more privileged areas (Zinkernagel, 2017 P.C.; Baeten, 2012). Therefore, this is where the majority of Sunfleet's vehicle lots are also clustered. The city's goal, adopted in 2014, to densify select residential neighborhoods to reduce car dependency has led to some more diversity in new development and thus car sharing parking lots, but the majority of Sunfleet vehicles are still disproportionately accessible to the more affluent population. (Malmö Stad, 2014). A final way the government has helped increase the number of car sharing vehicles available through Arbetsförmedlingen, the public employment agency. Not confined just to the city of Malmö, the public agency does not own any vehicles and instead utilizes Sunfleet vehicles during standard working hours, making the vehicles available to share in off hours. This has led to a greater number of vehicles available in the city outside of standard working hours (Alguren, 2017, P.C.).

3.4.2 Peer to Peer

Sunfleet has remained the only B2C car sharing company in the region, yet two peer to peer (P2P) car sharing companies have taken hold in Malmö with a moderate amount of success: GoMore and Snappcar. GoMore is a car sharing and ride sharing company that allows users with cars to advertise trips they are going on to see if other users wish to join. In Malmö in April 2017, there were 33 available cars for rent; Snappcar had 19. Both companies, require the keys of the vehicle to be retrieved personally, and require finding a mutually agreeable time to meet. For this reason, these services are more useful for longer term rentals such as a weekend. Overall not much research has been conducted on P2P research in the context of Malmö.

The prices on Snappcar's vehicles that were available in April 2017 were from 200 krona/day for an old two door sedan to a Sports Car that went for 1,450 krona/day. For GoMore, the low price was 195 krona/day for a newer small sedan with a minimum of two-day rental, to 1950 krona/day for a range rover SUV with a minimum one-week rental period. From looking at other available vehicles on both sites, GoMore seems to be much more targeted toward longer term rentals with slightly newer and more upscale vehicles available presently. Snappcar, while still requiring at least a day rental, seems to accommodate shorter term P2P sharing. What should be noted before comparing the prices between these three options is that Snappcar and GoMore's prices do not include fuel, Sunfleet's prices do (Table 5-2).

3.4.3 Pricing

Table 3-2 Malmö car sharing prices in Swedish Krona

B2C	Sunfleet				P2P	Snappcar	GoMore
Use Patterns/ Price:	Rare/ Seldom	Few times a month	Few times a week	Often	Km Included in rental price	100 (typical)- 300 (rare)	150 a day
Price/month	0	169	499	999	Price per day	200-1450	195- 1950
Price/time	80	40	30	15	Minimum rental	Day	Day-week
Price/Km	2	2	1	1	Additional Fees:	Driving over the km	Driving over the km
Whole Day	639	439	359	259			
Weekend	719	519	469	399			

Source: Information was retrieved from each companies' respective website.

4 Case Study 2: San Francisco

4.1 Background on Mobility and Car Sharing in California

There are just under fifteen million registered vehicles in California (Stastica, 2015). With roughly 39 million people living in the golden state, the proportion of car ownership is less than Sweden; however, with landmass being very similar, California accommodates substantially more vehicle traffic. Much of the traffic is concentrated in the two largest urban hubs: the greater Los Angeles area and the San Francisco Bay Area. These two cities are home to some of the worst traffic in the United States (Siu, 2017). Car sharing first arrived in the United States in 1983, with one of the original cities being San Francisco. The concept was discontinued after a few years and car sharing didn't return again until just after the turn of the century.

California legislation dictates that each city is responsible for determining taxes on car sharing organizations; resulting in a wide range of tax rates. Many of the larger cities: Oakland, Los Angeles, San Diego, San Francisco etc. tax car sharing roughly at the same rate as their sales tax: from 8-10 percent. This percentage stays relatively consistent regardless of the time rented. There are other outlier cities, such as Fresno that has a 62 percent tax on car sharing programs operating within their city (for an hour rental) however the tax goes down significantly to 22 percent if the rental time is moved to five hours (Schwieterman and Spray, 2016).

Despite taxes being determined on a city level, California on a state level has enacted legislation in order to protect peer to peer car sharing. In 2011 California enacted a law that made it illegal for insurance companies to adjust their rates if an owner of insurance decides to enter their vehicle into a peer to peer car sharing scheme. This law was supported by a number of different transit companies within California (Gorenflo, 2010) and can be found here: http://www.leginfo.ca.gov/pub/09-10/bill/asm/ab_1851-1900/ab_1871_bill_20100929_chaptered.html

In addition to protecting P2P car sharing users from hiked insurance rates, that same year, California tied car sharing in with the state's larger land use goals. This bill, known as Transit Priority Program allows cities to allocate parking exclusively for car sharing, reduces permitting costs for high density developments near transit that include car sharing vehicle station in their building, and allotted funds in an effort to expand car sharing. Outside of car sharing, California has voted in electric transportation bills such as the train spanning San Francisco to Los Angeles as well as the electrification of Caltrain in the Bay Area. These improved mobility options would lessen the demand on private vehicles in two of California's most densely populated urban areas. Improved public transportation and its potential effects will be discussed later in the context of San Francisco.

4.2 Mobility in San Francisco

Around 865,000 people live within the borders of San Francisco, however the greater region surrounding the city (the Bay Area) hosts over seven and a half million people. Each day 265,000 people commute into the city for work, while just over 100,000 reverse commute (leave the city to work in the surrounding cities or suburbs) (Barmann, 2016). The massive number of people going in and out of the city has resulted in the city having some of the worst traffic in the entire country (Morse, 2016; Siu, 2017). Roughly one third (33.1 percent) of San Francisco residents use public transportation to get to work, compared to the national average of 5.2 percent. Using a private vehicle to transport a single occupant to work is the most popular option, accounting for 35.9 percent of the population (Siu, 2017). This is still substantially lower than the national average of 76 percent (Table 6-1) (US Census A, 2015; US Census B, 2015). While the numbers

for San Francisco are relatively impressive, if we zoom out just a little and look at the Bay Area, a private vehicle, carrying a single person, account for 68 percent of all commutes (Siu, 2017).

One of the reasons so many people in San Francisco utilize public transportation, is that San Francisco has a “parking ceiling” or limit on the number of parking spaces that a development can have (Henderson, 2017, P.C.; Thornley 2017, P.C.). For reference this is the opposite of Malmö that has a parking minimum. In part due to this lack of parking in offices, many large tech companies also employ their own “busses” to shuttle employees to and from work (Crucchiola, 2016) In lieu of parking, the city has a “menu” of transportation offerings that buildings are required to implement to offset the need for cars and reduce the vehicle miles traveled (Thornley, 2017, P.C.; Bliss, 2016). The 26 researched options, each assigned a different point value, were designed by city to establish a citywide “transportation demand management” (TDM) program that will give the developer a choice of mobility alternatives they provide in place of parking, should they decide to do so. The entire list can be found here: http://default.sfplanning.org/plans-and-programs/emerging_issues/tsp/tsp_TDM_Menu_Options_v3b_handout.pdf

Table 4-1 Commuting habits in the U.S. and San Francisco.

Location	San Francisco Residents	United States
Sample Size	468,350	143,621,171
Car (single occupant)	36%	76%
Carpool	7%	9%
Public Transport	33%	5%
Walked	10%	3%
Taxi, Bike, Motorcycle, other	6%	2%
Worked from home	7%	4%

Source: (US Census A., 2015; US Census B., 2015)

The system of automobile ownership in San Francisco is a unique combination of factors. It has one of the lowest car ownership per capita ownerships in the country, averaging just over 56 cars per 100 people (Golub and Henderson, 2011). Which is beneficial because around 60 percent of car sharing members do not have cars when they register (Martin and Shaeen, 2011). However, due to the compact nature of the city, San Francisco has the highest density of car

owner in the United States. These factors in compilation with San Francisco's mobility politics being some of the most progressive in the US, it is an excellent platform to analyze alternative forms of mobility (Henderson, 2009; Golub and Henderson, 2011).

The second largest form of mobility used for commuting, public transportation (Table 6-1), is in dire need of funding to update old systems, the majority of which are well over capacity. In response to aging transport, the Bay Area back in 2008 voted into effect several propositions that allocate funds to improving and expanding existing transportation infrastructure (SFCTA, 2016). However, despite the public acknowledgement public transportation has far exceeded capacity and is in desperate need of repair, politics at the state and federal level have had a crippling effect enacting public transportation changes in the San Francisco Bay Area (SFCTA, 2016; Henderson, 2017, P.C., Fuller, 2017). In late January of 2017, all 14 Republican members of the House of Representatives, authored a letter to President Trump and the Transportation Secretary, Elaine Chao, that asked them to stop funding of a pre-approved grant that would electrify and greatly increase capacity and speed of Caltrain route. Caltrain is a train that is responsible for a large proportion of commuters coming in and out of the city on a daily basis.

The current train system still runs on diesel, is well over capacity, and prone to failure (Fuller, 2017). The project, originally approved by California voters in 2008, used local, state, and available federal funding for the improvements. In February, President Trump halted the promised federal funds and effectively brought the project to a stop. Thus, the current system that, according to Caltrain engineers, has more than 19 mechanical failures a month, appears to be there to remain (Fuller, 2017). These effects reach beyond Caltrain electrification improvements, many other mobility projects and improvement are pausing currently due to political uncertainty that the current federal administration has brought to California's transportation (Henderson, 2017, P.C.). As already stated, San Francisco and the Bay Area is home to some of the worse traffic in the US; with 81 percent of Bay Area residents agreeing that traffic in the region has reached "a crisis level" (Siu, 2017; Morse, 2016). Thus, with further delays on public transportation the situation is likely to worsen.

Caltrain however, is not the Bay Area's only aging means of transport. BART (Bay Area Rapid Transport), in addition to being well over capacity at peak hours, is losing riders due to its old age, overcrowding, and lack of user confidence (Baldassari, 2017). Finally, primarily operating in the city of San Francisco, Muni, a light rail street car hybrid system run by the city's municipal transport agency, SFMTA is in dramatic need of improvements as well. It is over capacity (Henderson, 2017, P.C.) and in a survey conducted in 2015 by the city of San Francisco, it ranked at a "B-" or lower on all categories except "courtesy of the drivers" (San Francisco, 2015). Residents rated its "reliability" at a "B-" and the category of "managing crowds," Muni received the lowest grade out of every city service measured: "C" (San Francisco, 2015).

In addition to public transportation, San Francisco has been putting heavy emphasis on other alternative means of transportation with their "Vision Zero" initiative. The city initiative envisions zero traffic fatalities by the year 2030 through expansive improvements to biking and walking infrastructural (SFCTA, 2016). This emphasis on non-motorized transport, in 2016 resulted in San Francisco being unofficially called the second most bike friendly city in the US (Dille, 2016). Additionally, it has been actively trying to change mobility culture through programs such as "Sunday Streets" (Golub and Henderson, 2011). The practice of shutting down city streets and throughways to cars for part of the day on Sundays to encourage biking and people to get outside, was a concept that originated in Bogota, Columbia and has since spread across the world (Golub and Henderson, 2011).

Finally, an additional initiative that San Francisco has enacted to try to reduce private car dependency is the 2013 “Transit-First Policy;” intended to guide the city’s decisions with street space to preference walking, biking, and public transportation in lieu of private cars. In line with this policy in April of 2014, the city of San Francisco began to rent on street parking to different car sharing organizations under the requirement that the vehicle is available to rent by the hour (SFMTA, 2017). Additionally, there are very few block within the downtown of the city that do not have a car sharing lot or “car sharing pod” located somewhere off the street (Golub and Henderson, 2011).

4.3 Car Sharing in San Francisco

Table 4-2 Car sharing in San Francisco

Zipcar	City Car Club (Merged with Getaround)	Getaround	Turo	Maven
Owned by Avis	Non-profit – rentals run by Getaround	Toyota, Ford Invested but independent	GM Invested, but independent	GM Owned
Founded in 2000 in Boston. Came to San Francisco in 2005.	Founded in 2001 in San Francisco	Founded in 2009 in San Francisco	Founded 2009 in Boston. Came to San Francisco in 2010.	Founded in 2016 in Detroit. Came to San Francisco in 2016.
Charge by hour/day – gas included Rates dependent on car	Charge by hour/day – gas included Rates dependent on car (Booked through Getaround App)	Charge by hour/day – gas not included Rates determined by owner	Charge by day/week(s) – gas not included Rates determined by owner	Charge by hour/day – gas included Rates dependent on car
180 miles per day; B2C Lot Based	200 miles per day; B2C Lot based	200 miles per day; P2P	Owners define Mileage; P2P	180 miles per day; B2C Lot based
Automated Card opens car	Automated Card opens car	Automated Card opens car	Key had off by owner	Smartphone app opens car

Source: Information was retrieved from each companies’ respective website.

In 1983, the two first car sharing organization appeared in the United States, one was the result of a university feasibility study in Indiana, and the other was project funded by the California Department of Transportation in San Francisco. The program, named STAR (Short-Term Auto Rental) allowed users to rent vehicles for a time scale of minutes to days (Shaheen, Sperling, and Wagner, 1998). The program only operated for a few years, until 1985 when it had to be closed down, prior to the intended stopping date, due to unaccounted factors. Car sharing as a concept in San Francisco lay dormant on a commercial scale until 1997 when a group of environmental organizations and researchers formed a nonprofit called City CarShare. Ultimately the nonprofit did not launch until 2001, and was the only car sharing organization in the city until 2005, when Zip-Car and Flexcar moved to San Francisco. The two new, for profit, business to consumer, companies eventually merged on a national level under the Zipcar brand in 2007. City CarShare, like Zipcar utilizes a round trip lot based car sharing model (Table 6-2).

4.3.1 Business to Consumer

City CarShare, despite having to compete with numerous privately funded organizations has maintained vehicles up to present day however it is currently being run through and merging with Getaround, a peer to peer application. In 2006 it had more than 200 vehicles and around 20,000 active members (Said, 2016). A modest amount in comparison to its lot-based competitor, Zipcar.

The largest actor in the San Francisco car sharing scene, Zipcar was founded, in Boston in 2000, and five years later, brought its first cars to San Francisco. Zipcar continued to grow and in 2013, was acquired by the car rental company Avis. Cars are available by the day or the hour and gas as well as insurance is included in the cost. As previously stated it uses a lot based model and an entirely automated booking system with an electronic key card. While San Francisco is not one of the cities where the service is available, in select locations, the company allows one way trips. The company's story on its website highlights its size; it is the largest car sharing company in the world. It has 1200 vehicles in the Bay Area, well over 100 different locations in San Francisco alone, and includes 180 miles included in the day rental price. Like many other car sharing companies, the company emphasizes that it is trying to redefine our current mobility system to a more "sustainable one" where car sharers outnumber car owners (Zipcar, 2017). They frame themselves as the perfect complement to public transportation, which in addition to density are two of the most important characteristics they examine in a city when deciding if an area would be suitable for one-way car sharing or a new Zipcar location.

The final large scale business to consumer actor in the San Francisco sharing scene, is Maven. Still in its infancy, the General Motors (GM) subsidiary moved to San Francisco in 2016, with 30 lots and 60 cars spread around the city's downtown core, the subsidiary of GM uses its smartphone app to do everything from reserving the car (30 minutes to 28 days) to connect your music and GPS. The company does not release the number of its users in specific areas and thus it is difficult to measure the success it has had thus far in San Francisco. GM has invested heavily in vehicle sharing and alternative taxi methods. It has over \$500 million USD invested with Lyft (Uber's largest US competitor).

Additionally, GM originally supplied all the vehicles for Enterprise CarShare, when in 2015, it was founded in San Francisco (Dalton, 2016; Enterprise, 2016). Enterprise CarShare is not covered in the scope of this thesis. It has roughly the same pricing and model as Zipcar except that its prices change depending on the time of day and day of the week. Thus while certainly not necessarily precluding the company from all car sharing definitions, it was decided it would not be addressed within the scope of this thesis.

4.3.2 One-Way/Free Floating Car Sharing

While these are the three large business to consumer models currently in operation in San Francisco at present time, this was not always the case. In 2012, DriveNow, BMW's fully electric car sharing program came to San Francisco. The key difference and difficulty of DriveNow is that it allows for one way trips and was hoping to expand to a free floating model in the dense downtown core (Fingas, 2012; Nelson, 2015). Andy Thornley, a senior analyst in San Francisco's sustainable streets division, is in charge of managing the city's streets, curbs and sustainable mobility. When DriveNow came in 2012 to San Francisco to operate one-way/free floating vehicle sharing, it arrived asking for something that was not in existence: what Thornley referred to as a "super-permit" (Thornley, 2017, P.C.).

The "super-permit," as requested by DriveNow, would have allowed DriveNow vehicles to park anywhere, for an unlimited amount of time - to allow for the one-way/free floating car sharing within a designated area to work. The city, at the time was not ready to invent or issue permits such as these, but was open to the concept in the future (Thornley, 2017, P.C.). DriveNow saw this as sufficiently promising and it initially opened with 70 vehicles, 8 designated parking spaces with charging and 14 parking lots in an area outside of the congested, fee-parking downtown where it did not require the "super-permit" to operate its business model (Fingas, 2012; Nelson, 2015). However, after a little over two years, DriveNow closed its doors in San Francisco, citing the city's parking policy as the primary reason. When asked about if the parking policy was flexible or apt to change in the future, Thornley (2017, P.C.) responded positively saying that new research coming from University of California, Berkeley on one-way car sharing was an important motivating factor has definitely influenced the city's policies to being more open to the concept.

In summer of 2017, Thornley stated he believed there would be a report given to the board of San Francisco's municipal transit agency (SFMTA) that discusses the possibility of a one-way car sharing pilot program in San Francisco. SFMTA however, is in a complex position as it is responsible for on street parking and the permits that go along with it, as well as San Francisco's taxis. One-way car sharing is a potential competitor especially to taxis and thus, before the first "super-permit" is issued, there will have to be significant deliberation to ensure the streets in the city continue to "move equitably" (Thornley, 2017, P.C.).

4.3.3 Peer to Peer

In 2009 the peer to peer (P2P) car sharing service, Getaround was founded in San Francisco. A year later, in 2010, RelayRides another peer to peer car sharing service that started in Boston would expand to San Francisco and soon thereafter relocated its headquarter there. These two P2P car sharing services initially competed in short term rental services, however shortly after RelayRides acquired Weelz a much smaller Bay Area based P2P car sharing startup, it turned its attention to longer rides, no longer accepting reservations for less than a day. In 2015, with a new push for funding, RelayRides rebranded itself as Turo.

"Turo" the CEO says "evokes both 'touring' or in Italian, 'tursimo'" (Loizos, 2015). Turo doesn't release the number of users or cars that are registered, however, it has stated that a lot of its users are tourist – justifying the name. Interestingly enough, unlike many of the other car sharing Turo does not mention how sharing takes cars off the road, or counteracting a capitalistic, driving obsessed culture, rather it almost glorifies the use of cars, similar to automaker's advertisement as means of adventure and exploration (Turo, 2017). It has renters and users all across the US thus allowing it to serve clients in numerous travel destinations.

To access a Turo rented vehicle today, you have to arrange a meeting with the owner, and exchange the keys. Turo provides insurance, and while the company used to install an automated box to unlock the car, it now believes that the meeting the renter and car owner is an important characteristic and makes people more respectful of one another's property (Bush, 2015).

Getaround conversely, installs automated unlocking systems in all of their cars, accessible from a smartphone app and has dedicated the company focus more on short term rental. This system, like Zipcars', eliminates any need for human interaction, despite being a P2P model and makes hourly rental much more feasible. Like Zipcar, Getaround promotes the idea that their company cuts down on car ownership and is beneficial to the environment; advertising their company is a solution to "Car Overpopulation" (Getaround, 2017). Their "blog," is an interesting combination of adventure promotion accessible only through driving, how Getaround allows a renter to pay off their car, and stories of people greening their lifestyles (Getaround blog, 2017).

This sustainable narrative was what Getaround CEO Sam Zaid, cited, when in 2016, they took over City CarShare's parking spaces and gained access to its members (Said, 2016). Zaid stated that putting City CarShare on the more modern Getaround app was in an effort to further City CarShare's goal of lessening traffic and promoting more sustainable behavior (Said, 2016). For the time being, City CarShare is retaining control of some of its vehicles, however, as more parking spaces become exclusively under the ownership of Getaround and all reservations are now booked through Getaround's app, it appears that San Francisco non-profit car sharing is having to face the reality of competing with private car sharing companies and appears to be on the way to being absorbed by Getaround (Said, 2016).

Additional partnerships that Getaround has formed include Ford and Toyota. Promoted as mutually beneficial relationships, Getaround gets to expand its influence and the two car producing giants get to promote their "green initiative." Toyota in particular is working with Getaround, to pair their technology with Getaround's to make the car sharing experience "seamless" (Getaround, 2016). With Ford, the rationale, is marketed more under the guise as creating a sustainable future, earning extra cash for Ford owners and transitioning toward more sustainable cities (Getaround 2015). Below table (6-3) allows for comparisons between all forms of shared vehicles in San Francisco.

4.3.4 Pricing

Table 4-3 San Francisco car sharing prices in US dollars

B2C	Zipcar			Maven	P2P	Getaround (and City CarShare)	Turo
(Gas and insurance included)	Yearly Plan – Pay all at once	Monthly Plan – pay month by month	Extra Value Plan – pay month by month	Single option	Km Included in rental price	20 miles per hour	Owner determined
Monthly Cost	\$5.83	\$7.00	\$50.00	Free – Pay as you go	Price	From \$5/hour and up	\$21/hour and up
Hourly Cost	\$7.00	\$7.00	\$6.30	\$8 and up – car dependent	Minimum rental	1 hour and up	1 day and up
Miles included per day	180*	180*	180*	180	Additional Fees:	Tolls, cleaning fees	Long term discounts
Additional Information	\$25	Application	Fee	Up to 28 day rental available			

**There is no specified mileage limit per hour, it is only based on the user per day. A single user renting a car has 180 miles within a 24-hour period, and is then charged for every subsequent mile they drive past. Thus, for shorter time frames there is essentially no mileage limit, as it is not possible to drive 180 miles in an hour.*

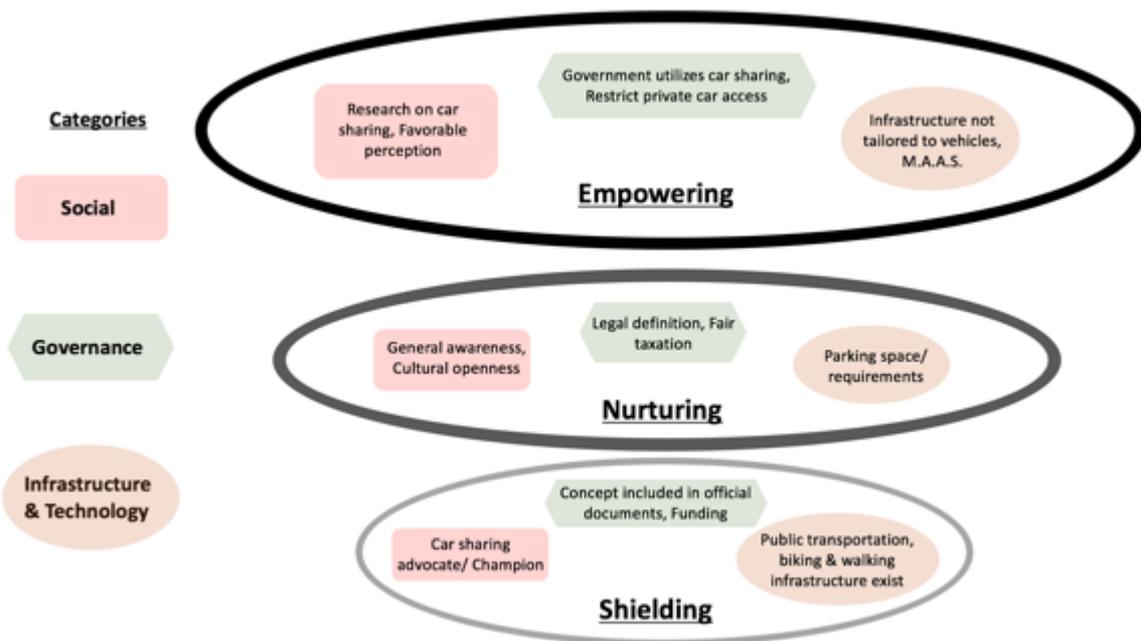
5 Discussion and Analysis

Before delving into the analysis of car sharing in Malmö and San Francisco, this section briefly zooms out to remind the reader of the space that car sharing actually occupies. The usage percentage in both cities is around 2-3 percent, and a study done in 2006 found that car sharing's theoretical future potential in North America only slightly exceeded 10 percent (Shaheen, Cohen, and Roberts 2006). In Boston, the place where Zipcar was founded, research conducted in 2012, revealed that many car sharing users saw it as a temporary solution until they could afford their own private vehicle (Bardhi and Ekhardt, 2012). Other reports (Cornet, et. al., 2012) likewise suggest that while conceptually sharing vehicles is challenging private car ownership, in practice, it is perhaps less of a real threat on its own for a variety of reasons. Finally, while some optimistic claims by car sharing reports stated that the younger urban generation was not purchasing vehicles in as high of numbers as their parents, research from the United States and Europe shows that car purchases were simply being put off slightly. Like previous generation, younger people generally were following the same pattern when they aged or started a family, they moved to less urban areas and purchased a private vehicle (Naughton, 2014; DeBord, 2016; Cornet, et. al., 2012). Despite car sharing's progression in the last 20 years, it has not shown itself to challenge car ownership on its own (Hannon, Mckerracher, Orlandi, and Ramkumar, 2016; Cornet, et. al., 2012).

However, whatever limited growth potential that car sharing has on its own, should not be mistaken for lack of importance in an alternative mobility actors network that challenge private car ownership. Car sharing supports and benefits alternative modes of transport such as public transportation (Loose, 2010), and these relationships play an important role in understanding what is needed to overturn the dominance of the private vehicle. While these relationships will be discussed and analyzed later on, first, the background of the progression of car sharing, in the context of both Malmö and San Francisco will be analyzed.

The progression of the concept is framed by the Smith and Raven's (2012) niche dynamic framework using "nurturing, shielding and empowering" as different levels of shielding and support that the concept has given to it from outside actors. This is an important consideration to note: that when using the multi-level perspective (evolutionary perspective), agency is not able to be expressed by the socio-technical challenging incumbent. Thus, we can imagine car sharing being pushed up through these levels, as opposed to climbing up through them. This shortcoming in the method of analysis of car sharing will later be compensated for, through switching perspectives to the relational perspective. The relational perspective not only allows the expression of agency, but without a retrospective lens, enables more thorough analysis of the *current* mobility environment in both urban settings.

Figure 5-1 The niche dynamics of car sharing



This graphic depicts the three categories: social, governance, and infrastructure & technology and the protective actions which each category can offer car sharing was divided into. The progression of the car sharing is shown as well through three levels of niche protection: shielding, nurturing, and governance (Smith and Raven, 2012).

The evolutionary perspective provides a lens through which to examine the incumbent social technical challenging concept (Figure 7-1). However, because of its retrospective approach, it does not provide an excellent depiction of where car sharing is as a socio-technical incumbent concept, so much as it illustrates how car sharing got to the current state. This historical context is useful in it of itself for analysis, but also later on, when the lens of analysis is switched to the relational perspective. The context provided through using this framework offers insight into how the concept was shielded and promoted by other actors.

Drawing heavily on the report from the United States Federal Transit Administration: *Car-Sharing Where and How It Succeeds* (TCRP, 2005), *Carsharing 2000 – Sustainable Transport’s Missing Link*, (Britton, 2000) as well as expert interviews, different actions and criteria were sorted into categories and levels. The documents and the interviews were analyzed, asking the following questions:

- What was advocated for by pro-car sharing actors and academics?
- When these actions were called for?
- Who (or what) was called to change?

Finally, the definitions provided by Smith and Raven (2012) describing each of these categories was consulted to ensure that each of the protective actions fit with the prescribed purpose of the allotted category.

Car sharing with the existing round trip B2C and P2P models in San Francisco has progressed through the shielding and nurturing stage in all three categories, and has begun to make headway in the empowerment level (Figure 1). In the case of Malmö, the situation is slightly more

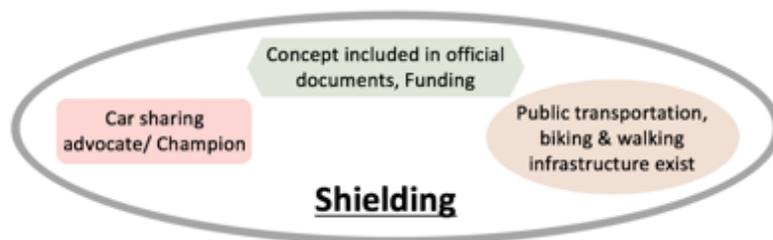
complex because car sharing does not yet possess a legal definition and taxation is still much higher in comparison to other forms of mobility, both of which are protective actions in the nurturing level. However, select government agencies already utilize car sharing in lieu of owning their own vehicles and EC2B, a MAAS company, is close to coming to fruition and these actions are both in the empowering level. This means the progression of car sharing in Malmö was awarded some of the protective action in the empowering level *before* the nurturing (Figure 1). This is a real world example of how a socio-technical challenging concept can progress in a nonlinear fashion through different levels and categories. However, the protective actions that have been “skipped” or not awarded to car sharing can act as anchors, such as the lack of on street parking in the case of Malmö, which the CEO cites as one of the main limiting factors to growth (Alguren, 2017, P.C.). It is also a good reminder that this framework is not intended to be applied blindly as a road map in other urban contexts; rather intended to serve as a basic compass guiding general growth.

5.1 Research Question 1

What are the social, governance, and technology/ infrastructure factors that have shaped the niche dynamics of car sharing in Malmö and San Francisco?

In the following section each of the different levels (Shielding, Nurturing, and Empowering) will be analyzed; organized internally by the three different categories previously justified: social, governance, and infrastructure/technology. The purpose of this will be to discuss events that have transpired and affected car sharing. In levels/categories where car sharing has not yet received protection or promotion from outside forces to meet the criteria mentioned, the rationale behind why that action is important in the context of car sharing will be discussed.

5.1.1 Shielding



5.1.1.1 Social - Car sharing advocate/ Champion

A champion or strong advocate with influence and resources is a critical component in getting car sharing off the ground (TCRP 2005). While this person or group can help with the shielding phase for social acceptance and initial niche creation, it can transcend and assist through the other categories and levels as well. In the case of Malmö, the advocate was an EU appointed representative funded under the CIVITAS project and had the resources and influence of Brussels at their disposal in order to ensure that the objective was accomplished. In San Francisco, a group of transportation activists founded a nonprofit called City CarShare. While it has served primarily as a car sharing organization its founders recognized the future of urban mobility depended on more than just car sharing. For this reason, City CarShare has been involved with other mobility improving initiatives.

City CarShare, was the first car sharing program in the Bay Area, so concept recognition was very important and in order to gain public familiarity, it acted as its own advocate for public and legislative awareness. Founded in downtown San Francisco, it quickly spread to other locations and neighboring cities. Social recognition in Malmö also played an important role, though the strategy was a smaller scale, community based one. It began with a single car in a targeted neighborhood and slowly spread outward from there. The differences in strategy have to do with funding and company size, and are discussed in the subsequent section. With just two case studies it is impossible to draw any definitive conclusions, but the differences between a publicly controlled advocate and a private one are an interesting difference in the case of these two cities.

5.1.1.2 Governance - Concept included in official documents/ Funding

Just as car sharing requires an advocate(s) to initially open up social space for a path breaking concept, recognition in government documents is critical as well. Both Malmö and San Francisco include car sharing in official documents and use it as a tool to assist in reshaping the city's mobility plans. In Sweden, governmental documentation of the concept dates back as early as the 1970s. However, it was only due to significant lobbying efforts, from Swedish car sharing advocates like Per Schillander in the early 2000's, that awareness of the concept became commonplace in municipal governments (Schillander, 2017, P.C.). In San Francisco, City CarShare, founded by a group of transportation activist, was very active in shaping legislation surrounding the concept. One of the early CEO's, Larry Magid, had worked in government previously and strongly advocated for legislation surrounding car sharing. Both Magid and Schillander recognized that inclusion in city documentation legitimizes it and allows public agencies to support the concept through inclusion in city programs. This inclusion has benefited car sharing organizations in both Malmö and San Francisco

Funding, in many cases is necessary for car sharing organizations to establish themselves. Especially in the initial location, grants can play a critical role in helping car sharing companies with high startup costs. In both cities, funding came from high level public agencies. In the case of City CarShare, San Francisco was the place of origin and thus it had to more quickly reach a critical mass of vehicles to be accepted by a wide customer base, and for it to meet an economic baseline. City CarShare's initial fleet was 12 lime-green Volkswagen Beetles, that federally awarded grants helped procure. In the case of the city of Malmö, Sunfleet was already well established elsewhere, which contributed to its capacity and willingness to grow at a much slower pace initially. It began with one vehicle, with logistic and economic support from the EU program CIVITAS.

5.1.1.3 Technology and Infrastructure - Public transportation, biking, & walking infrastructure

Public transportation and appropriate pedestrian infrastructure both played critical roles in the initial shielding stages of car sharing in Malmö and San Francisco. Both cities have well established, and -in comparison to the rest of their respective countries- relatively good internal public transit systems. In San Francisco, at the time City CarShare was being conceived, the "dot-com" boom was happening in the Bay Area and public transportation options like BART and Caltrain were expanding and offering an increase in service to accommodate the mass of workers coming into San Francisco.

Malmö, in 2006 when Sunfleet arrived, had excellent internal public transportation. It was already home to an extensive bus and train network. A key difference between the two is that Malmö had and still has, a substantially more advanced and connected bike infrastructure than San Francisco does. While improvements in this category can help the concept of car sharing during any stage of its development, both cities housed suitable internal public transport to

support adequate urban mobility not contingent on the private vehicle at the time car sharing initially came to their city.

5.1.2 Nurturing



5.1.2.1 Social - General awareness, Cultural openness

Swedish culture is known as quick to pick up new ideas (Wendel, 2017, P.C.) and San Francisco, one of the most progressive cities in the U.S., is often used as a testing ground for new businesses (AirBnB, Uber, one of the U.S.'s first car sharing organizations, etc.). Thus, in the case of both urban areas, the large community and widespread social culture of being early adopters has likely contributed to helping car sharing more quickly expand its customer base (Celsor and Millard-Ball, 2007; Florida, 2003, TCRP, 2005). While not something that a car sharing company on its own can propagate, a city accustomed to change is less likely to be permanently locked into their current means of transportation.

5.1.2.2 Governance - Legal definition, Fair taxation

As car sharing gains recognition as a concept that cities can utilize to help meet mobility goals, a legal definition of car sharing becomes an important asset. A definition can allow different levels of government to shield and exempt car sharing organizations from legal issues and restrictive policies. Car sharing in California has been legally defined and the state has passed legislation that prevents insurance companies from raising rates on individuals who participate in P2P car sharing. Additionally, in the case of San Francisco select street parking can be reserved by car sharing organizations as long as the organization meets the legal criteria of a car sharing organization. Sweden has yet to legally define the concept. This lack of definition is one of the most limiting factors for the company on a national level according to Sunfleet's CEO and has direct implications at the municipal scale (Alguren, 2017, P.C.).

Unfair taxation, in comparison to other means of mobility, is another significant, governance-influenced factor that can significantly inhibit the growth of car sharing in an area (Schillander, 2017, P.C.; Alguren, 2017, P.C.). California law allows municipalities the capacity to choose their own taxation rates for vehicle sharing. San Francisco taxes car sharing at the same rate as sales tax - around 9 percent, regardless of the rental time. Thus, for car sharing in San Francisco, taxation has been a non-issue.

In Sweden, the environment and narrative surrounding taxation is quite different. As previously mentioned, taxes on car sharing companies far exceed those on taxi cabs or other means of transport in Sweden. A sales tax level of 25 percent on car sharing services in comparison to 6 percent for other modes of transport puts car sharing concept at an enormous disadvantage. Car sharing companies and advocates in Sweden have long held that they do not need subsidies - just a fair taxation rate (Schillander, 2017, P.C.). However, a government funded study published 2017 shows national acknowledgement of these issues. The report on the sharing economy addresses the lack of definition, proposes tax reductions, and acknowledges the benefits in awarding municipalities the agency to distribute on street parking to shared vehicles (Staten Offentliga Utredningar, 2017).

Directly comparing legislation passed on a state level (California) in the United States and National legislation in Sweden is not a fair direct comparison. In the US, states have strong autonomy in regards to taxation and with California being one of the most progressive and environmentally conscious states, it is unsurprising that it is one of the first to adopt legislation defining and protecting car sharing. Regional governments have very little power in Sweden, meaning change at the national level would be required for any alteration in the legal status of car sharing in Sweden. These case studies show that while the structure of governance is far outside of any car sharing organization's control, it is a strong influencing factor and should be taken into consideration.

5.1.2.3 Technology and Infrastructure - Parking space/ requirements

In a study published in 2014, about parking in San Francisco, researchers found that between 30-50 percent of cars on an urban street at any given time were looking for parking (Millard-Ball, Weinberger, and Hampshire, 2014). The CEO of Sunfleet, when asked about what municipal policies most dramatically influence car sharing at a local level, stated availability of parking was enormously important; and lack thereof was a limiting growth factor for the company (Alguren, 2017, P.C.). Sweden’s public procurement policy with on-street parking has been a large factor in limiting Sunfleet’s growth to 20 percent per annum and will continue to do so unless it is revised (Staten Offentliga Utredningar, 2017).

The present sharing models in San Francisco have had success in procuring lots for their vehicles and very few city blocks in the downtown do not have a place for a car sharing vehicle (Golub and Henderson, 2011). However, the lack of DriveNow in San Francisco exemplifies varying parking needs, for different car sharing models. DriveNow came into San Francisco before a “super-permit” was even considered by the city and tried to establish a business without it, hoping a permit would follow (Thornley, 2017, P.C.). San Francisco Municipal Transportation Agency, SFMTA, (the agency in charge of all San Francisco curb space) was not ready to hand out a super permit at the time. One of the reasons was that there had been very little research done up to that point on the effects of one-way/free floating car sharing in cities (Thornley, 2017, P.C.). Additionally, SMFTA is also responsible for the San Francisco taxi industry. One-way/free floating car sharing is seen as a direct competitor to the taxi industry, thus making the bureaucratic process complex, political, and difficult (Thornley, 2017, P.C.). This is an example of how governmental organizations can become trapped between two competing actors of two different socio-technical regimes.

5.1.3 Empowering



5.1.3.1 Social - New discourse appropriate for new regime, Research on car sharing

Research on car sharing, both entrepreneurial and academic, has had real impact in the overall success of the concept. Research is put in the “social category” because while findings can inform policy in governance and lead to new technology, it is guided by society and social institutions (e.g. universities or companies). Unlike some of the other previous categories,

research is ongoing. Almost 20 years ago, the invention of key card technology to unlock vehicles helped rapidly expand vehicle sharing (TCRP, 2005). This year, in 2017, for the first time Volvo produced a keyless vehicle that is already being tested on Sunfleet vehicles in Sweden. Inventions that push car sharing to offer more instant and convenient service, will continue to be critical for the regime challenging service.

Research can play a role in influencing policy as well. In San Francisco, as previously mentioned, academic research is playing a real role in shaping city regulations surrounding free-floating car sharing. Members of SFMTA, are meeting to discuss in May of 2017, the possibilities of introducing regulation surrounding a “super-permit” for free floating car sharers in San Francisco, based on the findings from research conducted at University of California, Berkeley. The city of Malmö too, is considered an entrepreneurial city that has an emerging technology industry and works with numerous academic institutions. This proclivity toward innovation and research will undoubtedly continue influence urban mobility in the city.

While research plays a critical role in influencing and informing governance decisions the concept is framed and perceived by society is an important consideration as well. A positive perception does not necessary require widespread use of the service, rather it refers to adjusting the socially constructed norms that accompany our current system of mobility. Mobility’s ties with status, the organization of geographical space-time (i.e. living 70 miles from work), and the associations with and language used about mobility, all actively shape people’s choices of transportation (Freudental-Pedersen, 2009). The automobile industry plays right into some of these cultural expectations, especially in the notion of freedom and its association with the private automobile (Hagman, 2010). Both Malmö and San Francisco are in the beginning stages of redefining how mobility and car sharing is perceived. Empowering car sharing in a social context will require multiple actors to come together to actively reframe the negative stigmas about car sharing and alternative mobility in urban contexts.

5.1.3.2 Governance - Government utilizes car sharing, Restrict private car access

Up to the empowerment level, criteria in this category has included passing regulation *relating* to car sharing and *supporting* it through funding. In the final level, adoption or actual *utilization* of the service not just legitimizes it, but allows it to exist in markets where otherwise it would not be possible - and not just in the short term as grant funding often does. As already mentioned in the case of Sweden with Arbetsförmedlingen, opting to use Sunfleet vehicles allowed Sunfleet to operate in cities where the population and market is otherwise too small. While the city of San Francisco has yet to do this, the city of Berkeley (a neighbor to San Francisco) opted to use City CarShare vehicles in 2004 for some of its agencies. In both Malmö and San Francisco, the market size is sufficient that without public agencies using the service, car sharing organizations still have an adequate market. Thus, with these two cities, (further) public agency adoption would increase exposure, and allow quicker growth of the company rather than be a pre-requisite to its existence.

An additional strategy to empower car sharing is to restrict private car access; necessitating greater use of alternative mobility options. Malmö and San Francisco, like many cities, have mobility plans in place that aim to reduce the number of vehicles downtown and make the environment more favorable to pedestrians and cyclists. While neither city has implemented congestion charging or other legislation actually restricting people from driving downtown (though San Francisco tried unsuccessfully in 2011 - it failed to get state approval), both have implemented urban planning strategies that preference other means of transportation and included them in their city mobility plans (Henderson, 2017, P.C.; Malmö Stad 2016). Car

sharing is mentioned as a key player in both documents alongside public transportation, bike sharing organizations, etc.

The inclusion of car sharing as an alternative form of mobility along with the other actors greatly assists in fostering the partnerships that will be displayed in the following section and in the shift away from the transportation dominance by the private vehicle (Plepys, Heiskanen, and Mont, 2015; TCRP, 2005). However, a key difference between the two cities is that San Francisco has a parking ceiling for new developments, whereas Malmö has a parking floor. While Malmö has been making notable exceptions to its parking requirements, the fact that a limit on parking is the standard in San Francisco demonstrates the city's strong intentions to reducing the dependence cars in the city and this is very beneficial to the propagation of car sharing and other alternative mobility actors.

5.1.3.3 Technology and Infrastructure - Infrastructure not tailored to vehicles, MAAS

Biking/walking infrastructure and good public transportation have both been shown to positively influence car sharing (Plepys, Heiskanen, and Mont, 2015; TCRP, 2005). City infrastructures' direct relationships to municipal governance city's mobility plans are self-evident. Both Malmö and San Francisco have both passed legislation seeking to modify the existing infrastructure. In Malmö there are bike corridors, exclusively for pedestrian and cycling (Zinkernagel, 2017, P.C.). In addition to the planned expansion of these corridors, Malmö is planning on continuing to redesign existing streets increase walking and biking ease. San Francisco has added many miles of bike lanes and bike racks in the past couple years and the city's mobility plan includes plans for extensive further improvements (Holcomb, 2016).

Public transportation too, is a critical consideration when constructing an infrastructure that does not require a private vehicle to be mobile. While both cities offer extensive public transport, in San Francisco the age and the overwhelming number of users has resulted in low user confidence (San Francisco, 2015), and in some cases a drop in riders (Baldassari, 2017). Malmö conversely has relatively high user satisfaction in their public transport within the city (European Commission, 2016).

Finally, as has been demonstrated by the interwoven influence of all categories and levels, relationships are important in positively influencing the future potential of car sharing and an alternative mobility regime. Mobility as a service (MAAS) is an emerging concept offers situationally appropriate transportation under through one common network. In connecting different mobility actors, MAAS programs have a real potential to bring about a change (Vägverket, 2003; Loose, 2010)

In San Francisco this concept is in its infancy. The "clipper card" which ties several of the city's and Bay Area's transit companies together allowing users pay with a single card is an example of an extremely limited form of connecting transit. However, BART, one of the connected companies, does not allow bikes on the train during commute hours due to space issues. This constitutes a prime example of when sustainable modes of transport not working together can reinforce private vehicle dependency.

Malmö, is further in its development thanks to a municipal government that has shown great enthusiasm in working to promote this idea. EC2B, the idea of a local consultancy firm, Trivector, while still in its conceptual stage, already has a project lined up for mid-2019 (Schillander, 2017, P.C.). EC2B's linking of multiple mobility providers and developers has

already been responsible for generating new dialogue and with further development could constitute a serious challenge to the current socio-technical mobility regime in Malmö.

5.1.4 Evolutionary Perspective as a Tool of Analysis

The separation in the levels of the different stages of niche protection as defined by Smith and Raven (2012) is a helpful analytical lens to compare the progression of the concept in multiple locations. The levels (Shielding, Nurturing, and Empowering) are stages of protection for all socio-technical system challenging concepts; and the categories within the different levels (social, governance, and infrastructure/technology) were formed from the analysis of car sharing data in an international context and are an applicable measuring tool for all urban environments in the global north.

Within this perspective, different protective actions exercised or milestones met in the evolution of car sharing are expressions of real world actors and factors attempting to create a “space” for the concept. What this perspective has demonstrated is that in real-world mobility scenarios success in one category does not translate to acceptance or protective actions in another. Also, in the case of Malmö, linear progression up through the levels is not always observed. As is the case with the lacking legal definition in Sweden, skipping levels, while it does progress the concept, can hold back the emerging concept later on in the journey to being competitive with the current regime.

The evolutionary perspective gives an overview of where car sharing is in each of the respective categories, as well as the few concrete milestones that would assist in propelling the concept to no longer be in need of niche protection, it offers very little insight as to *who* could potentially abet in this process, outside the more apparent answer of the government. This is in part due to the intense focus it has examining what affects the system challenging concept and disregards how the concept affects its own environment. And while its retrospective view allows for a rich description of the concept’s progression, it is limiting when considering currently emerging aspects of the concepts development. Overall, however, this perspective lends itself as a useful tool in providing historical context for the current situation in both urban environments. Building upon this context with the objective to offer a more insightful picture into the current situation of car sharing in both cities, this thesis switches perspectives to the relational, while still staying under the umbrella of socio-technical theory.

5.2 Research Question 2

How is car sharing framed by the mobility actors network within different urban contexts and what implications might this have on the potential transition pathways?

To look to the future of car sharing as an isolated social technical system challenger is not realistic or productive. The future of sustainable transport rests on “different ontological assumptions” from varying actors (Garud and Gehman, 2012), and actor’s goals, made in isolation can actually work in competition against other alternative modes of transportation, instead of against the private vehicle. Going forward, if the concept of car sharing is to play a larger role in urban mobility, the current status quo of the personal vehicle must be overturned. No single concept is equipped to tackle car ownership on its own, and each actor’s capacity is directly tied to an actor network; thus, real change can only be made with a web of synergies empowering and reinforcing shared ideas between actors (Garud and Gehman, 2012).

This section aims to present an insight into the current mobility environment in Malmö and San Francisco from the perspective of actors and networks. Pinch and Bijker (1984) believe it is

essential to map the multidimensional connections when dealing with “social constructivist account[s] of technology” to help accurately portray the present environment. To map the aforementioned connections, the relational perspective was chosen. The relational perspective allows analysis of a system through graphical representation of common synergies between problems, actors, and concepts (Garud and Gehman, 2012). Below, maps of the main mobility actors at play in each case study city are presented. They are inspired by the model and process Pinch and Bijker (1984) used to map the development of the bicycle (Appendix 1). The main difference is that at the bottom of the diagram Pinch and Bijker (1984) constructed is a finalized entity: a specific bike design. Neither car sharing nor urban mobility has a finite end point as it is constantly evolving in an organic fashion as new technologies and social partnerships are formed. Thus, the models below are not designed in the same way: they do not have a finalized version of any concept on the bottom, nor do they seek to represent a single entity or progression over time in anyway. They depict the complexity of the urban mobility situation in each city as it stands today.

Mapping the relationships and interactions between different mobility actors and problems is a perspective favored by several scholars, as “through the mutual entanglements of social and material actors that meaning emerges and is translated into practice” (Garud and Gehman, 2012, 983). As the goal of utilizing the relational perspective was to understand car sharing’s role in each city and gain a deeper understanding of some of the issues surrounding mobility, both charts started with the primary problems the private vehicle represented: traffic, parking and the unsustainable nature of the private vehicle. From there, based on the interviews, and research conducted in both cities, the author connected alternative mobility actors, service, and additional problems that are related to these issues, using the context that the evolutionary perspective provided. There are two important aspects to note here:

- The relationships depicted through lines represents direct connections to problems or other actors. For example, while Caltrain, in San Francisco, undeniably decreases the traffic by carrying a mass of commuters, it is owned by three counties (San Francisco county being one of them), and decreasing traffic in San Francisco is not its primary objective - transporting commuters from other cities is. Thus on the diagram of “Mobility in San Francisco” Caltrain is connected to the “City of San Francisco,” not “Traffic.”
- The second key point is that the lines do not have arrows designating which direction the actors are affecting each other (or a problem). This is because it in almost all cases there is an oscillating relationship between the two depicted influences. For example, in the case of Malmö bike share: it was created in part to reduce traffic in downtown Malmö and the traffic in downtown Malmö was part of the reason it was created. The relationship goes both ways.

In the relational perspective, there is no ranking or hierarchy. Rather, all actors are equally entangled in influencing mobility; even actors, such as developers, are included though mobility is not their primary business. A web depiction allows the expression of agency of individual actors (Garud and Gehman, 2012), since they are able to choose to work to address problems and influence other actors. Not all lines of influence are shown on these maps, though most of the main connections are depicted.

Finally, these diagrams were used heuristically. The author had no preconceived notion or intention of certain findings in the mapping of the different mobility actors and issues. The connections between the actors, problems, and services are seldom internal, isolated

manifestations between the two involved parties, rather, at least in part, they are symptoms of a shift in the broader system that helped bring the two actors together (Watson, 2012). Thus, the discussion of current relationships between entities displayed in the different diagrams is more straightforward than the discourse on how the relationships originally came to be. The previous section, under the evolutionary perspective, has already provided historical context, for many of the relationships depicted in the web of mobility representing each case study. Thus, this section builds upon these backgrounds and explores the current system of mobility in both Malmö and San Francisco.

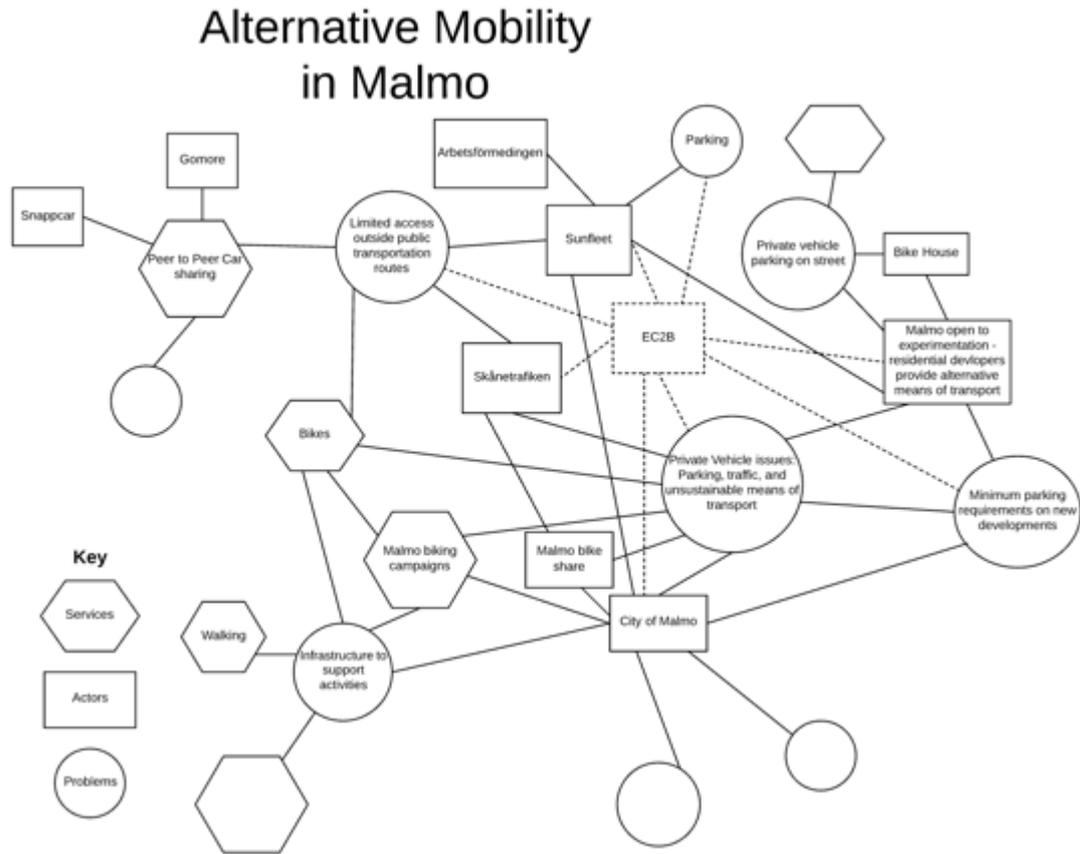
5.2.1 Malmö

The “bike house,” in Malmö as previously discussed is a city experiment on how a residential complex will operate without parking. The project's success, or failure will strongly influence if the city is willing to take further steps away from private vehicle transportation norms embedded within their building requirements (Zinkernagel, 2017 P.C.). As parking can be responsible for up to 18 percent of the cost of a new development, local developers have a financially vested interest in mobility projects that, with adjusted parking requirements, aim to nudge residents to utilizing alternative forms of transport.

The proposed concept “EC2B,” the MAAS provider, aims to make the links between alternative forms of mobility and developers even more concrete. The Trivector project has brought together a community of mobility and development actors and put together a service that provides a slew of mobility services to residents of the partnered developer’s new project. The developer would in theory fund or subsidize mobility for their residents and or tenants, and the city would then dramatically lower, or do away with the parking floor. EC2B hopes that with the services it supplies it can “nudge” its users toward more “sustainable mobility behavior” through the coordinated cooperation of all actors involved (Wendel, 2017, P.C.).

If Trivector, the creator of EC2B, is able to bring the concept to market and involve all the actors it is currently in discussion with, together they pose the biggest threat to car ownership that has yet to come to Malmö. With developers and the municipal government both working alongside multiple mobility actors, the groundwork for a new social technical system is already laid out; now contingent on federal government regulation and continued willingness from Malmö government and population to accept the mobility alternatives. A visual perspective of Mobility in Malmö through the relational perspective is presented below in Figure 7-2; EC2B and its connections it is currently in dialogue with are shown on in dotted lines.

Figure 5-2 Mobility in Malmö through the relational perspective.



This chart is a modified version of the one created to depict bike development by Pinch and Bijker (1984). Not all issues or actors are shown due to lack of space. The blank shapes are there intentionally to serve as a reminder that the chart is not free floating and is connected to multiple other issues, actors and influences.

Ignoring EC2B for the moment, all of the solid boxes and lines are representations of actors, problems, services, and relationships that are already at work shaping mobility in Malmö. There is no hierarchy, rather, all actors are presented as equally entangled in the mobility web; even actors, such as developers, where mobility is not their primary business. While this model does not afford the benefit of developments over time, the inclusion of EC2B is a glimpse into a potential future. With its first contracted project is scheduled for 2019, EC2B's place and connections in Malmö's web of mobility is slowly metastasizing (Wendel, 2017, P.C.). Through analyzing the shifting interdependencies and relationships between the problems, services, and actors; opportunities for influence and intervention are illuminated (Watson, 2012) and previously concealed opportunities can be exposed (Watson, 2012, Garud and Gehman, 2012).

One such new opportunity for car sharing is its revised role in the incumbent social technical system. Presently, Sunfleet in Malmö exists on the fringes; utilized by less than two percent of the population (Alguren, 2017, P.C.). With new connections, thanks in part to increased entanglement created by EC2B, the Sunfleet is further locked in more centrally and the concept is depended upon by a number of different previously indifferent actors. The company acts as a solution to one of largest hurdles in motivating people to move away from privately owned vehicles: the fear of loss of access. With Sunfleet offering a means of mobility, free from any scheduled route, the potential to access areas or locations as one could with a private vehicle is unchanged. This maintained *potential*, is very important when it comes to transportation (Freudental-Pedersen, 2009), and because car sharing is presently the only mobility actor in

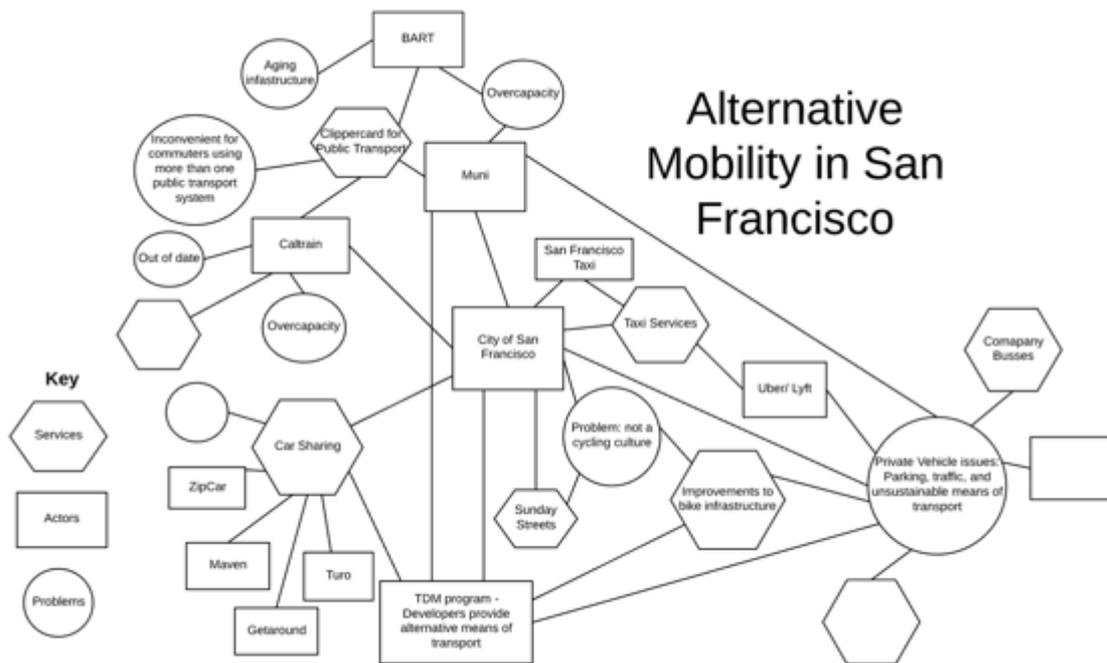
Malmö that allows convenient access to areas outside the scope of public transport, it has locked itself into the incumbent system comprised of alternative mobility actors. The two P2P car sharing companies are obviously isolated, lacking connections to any other actors. EC2B's creator, Wendel (2017, P.C.) however, has mentioned that in the future, that the MAAS provider would be interested in engaging in dialogue with a P2P company.

Finally, one of the most striking features of the relational diagram is that number of actors surrounding the central problems related to private vehicle ownership. This centralized organization around problems associated with the private vehicle suggest that many of the actors and services have something to gain from solving one or more of the problem. As the issues surrounding private cars affect so many of them, mutualistic thinking and action could occur with multiple actors working together to tackle these problems. In looking at EC2B and the increased relationships it would establish; it creates a web of actor not all previously connected. Presently, Sunfleet has limited contact with new residential developments; if/when EC2B is implemented on a city-wide scale, they will be linked under a business, working together to connect residents to vehicles when they are needed.

5.2.2 San Francisco

The city of San Francisco, due to its size and position in the Bay Area has an extremely complex and intricate web of mobility that would be extremely difficult to depict in its entirety. Figure 7-3 depicts a basic representation, of a limited look into mobility in San Francisco as it stands today.

Figure 5-3 Mobility in San Francisco through the relational perspective.



This chart is a modified version of the one created to depict bike development by Pinch and Bijker (1984). Not all issues or actors are shown due to lack of space. The blank shapes are places intentionally to remind that the model is not free floating.

In contrast to the depiction of mobility in Malmö, this chart focal point is not the problems surrounding private vehicles, but instead the city of San Francisco. A grouping surrounding a municipality is not inherently better or worse. However, in the case of San Francisco lack of mutualistic thinking among alternative mobility actors has led to narrow cutoff thinking as was previously discussed with the case of BART not accommodating bikes during peak commuting hours. Additionally, when regulatory bodies are placed between two actors systems; as was the case with SFMTA regulating the taxis and the curb space for free floating car sharing, it resulted in a winner (SF Taxi) and a loser (DriveNow) as opposed to a mutually beneficial solution to a problem. On the map of San Francisco, there are many more actors than on that of Malmö. One reason is due to multiple companies operating public transportation, however, the city of Malmö also has taxis and Uber, yet they are not depicted in Figure 2. This is due to their lack of mention in literature and in interviews in regards to heavy influence on traffic. In San Francisco, both of these concepts are mentioned (Henderson, 2017, P.C.).

Car sharing in this diagram is obviously isolated and unlike in the Malmö diagram, grouped together. As San Francisco does not exclude different models of car sharing, as long as certain criteria is met in the parking applications and in their Transportation Demand Management program, this representation was deemed appropriate. The isolation for larger companies like Zipcar is perhaps not an enormous immediate concern, however if car sharing companies wish to expand beyond its statistically small user group, partnerships will become increasingly important (Loose, 2010; Celsor, and Millard-Ball, 2007). An MAAS provider in San Francisco (or at the very least further partnerships between mobility offerings) would certainly improve dialogue and partnerships, within the current infrastructure. However, the fact that all three major forms of public transport are linked to the problem of “overcapacity” suggests that perhaps infrastructural improvements are of higher priority before a mobility linking service can be truly effective.

When discussing the issue of mobility in all cities but especially San Francisco, it is important to recognize the broader reaching implication. For those working at San Francisco inflated “living wage” (a citywide minimum wage substantially higher than the states), housing prices are unaffordable. What this translates to is longer and longer commutes for people of lower socioeconomic status. Thus improvements to transportation in the Bay Area is not just a question of sustainability, but social equity as well (SFMTA, 2016).

5.2.3 Relational Comparisons Between Malmö and San Francisco

In San Francisco, there are more actors that directly and indirectly contribute to traffic and lack of parking than in Malmö (ex. Uber/Lyft, lack of a biking culture, over capacity public transport, etc.). In Malmö, causes of traffic outside of people driving were not mentioned as enormously influencing factors, hence the lack of Uber, or taxis on the mobility in Malmö diagram. However, aside from the web of mobility in San Francisco being more crowded, there are other important differences to note as well. The dramatic differences in organization between the two webs of mobility suggest different potentials and challenges for the car sharing in the respective cities. As mentioned previously, the focal points of the charts differ. This is in part due to difference in how the concept is framed by each area, in terms of legislation and partnerships. In the map of San Francisco, the web of mobility actors is notably surrounding the city and mobility problems associated with it vs. in Malmö, where the actors surround the problems associated with private vehicles. With each means of organization come benefits and consequences and the framing of car sharing in each urban context gives clues into what they are.

In Malmö, Sunfleet’s connection to Arbetsförmedlingen, as well as the parking allotments/memberships that happen in new developments due to Malmö’s experimentation with the

developers, have both played a large role in the company's success. These partnerships have been somewhat of a necessity and act as compensation for unfavorable administrative rules and the higher taxation of car sharing in Malmö/Sweden. Additionally, Malmö's parking floor, or minimum requirement, has ensured that businesses and residents alike will be able to accommodate vehicles for the time being.

San Francisco and California on the other hand, through low taxation rates, on street parking for car sharing, and legislative protection, have created a more nurturing environment for the concept and perhaps for this reason, fewer partnerships have formed. Also, the parking ceiling the city has for its new developments does not continue to propagate a conducive environment for private vehicle transportation. Instead, the city's Transportation Demand Management (TDM) program, which includes car sharing, offers a number of different alternative mobility options. Despite car sharing's inclusion in this program, this partnership was not mentioned once as being supremely influential in car sharing's overall success.

Car sharing in San Francisco appears to be framed much more as an independent competing business entity, operating in a market, where the existing regulation allows car sharing companies to meet the required economic baseline of users without necessitating many partnerships. Viewed by some departments in the city as starting point for more radical mobility changes (such as a shift to electronic or autonomous vehicles), car sharing in San Francisco appears to be framed as a *promising* alternative. Conversely, in the discussion of car sharing in Malmö, partnerships seem to play a much more critical role. Clustered around the problems associated with the private vehicle, along with numerous other alternative mobility actors, car sharing in Malmö seems to be framed as a *complimentary* alternative. To be clear, this is not to suggest that car sharing in San Francisco would not compliment and benefit from relationships with other alternative mobility actors, rather the concept is currently framed in such a way that promises more independent success than in Malmö.

Legislation that formally recognizes, protects, and allows on street parking has a noticeable effect on the potential of P2P car sharing. In Malmö, Snappcar and GoMore exist on the fringes of the web with noticeably limited mention and connections compared to Sunfleet. In San Francisco this seems to be less of the case. P2P car sharing companies can own on street parking and can supply their members with parking space as motivation. Getaround's recent acquisition/merging with City CarShare now has the previously exclusive P2P car sharing company, owning cars and parking spaces, making the future of the company's business path forward uncertain. Finally, San Francisco's TDM program allows P2P memberships, along with traditional B2C memberships to count toward their demand management point system. This legitimization of multiple forms of car sharing is empowering for P2P and increases the motivation for more people to enter the sharing economy. It is also most likely contributing factor as to why the two P2P car sharing companies have had more commercial success in San Francisco. The actual effects of this on car ownership require further research.

In addition to partnerships, acceptance of the current mobility environment is likely to be instrumental in influencing car sharing's future potential. San Francisco is in dire need of a drastic mobility transformation, especially in comparison to Malmö. With more than 80 percent of Bay Area residents unsatisfied with the traffic and the two largest metro/train systems well over capacity, the city and state are exploring different alternative mobility options. In 2016, acknowledgement of this need for radical change came from the mayor's office in San Francisco, when they published the document: *City of San Francisco, Meeting the Smart City Challenge*. This nonpolitically adopted document outlines a transition for the city to shared-autonomous-electric vehicles to solve the issue of traffic and transportation; framing car sharing as playing a critical role in the present day of familiarizing the city's residents to sharing modes of transport. This is

an important insight into how certain sectors of government view and frame car sharing in a future socio-technical system no longer dominated by the private vehicle. While having no legal impact on policy the document does signify to other city departments the urgency in altering the current system and places a significance on modern day car sharing.

In Malmö, the situation with public transport is much different. Skånetrafiken is in the process of adding a whole new tram system to their already impressive public transport system. With public satisfaction at over 70 percent with the current infrastructure, alternative mobility in Malmö is at present, perceived in a much better light.

Despite wide variation in the current state of their respective public transport systems, both Malmö and San Francisco, if they are to meet their mobility goals and objectives by 2030, need to mobilize multiple alternative mobility actors represented in (Figure, 7-2, 7-3). The map of relationships in alternative mobility actors in Malmö forms an integrated web. These relationships lock in and support the different actors. Especially with EC2B's impending market debut and the potential new connections and customers it offers; the web of alternative mobility actors in Malmö, could empower Sunfleet sufficiently where it can overcome unfavorable administrative legislation and high taxes that effectively cap its growth at around 20 percent annually.

San Francisco however, has a more stable and stronger car sharing environment that is less contingent on outside actors for survival. Additionally, the increasingly urgent demand for a change in the reigning socio-technical system suggests that rapid change is in higher demand than in Malmö. While, at the municipal and state level, legislation has been relatively conducive to car sharing and alternative forms of mobility, the recent move by the US Federal government to block Caltrain's electrification, has left the future of mobility in the Bay Area a bit uncertain. Thus, if federal regulation continues to suppress improvements to alternative mobility actors, car sharing in San Francisco may need to adopt a similar strategy to Sunfleet and turn to partnerships with other actors to ensure growth in their user base.

5.2.4 Relational Perspective as a Tool of Analysis

This perspective allowed a visual mapping of the alternative mobility actors, services, and transportation problems in both urban case study settings. Due to the lack of time representation it does not allow for the representation of historical context. However, when utilized after the evolutionary/multi-level perspective, it serves as an excellent tool to map out the current web of alternative mobility actors, services, and problems. In this perspective, the system challenging concept is not a passive actor as is the case in with the prior one; allowing steps taken by car sharing actors to be represented. The differences in the framing of car sharing in the two cities, illustrate two very different mobility environments. This information is very useful to consider when considering future potentials for car sharing, and the incumbent socio-technical in its entirety.

6 Conclusions

This thesis set out to analyze car sharing, within the context of two case study cities, Malmö and San Francisco. After a brief discussion of the concept and a background contextualizing mobility and car sharing in both urban environments, the focus turned analytical. Under the umbrella of socio-technical theory, two frameworks, the evolutionary/multi-level perspective and the relational perspective, were used to analyze the concept. The unique lenses and perspectives awarded by the specific frameworks, allowed for content analysis that produced findings to respond to both of the research questions: 1. what factors have shaped car sharing's niche dynamics? And: 2. how the different framing of the mobility actors network influences transitional pathways?

The evolutionary perspective allowed dissection of the rich details uncovered in each of the case studies. Its retrospective lens gave insight into the important protective actions that had supported or still hindered the concept in each of the two urban environments. Additionally, the intense focus on the external factors that have influenced car sharing was very useful in providing historical context. Under this perspective, Malmö serves as a real world example of the non-uniform nature of concept evolution. Despite lobbying efforts from a number of different car sharing organization for a legal definition of car sharing since around the turn of the century, Arbetsförmedlingen, a government program, began utilizing car sharing in 2009, before it was legally defined. As it allowed Sunfleet to operate in smaller cities where it otherwise would not have been able to, this partnership illustrates the benefits connections serve when incumbent system challenging ideas, are trying to grow at a pace quicker than the market would otherwise allow. San Francisco from the evolutionary perspective has met more of the prescribed protective actions than Malmö. A legal definition, parking allowances and fair taxation, have allowed a more independently competitive and inclusive car sharing environment in San Francisco.

Illustration of this independence is seen later on in the relational perspective with car sharing being much more isolated in San Francisco than it is the case in Malmö. It has progressed independently from partnerships and appears to be framed in the web as a *promising* alternative means of mobility. In Malmö, car sharing's dependence on other actors is depicted in the very integrated web that frames the concept as more *complimentary* to the entire alternative mobility actors network.

However, in both cities, no one form of alternative mobility is capable of tackling car ownership on its own. Dissatisfaction with the current mobility environment and public transportation infrastructure in dire need of repair in San Francisco and the Bay area; may be the necessary catalyst to unite an incumbent regime of alternative mobility actors to work together and empower car sharing to further growth. However, as it currently stands, Malmö's incumbent regime of alternative mobility actors are framed in such a way that they are much more capable of assisting and supporting one another from within.

Malmö and San Francisco both have specific, politically adopted agendas to push their respective mobility environment away from private vehicle dependency. To accomplish this goal, the cities will need to ensure that mutually beneficial collaboration between alternative mobility providers is taking place. Examples such as the prohibition of bikes on BART during commuting hours, demonstrate the necessity of coordination within the actor network if the city wishes to reach its goals. In the case of Malmö, it appears that partnerships in working toward a common goal have been fostered through uniting against the common problem of private vehicle ownership.

An exceptionally important consideration when looking at mobility through these, or any, frameworks is the continual evolving nature of it. As developments in mobility continue transform our lives; and our lives continue to necessitate transformation in mobility, it is in a constant state of evolution. As neither of the frameworks utilized in this thesis could, on their own, incorporate all aspects, past and present, that shape(d) and influence(d) car sharing, it was important to use both to provide a holistic representation. With the evolutionary/multi-level perspective providing historical context to the mobility environment and the relational perspective framing the agency and relations between car sharing and the other mobility actors in the present, these two socio-technical perspectives allowed in-depth analysis of the car sharing up to the present and suggested future pathways for its progression.

A deeper understanding of the current mobility environment in multiple urban areas allows for comparative analysis and lends itself to a more profound understanding of car sharing's niche dynamics and the implication of relationships in the mobility actors network. This thesis has sought to advance not just the understanding of the mobility environment in San Francisco and Malmö, but also offer a critique of the two chosen methods of analysis. The complex social and technical nature of mobility and the interplay between the two categories requires indebt, rich analysis that the case study approach helped facilitate. The chosen lenses provided focus perspectives on the data collected and illustrated that while mobility is critical to the understanding of modern society, (Urry, 2000), so too are the tools used to analyze it. Ultimately two case studies are not sufficient to make broader conclusions about the car sharing in urban environment, however, they illuminate some interesting differences between the two cities and the findings discussed above can give clues as to what aspects are of note for future research.

6.1.1 Future research suggestions

Do institutional hindrances, as observed in Malmö, cause additional partnerships and relationships between alternative actors in socio-technical systems? Autonomous vehicles are seen by many in the Bay Area (both in the private and public sector) as imminently approaching; and car sharing is viewed as an initial stepping off point for the concept (SFMTA, 2016; ITDP, 2017). Thus, further research could explore how the current framing of car sharing in each urban environment affects the likelihood of how autonomous vehicles and other future forms of mobility will interact in an alternative mobility network. Additionally, how do different arrangements in alternative mobility actor's networks influence the future potential for these regime challengers?

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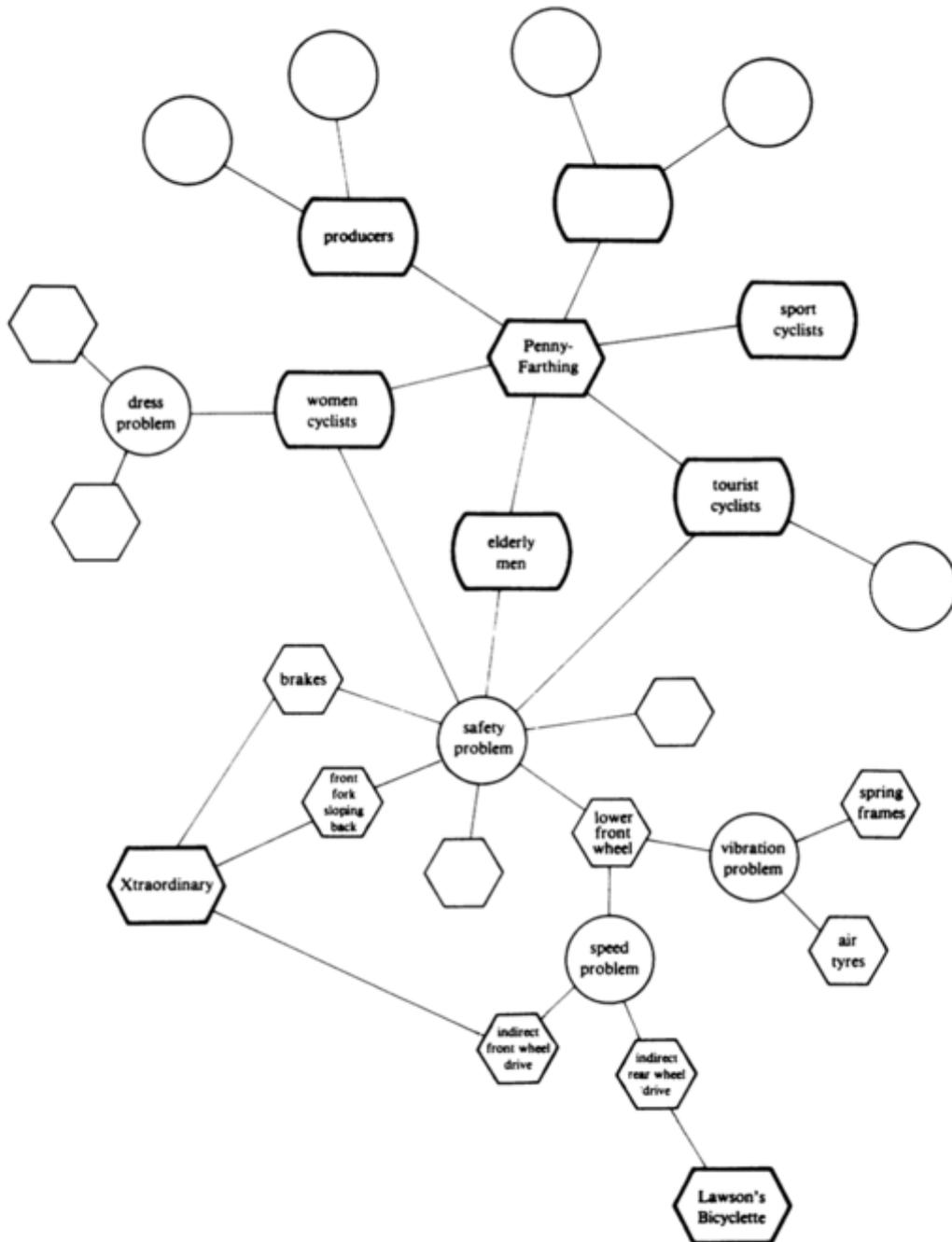
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Appendix

Appendix 1. Pinch and Bijker's (1984) mapping of bicycle development through the relational perspective.

Some Relevant Social Groups, Problems and Solutions in the Developmental Process of the Penny-Farthing Bicycle



Note: because of lack of space, not all relevant social groups, problems and solutions are shown.

Source: (Pinch, and Bijker, 1984)

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And a thank you to:

Eddy, J. P.C. Interview. (2017). March 16, 2017. Mobility Consultant ARUP, Board Member Bay Area Council

Henriksson, G. P.C. Interview (2017). March 15, 2017. Researcher at KTH

*Note this interview was not conducted by the author, but by Dr. Peter Arnfalk, one of the author's supervisors. The transcript of the interview was utilized.