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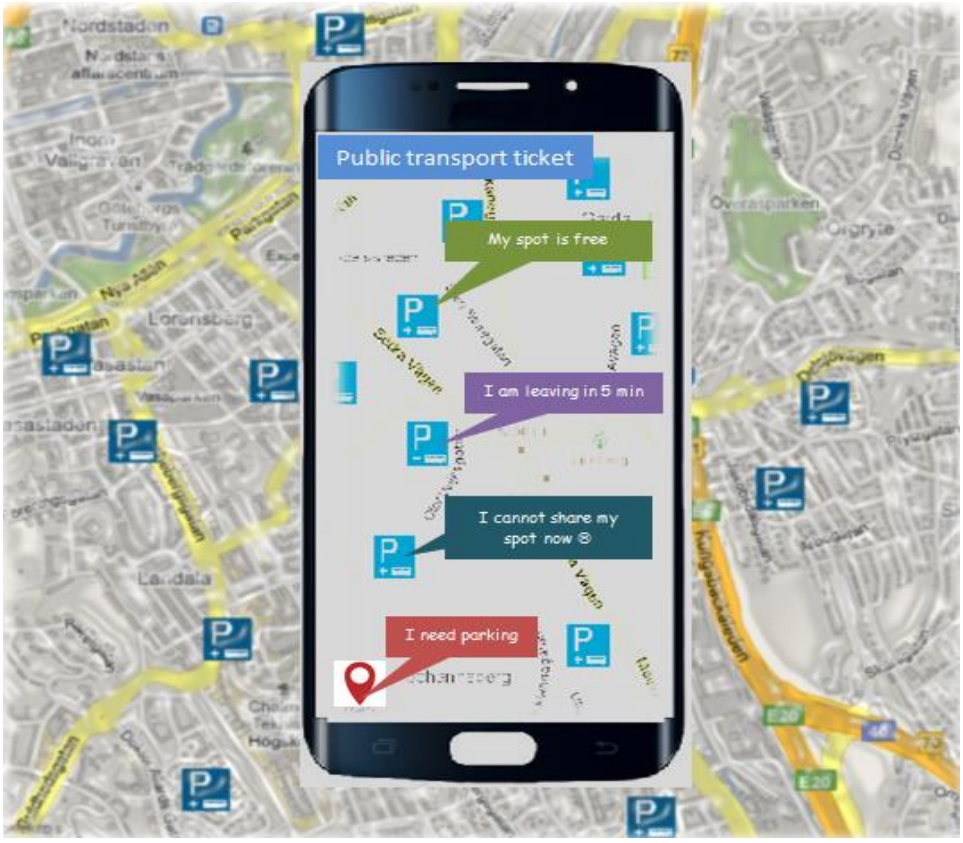

Integration of shared parking and public transportation for sustainable mobility

Through an investigation of business case and stakeholder perspectives

Master's thesis at Challenge Lab

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Department of Space, Earth, and Environment
CHALMERS UNIVERSITY OF TECHNOLOGY
Gothenburg, Sweden 2018

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ABSTRACT

If the road transportation sector in Gothenburg is to meet its Climate 2030 targets, traffic in the city and resulting emissions must decline. To drive this transformation, emergence of new mobility services is necessary. Currently, combined mobility services are being investigated to understand their feasibility in combination with public transport services. To foster public transportation, the city intends to limit private car usage by reducing parking spaces. However, if a certain population continues to rely on private cars, it is necessary to accommodate the fleet efficiently, meanwhile expanding the share of public transportation. Therefore, I investigate the business case of combining the concept of shared parking and public transportation into a common digital platform to facilitate sustainable travel. Subsequent research questions are,

(1) How can combining shared parking and public transportation fulfill the user's needs and preferences?
(2) How do key stakeholders respond to an evidence-based understanding of user's needs and preferences regarding the combination of shared parking and public transportation?

Shared parking is an effective parking instrument allowing private parking owners to share their parking space during off-peak hours by renting them out to the car users at a reasonable cost. The thesis utilizes a business model approach to examine how shared parking can bring sustainable value to users, stakeholders, and society. Research analyzes user's travel needs through a questionnaire and present the sustainable value of combining shared parking and public transportation through the value proposition canvas. The two user segments are tenants owning/renting parking space and car users. For further validation, research investigates broad perspectives of heterogeneous actors through interviews and a workshop.

It is found that the car is perceived as preferred transportation mode due to convenience, quick travel and flexibility factors. However, public transportation is gaining importance among commuters and with shared parking, it could hypothetically result in sustainable transition. User's and stakeholders partially appreciated the new mobility service due to its economic advantage and sustainability benefits that could reduce car usage, improve parking infrastructure efficiency, and promote public transportation. However, research unveiled that the behavioral, societal and institutional barriers like incompatible operating system, regulations and lack of evidence hinders the adoption of new mobility service into the existing system. To overcome these barriers business model innovation, reconfiguration of existing system, collaboration among relevant actors, and future study on the concept is recommended. Further policymakers should promote the collaboration of private and public agencies, and experiment with pilot studies which can initiate changes in travel behavior. Research concludes that parking is huge untapped resource, thus shared parking with public transportation can potentially reduce the car use and externalities, thereby supporting the sustainable development in urban transport.

Keywords: shared parking, public transportation, stakeholder, value proposition canvas, sustainable business model, sustainable mobility, urban mobility

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In addition, I would like to thank all the interviewees and stakeholders who participated in the workshop, validating and adding valuable insights to the thesis. I also appreciate the participants who answered the questionnaire without which the thesis could not have been successful.

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Adarsh Srinivasa Rao, 2018

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1. INTRODUCTION

The 1992 conference in Rio de Janeiro which is known as “Earth summit” organized by United Nations, entrenched the awareness of climate change and the necessity to integrate environment and development (UNCED, 1992). The issues like fossil fuel use, transportation, and increasing demand for water were addressed which stimulated the growth of ‘Sustainability’ (UNCED, 1992). Sustainability is defined as the *“Socio-economic development that meets the demand of the the current generation without compromising the ability of future generations to meet their own needs”* (United Nations, 1987). Further with successive conferences, sustainability has been applied across various sectors influencing the social, economic and ecological growth of the society. This research will focus on sustainable mobility.

The current generation is witnessing revolutions in the global economy, technology, emerging of decentralized systems and many more trends as positive, amidst population expansion, energy consumption causing catastrophic events like climate change, floods, and droughts (Bizikova, Robinson, & Cohen, 2011). The most pressing challenge is to explore the overlapping concerns of climate change and sustainable development (Bizikova, Robinson, & Cohen, 2011) with transportation being one of the key contributors (Chapman, 2007).

The global externalities and transforming urban demographics, urban lifestyles are impacting transportation sector, with growing demand for the use of cars, which the current transportation system is unable to handle (Pollanen, Utriainen, & Viri, 2017). This has been perceived as an opportunity to create a shift from car ownership to providing customized transportation services to the commuters. Besides, digitalization and innovative business models are enabling commuters to personalize their mobility services making their daily travel easy and convenient. One of the well-known multinational mobility service providers is UBER which allows the user to book the car when needed through a digital platform (Uenlue, 2018). In addition to the growth of cars, parking has been recognized as a vital tool to control transportation externalities like congestion (Glazer & Niskanen, 1992). The availability of parking is affecting the choice of transportation mode as well as urban land use, further it is found that the queuing caused by parking and cruising around to find parking space in the city leads to higher congestion (Shoup D. , 1997). Thus, this research focuses on providing an alternative mobility service as a means for the sustainable transition by introducing the concept of shared parking in combination with public transportation.

The city of Gothenburg has adopted various policies for sustainable development to become a climate-neutral city. The initiative is the result of various collaborations between organization, industries, research centers and people (City of Gothenburg, 2014). This inspired the development of a unique set-up called Challenge Lab in 2014 by John Holmberg in collaboration with Chalmers University of Technology. The lab focuses on sustainability challenges using backcasting methodology which is useful in dealing with complex societal issues (Holmberg J. , 1998). To realize the transition, the lab brings together three key actors public, private and academia with the knowledge of students who act as change agents.

This master thesis has been conducted in this neutral arena in two phases.

Phase 1 (Appendix) was a 4-week long process where students from multiple backgrounds were grouped based on their interest in three thematic areas: Mobility, urban future, and circular economy. Using backcasting approach and discussion with several stakeholders, mobility was chosen as key area for transition, where parking system as a critical factor to intervene in the mobility sector which can result in sustainable transition. With further iteration and support from the supervisor, the following research questions were finalized.

(1) How can the combination of shared parking and public transportation fulfill the user's needs and preferences?
(2) How do key stakeholders respond to an evidence-based understanding of user's needs and preferences regarding the combination of shared parking and public transportation?

Phase 2 spans for 16 weeks which outlines theory, methodology, and results to answer the above-mentioned research question. In combining shared parking and public transportation which is a niche concept, the research aims to provide a basis to design a sustainable business model that also promotes stakeholder engagement in the need for innovative mobility services. Research draws insights from multi-level perspectives (MLP), Backcasting, and Business model. The process of data collection involves a stepwise approach which is further analyzed and presented in the form value proposition canvas in the results section.

1.1. Problem Description

In the fossil fuel world, Sweden has set climate goals to bring about a sustainable transition in society focusing on multiple sectors (European Commission, 2017). Major infrastructural and organizational change has been underway to reduce emissions and make efficient use of land, energy, and capital. The initiative intends to achieve reduction of 21% carbon di-oxide emission by 2020 in reference with 1990 levels (City of Gothenburg, 2014). Along with these initiatives it is important to create measures that can bring behavioral changes that are vital for transition. Therefore, it is essential to support those who are willing to change their lifestyle, also create awareness among others for the change. To reach the climate targets, the measures includes all dimensions of the society and targets individual areas with specific goals (Region West Sweden, 2018) where transportation is one of key areas.

The transportation sector accounts for nearly 1/3rd of the carbon emissions in the city of Gothenburg and aims to reduce 25% of the traffic by 2030 (City of Gothenburg, 2014). In order to do so, it is necessary to reduce car usage in the city and increase alternate modes of transportation. As a part of the strategies, the decision makers are encouraging the use of public transportation as well as slowly reducing parking spaces to encourage the shift from car use to public transportation (City of Gothenburg, 2014). An adequate amount of parking which drives the city traffic also consumes considerable urban land thus links transportation and land use. Therefore, the city's parking policy proposes to reduce parking spaces and increase parking charges to reduce car use in the city (Stadsbyggnadskotoret, 2018). However, if a certain population relies on cars, it is necessary to accommodate the existing fleet concurrently expanding the share of public transportation. Meanwhile, the efficient utilization of existing residential parking space could be an effective solution to complement the reduction of city parking spaces. All these challenges and developments demand sustainable transition in the transportation sector and must be supported by innovative mobility systems and behavioral change in the society. This motivated to explore the mobility sector: parking system.

Further, the city is incorporating car pools, expansion of public transport services, and electric bikes for speed transition towards low-carbon transportation (Region West Sweden, 2018). This is supported by setting up parking lots closer to the public transportation hubs. The author Litman T (2018) states that the future parking planning must comply with the traffic goals and should aim to reduce the car demand. Therefore, this research utilizes an opportunity to propose an efficient way to utilizes existing parking infrastructure, meanwhile, provide an alternative mobility service to reduce car usage in the city.

1.2. Purpose and aim of the research

As highlighted in the previous section regarding the necessity of reducing car use in the city and fostering public transportation, certain shared mobility services, pilots and integration models to develop public transportation have been set up in the city. The concept of combining various mobility services has spread across Nordic countries in alliance with digital giants like Ericsson, Sonera etc. One of them was piloted in Gothenburg by Ubigo in 2014 and Finnish MaaS service has been started in Finland with the intention to spread across the globe by combining multiple mobility services (Holmberg, Collado, Sarasini, & Williander, 2016). In Sweden, a roadmap has been designed by Kompis to scaleup the combined mobility services which include various levels of integration where public transportation has a key role to play (Brenden, Homberg, Smith, & Laurell, 2018).

With this motivation and considering the innovation in mobility sector in Gothenburg, to complement the transportation goals, the novel concept of shared parking in combination with public transportation could bring innovation in the sector. The hypothesis is proposed to promote sustainable travel and foster public transport. The aim of the research is to investigate the possibility that shared parking, when combined with public transportation, can encourage private car users to adopt more sustainable travel patterns. In principle, this may be realized via decentralized park and ride schemes, but here the focus is to integrate under-utilized residential parking spaces with the incentive of public transportation tickets. In addition, one of the research states shared parking as one of the key strategies to efficiently utilize land and accommodate more cars in the space (Litman T. , 2009).

When new services emerge, they are bound with uncertainties and experimentation to deal with the market competition before stabilizing (Sochor, Sarasini, Arby, & Karlsson, 2017). Therefore, it is important to understand the market necessities like customer needs and various stakeholders' perspectives who show interest. In addition, the integration of new services deal with the existing robust business models, which obstructs the transition (Sarasini & Linder, 2017) and several institutional barriers. Hence, the purpose of this research is to investigate the feasibility of the new mobility service by investigating user's travel needs and preferences and stakeholder perspectives on the evidence-based research. This is investigated by literature review, questionnaire, interview and multi-stakeholder workshop.

2. BACKGROUND

The megatrends across the globe like demographic change, urbanization, climate change, technology, digitalization etc. (Burrows, Bradburn, & Cohen, 2015) are challenging urban transportation system to adapt to the change and thus are in persistent research of innovative mobility solutions (Chapman, 2007).

The rapid increase in world population which is expected to reach 9.5 billion by 2050 and urban sprawl is reshaping the trade of goods, production, consumption, lifestyle and technology adaptation (URBANET, 2016). In recent years, Sweden is outpacing other European countries in terms of urban growth; with 85% of the 10 Million population living in urban areas (Sputniknews, 2017). One of the reasons behind rapid urbanization is population growth which in Sweden is expected to reach 12 Million by 2050 (Population city, 2018). The main reason for this trend is the high quality of life in urban areas, other reasons is that the major cities of Sweden have accepted the responsibility of immigration (Svanstrom, 2015). Summing up these reasons and trends suggest that the city population will continue to grow. Gothenburg, the second largest city of Sweden is also expanding, currently it has a population of around 580,000 and it is expected to climb to 1.3 Million by 2035 (Bergfors & Backman, 2016).

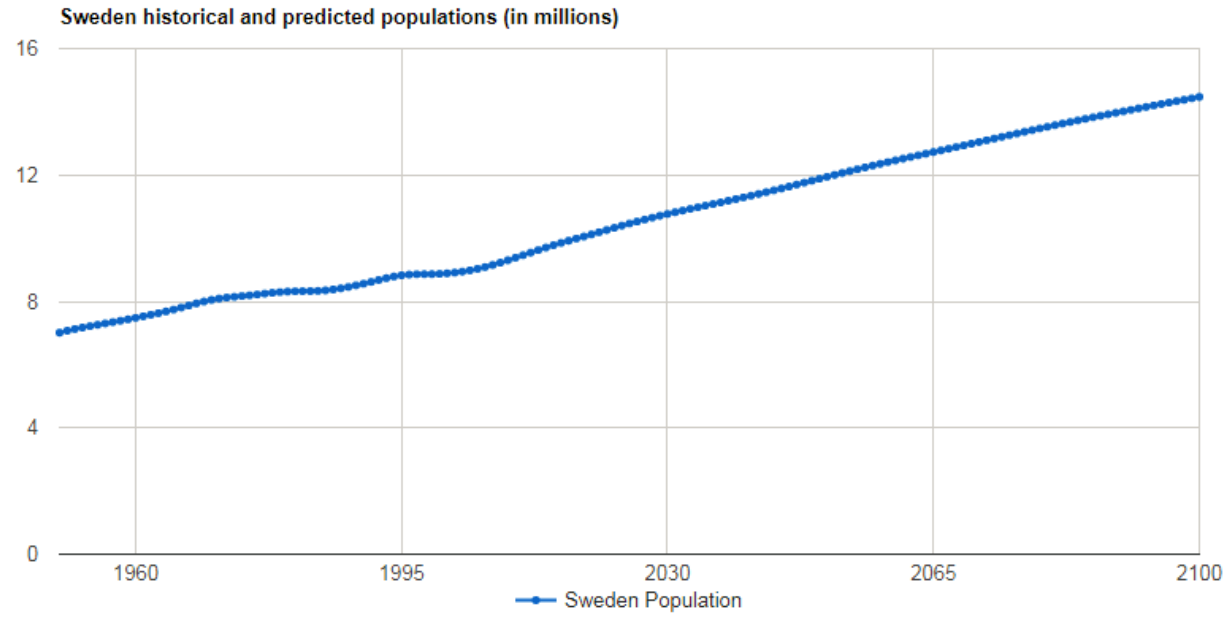

Figure 1: Population growth of Sweden (Population city, 2018)

Quoting Barak Obama. *"Climate change is no longer some far-off problem; it is happening here, it is happening now"* (Davis & Myers, 2015). One of the key contributors being transportation, accounted for nearly 25% of global CO2 emissions in 2010 out of which road transport was responsible for around 17% (Sims & Schaeffer, 2014). In Europe, its share is 2/3rd of total transport associated emissions (European Commission, 2010). In recent years, Sweden has gained

International recognition for its sustainable urban development with the introduction of mobility policies, alternative fuel use, electrification, and shared mobility models. However, the contribution of technological innovations to reduce emissions is rather not enough (Vaz, Rauen, & Lezana, 2017) and the persistent growth of car use is hindering sustainable developments. A recent study shows the increased traffic in Sweden could be due increased car sales (figure 2) which now accounts to nearly 4.85M cars (Trafikanalys, 2018). Amidst the presence of other modes of transportation, the car is still preferred by citizens. These statistics represent that car growth is outpacing the growth of urban and transport infrastructure which is leading to congestion. According to figure 3 (Traffic Index, 2016), in 2016, the congestion rate in Stockholm and Gothenburg was 28% and 23% respectively, consuming an average of 28 min and 23 min per day of extra travel time to reach their destination.

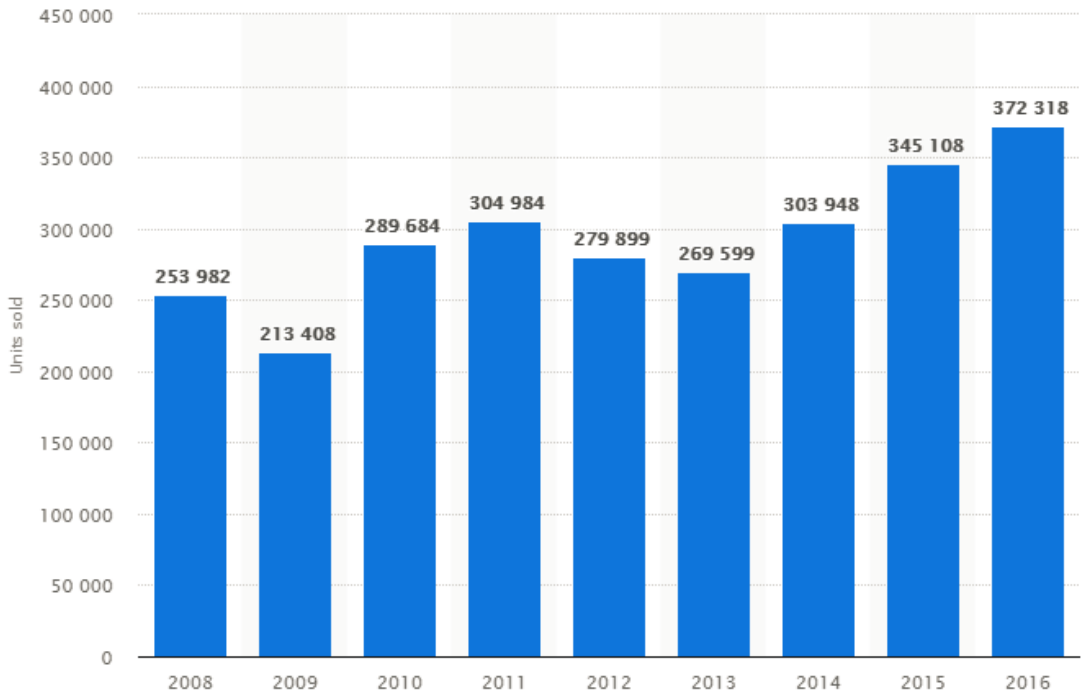

Figure 2: Car sales in Sweden (Statista, 2018)

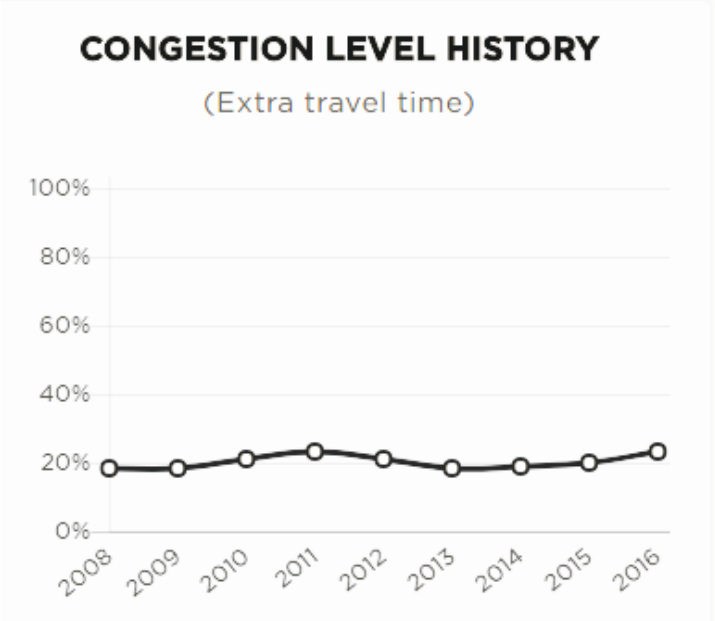

Figure 3: Congestion levels in Gothenburg (Traffic Index, 2016)

Persistent technological advancements like engine advancements, e-vehicles and more are impacting reducing emissions, however, Litman.T (2017) claims that mobility management strategies like shared mobility, MaaS are essentials to complement the technological growth to achieve sustainable transportation. This is complemented by the rise of the digital world which has restructured the design of communication, and businesses, unfolding new opportunities and innovation across industries and countries (Becerra, 2017). This can be termed as the Fourth Industrial revolution (Audenhove, Korn, & Smith, 2018).

The transformation in the term: transportation to mobility, can be referred to as the transportation service which is responsive to the user and societal travel needs and preferences (Kamargianni, Li, Matyas, & Schafer, 2016). Emerging new mobility services are offering a complete travel package with personalized services which are being supported by certain set of commuters (Audenhove F. J., Korniichuk, Dauby, & Pourbaix, 2014). The rapid expansion of shared mobility across cities could probably slow down the rate of car growth but not stop it (Heineke & Moller, 2017). These services are assisted by smart transportation systems, digitization, online ticketing and payment, new business models, and innovative services (Spulberg, Dennis, Wallace, & Schultz, 2016). New mobility services permit users to gain short-term access to different modes of transportation 'when needed' and typically 'shared' by other commuters. In this system, the modes of transportation (like car, bike except for public transportation) is usually lent/leased by the service provider and borrowed by the user, which is termed as Mobility-as-a-Service (MaaS) (Spulberg, Dennis, Wallace, & Schultz, 2016). It's a novel concept without a concrete definition. Car rental, car sharing, bike sharing, ride-hailing, ride sharing is often considered as new mobility services. These services intend to reduce the use of private car or car ownership and lower traffic. Some definitions of MaaS are:

"Mobility as a Service (MaaS – a system, in which a comprehensive range of mobility services are provided to customers by mobility operators" (Heikkilä, 2014)

"Mobility as a Service (MaaS) puts users, both travelers and goods, at the core of transport services, offering them tailor-made mobility solutions based on their individual needs. This means that, for the first time, easy access to the most appropriate transport mode or service will be included in a bundle of flexible travel service options for end users" (MaaS Alliance, 2015)

Mobility-as-a-Service (MaaS) integrates multiple options like transport-planning, real-time traffic data, payment under a single digital platform, and permitting the user to customize the journey with or without a subscription thereby, encouraging users to rely on mobility services instead of privately owned vehicles (Cooper, 2015).

Besides MaaS, another mobility term which is immensely used is *Combined Mobility Services (CMS).* In the article *Mobility-as-a-Service: Describing the framework* (Holmberg, Collado, Sarasini, & Williander, 2016) CMS is being considered as a part MaaS which includes the services of public transportation in combination with other modes.

Prior to the detailed discussion on combined mobility services and its link to the integration of shared parking and public transportation in a broader perspective, introduction to sharing economy is presented.

2.1. Sharing Economy

Some of the globally trending companies like Airbnb (house sharing), Uber (ride sharing) and many more are recognized under the model of sharing economy, where customer's resources are shared with other users for certain time frame and price (Fellånder, Ingram, & Teigland, 2015). These models are believed to be altering lifestyle and consumption behavior. The evolution in digital technology has unlocked sharing businesses with least investments and making way to sharing economy (also called as *Collaborative consumption)* which has been mentioned in the book "*What's mine is yours"* (Botsman, 2011).

Sharing economy can be defined as peer-to-peer sharing of resources (goods and services) in regional or global contexts (Fellånder, Ingram, & Teigland, 2015). Usually the exchange or sharing is facilitated via digital application, which are believed to be faster and economical from customer's and service provider perspective (Fellander, Ingram, & Teigland, 2015).

Developing sharing business models has potential advantages from an organization and environmental prospect, explicitly in urbanization aspect, which is being experienced by most of the growing cities. These are driven by interests from market imperfections, environmental policies to increasing demand for sustainable solutions from private, public stakeholders and consumers (Cohen & Kietzmann, 2014).

Three key factors that are encouraging to adopt these business models are the ability to share/access the goods on will, generate economic value with less investment, and collaborative approach that is leading to trust, social value and efficient resource use (Cohen & Kietzmann, 2014). Transportation is one of the key sectors to incorporate the sharing economy business model. The reason is rapid urbanization, increasing traffic, emissions and incapability of existing business models to solve the problems (Cohen & Kietzmann, 2014). According to the International Transport forum (2015), a typical car lies almost 23 hours idle which signifies the inefficient use of car and mobility infrastructure. This underutilized resource has the potential to provide new services, tackle the externalities caused by transportation and improve the efficiency of transportation infrastructure (Shaheen, Chan, Bansal, & Cohen, 2015).

One of the researches predict that the shared mobility market could reach a global worth of 20 billion euros by 2025 (Roland Berger, 2014) further stating, the market is expected to expand 20-30% annually. In addition to the emergence of mobility services by third party providers, the car manufacturers are eyeing to capture the MaaS market by introducing and investing in various mobility services (Vine & Polak, 2015). However, International transport forum (2015) illustrates that the current market of shared mobility is marginal even with 2 million users worldwide. With the fluctuating market and influx of various mobility services, it is essential to protect the consumers, investors, and market. Therefore, a flexible but robust legislation is recommended to meet the societal challenges and uncertainties (International Transport Forum, 2015).

2.2. Combined Mobility Service (CMS)

In simple terms, integration of various mobility services into a common digital platform can be termed as Combined Mobility Service (Brenden, Homberg, Smith, & Laurell, 2018). In CMS, public transportation play key role in integration with other mobility means (car, bike, ferry, tram etc.) and additional services (payment, real-time traffic data, parking, incentives etc.) which is depicted as a cohesive unit in one digital platform, also enabling the users to customize their journey (Kesteren, 2016).

Most of the current transportation services are offered independently via several channels, where the commuters must gather information from different channels, plan and combine the itinerary (Beutel, Gökay, & Kluth, 2014). To create a better environment for the commuters, it is important for them to have the authority to plan prior to their trip in one platform or channel. And also providing the accessibility of combined services in one ticket (Beutel, Gökay, & Kluth, 2014). Integration of multiple modes unlocks an opportunity to attract users towards public transport with access to car and bike pools in a simple and effortless way. Progressive introduction of additional services along with transportation could attract more travelers, thereby resulting in the reduction of driving own cars, which would create positive impact on the society (Holmberg & Brenden, 2018).

In certain European Cities, the combined mobility is offered in the form of ‘Park & Ride’, where the drivers can park at dedicated parking spaces and continue their journey by public transportation (Dijk & Parkhust, 2014). Parking spaces are often situated closer to the public

transit facilities and outside the city center (Dijk & Parkhust, 2014). The scheme aims to reduce the congestion in city centers and energy consumption by allowing the car users of all category to park at distance. However, the acceptability, depends on the location which connect the drivers and public transportation (Danilina & Slepnev, 2018), relative time and travel cost savings (Dijk & Parkhust, 2014) but offers an option to avoid driving in congestion. The proposed hypothesis sounds similar to park and ride scheme, but here the parking facility is provided in private space by sharing.

To implement combined mobility services into the current transportation system, a paper (Sochor, Sarasini, Arby, & Karlsson, 2017) proposes a topological approach identifying multiple levels of integration as per the figure 4. The MaaS topology has five levels from 0 to 4. The first level (level 0) indicates a mobility service run independently without integration of any information or services. Here individuals choose different mobility services under different channels without an interconnection between mobility operators. Few examples could be free floating taxi or car sharing services (Sochor, Sarasini, Arby, & Karlsson, 2017). One could argue this type of service exist from long time. But they seem interesting only if they can attract private car users to use their product which can result in some form of environmental sustainability. One aspect could be, this free-floating service provides accessibility to wide range of locations improving social sustainability (Sochor, Sarasini, Arby, & Karlsson, 2017)

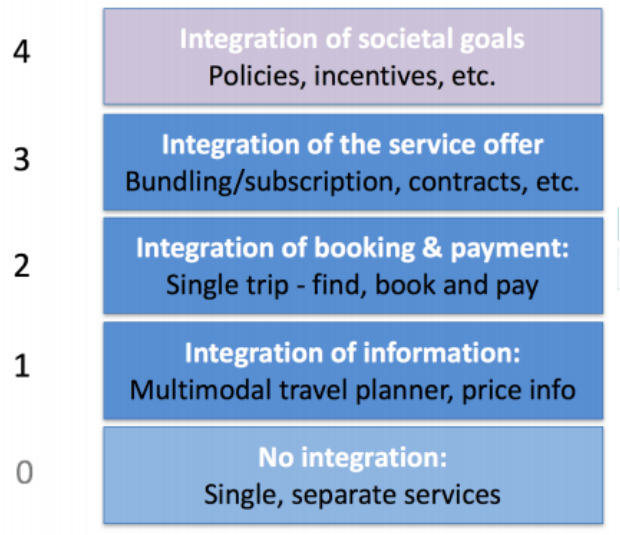

Figure 4: Levels of MaaS Integration (Sochor, Sarasini, Arby, & Karlsson, 2017)

Level 1 (Sochor, Sarasini, Arby, & Karlsson, 2017):
This level refers to the integration of travel information based on single trips. The information refers to the transportation from one place to another with detailed information on mode, time and route. This can be termed as multimodal travel planner which is centrally controlled. Travel planning applications are funded by advertisements or by tax money. The information flow is open and free to access to the public. Thus, they have users over customers (Sochor, Sarasini, Arby, & Karlsson, 2017).

The user travel data is crucial, information like travel planning, cost and booking option are collected by forwarding the user to the relevant service provider site (e.g. Google, Sky scanner etc.). The service of Level one operator is limited to forwarding the user to respective sites based on their travel needs and will not be responsible for their service quality and structure (Sochor, Sarasini, Arby, & Karlsson, 2017).

Level 2 (Sochor, Sarasini, Arby, & Karlsson, 2017):
This level can be regarded as an extension of level one service, as it includes services like booking and paying online. However, this service is possible due to the collaboration between level one and level two operators in order to guide the user and provide them with necessary options (Sochor, Sarasini, Arby, & Karlsson, 2017). The travel options include public transportation ticketing, taxi, bike booking or other transport modes if possible, where the customers can reserve and pay online for the preferred travel service. Individual services like car sharing, might attract certain set of users but not attractive enough to reduce car ownership.

The level 2 service providers usually will not take responsibility for the quality of service but just booking and payment to access the service. Their revenue would depend on the commission during booking and contract with suppliers. In addition, the data collected regarding user behavior might bring more revenue by selling it to traffic planners and decision makers (Sochor, Sarasini, Arby, & Karlsson, 2017).

Level 3 (Sochor, Sarasini, Arby, & Karlsson, 2017):
This level integrates the services from multi-modal transportation providers under one roof. The purpose of this integration of multimodal services is to provide comprehensive mobility service to the customer and aims to discourage car ownership. Overall, the service aims to meet the daily travel needs of customers with the ability to choose different modes, book and pay online via one application (Sochor, Sarasini, Arby, & Karlsson, 2017). The operator provides the option to communicate about the services from supplier and customer perspective in order to improve overall quality throughout the supply chain. Service is usually offered by subscription-based models with mutual agreement usually on a monthly basis (Sochor, Sarasini, Arby, & Karlsson, 2017).

Mobility-as-a-Service or Combined mobility belongs to Level 3. The Swedish roadmap focus on the level 3 services to promote integrated transport services and prepare them for the next level (Brenden, Homberg, Smith, & Laurell, 2018). The service operator works in close connection with the supplier as in order to design the efficient supply system and balance the demand and supply in the market, therefore create value to the supply chain (Sochor, Sarasini, Arby, & Karlsson, 2017).

The combined travel services operating at level 3 are attributed as “1) is attractive to customers in terms of flexibility, convenience and cost; 2) may be a viable alternative to private car ownership; 3) may encourage a shift towards more sustainable modes of travel such as public transport” (Sochor, Karlsson, & Strömberg, 2016).

Level 4 (Sochor, Sarasini, Arby, & Karlsson, 2017):
With level 3 operators this level integrates societal and sustainability objectives. The goals like reducing car ownership, congestion and emission can be applied to any type of mobility service provider. However, the key factor would be how well the societal goals of the local/national region are harmonized with the mobility service.

The regional goals are controlled and influenced by local / regional / national policymakers. Therefore, the development of new mobility services is often influenced by these actors. To achieve the desired sustainability goals in a society, the compatible conditions must be created that favors mobility services which can then influence the change in travel behavior with a balanced supply of resources and incentives. Two influential public authorities are, who plan the urban infrastructure and public transport provider (Sochor, Sarasini, Arby, & Karlsson, 2017). Considering the power and influence of these public actors in the future development of the city, it is crucial to collaborate with these actors in order to meet the societal goals. Public transportation as the backbone of city transportation (Falt, 2017), continues to be a monopoly in this sector and tries to attract new customers to use these services. However, a Level 3 operator may cooperate to provide last-mile solutions. Similarly, by sharing non-sensitive data like customer behavior, resource availability with city traffic planners (Sochor, Sarasini, Arby, & Karlsson, 2017), for example from parking perspective: the necessity of building new parking spaces can be reduced by utilizing the data of existing parking infrastructure, occupancy and parking behavior.

2.3. Parking

Parking is a key dimension in urban development, perhaps a link between urban planning and transportation (Marsden G. , 2006). Traditional parking systems were designed by enforcing minimum parking requirements (Scheepers & V, 2017). But this approach is considered as inefficient as it causes the excessive supply of parking lots which in turn results in the large use of cars, reduced occupancy in public transportation, inefficient land use, also affecting urban sustainability. The aim of providing parking is influenced by urban policy, which facilitates strong economic incentive to design efficient transport infrastructure, better accessibility, congestion free movement and safety (Marsden G. , 2006).

Building parking lots are expensive, and a driver always pays for the parking (Litman, 2018) although sometimes parking is offered for free, they are subsidized and often act as hidden costs (Shoup D. , 1997). The wide range of transportation systems, cost and mobility services often dominate the importance of where the trip starts and ends, also sometimes failing to consider the cost associated with parking. The design of the parking systems often influences the urban commuters and their mode of the transportation system. Certain research states that the traffic level varies from 8-74% while searching for parking, which takes between 3.5 to 14 minutes (Shoup D. , 2006). Thus, charging directly from the user could reduce demand for parking, congestion, and building of parking spaces (Litman, 2018).

According to the report in *Parking policy and urban goals* (Mcshane & Meyer, 1982) the parking policies should support the development of urban areas to achieving certain results: efficient utilization of land, transportation and other public amenities, easy movement and accessibility in the city, sustainable economic and societal development, attractive neighborhood, and reduced congestion and emission. Several parking strategies have been implemented across major cities to reduce car use. Some of them are shared parking, strict parking regulations, high parking pricing, development of cycling and walking infrastructure, and smart parking (Litman, 2018). Out of which, shared parking is emerging as a key parking management tool to improve parking efficiency and reduce the demand for building new ones (Litman, 2009).

2.4. Shared Parking

To eliminate the inherent problems of parking, along with the implementation of parking strategies in the city, shared parking would play an important role in the mixed land use and efficient utilization of parking. Shared parking was first studied by Urban Land Institute in 1981 (Scheepers & V, 2017). The study was motivated by the initial observation of mixed land use which required a lower number of parking spaces in comparison with standalone requirements.

Shared parking is a parking management tool to optimize the utilization of parking (Litman, 2009). This tool enables the private parking owners to rent their parking spaces to the public when not in use. *"Private parking owners drive their car out to work in the morning and will be back in the evening, which makes their private parking slots idle during their out time. These idle slots can be efficiently utilized to satisfy the parking demand of other drivers with flexible schedules for non-work activities (ex, shopping, leisure etc.)* (Xiao, Xu, & Gao, 2017). This strategy allows the private car users to access certain parking places which were not accessible before.

Similar to vehicle transport, parking experience high and low demands depending on the land use and location (Litman, 2009). For example, the parking at workplaces are usually in high demand during the day and low in the evenings and vice versa in case of residential parking. This pattern provides the opportunity for urban commuters to park their car in the shared space without demanding a dedicated space in the city (Kodransky M. , 2012). A study by Litman (2009) suggests that shared parking would reduce the parking demand by 10-30% when applied with parking strategies and when applied alone it would reduce the parking requirement by 10%.

In line with sharing economy model, sharing of parking space includes various dimensions. The current model of on-street parking is often shared among many car users for a specific period (VTPI, 2015). Business centers and commercial places have the model of sharing parking spaces among their employees and customers respectively. In some residential buildings, the off-street parking is shared among the residents, in addition, one or two spaces are usually reserved for visitors. Applying shared parking model to residential buildings is a unique concept which often needs permission from the tenants and building companies (VTPI, 2015).

Hypothetically, implementation of shared parking would contain a contractual agreement between the tenant (one who rents out the parking space), residential company, and public (multiple users).

However, the agreement must comply with municipal transportation regulations for future transportation purposes. The shared parking space must be open to the public (Kodransky, 2014). The regulations must state the rules to access the parking space, which would be possible only during off-peak hours with the owner's permission at certain pre-determined costs. The agreement between the developers and parking owners ensures the genuine functioning of the system stating the parking charges based on the facilities and location. Further, the contract clarifies the maintenance responsibility, safety for all the parties, regulations, taxes, applicable additional services and so on (Preiss & Shapiro, 2002).

In the process of sharing of parking, the time availability and reasonable price are key factors (Xiao, Xu, & Gao, 2017). The reason is, the public parking is owned and operated by local municipality, who sets a uniform price and without the provision of reservation. In case of shared parking, however, they are usually handled by the third-party providers who handle the transaction. The parking owner just provide the parking availability and price details, after which, the third-party provider assigns the parking to the driver who's in need of one (Xiao, Xu, & Gao, 2017).

Shared parking applications are raising in high congestion cities in Europe (Schonberg, 2016) and China (Xiao, Xu, & Gao, 2017). In some of the Chinese cities like Beijing, shared parking regulations are issued to the public, where the parking belonging to government, public offices, private institutions, commercial centers can share with the public (Xiao, Xu, & Gao, 2017). Another research claims that the shared parking market could increase by 25% by 2020, projecting a revenue of $1.9 Billion (Schonberg, 2016).

2.4.1. Combination of Shared Parking and Public Transportation

With the vast expansion of public transportation services in the last several years, still, the car is evaluated as more valuable than other modes of transport (Steg, 2003). Therefore, urban planners are developing strategies to reduce car trips and encourage the commuters to shift towards alternate modes of transportation such as public transportation, cycling, and walking.

Similar to park-and-ride scheme, the study of a unique concept: sharing parking in combination with public transportation can allow the private car users with the provision of parking their car in the shared space and continue their journey using public transportation.

This combination hypothetically offers the following benefits:
1. Efficient utilization of residential parking space
2. Encouraging car users to travel using public transportation
3. Easy availability of parking space reduces cruising in the City
4. Reduced time and fuel
5. Reduction of traffic and emissions caused by the car.

This disrupting concept of shared parking could be considered as a win-win situation for commuters and parking owners (Elaidi, 2015). The evolution of digital platform provides an

opportunity for parking owners to generate economic value by sharing the space during idle conditions. Private car users spend a substantial amount of time in the road causing traffic and emissions, while searching parking spot (Litman T. , 2009). Henceforth, this sharing model could enable them to find an affordable parking spot easily and quickly through the smartphone and reserve it online prior to their travel. Therefore, the same time which will be spent on searching parking can be used to switch the transport mode to buses or trams and continue the travel.

The international institute of public transport (Certfontaine, 2011) states that the public transport as the backbone of city transport donning the role of aggregator, surrounded by shared mobility services is the only way to compete with private car ownership. The role of public transportation is to provide affordable mobility service to the public and reduce the externalities caused by private cars or other mobility options by providing mass transit services (Holmberg, Collado, Sarasini, & Williander, 2016). One of the reasons for public transportation to collaborate with shared mobility services is that the combined service can facilitate flexible and multi-modal mobility service. Further, this could attract commuters who use cars to partially share their journey in public transportation, who would've completed the whole journey by car otherwise.

2.5. Road Transportation Goals

European Union in collaboration with national and local administrations are working towards establishing a sustainable transportation agenda and network (European Union, 2017). The main aspect of that collaboration is to develop a transportation network that is sustainable, energy efficient, economic and environmental friendly.

Similarly, the Swedish Government has designed a framework to deal with climate issues based on technological, social, economic and environmental factors. The ambitious target is to have zero net greenhouse gas emissions by 2045 and should have negative emissions in subsequent years (Romson A. , 2017). The successful transformation and development of the society involves collaboration and participation of all actors, shared responsibility and exchange of knowledge from regional to national level. The transportation network in Sweden is considerably well designed and aiming to further reduce the transport-oriented emissions. The goal is to reduce 80% of fossil fuel use by 2030 compared to 2010 which will result in the reduction of 60% of carbon emissions from the transport sector (Goldmann, 2015). To achieve the ambitious goals, the initiative includes incentives to shift the transport behavior, promotion of public transportation, alternative fuels, electrification, and taxation (Romson, 2016).

Several platforms and alliances have been formed between public, private actors, academic institutions and municipalities of Sweden on national and regional level (European Commission, 2017). The second largest City of Sweden, Gothenburg has relatable Climate 2030 goals too, which aspires to be the frontrunner to abate the greenhouse gas emissions with innovative strategies and technological developments (City of Gothenburg, 2014). The long-term goals are the result of partnerships between private, public organizations, academia, research centers, public, and City administration. The Climate plan aims to achieve long-term 2050 targets through

reaching smaller targets set for the years 2020, 2030, 2035 and 2050 (City of Gothenburg, 2014). The intermediate objective which is in accordance with City Environmental plan keeps the track of City's development to reach the final goal.

Transportation in Gothenburg is one of the energy-intensive sectors, which accounts to over a quarter of City's greenhouse gas emissions and one-third of carbon emissions (City of Gothenburg, 2014). Out of which the road transport is a major contributor and the City aims to reduce 80% of carbon-dioxide emissions from road traffic by 2030. To reach the target, 25% of the traffic level needs to be curbed, irrespective of the population influx (City of Gothenburg, 2014).

Along with the goal to curb traffic and emissions, the goal is to have long-term stability in transportation. To anchor the societal transformation from car use to more sustainable travel, the framework (City of Gothenburg, 2014) highlights the need for the alternative modes of transportation like mass transit, walking, and cycling. The current urban planning laws propose the encouragement of these transport modes also in the development of new neighborhoods. With an expectation of an influx of more than 150,000 residents in Gothenburg by 2035 (City of Gothenburg, 2016), mass transit seems to be economical and sustainable (UITP, 2016). Investments in efficient public transportation and easy accessibility are crucial in achieving Climate targets. According to the statistics (Trafikanalys, 2017), public transportation use surged by 4.3% between 2015-2016, with an average boarding of 156 per person. Stockholm recorded 365 boarding/person/year whereas Gothenburg recorded only 186 boardings. The stats illustrate the disparity in boardings between Stockholm and Gothenburg which means the need to rethink the transportation system with new regulations and combined services to motivate the modal shift towards public transportation.

2.5.1. Parking in Gothenburg

Parking policies in Sweden were formulated around the 1950s when urbanization and demand for dedicated car space began (Ekelund, 2014). Subsequently, car travel increased, leading to congestion and safety of the car was the main challenge which further demanded new policies (Lundin, 2014). The policies were designed to adopt a growing demand of households with dedicated space for parking and well-planned road infrastructure.

Municipalities have begun to redesign the parking policies to complement the transportation goals. The existing policies of Gothenburg state that its goal is to make the City attractive and available for everyone with sustainable development. The policy encourages the use of public transportat ion over car (Stadsbyggnadskontoret, 2009).

The recently updated parking policy is designed in the presence of stakeholders from City planning, traffic office, and Fastighetskontoret (Stadsbyggnadskotoret, 2018). It focuses on flexible parking rates, combined mobility services, reduction of car use and promotion of pedestrian and walking friendly infrastructure. Further, the number of parking allocation in upcoming buildings will be based on the area requirement which will avoid the unnecessary use

of a car (Stadsbyggnadskotoret, 2018). Therefore, the policy adopts new methodologies to study the parking necessities in a specific area, based on the supply and demand in the respective locality. However, the ideal plan is to allocate the least number of car parking with accessibility for disabled and dedicated space for loading and unloading of goods (Stadsbyggnadskotoret, 2018).

In the upcoming building projects, the building committee, traffic office, City planners and other parties will decide the number of parking spaces which will depend on the mobility solution offered by the property owner. In the existing buildings, the new study will propose a revised parking and mobility solution which will be adopted with detailed study. The mobility solution includes the accessibility parameters to public transportation, bike facility, carpool, electric charging etc. (Stadsbyggnadskotoret, 2018).

The parking norms are applied depending on the location of the building in the City. The City of Gothenburg is divided into three regions and parking numbers are allocated as shown in the following (Stadsbyggnadskotoret, 2018).
Region A: Inner City (Red): 0.2 to 0.5
Region B: Priority development area (Orange): 0.3 to 0.6
Region C: Between City (Yellow-ish): 0.4 to 0.8

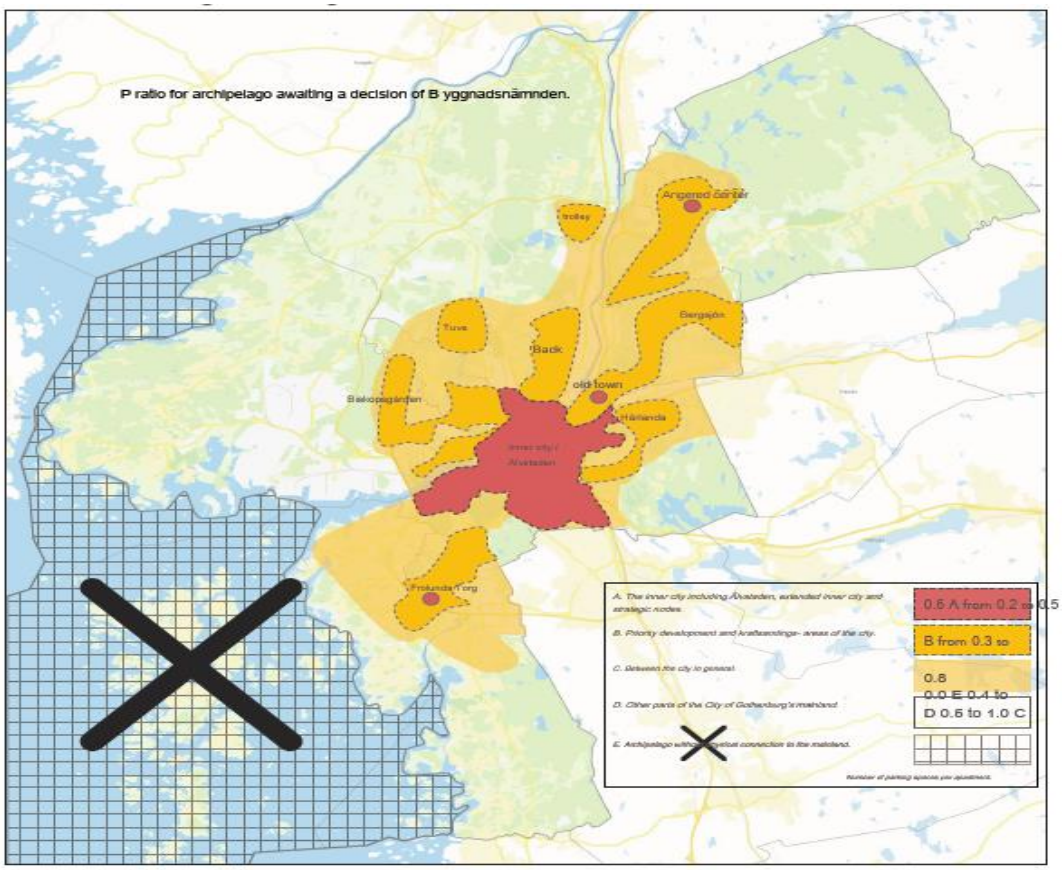

Figure 13: Geographical boundaries applied as per parking policy (Stadsbyggnadskotoret, 2018)

The amount of car parking and mobility solutions for a specific project will be decided based on the project location and project type: business, trade and residential (Stadsbyggnadskotoret, 2018). Initially, an investigation will be carried out by the building committee regarding the existing mobility options and answers to what extent it is possible to reside, work without owning a car. And the next stage optimizes the number of parking space for the users depending on the apartment type, visitors and neighboring parking availability. A solution will be sought for co-usage of parking, which will reduce the number than planned and a further decision will be made to charge only the user. Finally, the mobility measures will be decided that aims at adopting sustainable travel measures to create a transition in travel behavior (Stadsbyggnadskotoret, 2018)

The parking numbers which are decided based on different regions signify their existing and future developments. Region A includes the inner city, River city, and strategic hubs. These areas are projected to be highly densified in the upcoming years with several development projects (Stadsbyggnadskotoret, 2018). Therefore, the City planners aim to reduce the parking space in the central Gothenburg and utilize it for the development of urban infrastructure. The region B comprises the potential areas for future developments. The future growth will focus compact development of the City. When the urban development in region A reaches saturation level, the urban pressures will be gradually navigated towards Region B and C. However, the immediate effect will be on B. The final one Region C comprises the rest of the Gothenburg which shall see modern planning and latest infrastructure to meet sustainable criteria: economy, ecological and social (Stadsbyggnadskotoret, 2018).

The key point in the recent parking policy is adopting innovative mobility solutions with flexibility in parking which means the number of parking spaces can vary depending upon apartment size, location, and mobility options. Accordingly, the following numbers are proposed (Stadsbyggnadskontoret, 2017):

For region A

Size of apartment	1 room	2 room	3 room	4 room	5+ room
Parking number	0-0.2	0-0.3	0.2-0.6	0.3-0.7	0.5-0.8

For Region B

Size of apartment	1 room	2 room	3 room	4 room	5+ room
Parking number	0-0.2	0.1-0.5	0.3-0.7	0.4-0.8	0.5-1

For Region C

Size of apartment	1 room	2 room	3 room	4 room	5+ room
Parking number	0.1-0.5	0.3-0.6	0.4-0.7	0.5-1	0.6-1.2

Table 6: Proposed parking number in relation to the apartment size (Stadsbyggnadskontoret, 2017)

Special attention has been given for bicycle parking, to promote sustainable travel. Therefore, an average apartment will have 2 bicycle parking and 0.5 for the visitor (Stadsbyggnadskotoret, 2018). Supporting this, bicycle parking are built next to the bus/tram stops. The overall objective is to bring transition among urban commuters to adopt eco-friendly transportation.

3. THEORY

This section provides the theoretical principles that are applied in the research.

A transition or systemic transition can be defined as a radical transformation in socio-technical perspective from existing system towards a new system comprised of sustainable production and consumption (Smith, 2010). The transition can be applied in multiple sectors like transportation (Geels F. W., 2012), energy (Geels & Raven, 2006), food (Ramos-Mejia & Franco-Gracia, 2018), and other societal services (Geels F. W., 2006b) that are concerned to climate change. The transition is usually associated with:

- “Certain level of systematic transformation which influence technological, infrastructural, social, economic, environmental, cultural and institutional aspects of societal systems and sub-systems that are interdependent and influence each other in every step” (Kohler & al, 2009).
- "The structural change in societal systems, that occur through incremental and long-term processes” (Rotman, Kemp, & Asselt, 2001).
- “The different actors from various societal systems interact and co-operate to bring about change. Nevertheless, conflicts arise, which must be resolved during the process” (Smith & Sterling, 2008).
- “A secure and sustainable societal system can be established by reconfiguring the cognitive, normative and political framework” (Geels F. W., 2005).

The systemic transitions are a complex process which involves co-evolution among network and reinforcement of new systems in existing technological, cultural, institutional and behavioral inertia (Geels F. W., 2005). This kind of transition is necessary for the transportation sector because of the current problems such as the need of personal mobility has given rise to car dominated society causing congestion, low air quality, accidents, and energy security, there is higher interest in transition. (Geels, Kemp, Dudley, & Lyons, 2012). For a sustainable change, a disruptive innovation is needed which could challenge the status quo and bring radical change towards new socio-technical system that are characterized with sustainability and energy efficiency (Burrows, Bradburn, & Cohen, 2015).

Different scholars identify four transition theories: Technological innovation (Bergek, Jacobsson, Carlsson, Lindmark, & Rickne, 2007), Multi-level perspective (Geels F. W., 2002), Niche management (Kemp, Schot, & Hoogma, 1998), and transition management (Loorbach D. , 2010). The common approach among all these theories is each deal with systemic changes towards sustainability at different societal levels like socio-technical systems, niche, and regimes, though using different techniques (Sarasini & Linder, 2017).

3.1. Multi-Level Perspectives (MLP)

This research draws the transition aspects from Multi-level perspectives, as it provides insights of opportunities for changes and barriers. MLP structure states that the transition occurs from close co-operation and information exchange between heterogeneous actors representing three analytical levels of the market: Socio-technical landscape, socio-technical regime, and niches (Elzen, Geels, & Green, 2004).

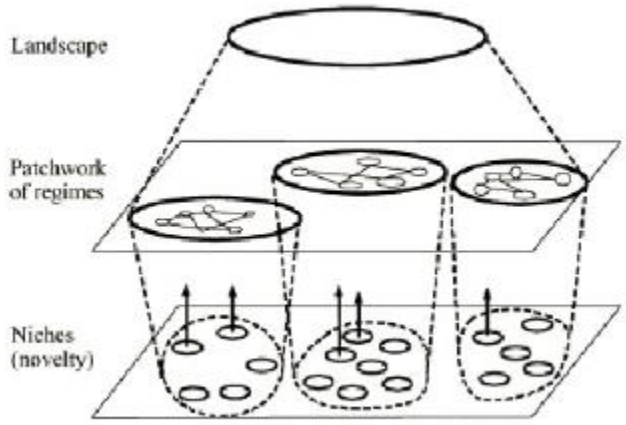

Figure 14: Levels of multilevel perspective theory (Geels F. W., 2005)

MLP is a heuristic means to examine the systemic transition. As shown in the above figure, the dynamics of transition is examined via three levels (Landscape, Regime and Niche) that exist in nested hierarchy (Geels F. W., 2005). Regime stands in between landscape and niche market. It offers various lock-ins which are the cause of barriers to the transition. The regime level is embedded with cognitive engineering practices (Nelson & Winter, 1982), directives (Unruh, 2000), policy, industry practices, user practices, institutions, culture, technology and various characteristics of social groups (Geels F. W., 2011) as shown in fig 7. Each actor or social group are characterized by certain features and inherit a certain level of freedom. But these groups or institutions in regime level are interdependent and overlap, based on certain activities (Geels F. W., 2004). The actors in this level resist the changes, and usually, they optimize their structure according to the availability of technology, policy, market, and behavior incrementally avoiding radical change (Geels F. W., 2002). This is due to their common principles and thoughts which disable them to think outside their preset beliefs, lifestyles, societal practices, and regulations. These lock-ins enable them to form a stable system that creates hinderance for the entry of new innovations, depreciating investments in infrastructures, machinery and human resources (Unruh, 2000). The incremental change and lock-ins are applicable to a range of actors like policymakers, social groups, engineers and political actors (Unruh, 2000), and technology, cultural groups, and industries (Geels F. W., 2011).

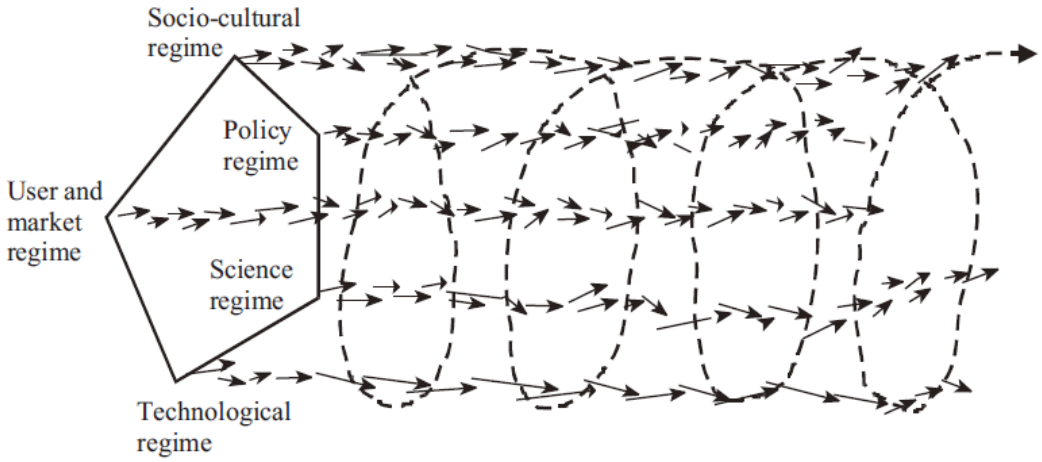

Figure 15: Cluster of the network at regime level (Geels F. W., 2011)

Niches are meant to generate radical innovations. Because they are shielded against the market inertia and societal lock-ins (Schot, 1998) and are incubated by entrepreneurs who seek changes in the market which are supported by subsidies. Entrepreneurs start off by experimenting and learning according to the market needs and user demands which is supported by several industrial actors. They need protection as they work against existing practices or regimes. Therefore, actors here learn and innovate their product/service in every step hoping to replace the existing practice in the regime (Geels F. W., 2011). It is, in fact, difficult to predict which innovation will eventually succeed, as they are usually complex and expensive. They gain momentum as their network of customers and stakeholders broadens (Geels F. W., 2002). But it's extremely difficult that it will gain market acceptance due to existing lock-ins without disagreements (Sterling, 2009), and user/societal benefits in terms of price and performance and economic incentives (Geels F. W., 2011).

The macro level is represented by the *landscape* which is wide and impacts the *regime* and *niche* (Geels F. W., 2005). This level influences the outlook of the society which includes urban infrastructure, economic inflation, political alliance, social values, and environmental problems like climate change, urbanization etc. They influence the socio-technical system from within or outside the societal level (Sarasini, Arby, Curtis, & Vanacore, 2017) but the radical change is almost impossible and typically stresses the regime which further needs longer time range to adapt to the new system (Kemp, Rip, & Schot, 2001).

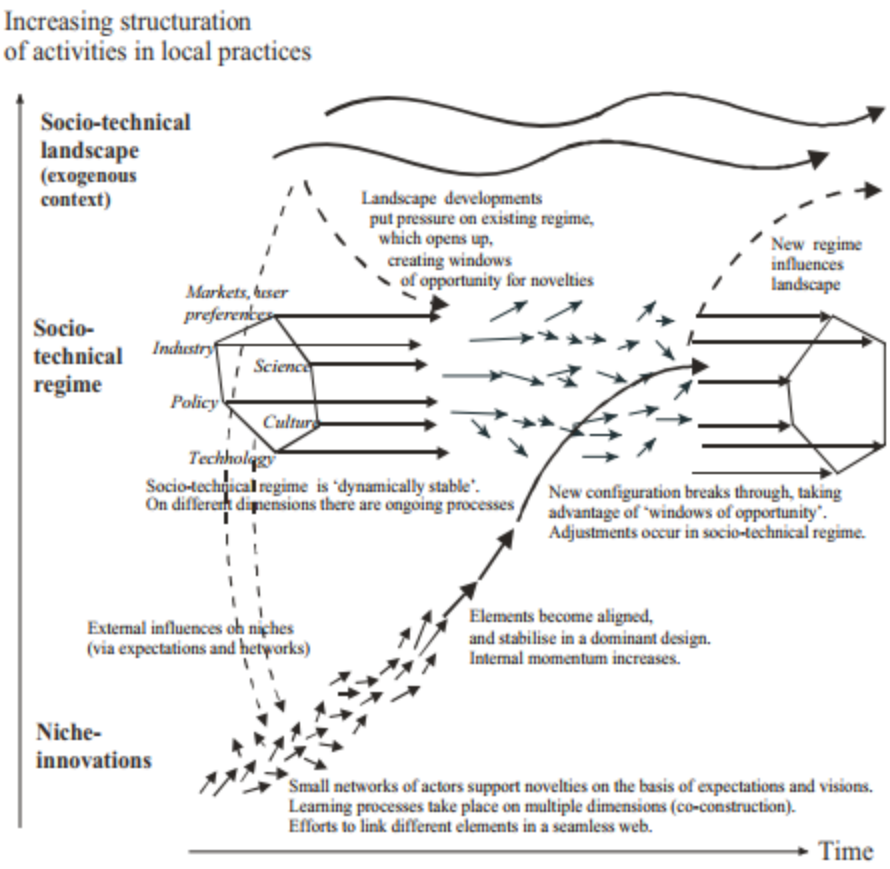

Figure 16: Dynamics of Multilevel perspective (Geels F. W., 2005)

The interplay between micro level (niche), meso level (regime), and macro level (landscape) market is crucial to bring innovation in the system (Geels F. W., 2005). The above figure displays how these three levels interact in a nested hierarchy which fosters the socio-technical transition in the market. The evolution of innovation from a niche level has the potential to break through the obstacles of the regime. However, when the regime actors feel the threat from the niche level, they align together with power and resources to resist the changes against their vested interests (Geels F. W., 2012). The landscape and niche level coordination lead to instability or internal tensions in regime level which then creates favorable conditions for radical innovation to emerge from niche. In literature this is usually termed as "Windows of opportunity" (Geels F. W., 2002). The tensions are represented by shorter arrows revealing uncertainties and divergent opinions. This tension unlatches the opportunity of creating a gateway for radical innovation resulting in niche technologies to enter the regime level. However, due to certain lock-ins and path dependence structure, these niche ideas face challenging time to expand the territory which also demands formidable changes in regulations and infrastructure (Geels F. W., 2012).

3.2. Backcasting Methodology

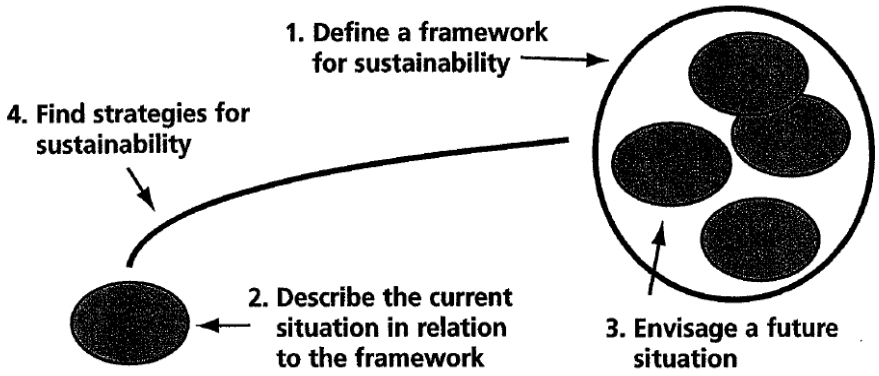

Figure 17: Backcasting process (Holmberg J. , 1998)

The path of transition towards sustainability must deal with traditional characters of the society such as uncertainties in user choices, market acceptability and regulations, which are complex to deal with (Holmberg J. , 1998). Therefore, Holmberg J (1998) suggests the need of system thinking to address complex and uncertain dynamics of society. This led to the rise of sustainability principles, which are applied in combination with backcasting for strategic planning of the future (Holmberg J. , 1998).

Backcasting (Figure 9) visualizes the desired future, then working backwards develops innovative strategies to create a change from the current state to the desired one. This approach is believed to bring changes in legislation and create new business opportunities in the market. The process maps the current and future condition considering sustainability aspects and possible risks in order to minimize the uncertainties (Holmberg J. , 1998). Therefore, the backcasting approach not only visualizes the future but also aids in developing strategies to reach the vision. Application of backcasting in transportation helps in addressing the existing conflicts and necessary measures to achieve the envisioned targets, thereby minimizing the respective externalities (Hojer & Mattson, 2000).

The process of backcasting involves the following steps (Holmberg J. , 1998) (Appendix):
1. Define a framework for sustainability
2. Examining the current situation with respect to sustainability criteria
3. Envisioning the future
4. Building strategies for the future

The backcasting principles suggest what should happen by recognizing the challenges of the future transportation system and propose the need for transition in societal behavior, policies and to achieve the target of sustainable mobility (Holmberg J. , 1998). In a way, the action plan and normative theory to achieve the target brings sustainable transition in the society which is similar to the concept of transition management, which itself acts as a tool to create a fundamental shift

in societal structure in terms of technology, culture, behavior, economy, environment, and policies (Loorbach D. , 2010). This transition shall be applicable to the society, public and private institutions and individual organizations.

3.3. Business Models

A business model articulates the process or design of how the product/service create, capture and deliver value to the consumers (Teece, 2010, Osterwalder & Pigneur, 2010). In one of the literatures the business model is defined as:

"A business model describes the design or architecture of the value creation, delivery and capture mechanisms employed. The essence of a business model is that it crystallizes customer needs and ability to pay, defines the manner by which the business enterprise responds to and delivers value to customers, entices customers to pay for value, and converts those payments to profit through the proper design and operation of the various elements of the value chain" (Teece, 2010, p.179)

The above definition describes that the traditional business models, that focus on how to create value and distribute them to the customer segments. The business model canvas designed by Osterwalder & Pigneur (2010) describes nine building blocks that are necessary for a business (Figure 10).

1. "Customer segments: Defines either one or several customer segments.
2. Value proposition: Value created and delivered to the customer to alleviate their pains and generate benefits.
3. Channels: Communication and distribution of values to the different customer segments.
4. Customer relationships: A healthy relationship with customer is important for profitable business.
5. Revenue streams: The cash a business generates from offered value propositions.
6. Key partners: Business partnerships, joint ventures developed to secure supply and demand
7. Key resources: Assets like finance, human, physical facilities are essential to create and deliver value to the right customer segment.
8. Key activities: Key actions like production, networking, designing etc., a business undertakes for successful operation.
9. Cost structure: Describes the financial model of cash inflow and profits". (Osterwalder & Pigneur, 2010)

The businesses which adopts creative strategies to deliver the right value to the right customer will be successful (Magretta, 2002) but only few companies have been successful (Anderson & Narus, 1998). This is common in emerging services which ignores the business outlook (Sochor, Sarasini, & Arby, 2017). Various approaches can be adopted by the businesses that leads to the value generation to the specific customer segment (Teece, 2010). Because the ultimate success of the business lies in the relation between the seller and customer, which create value for them. Most of the traditional businesses focus on monetary value, however, the trend is changing

towards the inclusion market competitiveness, buyer experience, market status, and social rewards (Aapaoja, Eckhardt, & Nykänen, 2017). For example: Uber delivers the car service and captures value in the form of fee from each transaction through their platform. Other mobility business like Ubigo, bundles the services from various service providers and repackage them to a single offer where the value is captured in accordance with agreement with service providers (Sochor, Sarasini, & Arby, 2017).

The traditional business models generally fail to consider the ways to capture sustainable values to their stakeholders while focusing only on monetary gains from end users (Sochor, Sarasini, & Arby, 2017). In the field of MaaS, where various stakeholders play key role in the development of the service, it is essential to also evaluate the value creation to the stakeholders by internalizing the environmental and social aspects.
Therefore, the next section describes Sustainable Business Model.

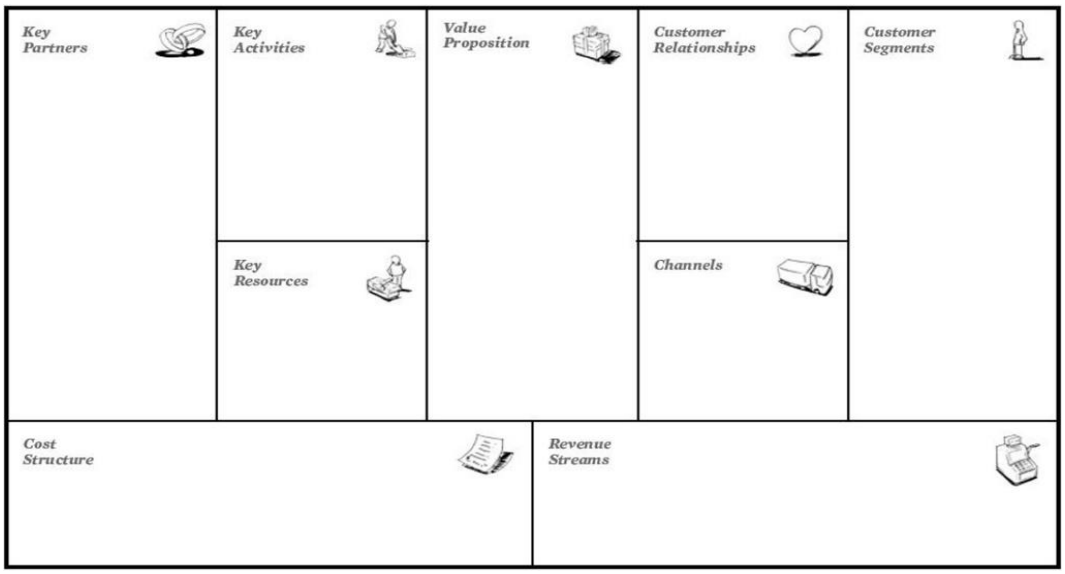

Figure 18: Business Model Canvas (Osterwalder & Pigneur, 2010)

3.3.1. Sustainable Business Model (SBM)

A business model which creates economic value for the organization and deliver customer needs with yielding benefits to the stakeholders, users, society and environment can be termed as Sustainable Business Model (SBM) (Herrador, Carvalho, & Feito, 2015). According to Schaltegger, Lüdeke-Freund, & Hansen (2012, p4), SBM is defined as their potential to integrate the sustainability principles into the business:

“A business model for sustainability helps [in] describing, analyzing, managing, and communicating (i) a company’s sustainable value proposition to its customers, and all other stakeholders, (ii) how it creates and delivers this value, (iii) and how it captures economic value while maintaining or regenerating natural, social, and economic capital beyond its organizational boundaries” (Schaltegger, Lüdeke-Freund, & Hansen, 2012)

And

"…a sustainable business model is one which is both sufficiently profitable and that results in a process of comparative absolute or relative reductions in environmental and socioeconomic burdens through the delivery of socially relevant products and services. Sustainability is not an absolute end-point, but rather an improvement process whereby future generations are progressively less prejudiced by contemporary practices" (Wells, 2016).

SBMs can be regarded as a type of normative business models with the set of sustainability norms which then be considered to resolve societal and environmental issues (Randles & Laasch, 2016). They are characterized to either negate the current externalities or create positive effects (Sochor, Sarasini, & Arby, 2017). For example: Uber collaborated with real estate company which shares the parking space with Uber carpool to optimize the space and reduces the car ownership among the residents in the respective building (Maximus, 2016).

Traditionally the value is captured by direct sales of product/service by assigning price which is paid by specific customer segement. The challenge is, the process of capturing sustainable values is unclear, especiallly when the market does not exist (Sochor, Sarasini, & Arby, 2017). However, when a public transport is subsidized by the public authorites to internalise the externalities, market does exist. Therefore, one can state that public transport is desinged with a financially feasible business model which essentially captures sustainable benefits through ticket sales. (Sochor, Sarasini, & Arby, 2017). Hence capturing sustainable value with economically viable model is challenging, when market does not exist . Some researchers argue that the sustainable value capture is possible indirectly (Sochor, Sarasini, & Arby, 2017), where in certain cases the financial performance could be low (Linder, Björkdahl, & Ljungberg, 2013) or directly by minimizing resources and costs (Porter & Linde, 1995). In either case, it is challeninging and individuals' choice to accept the product/service.

3.3.2. Value Proposition Canvas (VPC)

The core of any business is the value delivered by the product/service (Osterwalder & Pigneur, 2010). In the business model canvas, value proposition and customer segment can be considered as the core of the business. It illustrates what does the firm offer? What value does the product create for the users? To whom is the product intended for? The value proposition describes a set of characteristics of the product/service which when used, benefits the user delivering their needs and alleviating their problems (Osterwalder & Pigneur, 2010)

To understand the customer, Value Proposition Canvas (VPC) describes two components: Customer segment and Value proposition (Product/service profile) (Osterwalder & Pigneur, 2010). VPC can be applied to any organization that aims to develop a new product or re-design an existing one.

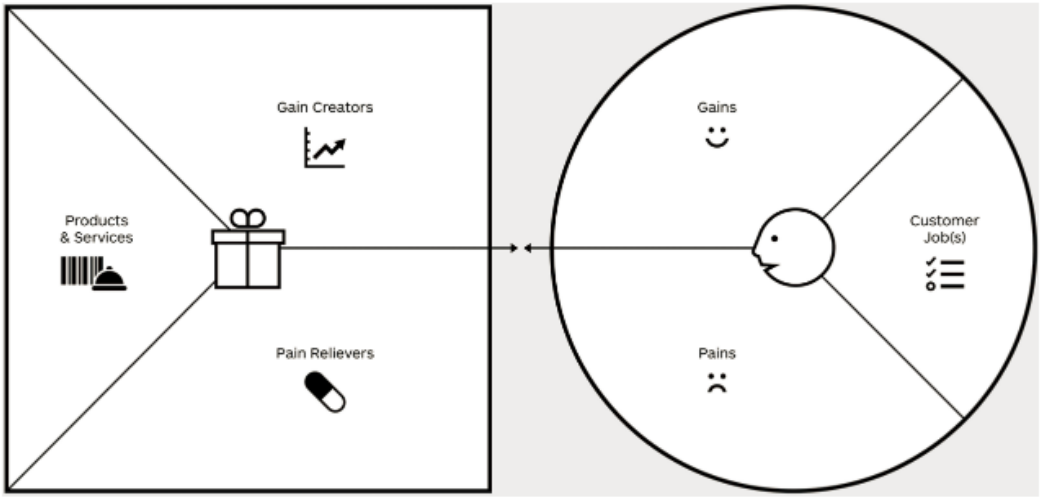

Figure 19: Value Proposition Canvas (Osterwalder & Pigneur, 2010)

The first step of designing a VPC is to identify the customer segment(s) which is on the right-hand side of the above diagram. A sole product/service can generate different benefits for different customer segments, therefore; it is effective to design the VPC for a diverse set of customer segments describing specific values they gain from the product/service. The customer profile is divided into three segments: jobs, pains, and gains (Osterwalder & Pigneur, 2010).

Customer job: This describes the tasks carried by the customer in their life. It could be the work they are completing, job to satisfy their needs, or trying to solve an issue. Job type could be functional, social or supporting (ex: traveling for work, shopping etc.). A single product can be used to perform multiple jobs (ex: A smartphone for calling, texting, ordering online, accessing media etc.) however, it depends on the context of the job done by the user (Osterwalder & Pigneur, 2010).

Customer pains: This refers to the challenges the customer face while performing a specific task. The pains could be risks, negative outcomes or negative emotions resulting from the job. Sometimes they face some obstacles that even prevent them from getting started with the task or slow down the progress of the job (Ex: congestion, stress while traveling) (Osterwalder & Pigneur, 2010).

Customer gains: Describes the benefits the customer desires in performing certain task. This could be functional, social, positive emotions and savings. While carrying certain tasks, the user expects some minimum benefits, but sometimes desires and expects more (ex: easy booking of services online, faster travel, reduced expenditure etc.) (Osterwalder & Pigneur, 2010).

The right-hand section provides a deeper understanding of the target user's needs, preferences and challenges. While evaluating the customers, it is important to list various factors in a broader perspective in each section and investigate the highly relevant ones for the product and rank those, starting from the most preferred ones. The left part of the VPC is a value proposition that

describes the value created by the product for the targeted customer segments. This has three sub-sections: Product/services, pain relievers and gain creators (Osterwalder & Pigneur, 2010).

Pain relievers: This section targets the important pains the users undergo before, during or after the job and describes how the product can alleviate their pains. This could be making their job easy, eliminating or reducing stress factor etc. (Ex: online delivery eliminates the need for travel) (Osterwalder & Pigneur, 2010).

Gain creators: This list the benefits the customer can receive from the proposed product/service. This addresses key benefits that are necessary for the customer to perform the job. Sometimes the product provides additional benefits which surprise the users. (Ex: cost savings, incentives on additional services, accessibility to a wide range of travel services under one platform etc.) (Osterwalder & Pigneur, 2010).

Similar to the customer segment, all the outlined features of the product in the value proposition canvas is ranked with the highest importance which addresses the prioritized user needs. The final step is to create a value fit between the product features and customer needs (Osterwalder & Pigneur, 2010). This is the crucial part of the process. The fit signifies how well the value proposition matches with the customer profile and is an iterative process.

Although, the final value fit (Figure 12) illustrates various features resolving the customer problems and providing necessary gains, in the real market the customers may not care about all the factors. Therefore, it is necessary to show the evidence what customers really care about. A prominent example of the value proposition is the value created by Uber, a multi-sided MaaS platform to its users (Uenlue, 2018). The stakeholders in their business are drivers, customers, technology partners, and investors. In their business, Uber relies on privately owned vehicles that are accessed by the commuters through a digital platform. For drivers, the value is an easy process to find users and earn money using their car or sharing it when it's idle. Further for riders, its hassle-free process to travel around without owning or driving a car (Uenlue, 2018). Finding a car to commute is never easy than now, which can be found in a click and the payment can be made online.

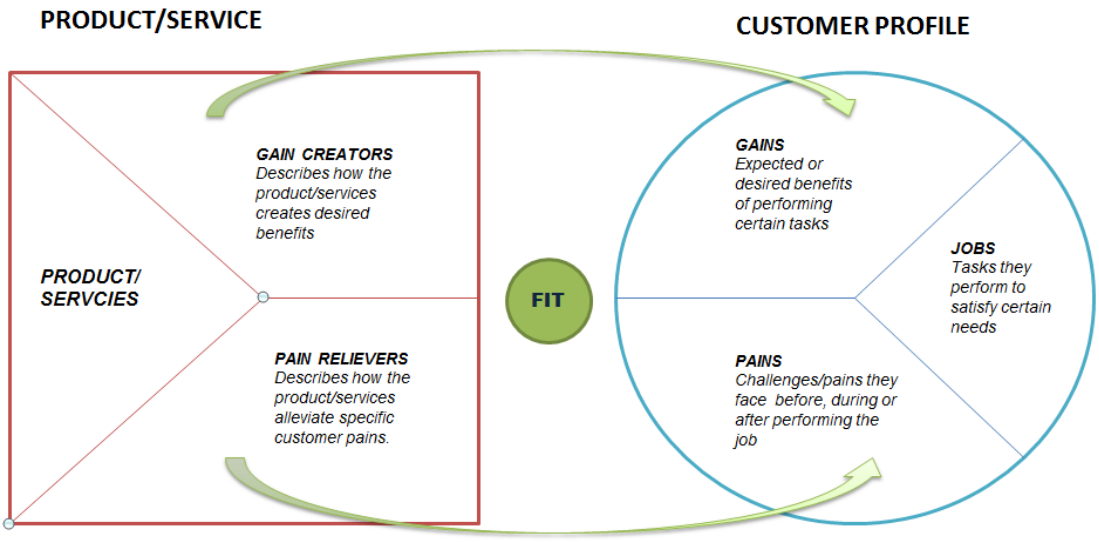

Figure 20: Value fit between product/service and customer profile (Osterwalder & Pigneur, 2010)

3.4. Synthesis of theories

(Refer figure 13: Synthesis between theories)

The recent developments in the field of mobility (like integrated mobility, shared mobility) can be attributed to bring transition in the field of transportation (Sarasini & Linder, 2017)). They are also perceived to target user behaviour and resource efficiency. Likewise, the proposed hypothesis (shared parking with public transportation) is believed to have similar characteristics which could result in systemic transition in the field of mobility.

Systemic transition in society refers to the shift from one socio-technical system towards a new system characterized with sustainability principles (Geels F. W., 2005). Backcasting and MLP approach are believed to play key role in evaluating the hypothesis. These theoretical approaches are broadly perceived as means to understand necessary sustainable developments in the society in relation to the existing climate challenges and evolving mobility practices (like shared mobility, MaaS etc.) (Geels F. W., 2005, Holmberg J. , 1998). The research draws insights from Multi-level perspectives (MLP) regarding the societal barriers for transition but also the opportunities created by the interaction between three analytical levels of MLP (Geels F. W., 2011). Existing socio-technical regime, which is the result of decades of semi-coherent rules when destabilize, due to landscape pressure creates “windows of opportunities” for niche innovations to flourish (Geels F. W., 2018). Niche innovations leads to successful system transition, when supported with sustainability principles (Smith, Stirling, & Berkhout, 2005) and precise vision (Geels F. W., 2011). This is particularly applicable when the transition system is complex, such as mobility or transportation. Hence, backcasting approach is applied to define the ‘vision’ which articulates the path of innovation to overcome the regime barriers.

Backcasting methodology further supports MLP in identifying current trends and unsustainable activities that are resistant to transitions (Holmberg J. , 1998). In addition, 'vision' designed by backcasting approach provides clear gap between 'future possibilities' and 'inertia in the current regime' that lead to innovation and efficient solutions (Holmberg J. , 1998). In context of this research, the essential transition is towards the detachment of private car ownership and motivating commuters to follow sustainable travel practice. Hence, backcasting is used in synthesis with MLP to propel the transition and the need of new mobility service in the future where the car-based personal mobility driven regime is no longer strong.

Therefore, for novel ideas (like MaaS) to diffuse into the existing regime, the transition could be the result of interaction between various innovations such as new business model and modifying user behaviour (Geels F. W., 2018). Mobility services are referred to innovate the business models to attract users to use the service than own cars. Therefore, in some cases, business model innovation acts as a tool to accelerate the diffusion of niche innovation resulting transitions (Sarasini & Linder, 2017).

Since the transition is guided by the sustainability principles towards the vision created by backcasting, each incremental step must be characterized with the creation of positive impacts or reduced externalities. Therefore, business model innovation is extended with the inclusion of 'environment' and 'society' as key stakeholder. This is termed as sustainable business model (Bocken N. M., Short, Rana, & Evan, 2014). In addition, Schaltegger (2012) states that business models which internalise environmental and social goals in the business objectives can create, capture and deliver the economic and sustainable value to the key stakeholders. Hence the features of sustainable business model are adopted with MLP and Backcasting, which could lead to radical innovation and justify the value proposition of the proposed mobility service.

Value proposition is one of the key elements of a successful business model (Sarasini, Arby, Curtis, & Vanacore, 2017). Therefore, this thesis use value proposition canvas as a tool to validate the value generated from the hypothesis with reference to the customer needs and preferences. Also, an effective tool to present the evidence of the value fit to key stakeholders for further investigation.

From the Business model perspective, the rest of the blocks are (re)structured based on the value creation and customer segments depicted in VPC. Using this, the business could move forward for testing the practical viability of the hypothesis and its relevance in meeting the 'vision'.

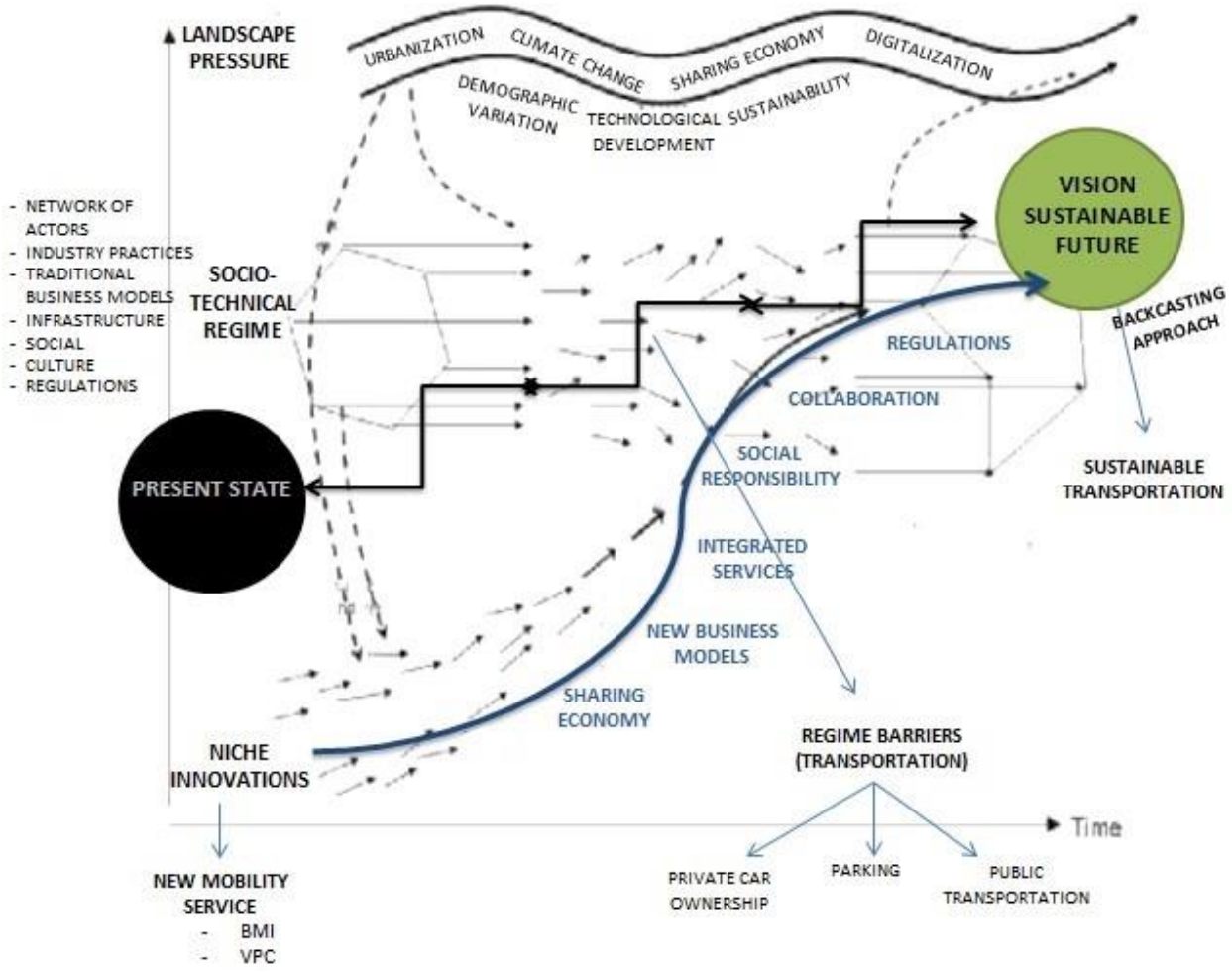

Figure 13: Synthesis of theories

4. METHODOLOGY

This section describes the methodological framework that is incorporated into the research to answer the research question. The qualitative research is often recognized to provide quality data about real situations and able to understand the certain behavior of people in a broader context (Dudovskiy, 2018). The purpose of the research is to study the feasibility of applying a shared economy model to the residential parking spaces termed as shared parking and integrate it with public transportation to encourage car users to adopt a sustainable travel. In the process of creating an evidence-based input to design a sustainable business model, initially, an in-depth literature review was carried to acquire a broad range of understanding on the research topic and theoretical aspect. Shared parking is a new addition to the shared economy business, has not been thoroughly studied or addressed in any literature. Thus, the literature that is closely linked to the research topic were reviewed. Further to generate the empirical data for designing VPC, the next step was data collection by document analysis, questionnaire, and semi-structured interviews. This means that collected data was later analyzed which led to the design of value proposition which illustrates how the concept can fulfill the user travel needs and preferences. Finally, to understand different stakeholder's perspectives a workshop was conducted which included the SWOT analysis (Strength, Weakness, Opportunities, and Threats) of the research topic. Altogether, the aim is to deliver a novel and consolidated perspective on emerging concept: shared parking in combination with public transportation.

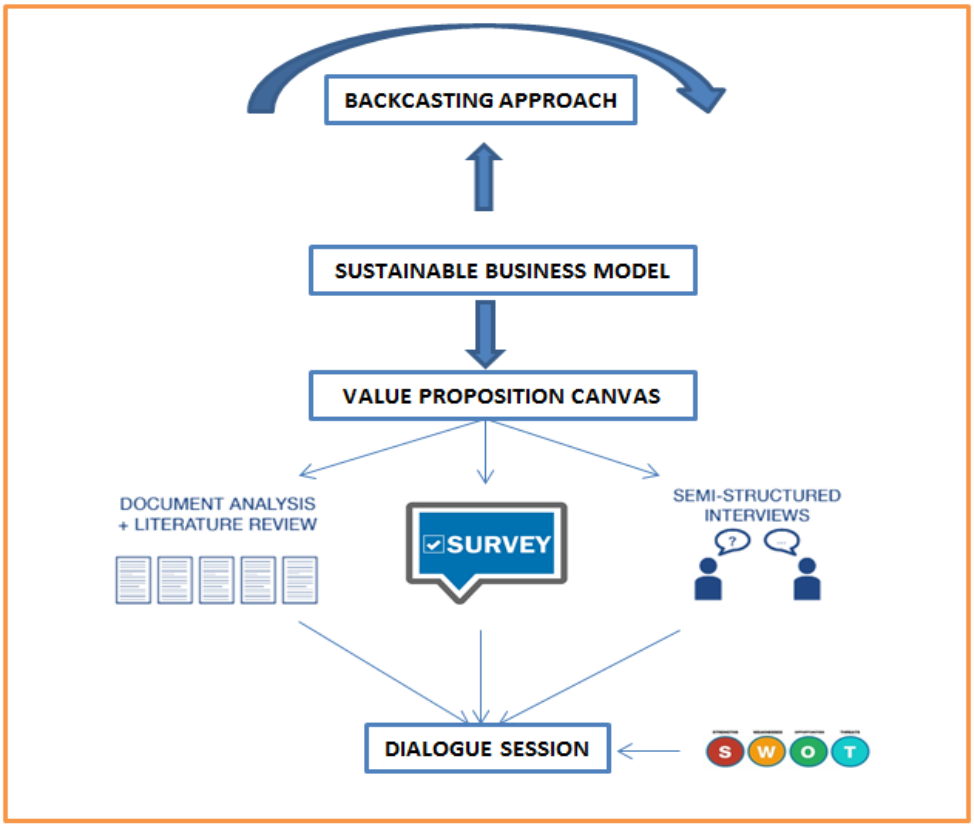

Figure 14: Methodology

4.1. Literature Review

A literature review is regarded as collection or investigation on a certain concept from a wide range of published resources (Avni, Burley, & Casey, 2015). As mentioned before a very limited amount of articles were found on the concept of shared parking. Therefore, along with limited documents on shared parking, the dynamics of the combined mobility service were reviewed. During the study substantial amount of data on the transportation situation in Europe, Sweden and Gothenburg were collected from various publications. Throughout the research limited number of articles had a direct influence on thesis topic as well as indirect contribution from other sources. Shared parking concerned with residential buildings is a relatively new concept but some case studies and suggestions pointing shared parking with mixed land use were found, which provided valuable information for the research. Further, the results of the literature were synthesized to get a broader view of the research.

4.2. Semi-Structured Interview

The research concerning with emerging topic in which wide range of perspectives, interests from various stakeholders are necessary to answer the research question and understand the practical limitations. As one of the research questions is to understand the stakeholder perspective on the concept it was important to choose the interviewees. The aim of the interviews was to get insights on the current role of parking for the sustainable development of the City and their insights on shared parking. During the process of identifying interviewees, a different set of questions were formulated depending on their organization and role. Interviewees were the representatives of a building company, parking company, research institute, and mobility firm. The process of interviews included the introduction of the research topic followed by a set of questions ranging from organization role in the development of the City, potential benefits and limitations of the concept and challenges for the adoption of shared parking (Yin, 2011). As said earlier, since the concept of shared parking is new, the number of interviewees were in a limited number. The interviews were conducted face-to-face, and stakeholders received brief information like the purpose of the study, the introduction of combining shared parking and public transportation, methodology, and other relevant data prior to the interview (Yin, 2011). The interviews were conducted in a semi-structured manner with an effort to have an open conversation. The research questions were framed across the thematic area and few were direct questions depending on the interviewee profile. Each interview gave a fresh perspective on the concept.

The process of semi-structured interview allowed two-way communication enabling the flow of useful information from the interviewee, in addition, providing an opportunity for learning. In the process, the majority of the questions were formulated ahead of the interview, but semi-structured manner also allowed to ask new questions based on the conversation which enabled to discuss critical reasons behind the parking issues (Keller & Conradin, 2018). However, some of the articles state that this method of data collection is sometimes unreliable, as the data collected is only the perspective of the interviewee and they share the information only what they are prepared for which may or may not reflect the organizational perspective (Alshenqeeti, 2014).

During the process, some of the critical representatives from building company, public transportation, and other relevant firms were not available for the interviews due to their busy schedule. However, if more time had been available, more interviews could've been conducted. Some of the participants suggested that the insights from the municipality, City planners, and policymakers would be useful for the thesis. However, due to time and resource limitations, this was not possible.

4.3. Questionnaire

The research concerns to design VPC in which understanding of customer's car travel and parking behavior in the city are decisive to answer the research question. One of the ways to reach customers is by formulating a set of relevant questions and circulating it. A questionnaire is a cost-effective method of collecting data from targeted groups by circulating a set of questions via the internet or by physically handing them to the individuals (Debois, 2016). The individuals are assumed to reflect the basic behavior of the local region (UCLA, 2014). Here the questionnaire is considered as the primary method of data collection to understand the customers' travel needs and preferences.

The questionnaire was directed for two different customer segments residing in Gothenburg city:

(1) Private car users
(2) Individual owning/renting a parking space.

The survey was conducted by circulating a tailored questionnaire for two separate user segments. Unlike interviews, the questionnaire contained closed-ended questions which intended to give more accurate results based on the respondent's personal experience and belief. The questionnaire responses are more authentic and valid when the questions are closed-ended rather than an in open form (Yin, 2011). However, the questionnaire had one open-ended question to understand their viewpoint on reducing the parking spaces in the City, as it would directly affect their travel.

The questionnaire began with an initial introduction informing the purpose of the survey, estimated time to complete and motivating them to answer the survey precisely also confirmed that their information would be confidential. The beginning of the questionnaire had demographic questions regarding gender, age, occupation, living status and location from the Gothenburg city center. This was followed by a set of distinct multiple-choice questions about the behavior of car and parking use directed for private car users and parking owners respectively. The overall format of the questionnaire for both the customer segments was similar but with a different set of questions. The next section in the questionnaire for car users was to understand their benefits and pains of driving a car. The questions were in Likert format with the options ranging from 'strongly disagree' to 'strongly agree' besides a set of statements (Vagias, 2006). The next division in the questionnaire (Likert format with a set of statements) was related to City parking with the purpose of extracting useful information about their personal experience with the current parking system.

The questionnaire for the parking segment had a similar format, contained fewer questions compared to the other segment. The section was followed by behavioral questions regarding their parking use, had a set of specific statements which intended to understand their benefits and downside of owning/renting a parking space. This section further provided the information about the pattern of using their parking space, which was useful to analyze the occupancy rate and possibility of sharing their parking space.

In addition, to understand the user perspective on overall research concept, a user-specific question was asked at the end of the questionnaire followed by an open-ended question on the idea of reducing the number of parking spaces in the City with a closing statement appreciating their time and valuable response.

The questionnaire was circulated in two ways, one by physically handing in the questionnaire to the potential users. The second way was by mailing the individuals who are regular car users and owns/rents a parking space in the City (Yin, 2011). The addresses were collected through personal and professional contacts.

This process of collecting data is time-consuming and needs several reminders to the targeted group of individuals to answer the questionnaire which they tend to ignore or forget. The quality of the answers varies because it's difficult to predict the honesty of the respondents and sometimes they tend to skip the questions if they fail to understand. Further, the data collected cannot convey the emotions of the respondents, therefore the Likert format is used where they can express by agreeing or disagreeing the statements (Debois, 2016)

4.4. Stakeholder Workshop

A workshop is a well-structured event which facilitates the discussion between participants or stakeholders who could influence or is influenced by the notion (Yin, 2011). In the process of developing a business which can capture value in interest to serve wide range of audience, one should engage multiple stakeholders to understand a broad range of perspectives, external factors, uncertainties and individual interest (Barter, 2011). The aim of the workshop was to present the findings from the value proposition canvas and engage the participants in identifying the opportunities, drawbacks, and constraints on the combination of shared parking and public transportation.

Stakeholder involvement in developing new idea can bring fresh perspectives creating a way for innovation which can benefit all the participants (Reed, 2008). Moreover, the participants bring their expertise and experience providing in-depth opinions on the development of the research topic. The research aims at providing a sustainable travel solution by combining residential parking industry and public transportation sector thus the stakeholders bring organizational perspective which representing a wide range of actors.

Identifying stakeholders for the workshop is an important step as anyone cannot attend the workshop (Reed, 2008). They were identified based on their power to influence the research topic,

willingness to engage and legitimacy. Stakeholder participation can empower other participants with their knowledge. Further, it is argued that the stakeholder participation may lead to a fair distribution of values considering environmental perspective and different actors in the supply chain (Reed, 2008)

In the process of analyzing the research topic, the participants were made to perform SWOT (Strength, weaknesses, opportunities, and threats) analysis. The participants were the representatives from the residential company, parking company, public transport provider, research institute, science park, and traffic office.

4.4.1. SWOT Analysis

It is an assessment tool used to identify strengths, weaknesses, opportunities, and threats of an idea or an organization. This analysis evaluates internal and external factors that can help determine the obstacles, risk involved in developing an idea at early stages. Internal factors are strengths and weaknesses of the service/product while the external factors are potential opportunities and threats. Identifying these helps in determining strategies to overcome the negative factors and captivate the positive ones (Elmansy, 2016).

In the process of analyzing the research topic, the stakeholders were made to perform SWOT analysis. The stakeholders were the representatives from the residential company, parking company, public transport provider, research institute, science park, and traffic office. SWOT analysis was performed with respect to different stakeholders, for example, SWOT analysis of the research topic with respect to a residential company.

In the process of SWOT analysis, the participants were divided into two groups: Group 1 and 2. Each group with 3 – 4 participants as shown below:

Stakeholder Group/ Representative from	For Stakeholder	Strengths	Weaknesses	Opportunities	Threats
GROUP 1 **1.** Johanneberg Science Park **2.** Research Institute **3.** Public Transport Provider **4.** Building company	Residential company				
	Public transport provider				
	Third-party app provider				
GROUP 2 1. Parking company 2. Traffic office 3. Research Institute	Parking company				
	City planners				
	Citizens				

Table 7: Stakeholder group for SWOT analysis

5. RESULTS

As mentioned in an earlier section, the questionnaire is a source of primary information and believed to be valid in this research. The questionnaire was categorized into private car segment and parking segment. The results of each segment are discussed below (Also refer Appendix C)

5.1. PRIVATE CAR SEGMENT

Private car segment refers to car users who can access the shared parking space.

5.1.1. Customer Profile

A. Demographics

A wide range of audience were chosen during the survey, anticipating different perspectives. In a period of nearly 2 weeks, 33 responses were received, out of which around 72% of them were male and 28% were women. They were categorized into six age groups with the minimum being 18. Age groups around 40 - 49 were the highest respondents with 45.5%, followed by 30-39 group covering around 24%. And around 54.5% lived with parents or family and nearly 34% were with their partner. Moreover, almost 88% were employed which signifies the financial stability to afford basic travel services. Nearly 62.5% of them resided in an apartment and the rest lived in houses. The respondents were spread across the city, where 42.4% were about 6-10 km from the city center who used the car and public transport quite often. Respondents who lived much farther from the City center preferred a car over public transport and few used public transportation on regular basis. Surprisingly, respondents who were in proximity of less than 5 km (24.2%) also preferred car travel for multiple purposes. Out of all the responses, close to 79% of them had their own car and the rest had either privately leased or a company car. The above numbers illustrate that the mid-age group people choose car travel over public transport which could be due to affordability, living with family and probably due to their life style.

On questioning about their preferred travel mode, around 87% agreed on public transportation as their second preferred choice followed by bicycle (11%). 50% of them agreed that they most frequently travel by car and sometimes by public transport. 12.5% admitted that they travel by almost always by car and similar number traveled mostly by other modes. Nearly 22% commuted by car and public transport on regular basis based on their travel purpose.

B. Customer Job

As shown in figure 16, job refers to the task carried by the user to satisfy certain own needs. Here around 88% of the commuters who traveled by car were regular users. Since most of them were employed their primary use of the car was to reach to workplace (74.2%) on time. Perhaps they preferred a car because of less travel time and convenience. Because, usually the peak congestion is in the mornings and evenings. According to Tomtom (Traffic Index, 2016), the congestion in Gothenburg peaks close to 40% and greater than 50% of the usual flow in the mornings and evenings respectively. Also, public transportation generally takes more time to

reach certain places, therefore considering the congestion; commuters (respondents) in Gothenburg preferred car usage, especially during peak hours. Surprisingly, around 71% chose car travel for shopping, which probably refers to either shopping after or before working hours or specifically shopping probably with family and friends, in addition, provision of carrying belongings in car adds more value. This was followed by leisure activities (51%) and holidays (35.5%).

The city center of Gothenburg is well developed with access to restaurants, shopping centers, and comprised of several leisure activities in the proximity. Hence, the preference towards the car to access these hubs along with family or friends. As per their preferences, their needs are ranked starting with work, followed by shopping, leisure, and visit family/friends, going to restaurants and cinema and finally going to school or dropping kids.

C. Customer Gains

The questionnaire results (figure 16) reveals that the car is assessed and preferred more positively over other modes of transport. Car is generally attractive to urban commuters, also to the questionnaire respondents in this case, because of the positive attributes like convenience, quick travel, flexibility, comfort, privacy etc. Some consider owning a car as luxury and few enjoy driving it. However, from figure 16 it can be stated that the most preferred benefits for car users are convenience and flexibility which allows them to travel as per their preference and reach any corner of the city.

The second reason for car usage is it's quick and takes least amount of time to reach the destination. As most of the respondents were employed and preferred taking their car to work, they usually need to reach on time, and it could depend on the distance between their residence and the work place. Additionally, car usage eliminates the time of waiting for public transportation. Further close to 82% of the car users agreed to the fact that traveling in a group with family and friends which as a key benefit of using the car. In addition, a car also provides space to carry their belongings. Another reason for owning this automobile is from the aspects of privacy and comfort; offers music, air-conditioning, and stop-over when necessary and many more. But surprisingly even though it's valued as a benefit, only nearly 38% preferred privacy and other 38% voted neutral. Surprisingly, few admitted that they enjoy driving!

D. Customer Pains

On one hand, car is attributed for its benefits, on the other hand, it has certain disadvantages and the users are disappointed with it (figure 16). The most important issue in traveling by car is congestion and pollution which has been admitted by most of the survey respondents: close to 94% of them feels that using the car is environmentally unfriendly. But continue to use the car due to the earlier mentioned benefits. Considerable amount of them agreed that the initial costs to buy a car is expensive. Moreover, the monthly travel expenses due to fuel, congestion tax, and maintenance costs are high, thus unsatisfied with the overall expenses.

In addition, parking is considered as a key negative factor for car users. Shoup (1997) states parking as an unseen reason for congestion. Every car which leaves one parking space needs

another spot, either at the workplace, shopping center, or at home etc. As the amount of car usage increases, the queuing/cruising for parking increases further leading to congestion in the city. Most of the respondents agree that it is not easy to find parking space in the city. The questionnaire revealed that around 74% of them spent an average of 5-10 minutes (Figure 15) in the traffic searching a parking space which is also stressful and time-consuming. Besides, they admitted that the parking prices in the city are expensive (71%) which further raised their monthly travel expenses.

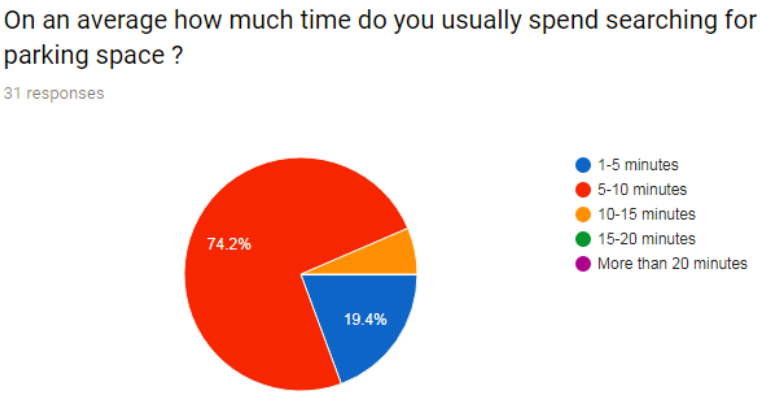

Figure 15: Time taken to find parking in Gothenburg

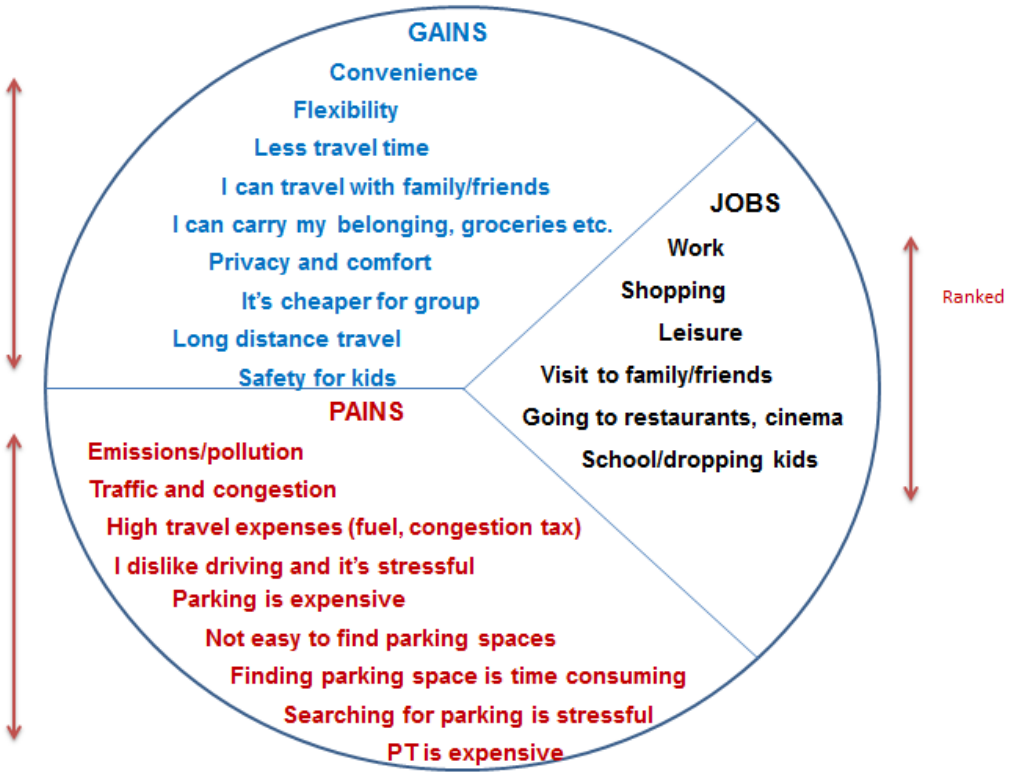

Figure 216: Customer profile of private car users

5.1.2. Product Profile

This section lists out the products/services offered which is shown in figure 17. The product profile illustrates the hypothesis; combination of shared parking and public transportation as a new mobility service. To make the service practically accessible and to enable the communication between the service providers, suppliers (parking host) and the buyers (car users) is by designing a multi-sided digital platform. A digital platform will enable the car user to find a shared parking space with features like reservation and navigation, additionally providing the accessibility to purchase the public transportation tickets. This provides an opportunity for the driver to shift towards a sustainable travel by parking the car en route and resuming the journey using public transit.

A. Gain Creators

With changing mobility practice, urban commuters are demanding faster, economical and reliable transport system. This (imaginary) multi-sided platform allow the drivers to find a parking space in close vicinity to the destination or away from the city center. After which the driver can choose to buy public transportation tickets via the same platform in order to reach the destination. With technological advancements, instant and real-time updates of parking locations in the platform could provide multiple parking options and enables the user to check the parking images, features, size, and cost to fit their needs and can book the space online prior to their journey.

With the ability of cashless payment and online booking, makes it easier for the drivers to access the parking space quickly without much hassle of spending time in traffic. This could make the whole journey convenient and reduce travel time. In addition, the availability of public transportation tickets with parking will promote sustainable travel and could be a solution for last-mile problems. The combination adds flexibility for the journey providing accessibility to a wide range of areas of the city by reducing the travel kilometer spent by a car and increasing the bus/tram journey. The effortless journey could be complemented by the navigation system which directs the user to reserved parking space also displaying the closest bus/tram station.

With business model innovation, depending on the pattern of usage of parking space, the user could get various payment options. One option would be to pay prior to using the service with the option of a monthly subscription or pay per usage of the service. The aim is to provide convenient parking service and modal shift which can be economical, faster and reliable for the users which can reduce the time required for searching parking in the city and traffic. Furthermore, free vouchers, promotional offers and discounts could encourage the user to access this service, gradually creating a shift towards the use of public transportation in the City. Further, the digital platform with an option of rating and feedback service on the parking spaces can encourage the service provider and supplier to improve the business quality.

B. Pain Relievers

The parking prices in the City center are usually expensive compared to outside of the core area. The availability of multiple shared parking spaces allows the driver to choose the cheaper and

convenient one. Further, the city center of Gothenburg comprises of congestion tax on certain roads (Börjesson & Kristofferssonb, 2015)**.** Therefore, with the possibility of parking in one of the shared spots, outside the expensive area, reduces the overall monthly expenses for the car user, also saving fuel costs. With this combination, the overall car journey can be reduced, meanwhile, gradually increasing the travel by public transportation which reduces traffic and emissions caused by cars.

Despite, a certain set of benefits of car travel, nearly 69% of the users responded that they dislike the car driving referring to its drawbacks. Hence the ability to access well connected public transportation in the same application can reduce the stress level caused by car driving meanwhile allowing the user to reach any place in the city.

Figure 17: Product/Service profile for private car user segment

The value fit which is shown below, display the key features of the hypothesis in the form of value proposition canvas in a structured way.

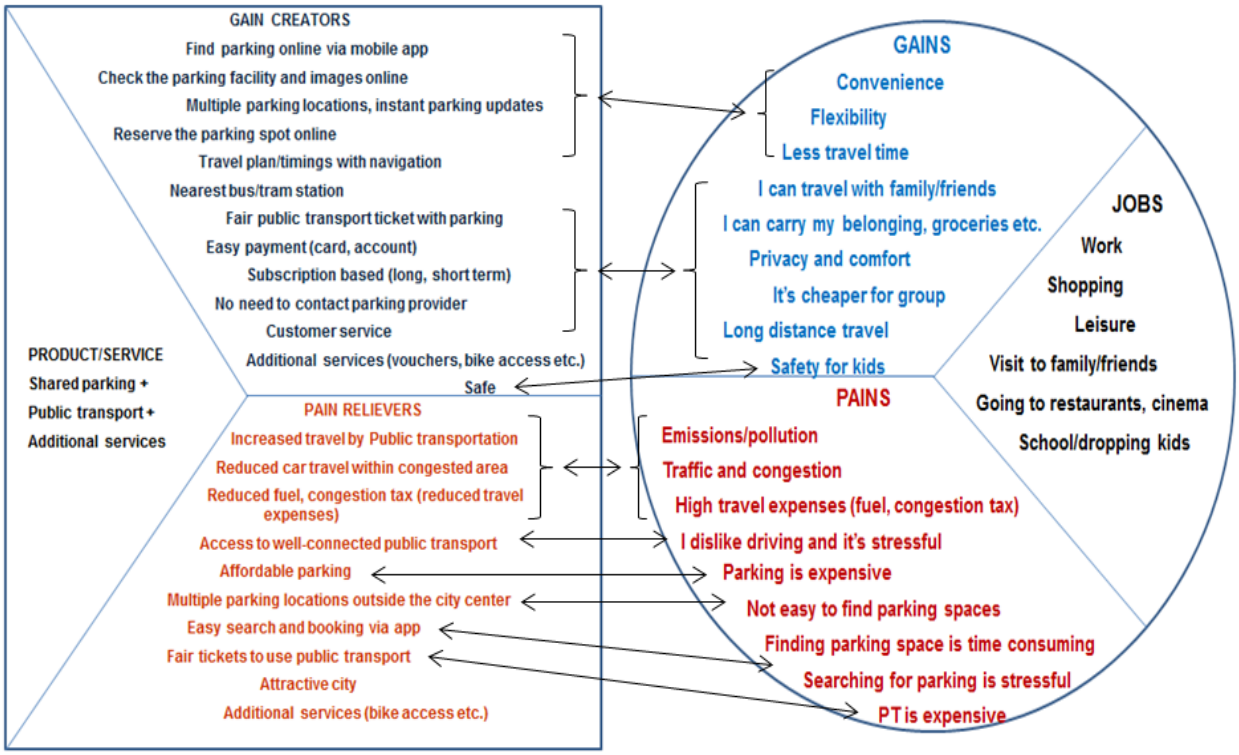

Figure 228: Value fit for private car user segment

5.2. Parking Segment

This segment represents the parking holders who can share the parking space to the car users.

5.2.1. Customer Profile

A. Demographics

Similar to the car user segment, the questionnaire about the parking was circulated to a broad spectrum of audience, who owned/rented a parking space in the city. In the span of two weeks, 25 responses were received out of which men's response was majority with 72% and women with 28% responses. Some of the responses were directly collected at parking lots in the form of hard copy and the rest were received via email. Most of the participants fall in the age group of 40-49 (40%) followed by the age group of 18-29 (28%), 50-59 (20%) and at last 30-39 (12%). Most of the respondents were employed (96%) with 75% of them staying in apartments and 25% in individual houses. Similar to the results of car segment survey, around 92% of the respondents either live with parents or partner across the City.

B. Customer Job

The respondents of this segment are the ones who have access to a car parking space near their house. According to the figure 19, their job is to obtain a parking permit to park their car either by owning or renting a space. The residential parking is said to be expensive, however, the price varies according to the type of parking. The results indicate that 64% of them rented the parking space out of which 54% of them in the private garage and the rest park it outdoors. 24% of the users had their own parking space and the rest relied on-street parking.

C. Customer Gains

Having access to a residential parking within the building or a space close to the residence provides the benefit of parking the car in their vicinity. Almost all the respondents agree to this and they say it's convenient to access the car when necessary. They feel that closer the parking space is better as it reduces the walking distance. From the results, it can be read that they like a closed garage as it provides safety (80%) and few (52%) consider that the protection from varying weather conditions as a benefit. One of the major advantages of possessing an off-street parking space is it eliminates the time needed for searching on-street parking in residential areas. Further, a few owners commented that owning is beneficial as the monthly rents/expenses are slightly expensive. In addition, 44% of them were generous to share their parking space with family and friends, which they attributed as a key benefit of having parking space, whereas 32% denied that and the rest remained neutral.

D. Customer Pains

The price of parking space is reflected by its construction costs (Ryan & Deci, 2000), therefore 76% of them agree that it's expensive to buy/rent, the rest stayed neutral. The important note

from the survey is that many participants commented that the rate of utilization of parking space is low in relation to the high price. When they drive a car to work or shopping, the parking space is left idle for a long time therefore, they feel it's underutilized and the payback period for the parking space is far from the reach. Figure 20 clearly show that 64% of the respondents' parking space is free from 25 hours up to more than 45 hours per week, where 20% admitting minimum idle time of 45 hours and more and the rest between 25 and 45 hours a week. 20% out of the remaining 36%, pointed that their space is empty between 15 to 25 hours a week and the rest had their parking space occupied not more than 15 hours. These stats indicate the dissatisfaction of underutilization of parking space. In addition, some of them even pointed out that space is a hassle to maintain due to the accumulation of dust from the car use.

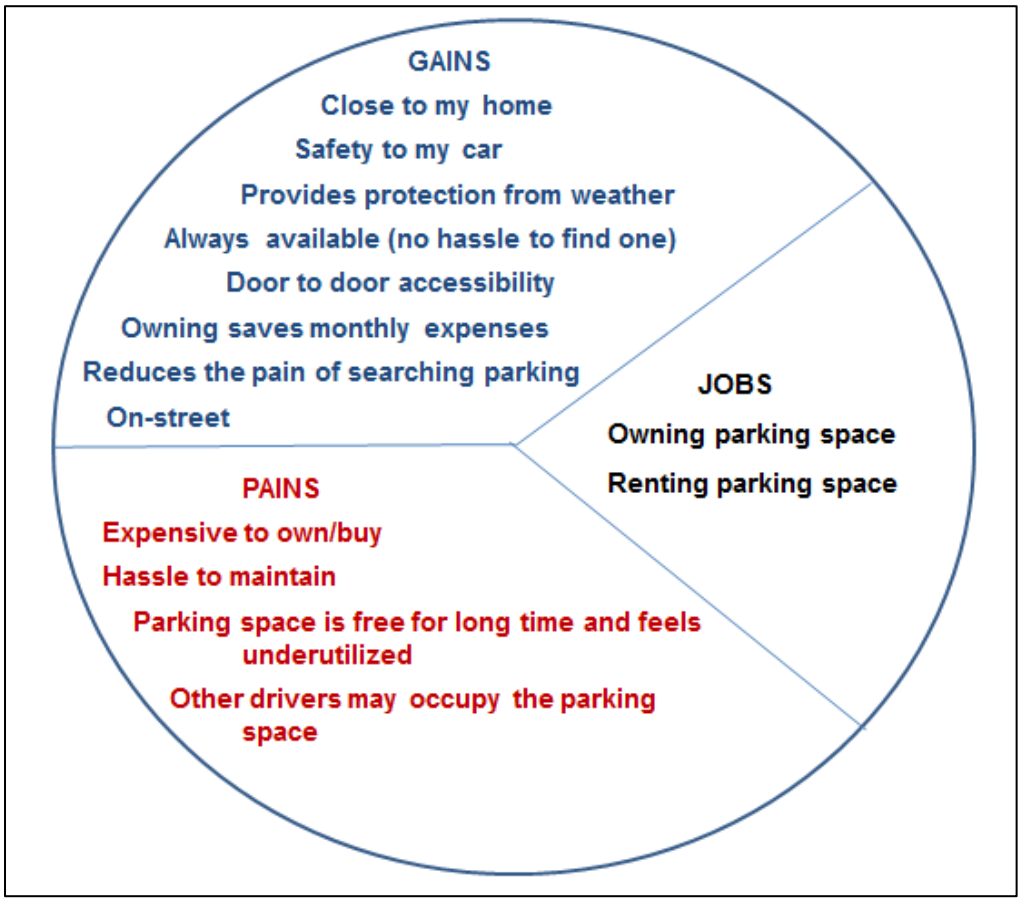

Figure 19: Customer profile of residential parking segment

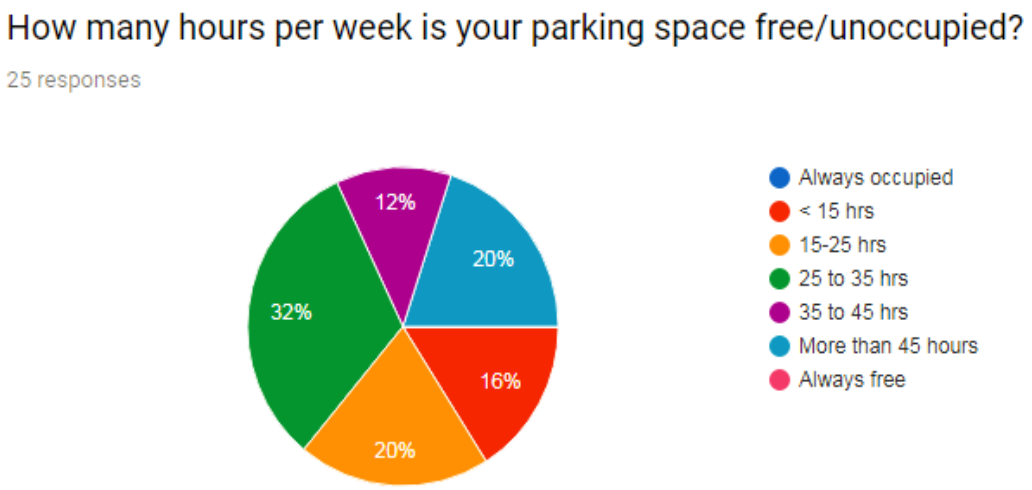

Figure 2023: Vacancy rate of parking per week

5.2.2. Product Profile

Tenants owning/renting parking spaces are the suppliers in the multi-sided platform. A probable digital platform provides an opportunity to earn money for the one who owns/rents parking spaces by sharing it in this platform with the freedom to reschedule the space availability based on their usage pattern. The relevant characteristics of proposed service to the parking hosts is shown in the figure 21 and 22.

A. Pain Relievers

Regular car users who travel to the city center are not the only ones who feel parking spots are expensive but also the owning/renting parking spaces near to their houses is an expensive task. Thus, sharing will reduce the overall expenses by generating economic value for the idle space. Further, this will increase the utilization rate of parking space eliminating the dissatisfaction feeling of underutilization in relation to the price they pay for the respective parking space. Including additional services like car wash, cleaning assistance etc., could assist the supplier with basic parking services eliminating the hassle of maintenance.

B. Gain Creators

Here the supplier is the core of the business concept. The tenants know their parking needs; can choose to share their space accordingly and reschedule when needed. Flexibility feature is a benefit for the supplier as it makes the parking always available for personal use. The simple job for the supplier could be a one-time registration in the server via a webpage or smartphone application and schedule the parking availability. Additional details like time of availability, location, and mode of accessibility will make it easier for the user/driver to access the space.

Further to boost the chances of finding a customer, they may choose to post the images and additional features of the parking facility. Monitoring of the parking space, payment, and

navigation for the user would be managed by the service provider by technological advancements, thus minimizes the task of meeting the user. Similar to existing e-business applications, the notification option will inform the supplier at every step of the business: from the point of booking until the user exit the space. Further with the feedback feature the supplier can check the user profile before offering the parking space and can also provide feedback after the use. Overall, without upfront investment, the tenant can generate revenue by sharing the underutilized parking spaces.

The below-shown VPC (figure 21) and value fit (figure 22) displays the unique values created for the tenants by sharing their parking space. The supplier will have the freedom to stipulate the price for the parking space. Depending on the parking availability and requirement, the tenant can choose to rent it on the hourly, weekly or monthly basis and fix the price accordingly. Therefore, the supplier can also benefit from the subscription-based model.

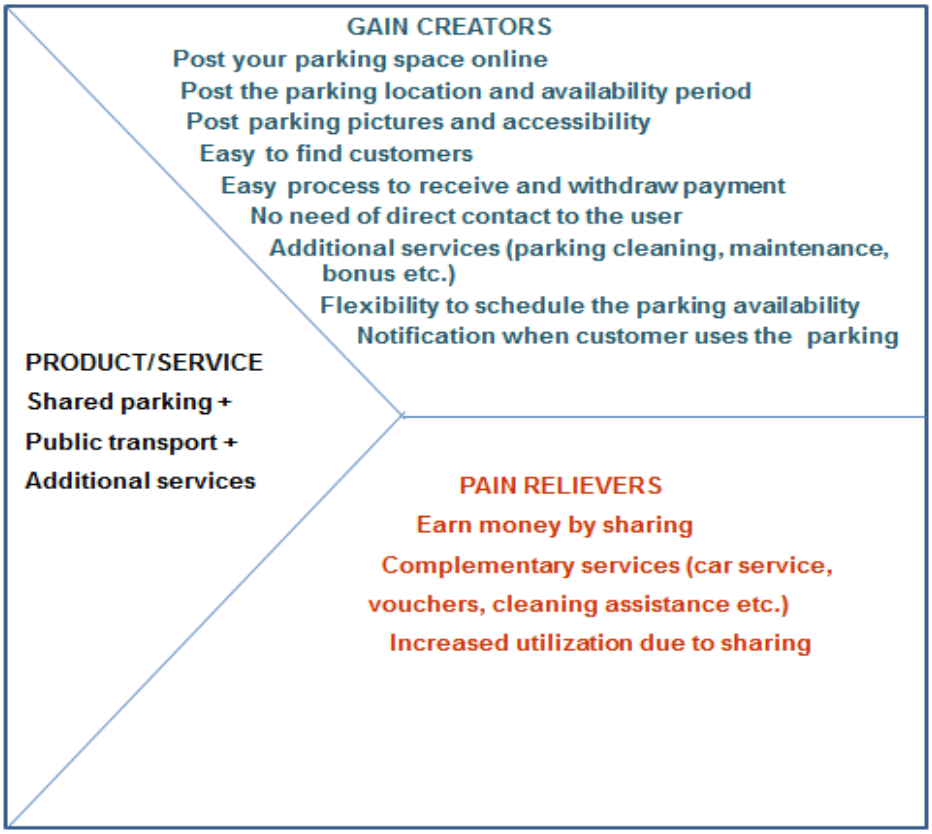

Figure 2124: Product/service profile for residential parking segment

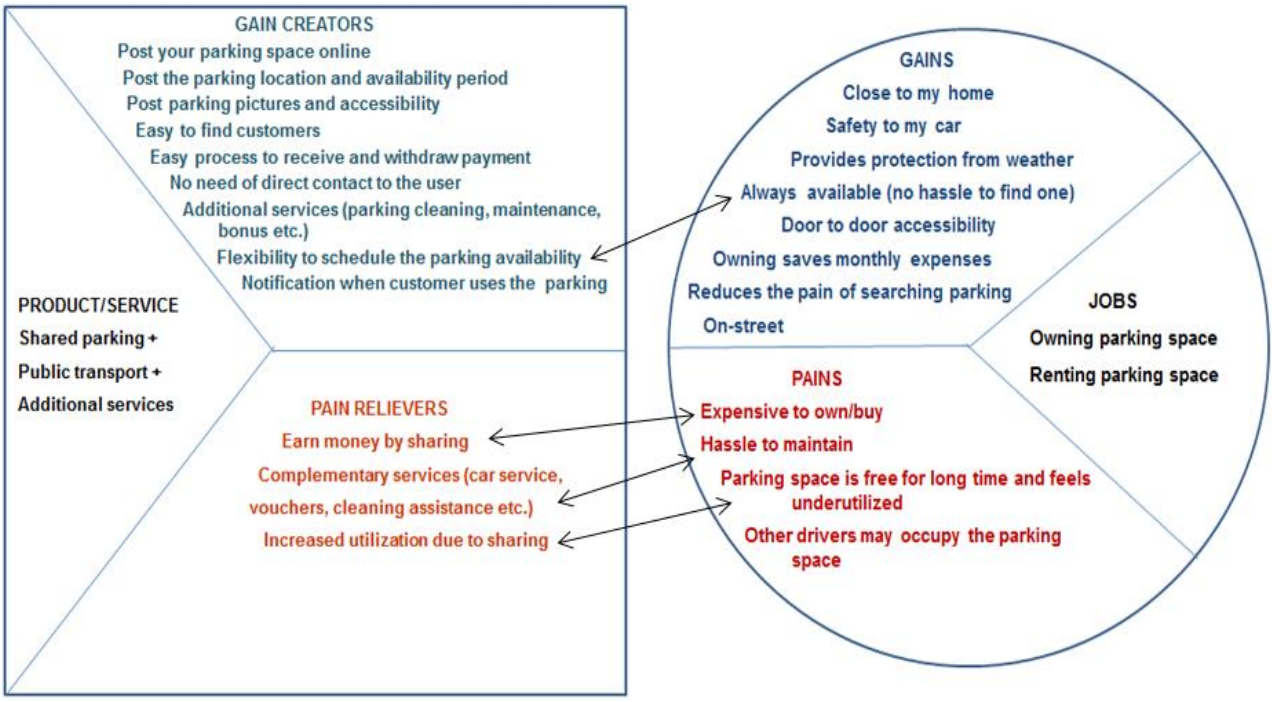

Figure 22: Value fit for residential parking segment

5.3. Consolidated list of Values

PRIVATE CAR USERS	TENANTS
An easy way to find parking online	Relatively no investment
Multiple parking locations and real-time updates	Earn extra money by sharing parking
Reserve the parking spot online (Short term or long term)	Easy process to share online
Less price than normal parking	Improved utilization of parking space
Easy online payment	Flexible and freedom to schedule the parking availability
Safe and secure	Short and long-term contracts
Navigation guides to the parking spot	Customers will find you
No long queues for parking	Easy process to receive the payment online
Can choose to park based on the closest tram/bus stop	Safe and secure
Buy public transportation tickets in the same application	Additional services and discounts
Flexible and travel to any corner of the City	
Reduced stress by less driving	
Eco-friendly travel by Public transport	
Additional services and discounts	

Table 8: Consolidated list of values

Referring to global growth in car usage in comparison with other modes of transportation, it can be expressed that a car is more attractive than public transport. Accordingly, the questionnaire results revealed that car is more important for personal transportation than other modes. However, that's true for the commuters who regularly dependent on a car for travel but a certain group of respondents chose public transportation as well as car, depending on the purpose of travel. Although the car provides a personalized trip, the privacy aspect was not a key parameter to travel by car which was reflected by choosing public transportation as their second preferred travel mode. However, convenience and quick travel were key components for using the car regularly, but respondents also showed concerns towards congestion and emissions. Further referring to high parking charges in the city and high time consumption to find parking, around 53% of the car users supported the concept to park the car on their way to the destination in the shared space and continue the journey using public transportation (Figure 23). Around 31% were not sure, probably due to limited information about the concept. Also, they were concerned about the time required for a modal shift during the journey, in addition, the safety of the car was also questioned. However, few mentioned that it promotes public transportation and reduces the parking pressure in the city if offered with right incentives, thus welcoming the concept.

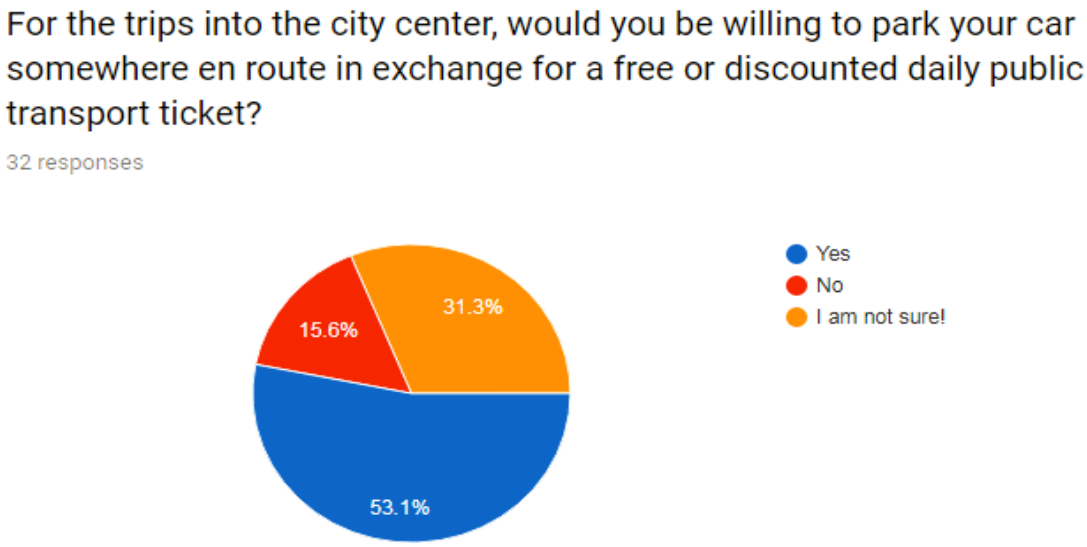

Figure 23: Share of respondents supporting to park their car in shared parking space

Most of the respondents had a private garage and admitted its high costs. Also agreed that it's unsatisfying to see the space underutilized. This is a huge resource and therefore, around 48% were ready to share their space and earn money, whereas 28% weren't sure of the how the process would work and showed concern regarding the parking safety and profitability of sharing (Figure 24).

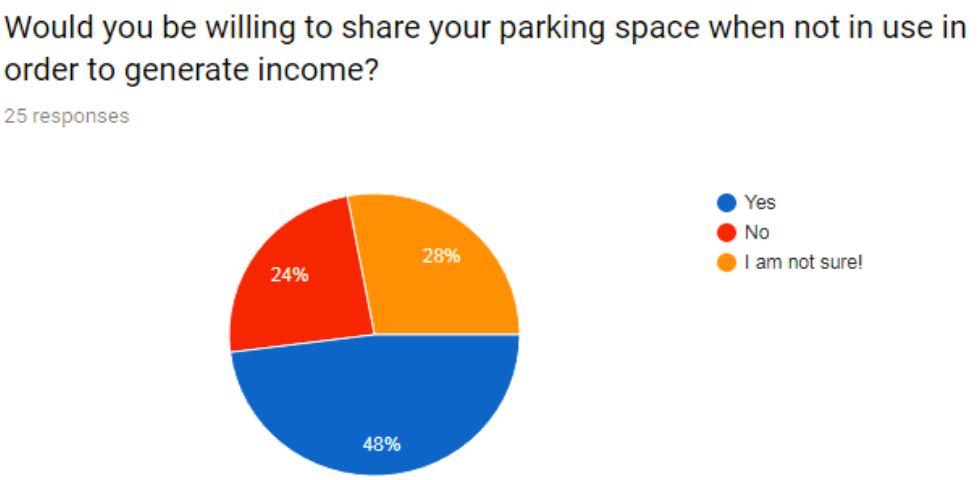

Figure 2425: Share of respondents agreeing to share their parking space

As mentioned in the table 03, theoretically those values seem to be beneficial for both the users, provided the travel time including the modal shift is reasonable.

5.4. Stakeholder Perspectives

5.4.1. Parking issues in the City

Different stakeholders value car parking depending on their role in the parking system and use. In recent years, parking is recognized as a tool to control the car usage in the city (Marsden, 2006), however, it's a delicate and complex process which involves a thorough understanding of the travel pattern and collaboration between actors. The parking demand in the city varies according to its location and purpose. During the day the demand rises in the business areas or workplace and simultaneously decreases in residential buildings. Later in the evening, the demand curve is inverted for residential buildings and the workplace. The issue is everyone needs parking space close to their destination. For example, a commercial shopping center or small shops need parking for their employees and customers and the same applies to residences, business centers and commercial centers (Interviewee 1). He further added that "*Gothenburg desires to be an Event City among Scandinavia, holding major events at major stadiums across the City"* Thus the parking spaces around the event centers will be utilized close to 100% at some point of the year but remains underutilized even though it's open to the public. This pattern of building parking spaces hinders the compact development of the City, thus needs efficient utilization of the space, which was stated and agreed by interviewee 1 and 2. Therefore, it's important to find the right supply and demand for parking in the City and this depends on travel pattern, local policies, location etc.

But,

"there is a balance between the required and necessary amount of parking space. And there is a balance between using them effectively and how much can be used effectively" Interviewee 3

Moreover, it is always difficult to reach the right balance. A similar issue was expressed by Interviewee 1 but with a different viewpoint.

"Parking demand at particular time peaks and might create traffic. More often the reason is not the insufficient amount of parking but lack of knowledge about where the parking spaces are that creates parking related congestion" Therefore, the flow of information to the citizens through the right channel is important.

According to Interviewee 3, Gothenburg aims to be a hub for visitors. Considering the car users in the City and visitors, there is a necessity for effective parking solutions in upcoming years. Further, he stated the importance is to create the right balance between on-street and off-street parking in the City. The purpose of having on-street parking is to allow the car users to park for short-time. But in the current situation, many users park their cars for a longer time as it is cheaper. Thus, the concern is to reduce that and shift long-term on-street parking to parking garages. In order to improve the occupancy rate in parking garages without building new ones, the City plans to implement the daily or weekly parking permits. This allows flexible parking, which is not the case in monthly permits or long-term permits (Interviewee 1).

5.4.2. Residential Parking Challenges: Stakeholder Perspectives

Along with City parking, the residential parking constitutes a substantial amount of space and resources. Tenants who use parking consider the space as a personal asset. Thus, it is difficult to modify the existing parking space to a sustainable resource (Interviewee 2). Looking into the future densification projects, it is, therefore, necessary to capture the value of empty lands and parking space in a sustainable manner.

The main issue in residential parking spaces according to Interviewee 2 is construction costs, which is difficult to recover. To support the compact development of the City and parking demand, multi-storey parking is necessary. But it's highly expensive; the costs differ depending on the type of parking. On ground parking is cheaper than garages. According to him, construction of parking comprises a substantial amount of building costs. In residences, these costs are reflected in apartment costs which are currently subsidized and paid by all tenants irrespective of them using it. It's challenging to separate these costs, however, if we (referring real estate firms) succeed in doing that, can have a huge impact on parking usage.

Another reason for the inclusion of parking costs in rents is low occupancy rate. It's usually cheaper to park on-street than in apartment parking or garages. Therefore, space remains unused most of the time. To recover the loss, the parking costs are reflected in apartment prices. In some cases, the parking is provided underground which is tough to access. In few buildings, different parking model has been applied where if the parking spaces are not purchased/used by tenants at all then they are open for the public to park. However, as mentioned before, it is difficult to attract public users to park in these closed spaces due to accessibility and security issues.

Interviewee 1 mentioned that for compact development, some of the City's on ground parking spaces could be utilized for urban development or to build housing. However, the pressing issue according to interviewee 2 is *"How to accommodate the existing parking users and new users in the same building?".* The proposal will be opposed by the existing parking users irrespective of parking space being public or private. Parking space could be utilized efficiently if both the users share the space but probably, they would oppose as they consider it as their personal space and expect its availability all the time. However, to accommodate all the users, building a new parking space would not be economically viable and it's against the societal goals. Thus, communication and creating awareness among users about the parking is essential.

5.4.3. Integration of Shared Parking and Public Transportation

Validation of this research or hypothesis is done adopting some of the techniques of qualitative research. The evidence-based research was presented to a certain set of stakeholders in the dialogue session to analyze the feasibility of new mobility service i.e. a combination of shared parking and public transportation.

The stakeholders were divided into two groups and their viewpoints are categorized into two segments (A) Strengths and Opportunities (B) Weaknesses and Threats

A. Strengths and Opportunities

The new mobility service was attributed as a fresh approach to promote sustainable travel along with effective utilization of residential parking space. Group one expressed that this service could promote a shift in commuters' behavior towards the use of public transportation. The expansion of the public transportation network to certain areas could be expensive due to lower number of travelers, but the service in combination with the car could increase the accessibility of public transportation. Further stating that it is an opportunity to integrate with other transport services like car sharing, car-pool, and bike share which can solve last-mile problems. Economically it seems more feasible than adding new public transportation to suburban areas. The opportunity of adding other transport services can reduce the necessity of using a private car. From the survey it can be derived that privacy is not a key aspect for car users, therefore, sharing of transportation resources/services can lead to new market creation.

From the public transportation perspective, this combination can attract new customer base from car segment which means increased use of public transport and reduced car usage. In addition, reduction in congestion can lead to faster and hassle-free travel in public transportation. They also noted that overall, this embraces sustainability benefits: revenue generation, improve public transport occupancy, reduction in car-based congestion and emissions, and sharing leads to the development of trust.

The most common benefits from group one and two were related to parking. Group one stated that this will improve the utilization of residential parking spaces. As mentioned before, it is difficult to reach the maximum occupancy rate and recover the parking investment, but sharing can potentially solve these issues. Further, the interviewee 2 who attended the workshop mentioned, in future buildings if parking costs are detached from the apartment price it could reduce approximately 10 - 15% from the current apartment price. This will benefit in identifying the actual user and share the revenue generated from sharing.

The inclusion of commercial private parking in the concept could further improve the efficiency of land use in the City thereby balancing the supply and demand for parking without building new parking houses. This was supported by the representative from parking company who was in group two by stating "*it's an opportunity for collaboration between public parking company and residential builders which can add new parking spaces in their existing portal without investment*

and expand the customer base". However, he further said that the existing portal is not compatible with the proposed concept and may need modifications. And the shared parking will reduce the burden from public parking organization in adding new parking spaces in the city. Supporting this, another member from group two commented that shared parking could be a solution for short-term parking users too which can reduce the need for on-street parking thereby reducing congestion. This will make way for urban development in place of on-street parking.

The collaboration between several actors can lead to the creation of a new market for shared parking and new mobility services. However, diffusion of a new idea into a non-existing market is challenging. But group one mentioned that this is a business opportunity for third-party service providers to create a new market for shared parking and could be a significant revenue source.

B. Weaknesses and Threats

New mobility services include some uncertainties associated with increased use of shared resources, insurance, and external factors like policies, incompatible urban infrastructure, transportation regulations etc. Thus, it is important to consider the practical problems and drawbacks of the concept from a stakeholder perspective.

As mentioned before, the concept of shared parking in residential buildings is relatively a new concept and no participant is aware of the practical problems unless it is implemented. Group 1 showed concerns about the hidden costs involved in expanding the service. Thus, determining the true costs of the service is necessary to facilitate transparency between the partners and customers. Further it was stated that the present parking market has been capitalized by public and private parking providers, with whom the car users are quite highly aware of the charges and conditions of parking. Therefore, it is uncertain of finding a customer always and even for the third-party provider it is difficult and involves high costs to market and penetrate new parking service amidst the strong players. This is in line with the statement provided by the representative from the parking company during the interview, *"One of the barriers is lack of scientific facts or proven methods in order to accept or implement the concept"* and further stated that the existing business models of parking and other mobility sharing companies are not compatible with shared parking concept, due to the inflexibility in the existing system and car sharing companies, they usually do not consider parking as part of their business.

Group 1 displayed similar concern that lack of evidence, questions the sustainability and economic factors and thus the engagement of new stakeholders although it is an opportunity for innovation. Another risk factor stated was, the unavailability of specific research or literature on business models for new mobility services, thus, challenges the type of business model necessary to create a new market. Further the group 2 mentioned that the evolution of shared mobility has disrupted the traditional business models, but due to inflexibility in the transportation sector and lack of supporting regulations, it has been difficult for new mobility services to take the lead, similarly the future transportation could alter based on changing landscape pressures, thus the business model of shared parking must be designed with the consideration of future uncertainties.

"To create evidence and understand the practical problems, a pilot study would be a great start" was mentioned by the representative from a building company. However, to do so it is challenging to convince the current management team without the strong evidence on the viability of the concept. Moreover, the existing tenants are used to a certain pattern of using their parking space, which is challenging to change the behavior. Considering the city norms of compact development, the future would see construction in existing on-ground/open parking spaces. Since the current parking spaces are subsidized, it is complicated to harmonize everyone's interest and to distribute the profits. He further mentioned that due to the current subsidization system, shared parking might trigger the demand for owning parking spaces to earn money.

He also mentioned during the interview that it is challenging to attract car users to park in the garage as the on-street parking is cheaper and convenient. Some residential parking garages are built underground which usually goes unnoticed and difficult to access even if shared. Some technological barriers were mentioned during the discussion, that is, providing accessibility to the buildings could be complicated process either must be done manually or technically. Supporting this, a participant commented that with the application of digital technology, a smart system could provide authorization to the user, however, the question is at what cost? And who bears the cost of installation? Is it the service provider or the tenant? Whoever takes the authorization of implementing such systems will be reflected on service costs. In this process, a huge amount of customer data is accessed by the service provider. Data management would be crucial in a multi-sided platform which involves parking suppliers, car users, and public transportation users. The transparency of client data with partners, insurance companies and relevant actors would be challenging (Group 1).

From public transportation perspective, although, the combination might promote the use of public transportation, however, providing discounts would lead to reduced revenue. Because the transport provider would do it anyway from start to end of the journey rather than waiting for the car user to reach midway of the travel. Group two stated that, discounts and availability of cheap parking at multiple locations must not promote the car usage. The threat could be this would increase the short-term car trips probably even from the non-car users due to the availability of multiple parking spaces. Further, the stakeholder representing traffic office stated that even though the above case could be in small proportion, shared parking would shift the process of finding parking from city center to may be a bit outside of the inner city.

Stakeholder Group	Stakeholder	Strengths	Weeknesses	Opportunities	Threats
Group 1 Representatives from, 1.Johanneberg Science Park 2.Research Institute 3.Public Transport Provider 4.Building company	Residential company	Fewer cars in the city. Improved utilization of the P space. Efficient land use. If parking is detached from the price of the apartment, it could reduce on an around 10% from the current apartment price.	Uncertain about the hidden costs involved in developing further. Currently building parking costs are subsidized therefore; this concept would trigger the ownership of the parking spaces in the residential buildings.	Possibility to link SP to car-share or car-pool and reduce the necessity of owning a car. Possibility of creating a new market.	How to “retrofit” in the existing building? Tenants are used to certain pattern of using their P space. Considering the city norms to reduce the space and the future would see buildings in the existing parking spaces. So it’s challenging to convince them and change their behavior. -coordinating SH interests
	Public transport provider	Reduced car use in the city. Increased accessibility to PT. Sustainability benefits.	How important is providing the incentives and at what cost? What kind of business model is necessary? Practical problems are usually unnoticed until implementation.	Possibility to integrate other modes (ex.: bikes-share) Integration of other modes may solve the last-mile problems. Attract new customers from car segment.	Incentives could lead to reduced revenue.
	Third party app provider	Revenue generation Creation of new market	Marketing! Attracting customers! Enough evidence and partnerships to create the app and market. Business model!!	Business opportunity Identifying “niches”	New entries/competition. Availability of too many apps! Digital maturity! Data security!

Stakeholder Group	Stakeholder	Strengths	Weeknesses	Opportunities	Threats
GROUP 2 Representatives from 1.Parking company 2.Traffic office 3.Research Institute	Parking company	Addition of new parking spaces without building it. No investment. Reduced burden on parking demand.	Data quality can be low – the quality of the service would depend on the individual. Data sharing should be handled in an efficient way.	Opportunity for collaboration and expand the customer base. The existing portal could be modified to implement this idea.	Future changes in the public transportation could alter the business model. Could be a threat to existing business which relies on public parking.
	City planners	Reduced burden on on-street parking.	This shouldn't promote the car use because of the availability of parking.	Possibly opportunity to utilize the on-street parking space for urban development. If the on-street parking reduces then it might eases the congestion.	Even if there's a possibility of reduction of car use (cruising for parking) in the City, it may shift this process somewhere else may be a bit outside of the inner city. Does this attract PT users to use their car?
	Citizens	Easy to find parking spot. Multiple options. No need to cruise around to find the spot.	Might take longer time to reach the destination, considering the time to change the mode of travel. Might be expensive if the PT is not subsidized. -Behavioral changes!	Income from sharing the parking spot	Shouldn't motivate them to use their car to share the space or due to availability of multiple parking options.

Table 9: SWOT analysis by Stakeholders

5.5. Internship at ApParkingspot

The investigation of novel topic with stakeholders resulted in an opportunity to work as an intern with a key stakeholder. The stakeholder represents a startup named ApParkingspot, located in Lund, Sweden. With the vision to be the most intelligent parking service provider, ApParkingspot presents a digital platform for sharing/renting parking spaces (https://apparkingspot.com/)

The research only highlights the sharing of parking but does not discuss the process of sharing. ApParkingspot presents manual and automated sharing but emphasizes on the latter. Automated sharing is achieved through sensor technology, which deep-learns the parking pattern over a period and rents out certain percentage of the parking automatically via the digital platform when it is vacant (ApParkingspot, 2018). Also, with certain partnerships, ApParkingspot presents online accessibility to parking. Thus, the idea is to eliminate the human errors, planning prior to renting and manual intervention for parking accessibility. For car drivers, the application presents online reservation and navigation to the parking space thus reducing the parking search time and fuel use subsequently reducing congestion and emissions.

During the internship, the responsibilities offered were market research, assisting in workshops, business meetings, fairs and exploring business collaborations and investment opportunities. In short period, several business meetings with real estate companies, property owners, investors, municipality and mobility experts were conducted. During which, certain real estate representatives highlighted the high parking costs, low occupancy, and binding regulations to build certain number of parking, which are leading to inefficient resource use and loss. Therefore, coupling new technologies like ICT with existing infrastructure could lead to cost savings and resource efficiency (Klitkou, Bolwig, Hansen, & Wessberg, 2015). Hence the concept of shared parking was highly appreciated, because of the innovation and economic benefit it could generate.

However, there are certain barriers which seems to be obstructing the implementation. The key barrier has been the incompatibility of digital application with the traditional parking operating system used in certain real estate companies. This could incur administrative costs either to the real estate firm to replace or modify the operating system or to the ApParkingspot to reconfigure the application to suit the purpose. This type of technological inertia can be termed as technological interrelatedness or lock-in where incompatibility of emerging technology exists with the dominant one (Klitkou, Bolwig, Hansen, & Wessberg, 2015). At the same time, it is challenging for the firm to overcome the technological lock-ins due to increased adaption to the existing framework (Klitkou, Bolwig, Hansen, & Wessberg, 2015). However, certain real estate firms agreed to go ahead with the new parking system and the implementation work is in progress. This would demand certain modification of existing parking portal, digital application, data collection and analysis of existing parking behavior.

Although, the startup has first mover advantage in Sweden, it is challenging to gain critical user base due to financial constraints. On the other hand, for investors it is a gamble due to uncertainty of market acceptance and lack of evidence. Hence, wait for more traction from the startups which in turn need financial support. Moreover, unlike other MaaS services like car sharing, bike sharing,

etc., shared parking is much fresh concept to Swedish mobility market, therefore it is still uncertain regarding the market acceptance, and lack of legal regulations further inhibits the growth.

During the period of stay at ApParkingspot, several applications were made to startup competitions. The concept of shared parking was highly welcomed than expected, where the startup was selected in top 300 at an event named Wolves Summit, Poland, top 3 in Di Digital Startup Tour in Skåne region and top 10 in Nordic road show (ApParkingspot, 2018). Altogether, the journey at ApParkingspot has been challenging and learning. For the growth of the startup, a collective action is essential which drives new norms, regulations, technological upgrades, and practice in favor of niche innovations (Klitkou, Bolwig, Hansen, & Wessberg, 2015).

6. DISCUSSION

MaaS can be attributed to bring transition in transportation with sustainable benefits (Sochor, Sarasini, Arby, & Karlsson, 2017). This transition can be realized as socio-technical transition towards a new socio technical system, where the targets are defined in the section 'Road transportation goals', which is applicable to the city of Gothenburg. At a deeper level, the transition includes the detachment of car ownership and motivating commuters to follow sustainable travel practice like using public transportation (City of Gothenburg, 2014).

Therefore, the research investigates a novel concept (integration of shared parking with public transportation) by the application of different theoretical aspects, which could bring radical innovation resulting systemic transition. With scope limited to the city of Gothenburg, the research attempts to investigate,
(1) How can the combination of shared parking and public transportation fulfill the user needs and preferences?
(2) How do key stakeholders respond to an evidence-based understanding of user needs and preferences regarding the combination of shared parking and public transportation?

To answer the thesis questions, the research attempts to understand the user's current travel preferences and challenges (car driver and parking holder). It has been presented in the form of value proposition canvas, which also highlights the value created by the hypothesis to specific customer segment. The following section further discuss about the insights drawn from literature review and semi-structured interviews conducted with key stakeholders. In addition, the insights gained from the workshop where stakeholders evaluated the hypothesis and evidence are discussed below.

The new mobility service which can be considered as a niche innovation has been developed with the guidelines of Multi-level perspectives (MLP) and 'vision' set by backcasting principles because both believed to lead to the path creation for sustainable transition (Geels F. W., 2005, Holmberg J. , 1998). Initial development of the new mobility service as niche innovation, is bound with experimentation until stabilization (Sochor, Sarasini, Arby, & Karlsson, 2017). However, it is important to understand the dynamics of the current regime with respect to transportation, which pose major barriers for transition. With persistent innovation and practices: car, public transportation, and parking strongly diffused to form a formidable regime.

Undoubtedly, car has dominated the travel community than any other modes, which is reflected in the customer's travel behavior. This is further supported by sunk investments in transport infrastructure (Geels, Kemp, Dudley, & Lyons, 2012), regulations, supplier and consumer networks, and practices (Klitkou, Bolwig, Hansen, & Wessberg, 2015). However, referring to other benefits owed from car use (figure 16) it is extremely difficult to replace private car ownership even with services which can offer similar characters.

The other regime of the transportation system is public transit services (Hoogma, Kemp, Schot, & Tuffer, 2002). Although it is characterized to provide commuting service, there exists a distinct

gap in benefits from using private cars, car sharing services etc. The planning and policies for the public transport services have always focused on dense areas like city centers with higher frequency of commuting options than sub-urban areas. Thus, the system is designed with timetabled and limited services (Hoogma, Kemp, Schot, & Tuffer, 2002). The ticketing system has been updated with modern digital technology to provide easy access of tickets to passengers. However, the price models have not been updated which is fixed at any time of the day unlike in mobility services implemented with dynamic pricing (Potter, Valdez, Cook, & Anders, 2015)

Parking has gained considerable importance in recent years, which is influenced by car growth and parking norms. The availability of parking has been embedded in citizen's travel practice due to the traditional regulation of building minimum parking numbers. In addition, the residential building is locked into a regime of parking regulations to build minimum parking (interviewee 1). Construction of residential parking is expensive (Roth, Larsson, Styhre, & Koucky, 2017) which is turning out to be a loss for the builders, however, they are forced to build probably due to the inflexible regulatory framework (interviewee 1). Further merging of parking prices with apartment pricing and subsidizing the costs have been a major lock-in for parking company which could be the reason for driving the car ownership.

The above factors describe the societal lock-ins that are resisting for transition. The stability in the existing regime is the result of interaction between these factors or heterogeneous elements. Transport infrastructure and policies are regulated by local/regional municipality, institutions and individuals adapt to these regulations, where car travel becomes an integral part of the business, user behaviors align accordingly and this adaptability for car driven regime from societal groups attract the manufacturers (Geels F. W., 2002). These activities when align and co-ordinate with minor adjustments lead to a stable regime offering incremental support towards innovation (Geels F. W., 2011). In addition, use of a car is not just the rational choice although it's an "affordable asset", but the users have an emotional, aesthetic connection with cars. The feeling for the car has been embedded in our social and cultural practices (Sheller, 2003).

From stakeholder workshop it was noted that the resistance to change is also due to the organizational commitment towards providing consistent positive value and satisfy their customers and there exists fear of losing the existing customers in course of transformation. Thus, the opportunities from business model innovation or change is forgone to restore the existing commitment (Lund, Kerttu, & Koglin, 2017). On the other hand, from analyzing the customer travel needs, it would be practically impossible to stop their car use overnight with radical regulations, however, allowing them to personalize their trips with limited car-based travel could result in gradual behavioral change. Therefore, with envisioned goals in place in the city of Gothenburg, several pilots are underway experimenting various MaaS business models for behavioral change. Likewise, the proposed hypothesis, a niche innovation which emphasizes private-public collaboration could overcome the regime barriers resulting in transition towards reduction of private car ownership and resource efficiency.

(1) How can the combination of shared parking and public transportation fulfill the user needs and preferences?

User travel needs:

From the research, it can be argued that several forms of urban characteristics influence the travel behavior and transport choice, particularly when the regime is embedded with traditional dynamics of car, public transport, and parking. A modern citizen wants to access all the places in a short-time, and this highly influences the travel mode and behavior. The results show that some of the factors like residing location, the location of work, purpose, and personal attributes influence the travel mechanism. The tendency of choosing a travel mode is highly influenced by the location of residence in relation to the purpose and location of the facility. If the location of the facility is concentrated with multiple facilities like work, shopping, leisure etc. then it could influence the commuter to use the car to these facilities also to access surrounding facilities or meet their purpose.

The research revealed with the evidence that car is preferred as a personal asset. The main purpose of their travel is to work and shopping. It can be noted that the cost of living in the city center is probably expensive than living a bit away from the dense urban area. Therefore, living away from the center and owning a car provide them the flexibility to travel and access the city center or facilities when necessary. Along with these factors, personal attributes play key role in the choice of travel mode. The questionnaire further revealed that the respondents living in city center generally walk, cycle or use public transportation to their work which slightly reduced the car use in the city, but was compensated by using the car for shopping, leisure activities, and weekend travel. In contrast, people residing in the suburban region preferred car to work over other modes. But they preferred to use public transport and bicycle for short trips and shopping.

The key attribute of using car was convenience, flexibility and fast travel. A key aspect to be noted is privacy and comfort is less valued than other benefits which is reflected by choosing public transportation as their second preferred mode of travel. This signifies that there's an opportunity to provide a new mobility service. A certain set of respondents even commented that they are willing to change their travel behavior if the above-mentioned attributes are met. Altogether, the citizens need a well-connected mobility service which is economical, fast, convenient and eco-friendly. Public transportation plays an important role in providing this service. Currently, public transportation is more efficient and easily accessible in dense urban areas than suburbs. But lack of last mile solution forces the use of the car. Further low frequency of public transport, high priced tickets and high travel time could be other reasons for the commuters (questionnaire respondents) to use the car. Expanding the public transit services beyond certain boundary may not be economically viable due to low frequent users considering most of them already own cars. Therefore, the change from car use to public transportation is not radical but a gradual process possible through right incentives and services.

Another concern is parking in the city. The city parking has been considered expensive by commuters resulting high expenses for car users but still prefer to use them, which explains that

commuters perceive the benefits of the car over its externalities and expenses. Moreover, the low availability of parking has resulted in queuing further resulting congestion. In contrast (Interviewee 3) state that the public and residential parking garages are less occupied which is due to affordable on-street parking. It can be derived that the on-street parking is on high demand due to its cheap prices, thus leading to inefficiency in parking garages. Also, the restriction for the public to use private parking results in low occupancy. Further, from the environmental perspective, a residential parking is expensive to build and contribute to GHG emissions (Roth, Larsson, Styhre, & Koucky, 2017). Therefore, shared parking could potentially contribute in improving the parking efficiency and reducing the need of unnecessary parking.

Alternative service to meet users' travel needs

The core of a business model is to satisfy the customers and meet their needs (Osterwalder & Pigneur, 2010). Also, when developed at niche level with experimentation, the business models are ought to create legitimacy to stakeholders (Sarasini, Arby, Curtis, & Vanacore, 2017). However, in case of MaaS, along with the creation of legitimacy, the business models are influenced by the user behavior and vice-versa. Therefore, value proposition plays key role in mapping how the service will benefit the user and meet their needs (Sarasini, Arby, Curtis, & Vanacore, 2017). In this case, with the aim to reduce private car use, the value proposition is to access parking and public transportation in a single platform. But the parking is in one of the shared spaces than regular parking.

This research reveals that, the user (respondents) prefer to use car for the following key benefits: convenience, flexibility and fast travel basically to work, shopping and leisure activities. To meet these needs and alleviate their pains, balancing of supply and demand of parking spaces is essential. Hence, sharing of several parking spaces, allows the user to book an affordable parking and generate savings from not parking at high parking space, avoiding roads with high congestion tax, also fuel by not cruising. At the same time, sharing their parking could generate income and further reduce the travel expenses. Moreover, it can be noted that nearly 75% spend 5-10 minutes in searching parking which can be saved when the provision of reservation is provided. This consequently reduces the respective tailpipe emissions and congestion. In addition, the provision of buying public transport tickets in the same application, allows the driver to reach any corner of the city without the need of driving till destination. Nevertheless, prior planning of the trip would be necessary, particularly when commuting to work.

Further with the technological innovation like instant and real-time updates of parking locations, navigations system, cashless payments and online accessibility to the parking could make the journey much easier and smoother. Thus, freedom or flexibility to choose allows the user to access multiple parking locations and public transport which would've been difficult otherwise, therefore, inducing social inclusion. However, from the perspective of time it is uncertain if the hypothesis would save or increase travel time. Hypothetically the time wasted for searching parking could be compensated with changing the travel mode thus more or less the travel time remains same. However, the research does not discuss about the practical problems associated with the travel. Nevertheless, around 53% of the car users and 48% of the parking holders

(respondents) welcomed the concept and few were uncertain due to probably limited information and benchmarks.

Hypothetically the combination of shared parking with public transportation seems interesting to the respondents and could induce behavioral change. The change is also influenced by the value created, captured and delivered by new mobility services (Sochor, Sarasini, & Arby, 2017). For example, in this case economic value can be generated for parking holders/real estate owners without upfront investments. Business model innovations in the platform like pay as per usage, or subscription-based models (for example: Whim offer both) (Hietanen, 2016) could attract more users.

MaaS proponents state the possibility of 'rebound effect' in mobility services, where some users could make a modal shift from 'only public transportation' towards 'combined service' (Holmberg, Collado, Sarasini, & Williander, 2016). Similarly, one could argue that the availability of multiple private parking locations could trigger the use of car. It could possibly draw more cars initially; however, it stimulates a change in behavior towards shared space, which could gradually reduce the public parking/on-street parking demand. In addition to providing services, it is important to offer incentives to attract the users (Sochor, Sarasini, & Arby, 2017) (*For example, A combined ticket for shared parking and public transport or a discounted public transport ticket for using a particular shared parking spot/area if public transport is used for a certain number of times.)*

Current user practices are the result of several years incremental growth, thus it is one of the key elements of socio-technical regime that needs to be overcome (Geels F. W., 2011). Technological innovations such as dynamic pricing, real time traffic and parking data (Dotter, 2016) could induce further change in user behavior (Geels F. W., 2011). It is unlikely to experience a radical transformation from private car ownership towards new mobility services (Durand, Harms, Hoogendoorn-Lanser, & Zijlstra, 2018). Because the shift is an incremental process where "technology, market and user preferences co-evolve" where users must adopt the new practices, routines which involves several iterations and learning (Geels F. W., 2011). Therefore, the change towards sustainable mobility or new mobility services in terms of time and direction is still unknown and remains uncertain (Durand, Harms, Hoogendoorn-Lanser, & Zijlstra, 2018).

(2) How do key stakeholders respond to an evidence-based understanding of user needs and preferences regarding the combination of shared parking and public transportation?

Institutional barriers

At regime level, various institutions like private, public play key role in developing combined mobility services (Mukhtar-Landgren, et al., 2016). It can be initiated by a private firm, but a collaborative framework is necessary to materialize the business. It may be challenging to understand the dynamics of the collaboration at initial stages, but the idea is to think unconventionally about essential future regime and stimulate the cooperation than enduring to the existing one (Holmberg J. , 1998). Particularly true in this research hypothesis, where the cooperation between private parking holders and public transit provider is essential. In addition,

the role of public transport is crucial in scaling the service (Holmberg, Collado, Sarasini, & Williander, 2016). However, barriers exist from both the parties, as shared parking and public-private collaboration is fresh concept.

Lack of scientific evidence was the key barrier raised by several stakeholders in the workshop, which would hinder the management to accept the idea. Unless a pilot study is conducted it would be uncertain about the hidden costs, practical problems and customer acceptability. It was agreed that the traditional semi-coherent rules that are inflexible and followed for several years has been embedded in the organization and societal behavior, resisting change. For example, the subsidization of parking costs with apartment prices has been embedded in the organization's operation which is nearly nondetachable. Furthermore, the lack of supporting regulations in transportation sector is main setback for the development of new mobility services.

The stakeholder from public transit provider, although appreciated the idea of selling public transport tickets in combination with shared parking, the key concern was the lack of regulations in their operation system regarding the allowance of buying public transport tickets apart from their application. Further the stakeholder from parking company (Interviewee 1) stated that the existing operating system is incompatible and inflexible to adopt the new way of parking and could lead to high administrative costs for the modification of the system. This illustrates the resistance towards business model innovation, even when the stakeholders were aware of travel issues.

This inertia to change can be derived from transition theory, where the regime is embedded with cognitive rules (Nelson & Winter, 1982), directives (Unruh, 2000), policy, industry practices, user practices, institutions, culture, technology and various characteristics of social groups (Geels F. W., 2002). Inertia due to traditional business model can be regarded as one of the key elements embedded in the socio-technical regime (Bidmon & Knab, 2014). These business models continue to resist changes in different ways. And any innovation in the field could lead reconfiguration of routines and regulations of all the stakeholders in the network (Matthyssens, Vandenbempt, & Berghman, 2006) and demands new set of regulations especially in firms that tend to integrate mobility services (Sarasini, Markus, Karlsson, Strömberg, & Friman, 2016).

Niche innovation

The current landscape externalities like urban congestion, emission and other environmental problems are the result of earlier mentioned factors of existing regime. When these levels interact within the nested hierarchy, leads to the creation of 'windows of opportunity' for niche innovations like MaaS, integrated mobility service etc., in transportation (Geels F. W., 2002), thus the hypothesis.

The hypothesis is intermodal travel, realized by combining shared parking with public transportation, which emphasizes the private-public partnership. A research states business model innovation enables the sharing of own private/public assets via the digital platform just like public authority enabling access to buses (Sarasini & Linder, 2017), private individuals providing access to their home (Airbnb). Likewise, property owners can allow private individuals to access

their parking. However, in this partnership between private and public organization, their respective roles are decisive which may result in trade-offs in terms of economic, social and environmental aspects (Holmberg, Collado, Sarasini, & Williander, 2016). Also, in the new form of collaboration, business models could be considered as one of sources of inertia (Sarasini & Linder, 2017). Therefore, in some cases, proving legitimacy is essential to meet the respective transport goals and acceptability by various societal groups (Sarasini, Markus, Karlsson, Strömberg, & Friman, 2016).

In this case, the business model innovation is to provide the possibility of online booking of shared parking space with an incentive for buying public transportation tickets as add-on service. Hypothetically this supports one of the backcasting principle “what changes, both over time and cultures, are not the needs but the forms or the means by which these are satisfied” (Holmberg J. , 1998). Referring to MaaS, the hypothesis could meet the travel needs with the following benefits:

To stakeholders:
1. Efficient utilization of residential parking space
2. Encouraging car users to travel using public transportation

To car users:
3. Easy availability of parking space reduces cruising in the City
4. Reduced time and fuel
5. Revenue generation from underutilized parking

And the sustainability vision
6. Reduction of traffic and emissions caused by the car.

With possibilities to reduce the car driven miles and increase in public transportation use, the hypothesis with backcasting guidelines could potentially lead to the envisioned regime of reduction of private car ownership and resource efficiency. This was agreed by the stakeholders who were present in the workshop (Results section 5.4). Also stated that it’s an opportunity to integrate other mobility services like car sharing, bike sharing etc. With technological improvements in the field of shared parking could allow the measuring of parking pattern and actual users, which then the property owner can estimate the required parking numbers in their future projects. Upon which, they would be able to save building of unnecessary parking in turn saving respective resources, emissions and costs.

Most importantly, according to the stakeholders from the workshop, shared parking could lead to partnership with public parking company and public transportation where the former could benefit with addition of more parking spaces to their portal and latter with new customer base from car segment. However, stakeholders (from public parking and public transportation) mentioned incompatible application and business model. This is particularly true for combined mobility services, and thus business model innovation could propose the alteration of the associated firm’s traditional regulations that eliminate institutional barriers (Sarasini & Linder, 2017).

This transition in the traditional business model towards a sustainable vision is possible at firm's level, when associated organizations take voluntary actions to include social and environemental problems (Schaltegger, Lüdeke-Freund, & Hansen, 2012), altering culture and routines of the firm (Boons & Lüdeke-Freund, 2013), increasing collaborative networking and learning programs, and defining framework for change with new vision and concepts (Roome & Louche, 2016).

6.1. Sustainability Benefits of Combining Shared Parking and Public Transportation

This research proposes business model innovation to deliver sustainable value to relevant stakeholders, users, and society.

Sustainability dimension	Potential Value generation	Potential beneficiaries
Economy	➢ Manmade infrastructure (residential parking space) will be shared and efficiently utilized. Thus, limits the unnecessary construction of parking infrastructure. ➢ Reduces burden on public parking thus land availability for urban development. ➢ Shared parking is flexible and adaptable to changes in future transport system and regulations. ➢ Almost zero investment from the residential builder and public transport authority. ➢ Income generation by sharing the vacant residential parking space. ➢ Short term income benefits with also consistent revenue for builders and tenants. ➢ Revenue generation for public transportation with the expansion of the customer base. ➢ Increased occupancy of public transit services. ➢ Affordable travel/parking prices for the public without disparity based on individual living status. ➢ The sustainable business model enables transparency and fair distribution of revenue among the supply chain.	➢ Residential building company ➢ Public transport provider ➢ Public parking company ➢ Tenants ➢ Car users ➢ Third party service provider

Social	➢ Residential parking will be open to all car users irrespective of their identity. ➢ Similarly, sharing can be performed by any individual who owns/rent parking in the City. ➢ Freedom of movement is achieved with equal accessibility to parking and public transportation. ➢ Enables movement and accessibility. ➢ Development of trust and respect in the transport community by sharing. ➢ Easy booking and affordability reduce the stress to find a parking space ➢ Reduced stress levels due to less driving ➢ Attractive and healthy neighborhood	➢ Public ➢ Car users ➢ City planners
Environmental	➢ Eliminates the emissions caused by constructing parking due to reduced demand. ➢ Decrease in the amount of car travel results in lower emissions and congestion. ➢ Increased occupancy of public transportation leads to better mileage i.e., reduced energy consumption per capita. ➢ Decrease in the use of parking construction related resources due to the efficient use of existing parking spaces.	➢ Public (pedestrians, cyclists) ➢ Car users ➢ City planners ➢ Parking company

Table 10: Sustainability values

7. CONCLUSION

The city of Gothenburg is in the state of transition towards a fossil free city, guided by sustainability principles towards the climate targets. The transition towards new socio-technical system cover various dimensions of the society with transportation as one of the key sectors under the umbrella. Drawing insights from backcasting principles and multi-level perspectives the thesis emphasizes on mobility as a service (MaaS)/Combined mobility service (CMS) in the form of shared parking with public transportation as a niche innovation, which could result in sustainable transition towards the reduction of private car use and foster public transportation.

With an aim to analyze the feasibility of the new mobility service, the research utilizes various qualitative methodologies to investigate the customer travel needs and further validation by multi-stakeholder perspectives. The application of Multi-level perspectives reveals that the transition is not smooth, it is hindered by socio-technical regime like institutional barriers, user behavior and semi-coherent regulations built around car, public transportation and parking.

It was identified that car continues to dominate personal mobility because of the benefits like convenience, flexibility, quick travel and comfort, although respondents agree to the fact that it is expensive and environmentally unfriendly. Other key finding is the reduction of parking spaces and increase in parking charges in the city as a part of city's transition strategy which is believed to benefit in reducing car usage but could also increase cruising time for parking. However, the respondents are aware of the landscape pressure and importance of sustainability, thus they partially appreciated the concept of shared parking with public transportation and are willing to change their behavior for environmental good. This illustrates that the shift is possible, and commuters are feeling the need of sustainable transition but as stated by Geels F. W., (2002), the change is incremental where the behavior, innovation and market coevolve with several iterations and learning. And there would be a trade-off between the value delivered by the mobility service and value perceived by the user. However, experimentation of business model innovation of emerging services is essential that can harness environmental and economic benefits.

Besides, to break the existing regime of car ownership, a radical change in the nested network of actors and regulations are necessary. Stakeholders appreciated the hypothesis as a unique combination that could promote the use of public transportation and parking efficiency. But organizational regulations, inflexible business model, and incompatible operating system were raised as key barriers for further development. Thus, research highlights the need of reconfiguration of organizational routines and regulations to accelerate the sustainable transition.

Further in a nutshell, the thesis and participants of the research believe that shared parking has huge potential to contribute to the process of transition. However, lack of scientific proof on the hypothesis and limited research on public-private collaboration is regarded as a huge setback, nevertheless, underutilized parking spaces are undoubtedly a significant resource to explore. Further eliminating the barriers for public-private collaboration and business model innovation, could lead to open and inclusive mobility ecosystem, where shared parking could turn out to be major part of integration.

7.1. Implication for Practitioners

The research proposes a hypothetical perspective of integrating shared parking and public transportation presenting the value generation through the value proposition canvas to meet urban commuter needs and societal goals. One major implication is that the scope of the thesis limits the value proposition canvas to account only the hypothetical value of the concept but lacks the practical aspect and the role of remaining building blocks of the business model. Therefore, a detailed study of all the building blocks of a business model is essential for further development. Further, this provides an opportunity for a pilot study which can facilitate collaboration between new actors and public authority. The pilot could include the development of a digital platform to integrate shared parking and public transportation ticketing. Further collaboration can facilitate the addition of other parking from hotels, business areas, commercial centers etc., as they also constitute to a substantial amount of land in the city.

To attract a wide range of users or to provide end-to-end mobility service; car sharing, car-pooling, and bike sharing services could be interesting to explore. Considering the growth of electric cars and supporting incentives by the government, sharing the parking along with electric chargers could be captivating for practitioners. Further business model innovation could include rewards, referral schemes, subscription models, eco-drive information, discounts on commercial products etc. However, the pilot could be a medium- or long-term study. Short term developers could emphasis on designing a business model for new mobility service that can capture sustainable value in consideration of practical barriers and risks. Some of the barriers could be to convince real estate companies to share their parking, diverting car users to use the new service from their regular pattern of traveling and uncertainties like rebound effect of using more car should be dealt carefully. Also, safety could be a major concern from car user and parking host perspective when parked in a private property.

Further research provides an opportunity to design new communication models, channels that can deliver sustainable value to the user and society also by capturing direct or indirect forms of revenues for the stakeholders or service providers. In addition to developing a business model, technical aspects of accessing the shared parking spot, online management of transaction and accessibility, and facilitating automated sharing of parking through automation could be more interesting to research to make the service efficient and convenient.

In general, a holistic approach of the study would reveal how a business model can create, capture and deliver the sustainable value of new mobility service. This would allow the practitioners to act as experts in broader context who can contribute to creating legitimate conditions for innovation to flourish.

7.2. Implication for Governance

Designing an efficient urban mobility is challenging and one of the most pressing issues in recent times. Expansion of public transportation to support the local movement has been a way of facilitating movement in cities in Sweden (City of Stockholm, 2012). However, can the addition of new trams and buses solve the transportation problems like growing demand, last mile problem and congestion issues? Another challenge is, can it compete with shared mobility, which offers personalized services and dynamic pricing?

Recent research shows that there is clear trajectory towards shared mobility services offering b2c, b2b yet haven't managed to capture the transportation market (Audenhove F. J., Korniichuk, Dauby, & Pourbaix, 2014). Also, with the emergence of new players, it is often difficult to choose the right service provider. Further, it is important to note, which transportation mode will the new mobility services are replacing. For authorities responsible for transportation, the new services shouldn't threaten the public transport services. Therefore, a coalition between private and public authorities would reflect the shared normative to reduce private car and associated externalities. Therefore, a system level coalition is necessary to identify the right service, which can be later groomed to meet the mobility demands.

The establishment of new mobility services could be supported in various ways by decision makers. One way could be enabling the sharing of government operated parking spaces/mobility assets with the public or local authorities could adopt the shared parking/mobility services in their travel behavior. The change in behavior could encourage the public to practice new mobility services.

Therefore, facilitating a platform for experimentation or conduct pilot projects would boost innovation in new mobility services. Generally, the innovation developed at niche lack financial support to test the services with the potential users. Incentives, tax benefits and funding from the government would encourage the new services to collaborate with a wide range of stakeholders, potential users and public authorities (like Vinnova and Energy agency in Sweden). Further facilitating collaboration between incumbent firms and niche service providers could lead to development of trust among the users and innovation. Also, when various services are integrated with public transportation, could lead to an expansion of the user base without the fear of losing the market share to new services.

Therefore, the role of government is crucial in the growth of new mobility services. The role as an 'aggregator' could increase the visibility of 'new mobility services' operated either by a private or public-private organization and steer a step-by-step transition towards reduced car ownership and sustainable mobility.

8. LIMITATIONS

The research question and aim were defined at the end of the process of Phase one (Appendix), however, the methodology and aim was slightly modified during the research process. Profound research process induced new ideas and thoughts stimulating continuous learning and this influenced the research question, aim, and methodology. In addition, notable effort and time have been put to ensure quality research with the selected research methodology and process, to answer defined questions and aim.

In the research, a new mobility solution or hypothesis has been proposed to the city of Gothenburg to effectively utilize the residential parking space by sharing meanwhile promoting the use of public transportation, thus the scope is limited to the city. As mentioned before, the research utilizes the concept of multi-level perspectives, backcasting, and sustainable business model. In general, sustainable business models are recognized to meet societal goals and generate economic value to the organization. However, no such literature has been found in relation to shared parking in combination with public transportation. Further, shared parking being a relatively new concept, extremely less amount of literature was found and with limited information. Thus, general literature addressing business models in relation to sustainability, new mobility services, MaaS were examined in the research. The key principles, information from limited literature has been incorporated in relation to the research topic and qualitative approach has been followed to provide a fresh perspective on the combination of shared parking and public transportation.

The scope of the thesis has been limited to Gothenburg city, which means that most of the actors involved during the process of thesis, is working or having expertise in the region. During the process of collecting data through interviews, some of the actors were not available due to their busy schedule, if not could've added more value to the research. Further, a dialogue session was the last step of data collection and to understand the stakeholder perspectives, but out of nearly 15 invites, only 7 attended the session. With everyone's presence, much broader perspectives could've achieved. The actors involved during the research were representatives from various organizations, and they provided their personal opinions which may not fully reflect their firm's perspective.

The research is limited to the private (residential) parking spaces and commuters who regularly drive a car in Gothenburg. Realizing Gothenburg has a large amount of residential communities with parking space, the research reflects only the opinions of few numbers of tenants owning/renting parking space. The number of invitations circulated to answer the questionnaire are uncertain and by the end of two weeks, a total of 58 responses were received. Due to limited time frame, this questionnaire was limited for a relatively small number of people. The responses received are assumed to be accurate and true to their travel experience. Further the responses cannot be assumed to reflect the city's perspective but provides a case to develop the new mobility service. The questionnaire results may not be same for another neighborhood of the city and may not reflect the city's behavior as a whole.

Moreover, the questionnaire does not provide the information of the type of car use, kilometers traveled, and emissions from the car, therefore it is challenging to address the climate impact with respect to the proposed mobility service. Further the questionnaire does not reveal the occupancy of car at the time of usage. Interesting point is, if the car is used at full capacity then the climate impact per person is lower compared to single user. Additionally, this study does not focus on the technical aspects of creating a digital platform and its services. However, proposes the possible features in the form of value proposition canvas that could be framed in a digital application.

In general, the hypothesis can be applied to various cities and may vary according to local transportation infrastructure, regulations, and travel behavior and so on. Similar to the developments in major cities, Gothenburg is experiencing landscape challenges like increasing urbanization which is leading to resource consumption, transportation externalities, also technological development, demographic variations, changing travel preferences, and advancements in shared mobility. Other reasons to choose Gothenburg are several pilot studies regarding mobility services are in process, with regional and national authorities favoring the growth of innovative services. Moreover, public transportation being the main transport mode of the city has involved in pilot studies to investigate the role of mobility services. Thus the research concludes that this qualitative research can be further developed to bring necessary sustainable transition in urban mobility.

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APPENDIX A PHASE 1

10. CHALLENGE LAB

The Master thesis is conducted at Challenge Lab, which represents a neutral arena and a source of innovation. This lab was started in 2014 in collaboration with Chalmers University of Technology to merge the three key knowledge sectors research, innovation, and education in order to bring sustainable transition in the society by focusing on sustainable challenges rather than technological needs. To achieve a sustainable transition, students from multiple backgrounds are chosen who can focus on five regional clusters: Sustainable mobility, urban future, bio-based products, maritime future and green chemistry (Holmberg J. , 2014).

The five regional clusters are represented by triple helix actor from public, private and academic sector (figure 25). Triple helix actors bring in their individual and institutional knowledge to drive the innovation and societal changes at different stages (Holmberg J. , 2014). Therefore, the lab provides a platform for students to identify leverage points within five regional clusters which are further investigated in collaboration with triple helix actors. It is believed that the students are considered as neutral agents who can engage the stakeholders to act in a collaborative approach enabling *two-way communication* (Holmberg J. , 2014).

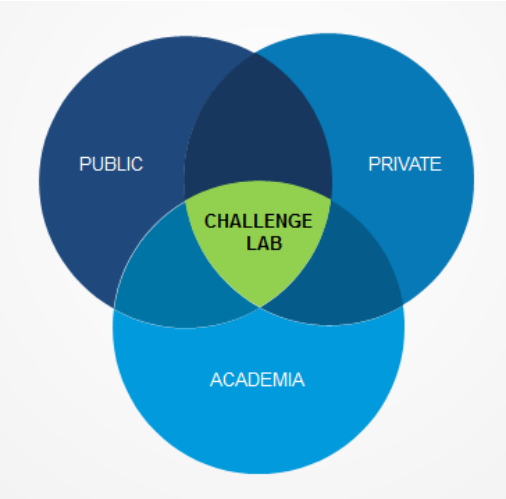


Figure 2526: Triple helix actors

The sustainable transition is a complex action consisting of persistent problems in society that can be tackled with long-term plans through a certain set of networks and decision-making processes (Loorbach D. , 2010). This is where the lab plays a vital role in educating the students with the necessary leadership skills and creating a platform for identifying the societal challenges and developing strategies.

10.1. Structure of the Lab

The objective of the lab is to build a platform for triple helix actors and students who can take the challenges from five regional clusters, meanwhile strengthening the educational dimension within the area of advance. The students are of value in the society because of their non-threatening nature and position them in building trust between relevant actors.

The Challenge lab in 2018 is being headed by the examiner, co-coordinator and two Ph.D. representatives. The Master thesis always starts in the spring semester, 15 students from 9 different educational backgrounds were chosen to conduct their respective thesis around sustainability. The diverse ethnic, cultural and educational background of students enabled a wide range of perspectives on sustainability challenges unlocking a path for innovation. The staffs in the lab provided students with relevant interdisciplinary skills and methods to understand their core life values and sustainability principles.

The thesis curriculum is facilitated by the staff. The layout consists of two phases.

Phase 1: This is 4 weeks process in which necessary methods are incorporated to understand own strengths, weaknesses, and values of life. Students were then grouped based on their interests under three thematic areas: Mobility, urban future, and circular economy.

With continuous research and discussion among the groups and with stakeholders and using backcasting approach students identified set of critical points in the current system to intervene. In an iterative process, each individual narrows down their interests and finalized one leverage point to form a research question. During the process, several leverage points were discarded based on discussions and interests of students, who think the chosen leverage point has high potential to create a difference in the system.

Phase 2: This stage is 16-week process which starts with the process of finalizing the area of interest and research question. Supervisors are allocated based on respective interests and research topic. Further iteration on the research question may be necessary, considering the valuable inputs from the supervisor.

With research question in hand, appropriate methodologies are identified to conduct the research. To attain insights on the research question, a qualitative study is conducted which incorporates literature review, semi-structured interview with stakeholders, questionnaire to collect user travel preferences and stakeholder workshop. The collected information is further mapped, examined and strategies are developed and framed to answer the research question.

11. THEORY

Earth is designed to shelter life with abundant resources. But we humans have consistently extracted and exploited the eco-system for the betterment of humanity. However, the consequence is threatening the human life and other species which is now demanding immediate action to establish a set of principles to tackle this global problem and shape the future.

Prior to understanding the backcasting process, research presents sustainability principles, as I believe it provides basic knowledge of sustainability in order to understand the backcasting process later.

11.1. Sustainability Principles and Criteria

The first three principles are formulated to alleviate the eco-system (Holmberg J. , 1998):

1. “The components extracted from earth crust must not accumulate in the ecosphere.”
2. “The components produced by the society must not accumulate in the ecosphere.”
3. “The exploitation of the eco-system must not deteriorate the physical conditions such as production and diversity of the eco-system”.

The next principle focuses on utilization of resources (Holmberg J. , 1998):

4. “We must use the resources efficiently and with respect to meeting the current generation needs also protecting the resources for future needs”.

These system conditions were introduced in a general fashion but can be applied to a wide range of sectors such as petroleum industry, mining, and infrastructure industry, and many more to save the biodiversity.

It is necessary to implement these principles in society and change the traditional pattern of lifestyle and behavior. To create a sustainable society, we must value eco-system, resources and human life (Holmberg and Robert, 2000). Four important socio-ecological factors have been set up by the experts which indicates societal and environmental goals.

After introducing system conditions for sustainability, we were given the task to investigate the criteria for sustainable future under socio-ecological principles. Four groups were made each representing different factors given by Challenge lab: Well-being, social, ecological and economic. Identifying the criteria implying these socio-ecological factors was an interesting but tedious job because of each student representing a different culture, lifestyle, and education which influenced their preferences.

A. Well-being

The basic concept of well-being is survival which involves health, food, shelter and consistent pursuit of feeling happy with less pain with other supporting factors such as autonomy, subsistence, feeling of belonging or acceptance, and purpose of life.

Ryan and Deci (2000) state that the well-being of society could be influenced by external factors like societal and political structure, freedom, opportunity, family and being with our loved ones. All these endeavors thrive to achieve a better quality of life. It could be either subjective or objective depending on how they value their lives and external conditions. Certain internal elements such as values, beliefs, principles, and goals also define the status of well-being.

B. Social

We categorized social sustainability into three main sections: Horizontal relations, vertical relations, and equity.

- Horizontal relations represent communication between groups and individuals. Certain factors which constitute this communication are creating openness to build trust, empathy, respecting each other and their choices.
- Vertical relations imply co-operation and interaction between institutions. The relationships between firms create healthy competition making them aware of their ethics, accountable for their activities. They induce trust and transparency in the system.
- Equity indicates legal and normative rights for providing equal opportunity and impartial society being unbiased towards gender, race, and status. Other factors include personal, religious and spiritual freedom, access to education, safety, public spaces and feeling of social inclusion.

Social sustainability also implies the societal relationship with the individual, business relationships with customers, employees, vendors which impacts on firm's profitability. In addition, it emphasizes human rights, empowerment, and equality.

C. Ecological

This implies that we must consume natural resources such as crude oil, minerals, land, water, forest products in a sustainable fashion. Few are found in ample amount than others therefore, it is necessary to limit the extraction of scarce materials which can be achieved by implementing circular economy techniques and keep the material flow closed. Similarly, the products produced in the society must be made biodegradable and should be recycled which then constraints the excess extraction and production.

It is imperative to understand that eco-system has limited assimilation capacity; therefore, the natural reproducing properties must not deteriorate by excessive dumping of waste. It is the

responsibility of individuals and organizations to reduce the carbon footprint, disposing of plastic and non-biodegradable products and other harmful effects on the environment.

D. Economic

This implies that utilization of resources should be in a sustainable manner which satisfies the current consumption without compromising the future needs. The responsible investments on infrastructure, resources and long-term planning result in short-term returns and consistent financial growth.

This was classified into four capitals: natural, manmade, human, and financial capital

- Natural: This indicates that natural resources must be consumed efficiently and responsibly that the society, organizations can operate in a sustainable manner and make a consistent profit. Substitutability factor must be considered before harnessing of resources.
- Manmade: The infrastructural development in the society should be well planned to adapt to the current generation as well as future needs. Being flexible and sharing these built resources limits the unnecessary expansion of urban areas and material usage.
- Human: The sustainable technologies and knowledge must be accessible and shared with neighboring communities/countries to build a sustainable society.
- Financial: Economic disparity among groups and individuals create financial and well-being gaps in the society, which hinders economic development and equity in the society. Therefore, structural changes, economic reformation, transparency in the system and fair distribution of wealth must be encouraged.

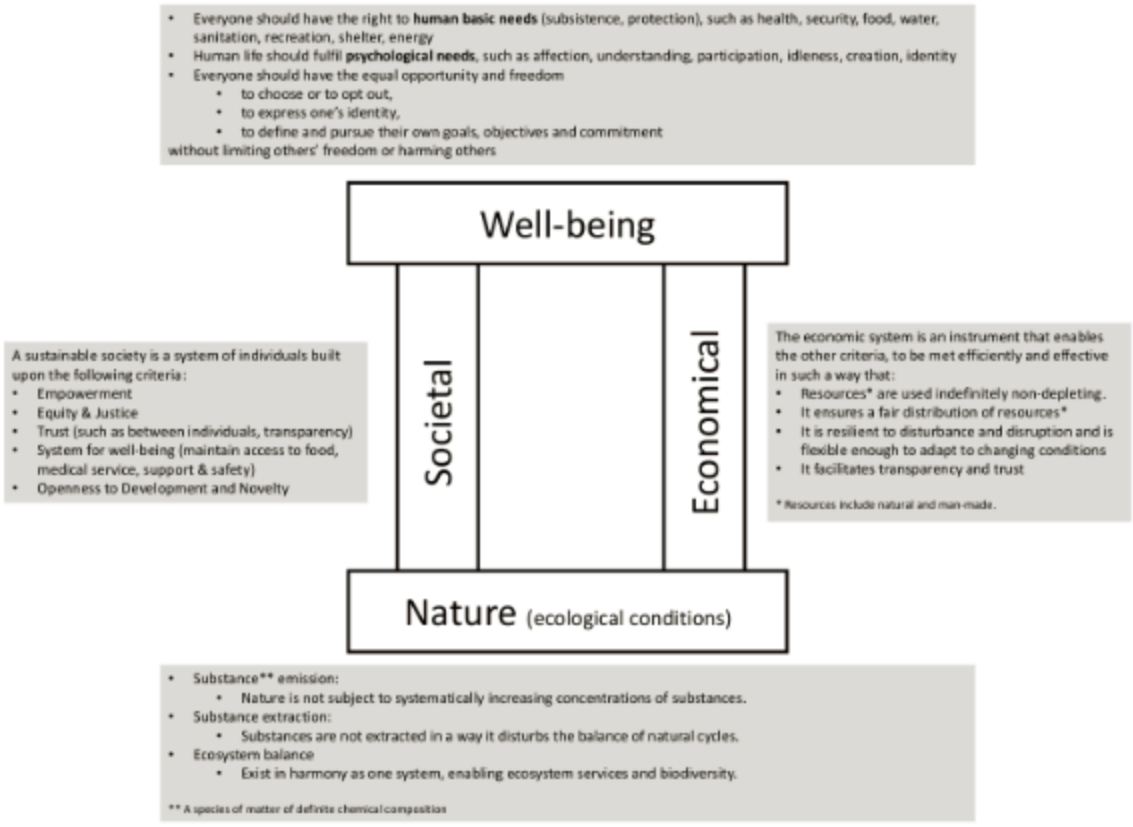


Figure 27: Four pillars of sustainable development (Challenge Lab)

11.2. Backcasting Methodology

The phase 1 started on January 15th, with a vision of identifying the research question. A Backcasting methodology was introduced to explore and identify voids in the current system based on sustainability principles in three main thematic areas; mobility, urban future, and circular economy. The first step was to inculcate the leadership skills and explore one's personal values and aim of life. This was followed by understanding sustainability principles, identifying criteria to define a sustainable future.

Several approaches are followed to distinguish the future based on existing trends and solve complex issues concerned with those trends. The three main ways of predicting the long-term scenarios (Vergragt & Quist, 2011):

"1. Extrapolation of the existing trends towards the future
2. Forecasting, foresighting and strategic scenarios
3. Normative scenarios, desirable future or envisioning the future case" (Vergragt & Quist, 2011):

The most common way to set the pathway is extrapolating the current practices, is often termed as business-as-usual (BAU) (Vergragt & Quist, 2011). This methodology assumes the growth of

certain practices without accounting the possible major changes in the future which is inherently uncertain. The technological, social, economic and cultures are predicted to follow the historical path towards the future. Although BAU illustrates what could happen if immediate actions are not taken, they are usually applicable to short-term scenarios and stable systems (Jensen & Nielsen, 2017). The current World is highly characterized by technological evolution, changing consumption patterns, economic inflation and continuous structural changes in the society and lifestyle with the relentless exploitation of natural resources (Jensen & Nielsen, 2017). The second method forecasts the possible scenarios considering certain uncertainties and changes in society. Anticipating unexpected future may help us to prepare for future but does not avoid facing it.

The current system of analyzing future is based on historical and current trends. Forecasting and extrapolation method of visualizing the future transfer the current problems to the future because it is unlikely to eliminate the current practices, though the transformation is likely to occur in the long run (Dredborg, 1996). In contrast, backcasting is a process to envision the desired future and necessary methods are applied to fill the gap between the current situation and the preferred one (Holmberg J. , 1998)(figure 27). If, the current incompetence continues in the market keeping current actors complacent, results in enlargement of gaps between on-going trends and planned future. Therefore, Backcasting enables us to step away from the existing unsustainable path to attain envisioned goals. This methodology detects the voids in the existing system and demand transformation in the market by creating a platform for innovation and business opportunities and reducing uncertainties (Holmberg & Robert, 2000).

Backcasting is appropriate for certain situations when:

• “when the problem to be studied is complex, affecting many sectors and levels of society;”
• “when there is a need for major change, i.e. when marginal changes within prevailing order will not be sufficient;”
• “when dominant trends are part of the problem – these trends are often cornerstones of forecasts;” • “when the problem to a great extent is a matter of externalities, which the market cannot treat satisfactorily;”
• “when the time horizon is long enough to allow considerable scope for deliberate choice” (Dredborg, 1996)

The process of backcasting is divided into four steps (Holmberg J. , 1998):

1. <u>Define a framework for sustainability:</u>

   The first step is to visualize the desired future and formulate the criteria of the future state. The criteria are independent of the existing trends and focus solely on predicted sustainable future (Holmberg J, 1998) which then enables the possibilities to design strategies to attain the future state. The criteria are defined by acquiring values, leadership skills, and sustainability principles.

2. Examining the current situation with respect to sustainability criteria:

   The existing trends, externalities, market is mapped and compared with the envisioned future state to identify the gaps between the two. By doing so, enables us to understand present sustainable and unsustainable practices and develop alternative solutions and business models (Holmberg J. , 1998).

3. Envisioning the future:

   A deeper understanding of present practices in relation to sustainable future is attained. Detailed mapping of the market is done to identify the gaps/leverage points which allow us to intervene in the system and examine further to bring long-term change. Innovative solutions are developed in purpose to fill the gaps (Holmberg J. , 1998).

4. Building strategies for the future:

   Business models, implementation and collaboration strategies are developed that can change the existing practices and lead towards the envisioned future. Long-term plans with short-term benefits are designed carefully which can be flexible enough to adapt to uncertainties, market trends, and economic inflation (Holmberg J. , 1998). However, strategies must possibly meet the criteria of four sustainability pillars: well-being, social, ecological and economical.

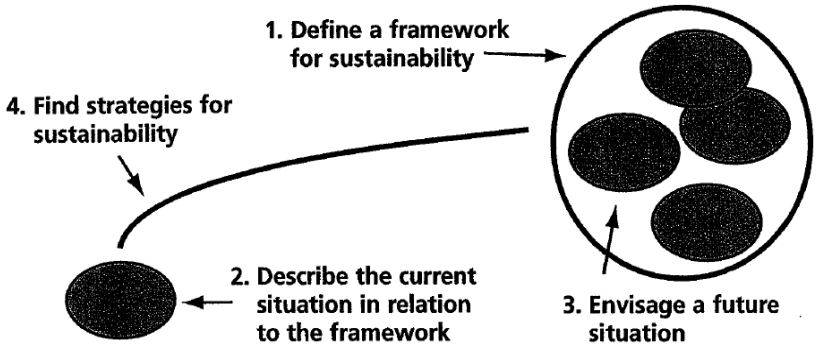


Figure 27: The steps of Backcasting methodology (Holmberg J. , 1998)

During the first phase, students were trained to become change agents within the knowledge cluster. The two key perspectives taught was *inside-out* and *outside-in* perspective.

1. Inside-out: This perspective was to understand our own values, strengths and reflect upon our vision (Ryan & Deci, 2000), (Stewart, Courtright, & Manz, January 2011)). This was merged with stakeholder collaboration and facilitation strategies (Allen & Sandow, 2005), (Isaacs, 1999) where self-leadership qualities led to developing trust within the team.

2. Outside-in: Sustainability principles were introduced along with multiple methodologies like system thinking (Meadows D. H., 1997), and multi-level perspectives (Geels F. W., 2005) to identify criteria to define a sustainable future.

11.3. Inside-Out Perspective

11.3.1. Personal Value and Leadership

This perspective was introduced by a method called *Coat of Arms* which reflected our personality, concerns, the reason for choosing Challenge lab and factors which makes us happy in a pictorial way. This was presented by other which enabled us to know our fellow-mates. This was followed by identifying our core values from a set of values which was then communicated with other students with life examples to understand their perspective on us. This event eventually helped in exploring our self by prioritizing our values, strengths, also induced bonding with students. The game was useful to improve our listening and assessing skills. Later, strength inventory exercise was conducted to make us understand that, overemphasizing a value or strength could turn out to be a weakness and vice versa.

Overall, this self-leadership exercise enabled us to understand our principles. As we participated in the event, we understood our peers, their background, expectations, interests, and skills which further eased group formation. Each week started with check-in where the week's goals, expectations were stated by each student and this was closed by check-out on Fridays to reflect upon individual's goals, challenges in accomplishing the goals and necessary steps were taken in the following week by learning from mistakes. All these events were necessary for building trust, bonding between the students and co-coordinators and highlighting on individual's strengths.

12.3.2. Dialogue

The success of a relationship between humans or organizations is due to the transparency and trust among them (Schnackenberg & Tomlinson, 2014). Similarly, societal growth or transition occurs when actors at different levels interact, share, and support which is possible by creating a healthy environment to think together. Combining political actions, technological innovation and business models in a dialogue would result in tackling the existing barriers, reducing uncertainties, and sustainable transformation (Holmberg J, 2014). According to Isaac W (1999), the growth of an individual and an organization is knowledge and network-based. The potential power of

sharing information and collective thinking is vital for holistic development. Because humans during a conversation; move, oppose, follow or by-stand (Four player model – Presented by David Kantor) (Isaacs, 1999).

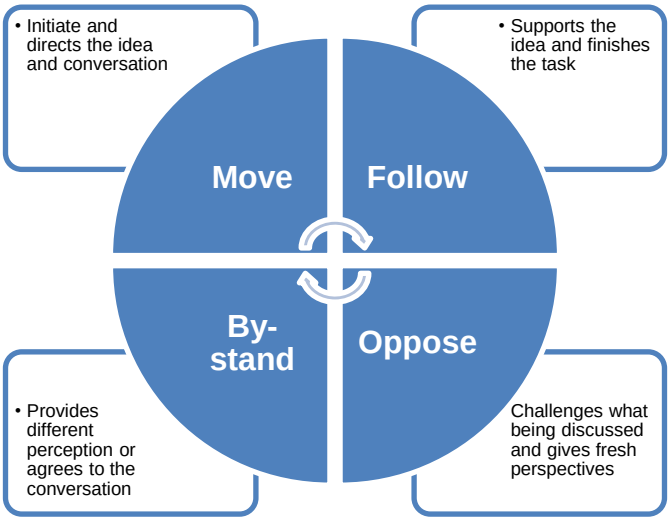


Figure 28: Four player model of dialogue

Listening to or being actively present during the conversation gives numerous amounts of information. Tracking the conversation indicates the quality and relevance of the dialogue to the topic (Isaacs, 1999). Other factors which support the dialogue are bringing own thoughts, respecting and listening to other person's views and sometimes suspending our thoughts to accept the right ones. As one follows these principles, it increases the chances of collaboration leading to new ventures (Isaacs, 1999).

11.3.3. Collaboration: The success mantra

Allen and Sandow (2005) suggest that organizational success depends on how formal or informal are their systems. In the past few years, the structure of an organization has changed, from being centralized to decentralized management practices. Withdrawing the hierarchical system has reduced stress and increased creative level and productivity of the staffs and leads to value-creation. Collaborative work within and outside the organization aims at solving complex issues and is an act of working together by sharing resources, skills, and knowledge (Allen & Sandow, 2005). This environment nurtures social learning and enables achieving envisioned goals.

As a part of Challenge Lab, students invite stakeholders from various sectors to understand societal goals and respective development. Further to establish a successful collaboration, the dialogue begins with listening. This leads to establishing trust among the participants further resulting in higher engagement and innovation (Jewell-Larsen & Sandow, 1999).

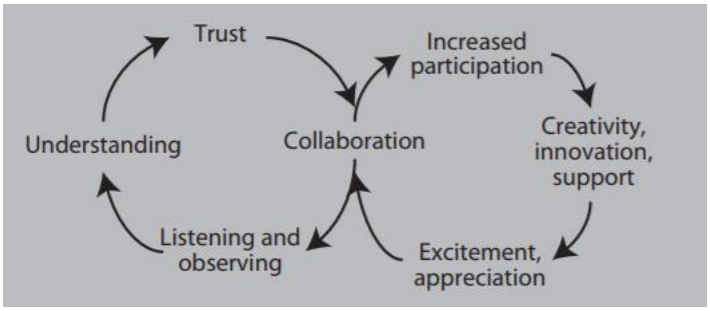


Figure 29: Collaboration begins with listening (Jewell-Larsen & Sandow, 1999)

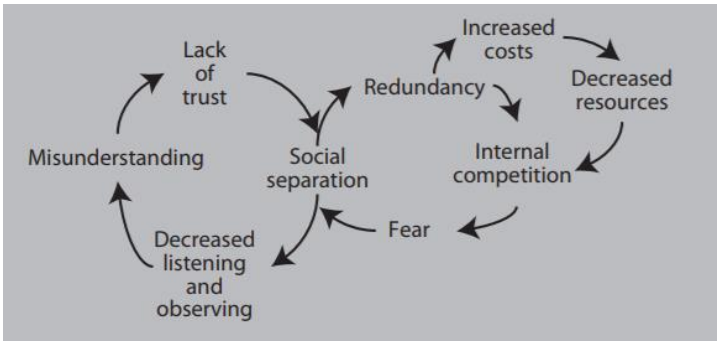


Figure 30: The cost of not listening (Jewell-Larsen & Sandow, 1999)

At the same time, insufficient listening skills would lead to mistrust among participants which results in reduced participation and inefficient management of resources (Jewell-Larsen & Sandow, 1999). Lack of collaborative action diminishes the social value. The presence of formal relationship leads to social separation, a decrease in transparency, and misalignment and often gives rise to unhealthy competition. Therefore, when the creation of social values is followed, it results in reducing the tension which creates business value within the organization as well as outside among stakeholders, government, customers, and suppliers (Jewell-Larsen & Sandow, 1999).

11.4. Outside-In Perspective

The rapid urbanization has given rise to numerous multidimensional problems. These persistent problems include urban expansion, transportation, deterioration of ecosystem, variation in the economy, social life, health-care system, and etcetera (Lemieux, 2016). The rise in inflow of population into the cities has challenged humanity with persistent environmental problems like climate change, depletion of resources, water, and air pollution. These challenges cannot be tackled with business-as-usual paradigm (Jackson, 2009). Confronting these, need necessary structural changes in the system along with technological changes. The structural changes involve modification of certain elements such as markets, policy, consumer behavior, technology representing a wide cluster of sectors (Elzen, Geels, & Green, 2004).

It is argued that, one of the approaches to lead the sustainability transitions is Multi-level Perspectives (Markarda, Ravenb, & Truffer, 2012). MLP structure state that the transition result from increased co-operation and information exchange between heterogeneous actors representing three analytical levels of the market: Socio-technical landscape, socio-technical regime, and niches (Elzen, Geels, & Green, 2004).

11.4.1. Multi-Level Perspective (MLP)

MLP focuses on the interaction between heterogeneous actors which is necessary for the transition in the existing structure (Elzen, Geels, & Green, 2004). The interplay between micro level and macro level market is crucial to bring innovation in the system. The macro level is represented by the *landscape* which is wide and impacts the *regime* and *niche* (Geels F. W., 2005). This level influences the outlook of the society which includes urban infrastructure, economic inflation, political alliance, environmental values, and societal values. At this level, the radical change is almost impossible and typically stresses the regime which further needs long time range to adapt to the new system (Rip & Kemp, 1998).

Regime stands in between landscape and niche market. It is robust and offers very few changes in the system. The actors in this level resist the changes, usually, they optimize their structure according to the availability of technology, policy, market, and behavior incrementally avoiding radical change (Geels F. W., 2005). The actors are also locked in due to preset rules and regulations which disable them to think outside of their scope. This concept is applicable to a range of actors like policymakers, social groups, engineers and political actors (Unruh G. , 2000).

While regimes are known for incremental growth, niches are meant to generate radical innovations. They are shielded against the market inertia and societal lock-ins (Schot J. , 1998) and are incubated by entrepreneurs who seek changes in the market and are supported by subsidies. They are the source of experimenting and learning according to the market needs. They need protection as they work against existing practices or regimes. However, they build custom models understanding the user needs (Hoogma, 2000). Niche is a huge system within itself, because of heterogeneous actors building various strategies and technologies which possess uncertainty. It is, in fact, difficult to predict which innovation will eventually succeed. Various innovation emerge in this market, however, many go unnoticed making way for few designs (Geels F. W., 2011).

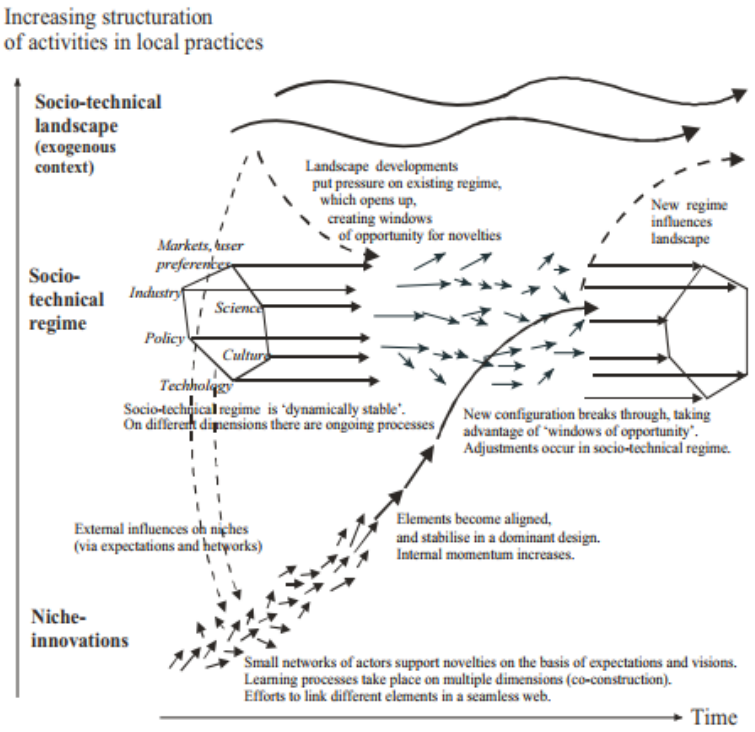


Figure 31: Process of socio-technical transition (Geels F. W., 2005)

The above figure displays how these three levels interact and foster the socio-technical transition in the market. The long arrows represent the incremental change in the socio-technical regime. These changes depend on certain factors like technology, market behavior, policy knowledge, and infrastructure and organization structure. When these levels interact, they result in tensions due to internal dynamics (Geels F. W., 2005). The tensions are represented by shorter arrows revealing uncertainties and divergent opinions. This tension unlatches the opportunity creating a gateway for radical innovation resulting in niche technologies to capture the market share and enter regime level (Geels F. W., 2005). However, due to certain lock-ins and path dependence structure, these niche ideas face a hard time to expand the territory which also demands formidable changes in regulations and infrastructure.

11.4.2. System Thinking

We live in a society which can be termed as a complex system (organizations, economy, City, transportation, an ecosystem and many more). The system is made of various levels of subsystems which interact with each other can be nested within itself (Meadows D. H., 1997). In order to reshape the system (energy, urban infrastructure, and transportation) towards sustainability we must understand how the existing system interact and identify the 'leverage points'. These are the factors, when targeted and redesigned can result in major transformation within the system (Meadows D. , 2009). The process of identifying 'leverage points' gradually unlocks the relationship between various actors, behaviors and characters in the system upon which we can reason the current unsustainable practices and think about better practices.

A system can be described as a set of elements, which are interconnected and interact with each other which takes shapes over a period to display a behavioral pattern. The characters, problems that system possess are intrinsic and are created within themselves (Meadows D. , 2009). When multiple actors integrate, the whole system acts differently for the development of society. However, practically system thinking encourages us to examine the existing inter-relationships between different parts of the society and find the strong connection that can influence the change in the system. At the same time, identifying information flow is key and complex as majority of interaction within the system is exchange of information, which holds the elements of system together (Meadows D. , 2009).

12. METHOD

12.1. Stakeholder Workshop

To get a comprehensive view of existing unsustainable challenges and practices, we (students) were suggested to read some documents like Climate strategy of Region West Sweden, City of Gothenburg environmental program, Strategy for sustainable neighborhood planning, Passenger transport criteria, circular economy, blue economy, design thinking, low carbon transitions, climate goals 2030 and many more. In addition to these we also collected more documents from desktop research and course literature. Most of the documents focused on three thematic areas mobility, urban future, and circular economy. The critical points from the documents were explained to each other which reflected on the dynamic behavior of the society, need of transition, practices harming the society like fossil-based technologies, public behavior, technology, policy lock-ins, and few sustainable developments causing gradual transformation in the society.

As per Challenge lab objectives, it was decided to focus on the local and regional context of these three thematic areas. Students then divided themselves as per their interests in these areas. Then using the knowledge gained from the desk research we identified the external factors or source which are driving the unsustainable behavior in the society, for example increased advertising of traditional cars is one of the rationales for the rise in cars, pollution and congestion in the city. Similarly, each group discovered a diverse set of elements or practices causing pollution, ecological imbalance, unaccountable use of resources and business models upsetting the weather, health, economy, natural resources and society. Further discussions led to mapping out the problems with existing regimes, society, and administration. Some of the examples in under mobility are the use of petroleum fuels, lack of utilization of public transport, inefficient use of intermodal transportation and many more. From urban future perspective lack of building policies and green initiatives, gentrification, inefficient space utilization, and etcetera. Finally, students interested in circular economy identified inefficient use of resources, lack of recycling efforts and technologies, people mindset of using only new products and insufficient regulations.

Additionally, these factors were supported by finding some of the interesting ongoing sustainable projects initiating change in the local region. Such as circular Gothenburg, second-hand markets, sharing city, drive-me Gothenburg, I-Move, carpooling, River-city, urban farming and many more. In the next stage, each of the identified factors was linked to four sustainability factors: Well-being, social, ecological and economical. Afterward, they were grouped under three categories, niche, regime and landscape and factors were merged, ranked and few were removed based their criticality and relevance to the existing system. The challenges were presented to fellow-mates in the form of questions, for example: “how to achieve certain sustainable future (keyword) in relevance with the current conditions (keyword)?”

For example:

Mobility	Sustainability challenges
Landscape (external factor)	How can we explore the possibilities of collaboration between emerging actors competing to gain market share i.e. knowledge and information sharing etc.?
Regime	How do we make space for alternate technologies given that the current socio-technical systems are locked-in with fossil-based propulsion?
Niche	How can we utilize waterways more efficiently concerning that the city is developing around the river i.e. new bridges and still a need for upstream transportation?

Table 6: Sustainability challenges from the thematic area, Mobility

Subsequently, to get a better understanding of the identified challenges, stakeholder dialogue was conducted. The challenges were further grouped based on the stakeholder expertise. The workshop was handled by a facilitator and secretory and interested students participated in the dialogue session. It was conducted in a well-structured manner as per instructions from the facilitator.

Following stakeholders were invited for multiple dialogue sessions:

Sl. No.	Organization	Field
1	First to know	Circular economy, urban future
2	The () Space	Circular economy, urban future
3	Region West Sweden	Climate strategy
4	County Administrative Board	Climate strategy
5	Johanneberg Science park	Urban future
6	Johanneberg Science Park	Bio-based materials and renewable energy sources
7	IVL	Mobility
8	Chalmers University of technology	Mobility
9	Circular Gothenburg	Circular economy
10	Chalmers University of technology	Circular economy
11	Consultant	Circular economy
12	Skjutsgruppen	Mobility
13	Traffic office	Mobility
14	Akademiska Hus, ElectriCity	Mobility

Table 7: List of Stakeholders for the dialogue session

The challenges were discussed with the stakeholders who gave deeper insights on the topic and gave a much holistic perspective on the regimes in these thematic areas. However, the discussion which caught my interest was mobility and urban futures. Several iterations were carried with the group before finalizing the interesting leverage points. During the dialogue, many aspects of mobility and urban future were discussed. Especially developing strategies for fossil free vehicles, ride sharing, Maas and its impacts, misalignments regarding the climate goals between several actors, lack of collaboration in the society, promoting cycling, utilization of urban space and promote densification, reduction of car ownership, policies, blockchain technology, and many more. But eye-catching discussion was about how to plan urban area and accommodate the growing number of cars and change transportation behavior though efforts are made to reduce the car ownership by promoting public transport.

After a series of discussions and presentations, the thesis groups were formed based on their respective interests. Further, the most interesting leverage points were identified by the groups and presented to the Challenge lab coordinator and fellow students with following details: challenge, topic, leverage point, main and connected stakeholders, benchmark projects, and possible supervisor. This was further refined by successive research and discussions which led us to formulate the research question.

13. RESULTS

13.1. Step 1: Defining Sustainability framework

The purpose of the Challenge lab is to foster students as change agents and bring transition in the society. After several months of planning by the coordinators Challenge lab identified a certain set of necessary tools that amplified our view on ourselves and the inevitability of sustainable developments for happy and green World.

The efforts put in the phase 1 period resulted in creating the Coat of arms to formulating a research question. This journey comprised of finding our core values and principles which our life is based on which further stimulated the collaboration between the students who are from different cultural and educational background. As the process of connecting within the group paced, we were introduced to sustainability principles which are needed to drive the World towards a sustainable future. Working in the group, respecting each one's thoughts resulted in trust and respect among the group which further grew stronger and made it interesting to finalize the criteria for a sustainable future.

Four pillars considered for healthy eco-system are well-being, social, ecology, and economy. While developing the framework or criteria we realized that these dimensions are inter-related. The eco-system is the base for other sustainability factors. Society and economy are built on this factor whereas the well-being is influenced by the combination of all these factors. Since the group comprised of students from different educational, cultural and national background, the discussion for identifying the criteria for sustainable future resulted in a diverse set of lists.

The necessity of this act was to understand the global variations in supply and demand of resources due to increasing populations, the disparity in living standards, health, and economy. The ever-increasing use of resources per person has raised the demand bar. But over extraction/production and a limited supply of certain resources has triggered environmental depletion, chaos is living conditions, therefore, insisting to move towards sustainable methods. However, criteria are necessary to envisage a sustainable future and initiate the transformation accordingly.

Figure 3228: Mapping of sustainability criteria 1

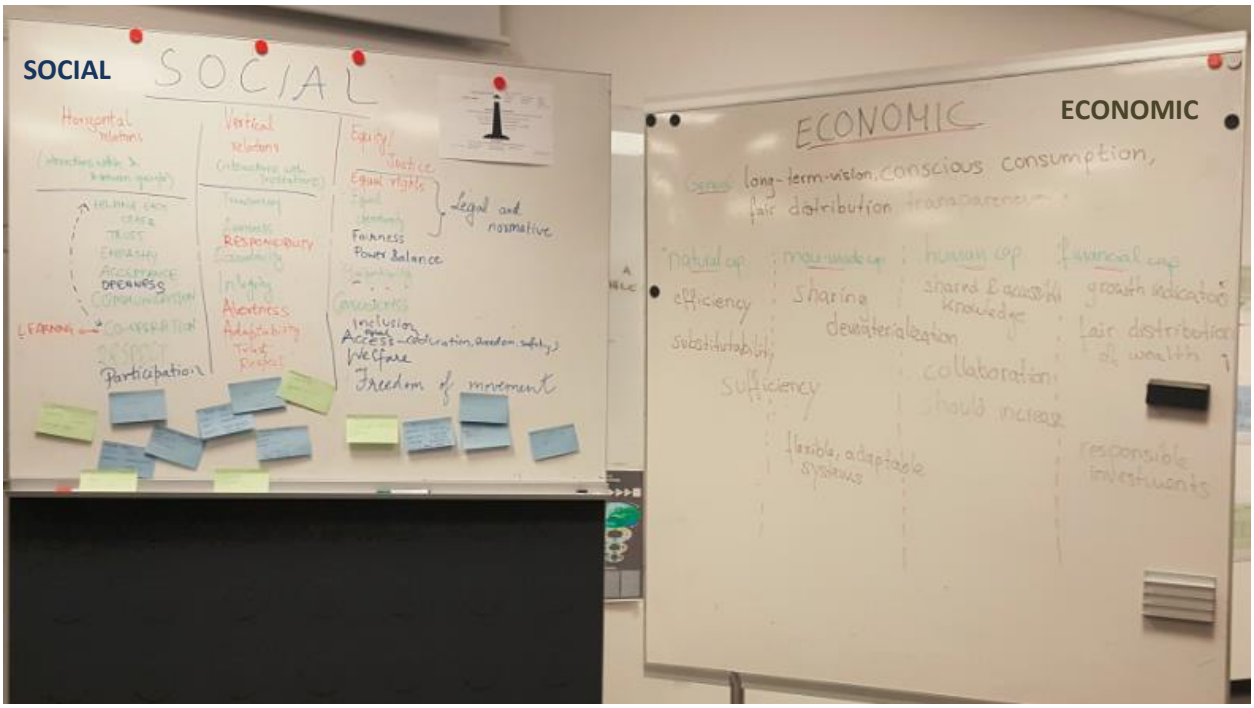


Figure 31: Mapping of sustainability criteria 2

13.2. Step 2: Exploring the current system

This step was to understand the current system in the City of Gothenburg and build a relation to the envisaged future based on identified sustainable criteria. The process set the base to find leverage points in the system and finalize our research question.

To bring sustainable transformation the society it is necessary to grasp the holistic view of the interconnections and how one event can affect the other actors in whole system level. Holmberg (1998) lists certain limitations in society to be considered in visualizing the transformation: Policies, market, culture, technology, and knowledge. He says these create lock-ins in the system, needs to be challenged for a sustainable transition.

Geels F W (2002) illustrates that transition can occur in three system levels: Landscape, regime, and niche. Landscape in its macroeconomic level comprises political and national actors with policies, regulations, cultural and normative lock-ins offering high resistance to change. The regime is a mature market decided by macroeconomic regulations, technological, behavioral lock-ins with incremental growth rather radical. Niche is a protected market, which is a source of innovation but faces uphill against the matured market (Geels F, 2002).

The system-thinking and multi-level perspective tools enabled to understand the market mechanism which was further strengthened by dialogue with a wide range of stakeholders. After the successive workshops on mobility, circular economy and the urban future, around 90 leverage points were listed.

Some of the key listings are as follows:

Thematic area	**Leverage points**		
Mobility	Dynamic systems in project planning for business and governments should ensure robustness/preparedness even with uncertain futures	How can we address the gap between the ambiguous climate goals (2030) for the VG-region concerning infrastructure and the regional infrastructure budget for the same period?	Zero-emission zones in Gothenburg
Urban future	How can urban farming be used as a tool for achieving the regions 2030 goals?	How can urban farming contribute to creating cross-cultural meeting places in the River City area, while creating a greener and more livable city with stronger local communities?	How can the public, academic, and private facilities be combined in the creation of cross-boundary meeting places with optimized energy use?

Circular economy	Create new market routes (to promote new materials which do not fit in the traditional descriptions)	Developing/identifying new criteria/metrics for public procurement	Mapping waste flows having the most environmental impact/ identifying critical waste flows

Table 11: List of some of the leverage points

Further iterations were made to finalize to narrow down the leverage points to number 8. This was carried out by voting the most interesting and critical leverage point. Based on the individual interests and ratings the list was narrowed down. Staffs from the Challenge lab supported in this process and in finalizing the research question.

13.3. Research Question

The foundation for the research question was self-interest, dialogue session, and list of leverage points which was developed by the team. In the mobility dialogue, some of the interesting topics were mobility-as-a-service, misalignments in the organizational goals, policy and regulations, green travel and mobility-as-a-service. The interesting aspect was that most of the mobility developments were reflected based on user behavior. Some interesting projects which were launched in concern to change the user behavior are *Drive me, Ubigo (car sharing), Skjutsgruppen (sharing travel)* and many more. Shared mobility was one of the keys take away from the discussion.

The concept of sharing mobility is changing the traditional style of commuting. The founder of Zipcar, Robin Chase defines three factors for sharing mobility: the ability to harness the potential of spare capacity, exponential expansion with limited investments and co-operative learning. The unused goods are the driver of sharing economy. The current market share of sharing economy is still marginal, however services like mobility, home, delivery, and other household goods are being shared among the community and market is expanding exponentially. Thanks for the widespread of affordable internet services which is the vital factor to reach the consumers.

I was fascinated with this concept and its huge potential around the globe. During the process of brainstorming to connect shared economy to mobility, I noticed the hidden potential of parking space, in which the usage varies during on and off-peak hours. Further reducing the amount of parking space in the city in addition to increasing the parking prices are certain common techniques to reduce private car usage. Therefore, I decided to explore the concept of shared parking in this research.

Further discussion with the supervisor, we decided to merge public transportation with shared parking concept which can provide flexibility in travel and motivate users to change their behavior. The concept brings advantage to the car user in minimizing the efforts to find a parking spot and bring the public transportation aspect closer to the users. However, to prove the viability of the concept it is necessary to generate evidence and most importantly the service or the product must satisfy the targeted users.

Gothenburg being the region of focus, I intend to integrate the concept of shared parking and public transportation into a common platform. It is necessary to collaborate with the parking providers, local public transportation agency and interested actors to understand the existing parking scenario and impacts of the thesis concept. Sharing improves resource allocation, but it questions about meeting the demand and service standards. Thus, it is important to understand the user perspective too to create a basis for further development of this concept. Hence in the process of Master research, I express my interest to answer the following questions:

(1) How can the combination of shared parking and public transportation fulfill the user's needs and preferences?
(2) How do key stakeholders respond to an evidence-based understanding of user's needs and preferences regarding the combination of shared parking and public transportation?

APPENDIX B: INTERVIEW INFORMATION

Table of interviewees

Interviewee 1	Parking company
Interviewee 2	Building Company
Interviewee 3	Traffic Office

Interview Questions

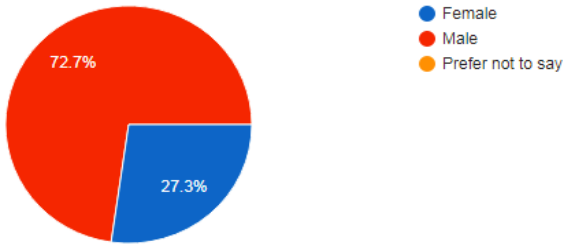
1 How does the current parking system look like?
2 What are the existing parking challenges?
3 Who are the main stakeholders and their roles?
4 Is there a pressure from tenants to expand the parking space?
5 How is their response to the reduction of parking spaces?
6 How well the public transportation is connected to their apartments?
7 The residential parking is expensive than on-street parking. What developments are necessary in making it competitive?
8 Can shared parking be a possible solution?
9 Will the tenant change their travel behavior if accessibility is provided to use public transportation?
10 How does building parking spaces affect the apartment prices?
11 How are parking spaces distributed across the city? In city center, suburbs?
12 What is the role of parking in the development of the City?
13 What services are you offering to your customers?
14 What is the role of policy makers?
15 How do you think the future parking system would be, considering the upcoming developments?
16 What is your opinion on shared parking?
17 What barriers do you see if this concept needs to be implemented?
18 Do people accept the idea and change?
19 What are the Institutional/policy barriers?
20 How does lack of scientific study affect in future development of the research?
21 How do you see the growth of car sales in the city for next five years?
22 Certain developments are in process to reduce parking space and make public transport competitive. Would you foresee the decline in car ownership?
23 What kind of developments is necessary in order to do so?
24 How to accommodate the growing fleet of vehicles and existing ones? Is there a approach to turn existing fleet into potential resource?

APPENDIX C: QUESTIONNAIRE RESULTS

PRIVATE CAR SEGMENT

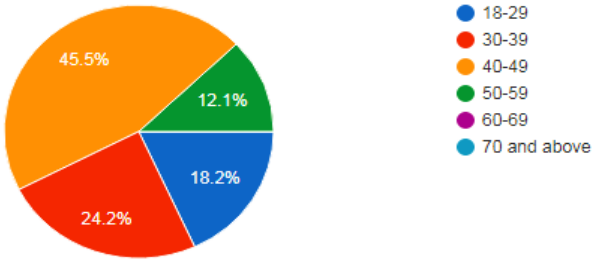
What is your gender?

33 responses



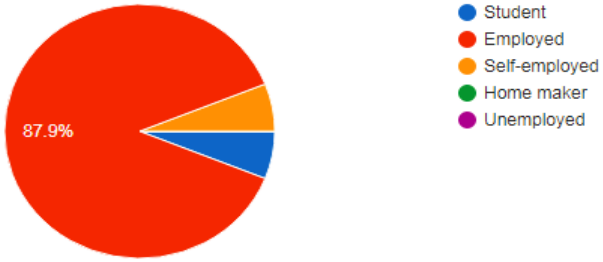
What is your age?

33 responses



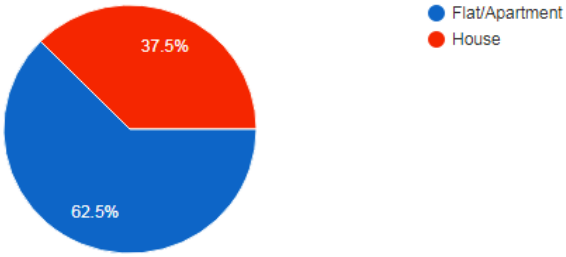
Occupation: Are you currently...

33 responses



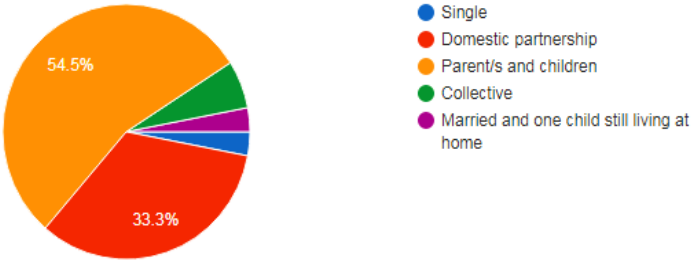
Living arrangements

32 responses



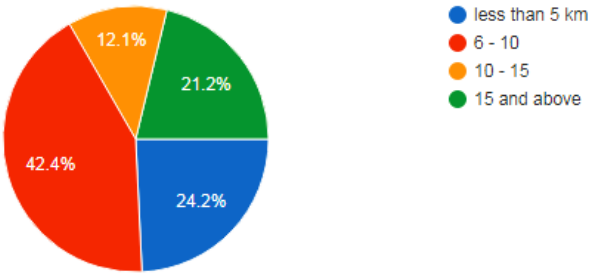
Living status

33 responses



Approximately how far is the Gothenburg city center from your living place?

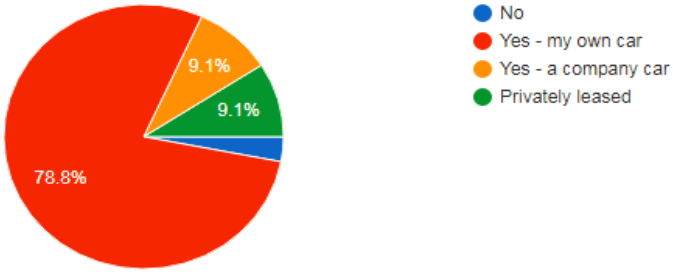
33 responses



TRAVEL BEHAVIOR

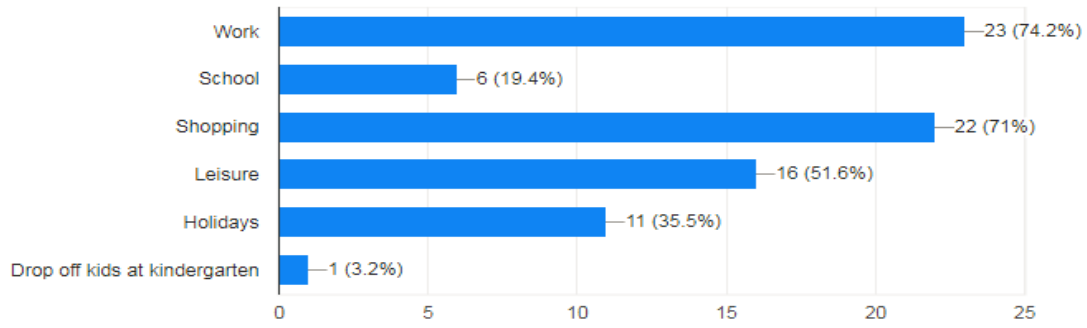
Do you own a car or have access to a company car?

33 responses



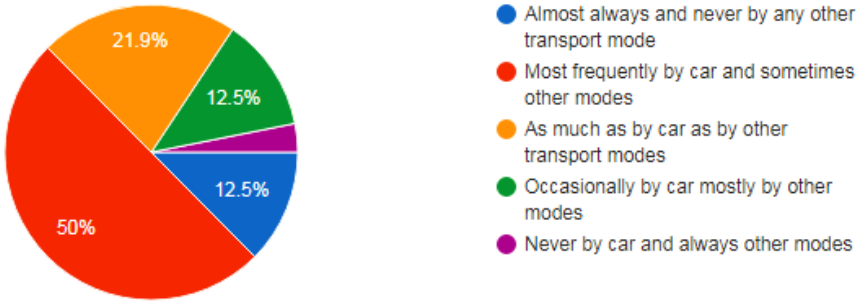
What is your main purpose of using a car?

31 responses



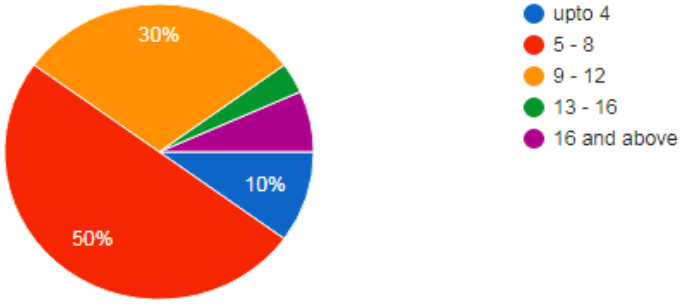
How often do you travel by car?

32 responses



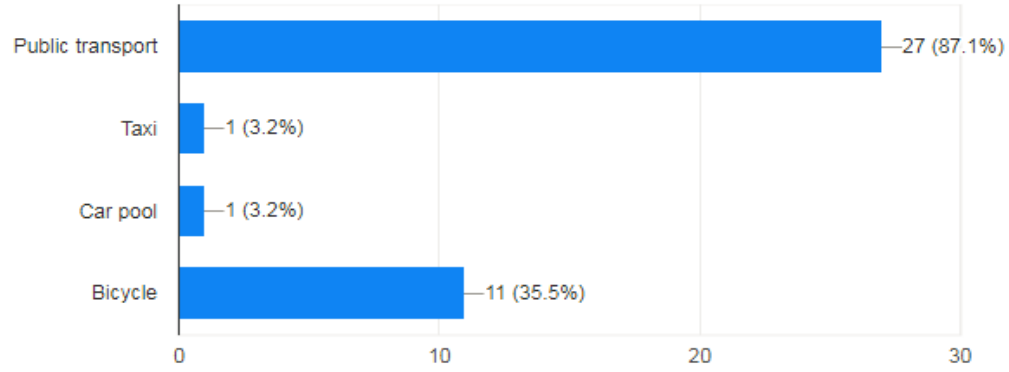
Approximately how many hours a week is your car in use? (e.g: 20 hrs/week)

30 responses



What other mode/s of transportation do you use?

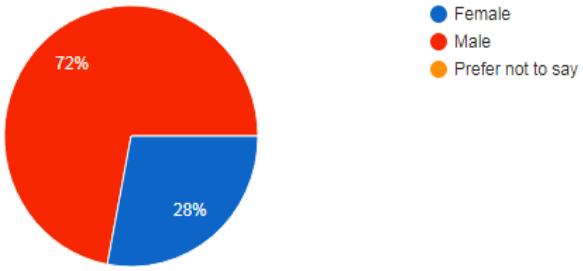
31 responses



PARKING SEGMENT

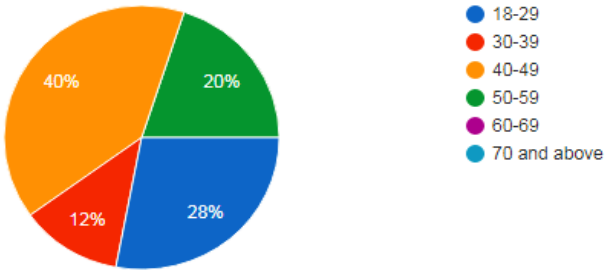
What is your gender?

25 responses



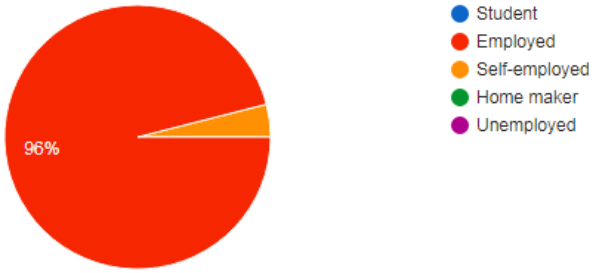
What is your age?

25 responses



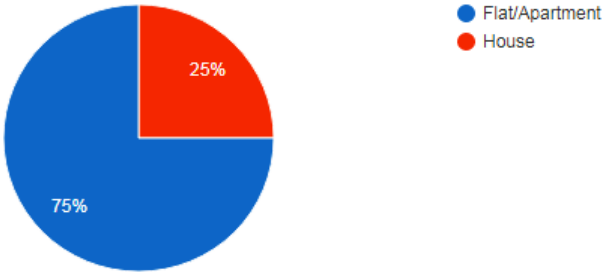
Occupation: Are you currently...

25 responses



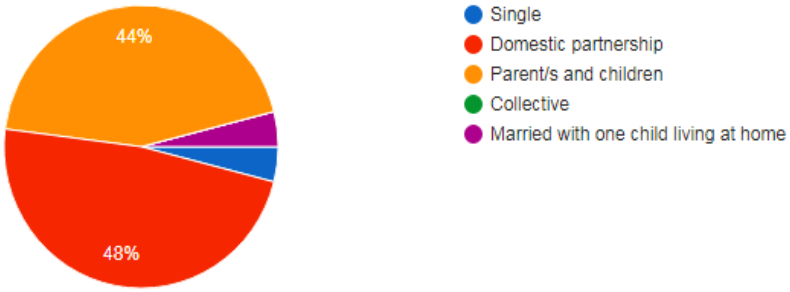
Living arrangements

24 responses



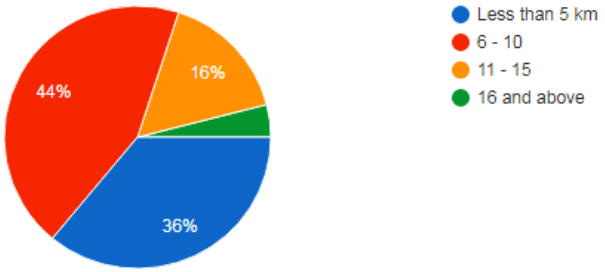
Living status

25 responses



Approximately how far is the Gothenburg city center from your living place?

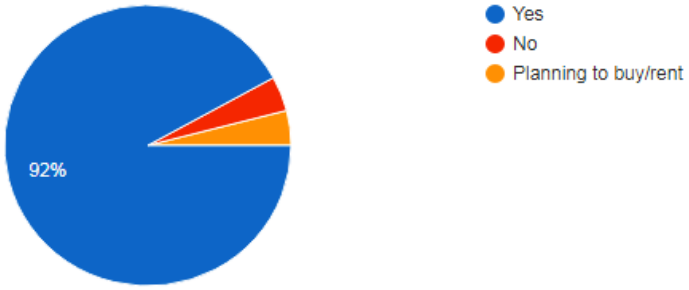
25 responses



PARKING BEHAVIOR

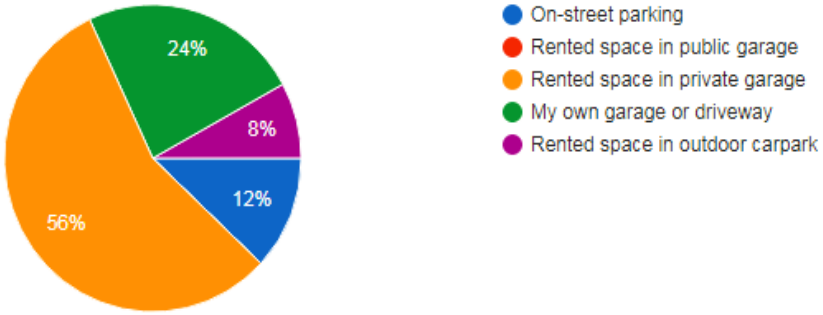
Do you own or rent a parking space?

25 responses



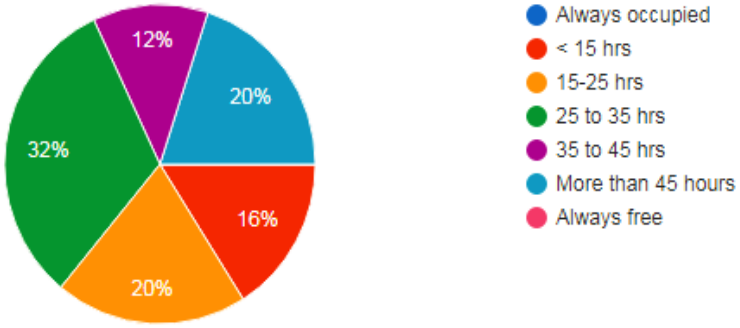
What type of parking space?

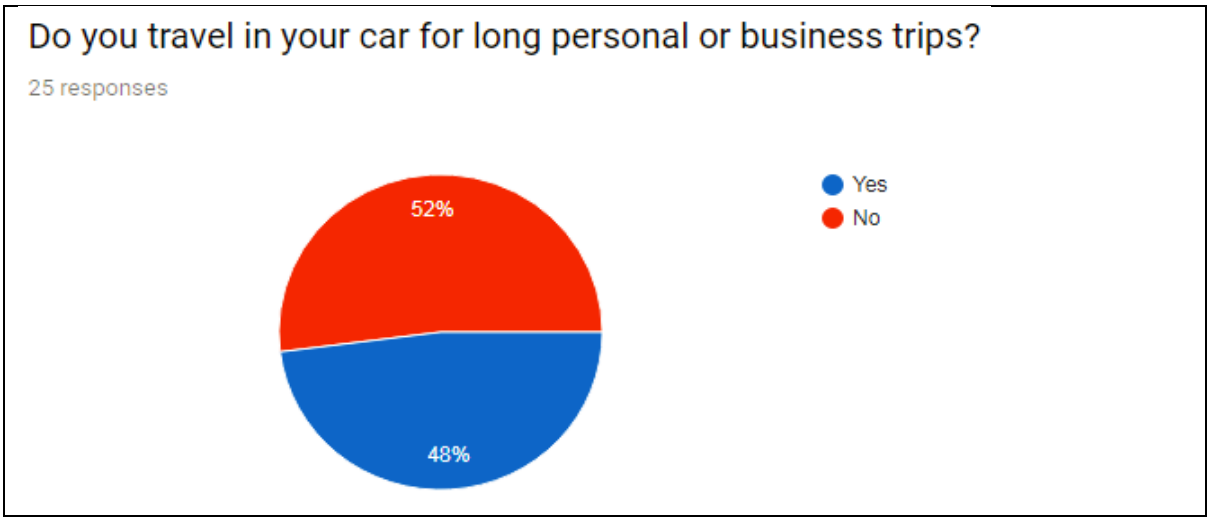
25 responses



How many hours per week is your parking space free/unoccupied?

25 responses




Do you travel in your car for long personal or business trips?
25 responses
52%
48%
Yes
No