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Future mobility in Frihamnen

How can a mobility service look like in a future DenCity area to act as an alternative to a private car?

Master's thesis in Industrial Design Engineering

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CHALMERS UNIVERSITY OF TECHNOLOGY
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Abstract

This thesis was conducted within the Challenge lab with the purpose of finding a mobility service that can function as an alternative to a private car in the developing area Frihamnen in Gothenburg city. The thesis describes a transport service package aimed to enable the new Frihamnen area in Göteborg to reach their goal of reducing car use, and it also describes how the transport service package was developed and the process used to determine the requirements on the services. ChallengeLab is a cooperation between university, private and public sector to enable students to develop solutions for multi stake holder challenges. Backcasting was the main method used throughout this thesis with support of design methods to conduct user research, idea generation and evaluation of the different concepts development throughout the study.

The theme of this thesis was developed based on a dialog about transportation challenges in Gothenburg with representatives of the triple helix. The author of the thesis found the challenge of how to reduce the need of private owned cars in the new residential area Frihamnen in Gothenburg especially interesting. Since Frihamnen have the goal of being innovative and want to reduce noise, emissions and create a so called “city for the people”, a parking policy called 0.1 will be implemented to reduce the number of cars in the area. Frihamnen wants to provide the inhabitants of the area with an alternative to the private car and the idea is that this alternative will enable the acceptance of the 0.1 parking policy by the inhabitants.

In this project, the ideas of mobility as a service, sharing economy and ICT was used to design a solution. Surveys and interviews were conducted to understand the mobility habits and needs of potential users of the solution. Based on these a service package was designed consisting of bikes, shared cars and autonomous buses. One of the main findings was that a single product (such as a bike) cannot fulfil the mobility needs of the users and this led to the idea of having several mobility options in a single service. Another important finding was that there are a lot of emotions connected to the use of a car and these emotions need to be considered when developing a mobility alternative. A third important finding was the importance of having total connectivity between the mobility options inside the service to increase the safety and to get a comfortable user experience. This project shows one possible way of challenging today’s mobility structures which can provide a high service level and give room for new exciting mobility solutions.

Reader´s guide

This report contains two phases which deals with very different topics, with each part communicating its own message almost independently of each other. Therefore, depending on interest, the reader can choose to read only one of them, or both.

The first phase explains a general theory and method to address complex sustainability challenges, and how challenge lab has been set up to train the students in doing that so that they can become change agents. This phase provides insights into how to analyse the overall sustainability challenge, and methods to find and address important parts of the problem. This phase also gives a thorough description of how the research question for this master thesis was defined.

The second phase describes the work of addressing one specific challenge, in this case the study of the research question defined in phase one. This phase is more of a standard setting of a thesis report with a thorough introduction describing the challenge defined in the first phase, theory, process, result, evaluation, discussion and conclusion.

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PHASE 1 – Defining the challenge

Challenge lab

The Challenge Lab (C-lab) is conceived as a free space or neutral arena where the knowledge can be shared in a multidisciplinary teamwork. Students of different disciplines and backgrounds work together towards the goal of becoming "change agents"; being challenging and courageous facilitators, daring to change complex system and address global challenges (Challenge lab, 2016)

Launched in January of 2014, this is the third year that the C-lab is held, causing a redefinition of how students can conduct master thesis studies within the academia. This free space of co-creation is a natural space for transformative learning, leadership and change (Holmberg, 2015).

According with the vision of Chalmers 'Chalmers – for a sustainable future' the structure of the university is focusing on the development of sustainable solutions through eight interconnected "Areas of Advance". The C-lab connects these areas advance with society and business, forming a "Tripe helix" (fig. 1).

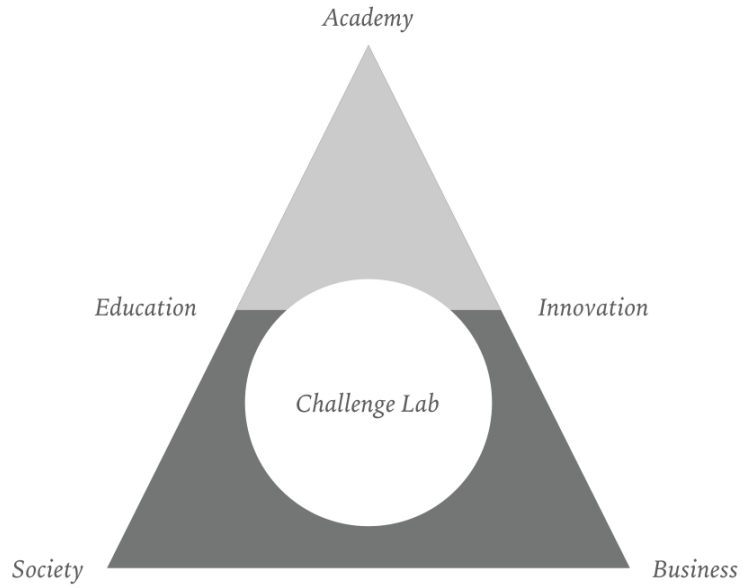


Figure 1-Triple helix; Area of advance in the top and Challenge lab connecting and facilitating AoA with society and business

As it is possible to observe in Figure 1, the students, Change Agents, are the connection between all the major actors. They take the facilitating responsibility to create and stimulate the exchange of resources, new ideas and knowledge. With this interaction between different actors, the C-lab accomplishes the mission to be a natural hub of exchange and also builds a space of trust among companies, public actors and students. C-lab is itself a natural space where it is possible to share knowledge in pursuit of sustainable solutions for a real and complex problems. At the same time, it is a new and innovative testbed to integrate different areas and create a real impact in our current environment and lifestyle.

Objectives of challenge lab

The main goal of the C-Lab is to develop and promote solutions for sustainability issues with focus in the Gothenburg area. The students first learn the principles of the Backcasting methodology and then how apply this knowledge to solve complex problems. This is done alongside the master thesis projects. In this process, the C-lab becomes a testbed area where it's possible to observe the interaction between different actors like companies, academia and the public sector. These relationships are the first step to create an environment of trust where it is possible to share common visions, challenges and solutions in an innovative approach to the sustainability problems detected at the beginning of the C-lab. During the process, it is possible to observe the interaction between actors and how solutions regarding the sustainability challenges emerge in a neutral arena managed by the students themselves.

The creation of a neutral area is important to enable the students the opportunity to challenge and question the status quo of current societal systems, traditional paths, and existing mental models.

Challenge lab master thesis process

The process of the C-lab consists mainly in two phases; Phase one of the C-lab where the research question is defined, Phase two of the C-lab which is the actual thesis. Both phases include a specific structure where the students gradually acquire the knowledge and tools to develop the different tasks and goals of the C-lab as a whole. Even when the participants of the C-lab share a common profile regarding the interest in the sustainability area, during these two parts it is intended that a transformation of the mind set and awareness of the students occurs.

This year, the Phase one of the C-lab consisted in the understanding of the sustainability situation and the problems related, in the Gothenburg area. During this phase, all the students that compose the C-lab worked as one big team as they tried to understand all the different aspects related with the possible complex problems. It is in this phase where the main purpose and framework of where exactly it is possible to have a real impact is defined.

The students tried to identify similar interests regardless of academic and cultural background and discuss how they can complement each other. The interests of each student were detected and it was possible to link those interests and locate where it is possible to have a real impact in the system. With this information, it was possible to form the teams that were going to collaborate together and the research questions could be defined. This process was very important since it was where the trust and confidence were built between all members of the C-lab. The theory of phase one is described in chapter *Theory of Backcasting* and a detailed description of the process is given in chapter *The process of phase one.*

During phase two of the C-Lab, the teams formed in the previous phase worked in a more traditional way with the defined research question. The main goal of this phase was to find answers to the research question by using the methodology and knowledge acquired in the C-Lab.

Theory of Backcasting

Backcasting is a planning methodology for envisioning desired future conditions and how to get there step by step (Holmberg, Robert, 2000) instead of using forecasting where the future is shaped by trends based on how things are today. By envisioning the preferable future, it is possible to step away from the present unsustainable path, by asking oneself what will be the future parameters in a society that have a sustainable transformation (Homberg and Robèrt, 2000).

Homberg and Robert refers to Dreborg (1996) stating that Backcasting is particularly useful when:

- The problem is complex
- There is a need for a major change
- Dominant trends are a part of the problem
- The problem is to a great extent a matter of externalities
- The scope is wide enough and the time horizon long enough to leave considerable room for deliberate choice

The four steps of Backcasting

The method of Backcasting consists of four steps (Holmberg, 1998) (fig.2);
Step 1 - *Defining criteria for sustainability*,
Step 2 – *Describing the current situation in relation to the criteria for sustainability*,
Step 3 – *Envisage a future situation* and
Step 4 – *Find strategies for sustainability*.

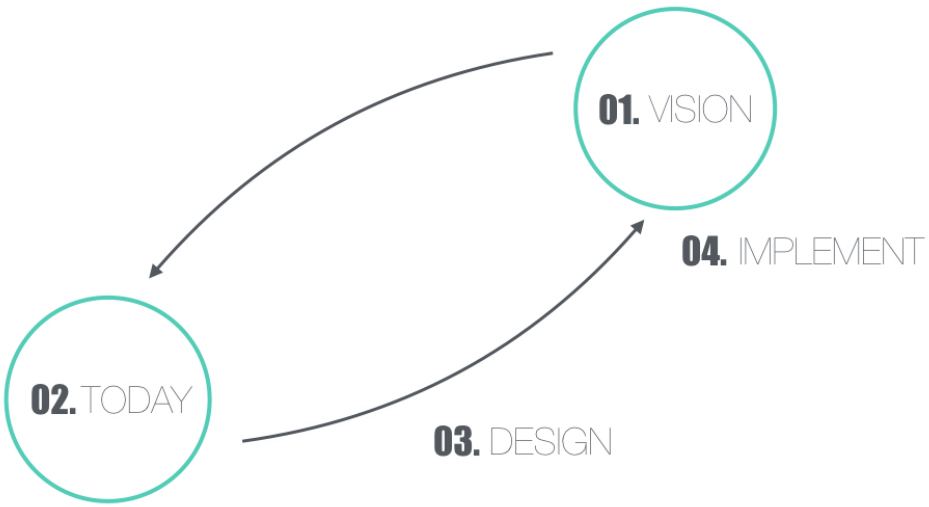


Figure 2-The four steps of Backcasting

Step 1 - Defining criteria for sustainability

The first step of Backcasting is to envision a sustainable future and define criteria of the future state. By doing so, it is possible to design strategies of how to reach the future state, which enables proactivity. On the contrary, there is taking current trends into account, take steps forward that will lead to a constant need of reactive problem solving (Holmberg, 1998). Backcasting can also provide support for proactive decision making and finding business opportunities since it can be applied to foresee changes in legislation and on the market.

A tool developed by Holmberg and Robert (2000) used to define criteria is the four pillars. It consists of four principles (fig. 3);
1 - Ecological,
2 - Societal,
3 - Economical, and
4 - Well-being

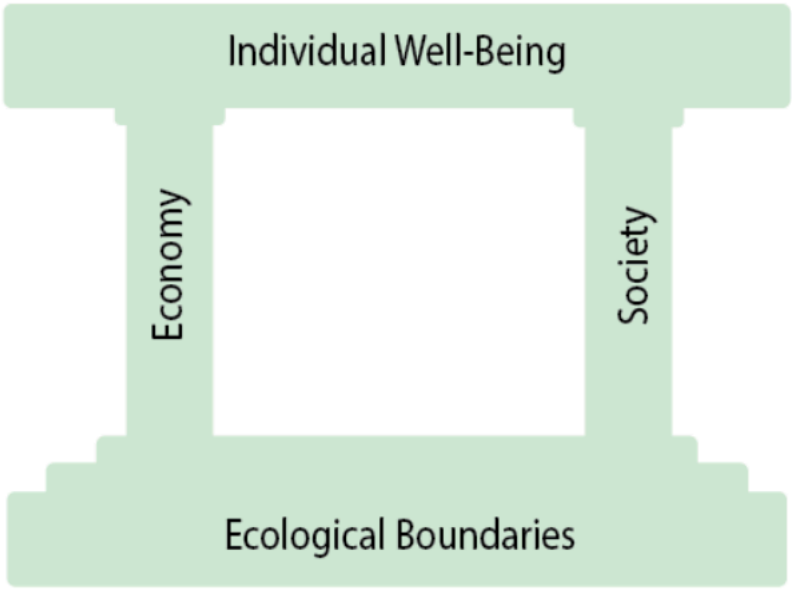


Figure 3- The four pillars

The ecological pillar can be seen as the foundation that needs to be fulfilled to support the economic and societal pillar. The three of them creates conditions to achieve well-being.

The four principles create a foundation for how to accomplish a transition for a sustainable future and how we can live within the planetary boundaries Rockström (2009) describes. The system conditions for such transition is according to Holmberg (1998) that our societal influence should not be:

"...subject to increasing concentrations of substances extracted from the earth's crust";
"...subject to increasing concentrations of substances produced by society";
"...impoverished by over-harvesting or other forms of ecosystem manipulation";
"resources are used fairly and efficiently in order to meet basic human needs worldwide".

The first three conditions are connected to the ecological principle and together they give a framework for ecological sustainability while the fourth condition is connected to the societal principle.

Step 2 - Describing the current situation in relation to the criteria for sustainability

The second step of Backcasting consists of analysing and describing the current situation, compare the present to the envisioned future and find the gaps between the two. In the third step of Backcasting when strategies to reach the desirable future is designed, focus is upon these gaps.

The funnel
There are a number of tools, methods and models that can be used to understand the present. One of the models is described by Homberg (1998) which visualize that the world is facing challenges from two directions, causing a funnel effect (fig. 4). On the top, the model illustrates a decreasing availability of resources, assimilation capacity and land area while the bottom of the model illustrates an increasing population, economy and demand of energy and materials. This is where we are heading and the window of opportunities for humans to meet their demands is only getting more and more narrow.

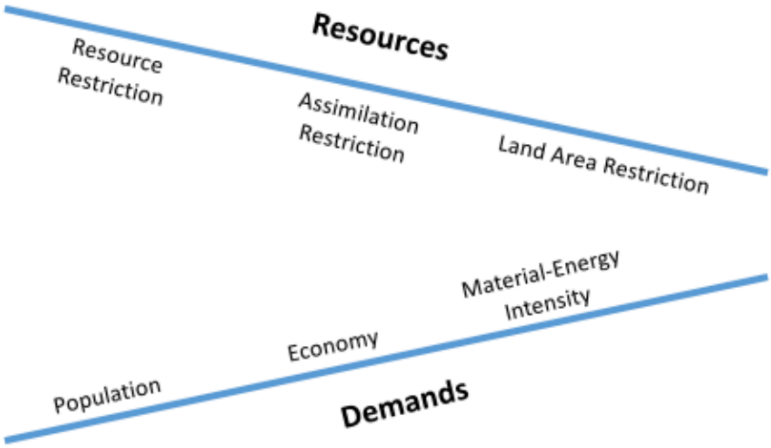


Figure 4-The Funnel (adapted from Holmberg, 1998)

System thinking
A method of how to truly understand a certain event is to apply system thinking. System thinking is to see things as a whole instead of several parts. Flood (1998) refers to Senge stating that this is very important since "the world exhibits qualities of wholeness". He continues explaining "These qualities relate to every aspect of our life – at work and at home. Events are distinct in space and time, but they are all interconnected.". This would mean that to really understand an event, one must understand the whole – the context and the events interconnected to the specific event one is exploring, by exploring the whole system.

One way to visualize the system is described by Holmberg (1998). It can be seen as a box, shaped by six different components (fig. 5);

1. current technology,
2. legislations,
3. the market,
4. policies,
5. culture and norms
6. knowledge

These components are limiting innovation and radical sustainable solutions. Holmberg (1998) describes that the changes are more commonly punctual which is not enough when it comes to sustainable challenges. In order to find the solutions for a sustainable transition, the box must be challenged.

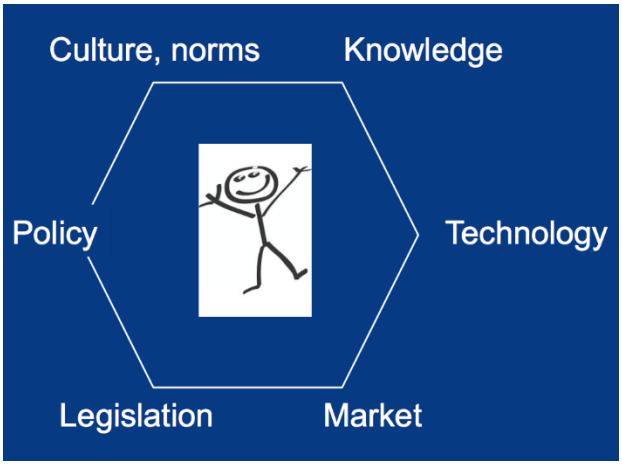


Figure 5 - The box (Holmberg, 2015

Muli-level perspective

Geels' (2004) Multi-level perspective is a tool used in the second step of Backcasting as a framework to understand how transitions can occur on three different analytical and heuristic system levels; landscape level (macro), regime level (meso) and niche level (micro). Geels describes that the three levels are linked, meaning that the niche level is embedded in the regime level which is embedded in the landscape level (fig. 6).

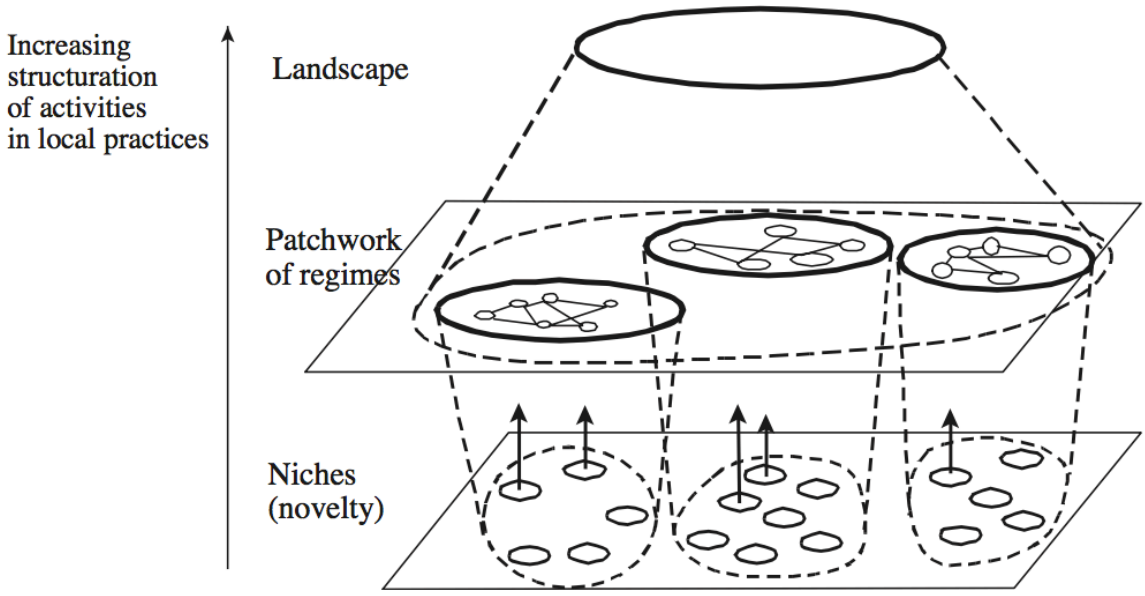


Figure 6 - Multi-level perspective (Geels, 2004)

The landscape level is the environment or the landscape that the system exists within, it could also be outer factors that affect the system (Geels, 2004). An example of a changing factor in the landscape level is IT that created completely new demands when developed. The macro-level is however not easily changed since it is not directly influenced by other actors from other levels.

The regime level is corresponding to the present technology, policies, infrastructure, and other existing socio-technical regimes. This level is more dynamic than the macro-level and can be changed and allow innovations of incremental nature (Geels, 2004).

On the niche level, there are novel technical solutions that are developed without interfering with externalities. If the innovations are strong enough they can push out existing solutions in the regime level and change the appearance of the niche level (Geels, 2004) (fig. 7). This kind of innovation is often idea-driven. Innovation can also be demand-driven, causing a change of the system from within. Changes in landscape level can help niches rise up to regime level.

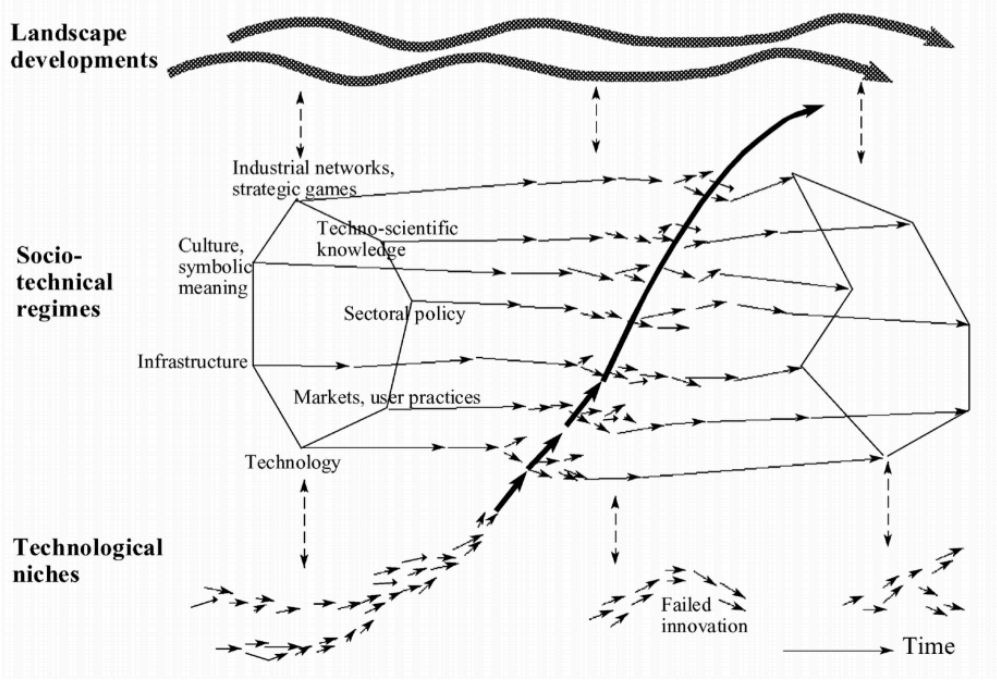


Figure 7 - Niches pushes up into the regime level (Geels, 2004)

Dialogs and building trust

In order to understand the system, how to challenge it and break free from the box mentioned previously, the theory of organisational learning and dialogues have been two important parts of the toolbox acquired by the Challenge lab students. Collaborating and learning is necessary parts of the strategy of overcoming current lock-ins and how to challenge the box. One way to initiate collaboration is by dialogue, since it according to Isaacs (1999) creates a free and safe space where the participants can speak up, allowing their thoughts to come forward.

Sandow and Allen (2005) describes active listening as an essential tool to enable learning in the dialogue setting. When the participants listen to each other, an environment of safety is established and allow for deeper conversation where the participants trust each other. In figure 8 the double-loop process is visualized where active listening and observing leads to understanding, trust and collaboration in a first loop. The second loop shows how collaboration leads to increased participation, creativity, innovation and support, leading to excitement and appreciation, which enables even better collaboration and so forth.

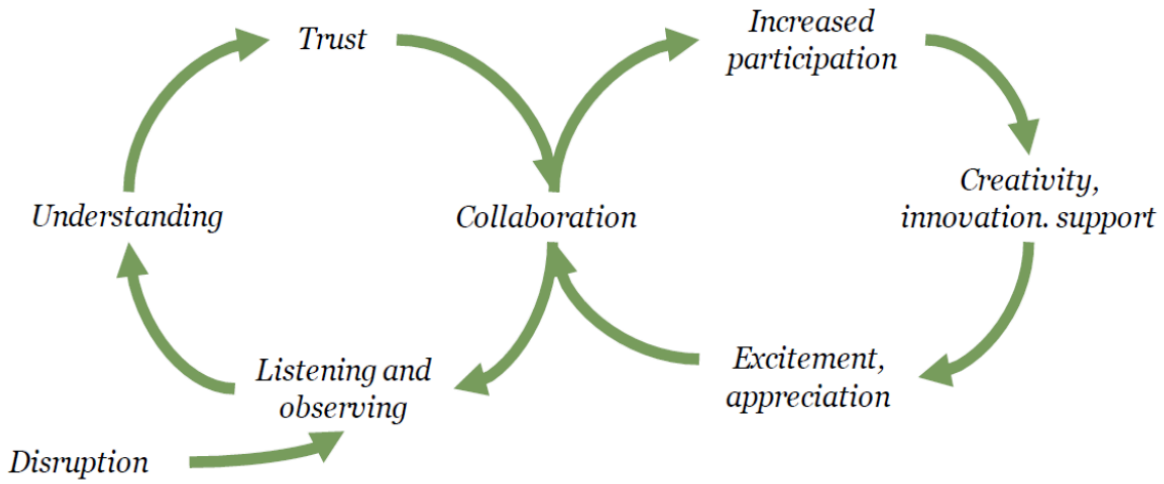


Figure 8 - Double-loop learning (Sandow and Allen, 2005)

It is however not always easy to have an open group dialogue (Sandow and Allen, 2005), and if the participants fails in active listening, tension can be generated between them instead of collaboration. As seen in figure 9, the decrease in listening and observing causes misunderstandings, leading to lack of trust and separation in the group in a first loop. Separation leads to redundancy, competition and fear. Redundancy to increased costs, decreased resources, competition and so forth. This is why the feeling of a safe space, where active listening is applied, is so important in the creation of trust within a group or organization. Not only in the event of dialogue.

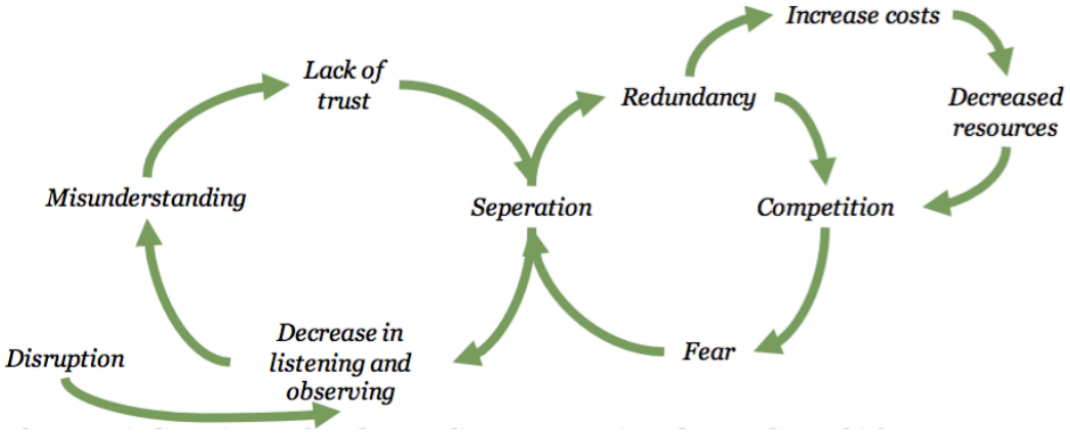


Figure 9 - Disruption cycle (Sandow and Allen, 2005)

As a leader, one should possess four important qualities that support the dialogic process according to Isaacs (1999):

1. *The ability to evoke people's genuine voices*
2. *To listen deeply*
3. *To hold space for and respect as legitimate other people's views*
4. *To broaden awareness and perspectives.*

(Isaacs, 1999)

Step 3 - Envisage a future situation

In the third step of backcasting solutions and strategies are designed and evaluated with the purpose to build bridges over the gaps of the present and a sustainable future. At this stage, it is important not to jump into conclusions too fast, but to stay in "the why" meaning exploring and analysing the actual needs and the vision for a sustainable future. This will enable developed strategies to stay aligned with the vision.

The principles defined in step one of backcasting set the restrictions for the possible solutions as well as releasing possibilities of stepping outside the box and reflect on how the box can change (see step one and two of Backcasting). The real challenge in this third step is to actually free oneself from the box mentioned in step two. Design thinking could be used as a method to accomplish the acquired level of free thinking to achieve this goal.

Design thinking can be seen as a nonlinear process (fig. 10) including three main stages; pre-study, development and verification. Each stage contains a number of various methods and tools to allow analysation, creativity and problem solving. A detailed description of the design thinking tools used in this report is given in chapter 2.1.

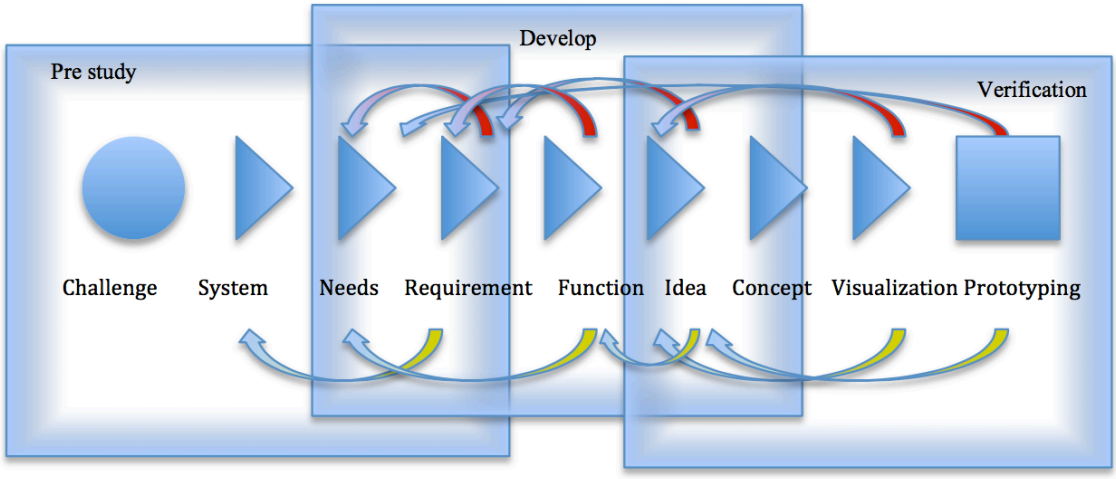


Figure 10 - The process of design thinking (Söderberg, 2014)

In the pre-study, the problem is deeply explored by different research methods to deeply understand the problem and the needs of the potential users of a future product or service. Söderberg (2014) explains that there is often a gap between what the users need and what they want, which is why the research in the pre-study must be thoroughly conducted.

The pre-study is followed by the development phase where ideation takes place to fulfil the needs discovered in the pre-study and to solve the actual problem. It is important to explore a broad number of ideas before designing a more detailed final concept since there is no evidence that the first idea that comes into mind is the best one. Iteration is an important factor here to evolve and build upon the ideas, always broaden and challenge current perceptions of what is the best solution in order to step away from potential system lock-ins. It can happen that one must go back to the pre-study phase once again to complement the insights collected from this phase in order to stay in "the why" and find a solution for the right cause (fig.10). When the ideation is done, the concepts are evaluated and sorted in order to find a couple of ideas that can be designed more detailed, prototyped and verified.

The third stage in the design process is verification of the concepts. This is where the concepts are tested to evaluate which concept works in the context and with the users the concept is designed for. If the verification shows a negative result, one must go back to the drawing board and ideate.

Step 4 - Find strategies for sustainability

In the fourth step of Backcasting, strategies are developed for implementation of the solutions designed in step three. Holmberg (1998) recommends the following questions to consider in this step when evaluating the solution:

- Will each measure (e.g. investment or product design) bring us closer to sustainability?
- Is each measure a flexible platform for the next step towards sustainability?
- Will each measure pay off soon enough?
- Will the measures taken together help society to make changes at a sufficient speed and scale to achieve sustainability without too many losses for humans and other species during the transition?

According to Holmberg and Robèrt (2000) two qualities of all investments should be combined, particularly when large resources are bound:

- Investments should be technically and ecologically as flexible as possible platforms for further investments in line with the vision of sustainability, and
- amongst the various flexible alternatives, the *low hanging fruits* should be picked first, i.e., measures that give early return on investment. It relates to the need of aligning the long-term goal with the short-term economic reality.

Holmberg and Robèrt (2000)

The process of Phase 1

The process of phase one with the aim to define the research question (fig. 11) began with exploring personal values and the execution of exercises in self-leadership. This was followed by the first step of Backcasting where a vision for this years' group of Challenge lab master theses were defined. The second step of Backcasting followed with the aim of understanding what problems exist in the region of Gothenburg today. To find this out, dialogs were held with participants from the public sector of Gothenburg and Areas of advance. This led to the definition of possible hot topics.

Based on the outcome of personal values, the students of Challenge lab choose hot topics of personal interest and paired up in teams. When the topic was chosen possible stakeholders connected to the topic were mapped. In discussion with the stakeholders, the hot topic was transformed into a research question.

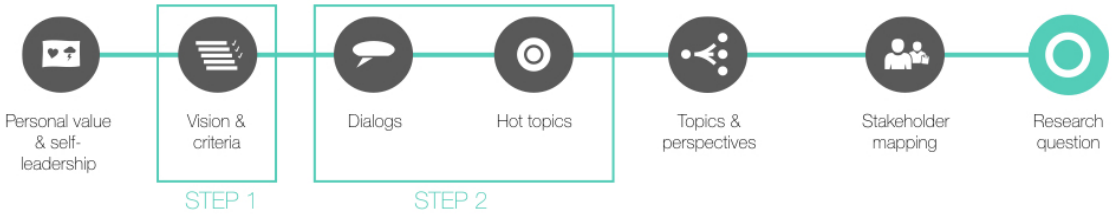


Figure 11 - The process of Phase 1

Personal value and self-leadership

A very important aspect of the transformation process is the study of the different perspectives that are involved in the process of understanding how to become a Change Agent. There are two perspectives *Inside - Out* and *Outside – In*. Holmberg (2014) means that the two perspectives will give the students a holistic view on how to approach sustainability challenges.

- The outside-in perspective is to understand the outer factors, theories and methodologies such as system thinking, multi-level perspectives and design thinking. This is to "understand and deal with the requirements global sustainability will put on the system" (Holmberg, 2014).
- The inside-out perspective is to understand and reflect upon personal values, strengths, knowledge and motivation (Holmberg, 2014). This is combined with learning about self-leaderships, collaboration theories and dialogue tools.

The first phase started off by the students visualizing themselves by sketching out a so-called Coat of Arms; why they choose to do their thesis in Challenge Lab, what their biggest concerns are and what they care about. This was followed by learning about the theories of the outside-in and inside-out perspectives and a workshop where the students mapped their inner values and strengths. This step was essential to this master thesis in terms of defining a research question of true interest and motivation.

Every week started with a check-in where the students told each other what their goal was for this week and how they felt at the moment, while practicing active listening. Every week ended with a check-out where the students reflected upon their goals of the week. This made

it easy to find a closure of the week and to learn from potential mistakes, and build upon learnings from the week. It also created a safe space where the student found ways to trust each other and enabled a good collaboration environment essential when the students later began to explore their research questions.

Vision and criteria

In the first step of the Backcasting process, the students defined a vision for a sustainable future, adopted by the 2015 Challenge lab students:

"We envision a sustainable future where we, approximately 10 billion people, are able to meet our own needs within the planetary boundaries without compromising the ability of our future generations to meet theirs" (C-lab 2015)

This was followed by defining the principles for a sustainable future within the four pillars; ecology, economy, society and well-being. The students started off with a literature review of theory connected to each pillar, the 17 UN Sustainability goals and the principles defined by 2015 challenge lab students. The activity following to defining the principles was called World café which was carried out by the students rotated between four tables where each table represented one of the pillars. Each table had a facilitator that led a dialogue about the principles. While the students rotated, the facilitator wrote down what the group had come up with, allowing the next group to elaborate and build upon the previous groups findings. The final result was as follow:

Ecological criteria
Decided to inherit Holmberg & Robèrt (2000)

"Human activities affecting nature´s function and diversity are not done in such way that they:

- do not increase the concentration of substances from the lithosphere in the ecosphere;
- do not increase the concentration of human-made substances in the ecosphere;
- do not systematically deteriorate the resource base; such as fresh water, fertile land, and biodiversity through manipulation, mismanagement, or over-exploitation."

Social criteria
The societal system is an instrument for individuals to live together within the other criteria with respect to the following conditions:

It enables the well-being, empowerment and productiveness of every individual while adhering to the ecological principles by:

- equitable accessibility to education and health care;
- gender and social equity;
- equal human rights;

Its governing mechanisms (and societal institutions) are built on transparency, accountability, mutual trust, adaptability and recognition of diversity.

Adopted and inspired by Raworth (2012), Pisano (2012), Post-15 Goals, Criteria by C-Lab (2015).

Economic criteria
The economic system is an instrument that enables individuals to meet the other criteria (society, wellbeing, nature) efficiently and effectively, as such:

The function of the economic system is driven by the other criteria and not the other way around;

- It enables further use of resources and avoids dissipative use of materials;
- It assures an equitable distribution of resources;
- It has an inherent mechanism of maintaining and serving societal infrastructure and institutions that permits human wellbeing to be met over time;
- It has the ability to change and to adapt when facing shocks and disturbances.

Adopted and inspired by Sen (1999), Anand and Sen (2000), Simmie and Martin (2010), Post-15 Goals, Criteria by C-Lab (2015).

Criteria for Well-being
First, we present the basics for survival and continue with components supporting self-fulfilment and self-realization.

The goal of the society and economy, lying on the nature as its fundament, is to serve the human wellbeing, where:

- Everyone has the right to human basic needs; health, security, future security, food, water, sanitation, recreation, shelter, energy;
- Human life includes: subsistence, protection, affection, understanding, participation, idleness, creation, identity, freedom;
- Everyone should have access to the same opportunity and the freedom to build a meaningful life;
- Everyone should have access to the same opportunity and freedom to explore and express your ”inner self” and to be your values without limiting others’ freedoms or harming others;
- social and economic inequalities are not justified unless they are to the greatest benefit to the least-advantaged members of society.

Adopted and inspired by Rawls (1972), International wellbeing group (2013), Cruz et al (2009), Post-15 Goals, Criteria by C-Lab (2015).

Dialogs

In the second step of Backcasting the focus lies in understanding the present situation. For this year of Challenge lab, it was decided to focus on problem on a regional and local scale. To gather understanding about the challenges in the Gothenburg region, four dialogues were held with different stakeholders from the public sector of the region and from Areas of advance at Chalmers. The dialogues were facilitated by the challenge lab students and prepared beforehand in how they were supposed to be executed, and what questions should be asked. The students were also reading about the different stakeholders beforehand to gain knowledge of the projects they were involved in to be able to ask the right questions at the dialogue sessions.

The dialogues had the following topics:

- Understanding the concept and idea of the Areas of Advance;
- Mobility and Urban Development;
- Transition Dialogue Johanneberg Science Park;
- Sustainability driven Innovation for Urban Development;
- Areas of Advance – Energy;
- Integration and Social Innovation;
- Urban agriculture.

To create a safe space between the stakeholders and the students, the dialogues had a fishbowl setting meaning an inner circle where the stakeholders, the facilitator and a couple of questioners was sitting, surrounded by an outer circle where secretaries and spectators was sitting quietly practicing active listening and observing. Two of the students in the inner circle were facilitating the dialog and some students were posing challenging questions for the stakeholders. Each dialogue started with a check-in to create an environment of free speaking and trust, and ended with a check-out.

The first dialog was with a stakeholder from the areas of advance (AoA). The main outcome from this dialog was the understanding of how the AoA works cross-disciplinary, their view of collaboration with students, and challenges for working with industry.

The second dialog stakeholders from Trafikkontoret, Viktoria RISE - DenCity, MaaS, EletriCity, Maritime management environment Chalmers, Boplats were present. Main challenges discussed were:

- how mobility can be used as a tool for social inclusion,
- Gothenburg must get dense,
- infrastructure designed based on how people move,
- changing behaviour for mobility and how to develop urban areas to not use a private car,
- lack of well-being in public transportation,
- our society is built for cars and men,
- users not trusting the safety systems,
- scaling up of car sharing and sharing economy in general,
- how to use water for transportation of goods.

In the third dialog stakeholders from the chemical cluster, HSB living lab, Innovation Roof, HSB, Chalmers fastigheter and Fastighetskontoret were present. The main challenges discussed were how to scale up the use of wood in construction, how to bring different companies and ideas together in a common space, the challenge of building 7000 new apartments for the 2021 goals and how to use existing buildings efficiently.

The fourth dialog was held with a stakeholder from the energy department of AoA with focus on, among other things, future energy sources.

The fifth dialog was with Stadslandet that is working with Integration and social innovation by letting them farm outside Gothenburg. Challenges discussed during this session were the lack of farmers, how to integrate skilled refugees and take advantage of the knowledge already existing, challenges for ecological certification, and locally produced food vs. ecological.

For this master thesis project the dialog about mobility and urban development was the most interesting, especially the challenge of how to change mobility behaviours and how to develop an urban area where a private car should not be used. For the author personally, the perspective of changing behaviour was very interesting and deeply connected to personal values where changing behaviour is seen as a must to be able to live sustainable. With a background in industrial design engineering, the author is used to work user centred, exploring needs of user and how they affect the behaviour and usage of services and products.

The study of this master thesis was conducted together with Fernando Gomez Peregrina, divided into two separate reports. Fernando also found interest in the challenge of mobility behaviour since his knowledge in the area of ICT could be used to identify mobility patterns which could lead to a constant development of better mobility alternatives.

Hot topics

During the dialogs, a large amount of interesting challenges was discussed. In order to find out which challenges could be part of the master thesis studies the challenges were categorized into three areas;

- Urban mobility;
- Urban development;
- and bio-innovation and energy

Within each area a so called hot topic was defined based on the challenges and the amount of stakeholder engagement that the C-lab group interpreted during the dialogs, along with the students' personal interest of the challenges mentioned. Another factor was the presence of an already ongoing project that the students could engage with and base their studies on. The hot topics were;

- Transport strategy – Including the challenges of scaling up electromobility, parking policy 0.1 and how Gothenburg can become a fossil free city for the people and not for the cars.
- DenCity – Including how Gothenburg can become a denser city and the exploration of possibilities of the Frihamnen area.
- Value chain of materials – Including challenges connected to the use of materials within construction industry.

The next step was that the students should define their research question within one of these hot topics. This led to that the theses studies within this certain topic could be connected to each other. This would create a possibility for co-creation between different studies and the students would be able to tackle the challenges from different perspectives.

Before rushing into the process of picking a hot topic, the hot topics needed to be further investigated if they suited for master thesis studies. The C-lab students received a list of seven questions to answer for each hot topic from the C-lab personnel. The questions were:

1. Is there a stakeholder interest for this topic?
2. What are the dimensions of sustainability?
3. Is it transformative?
4. Is it integrative?
5. What are the socio-technical aspects?
6. In what level of MLP is it? (Multi-level perspective: Landscape, regime, niche)
7. How does the value chain look like for this topic?

After having discussed and analysed the hot topics, the students reflected upon of which topic they found personal interest. For the author, the challenges of changing behaviour could fit into the topic of transport strategy and DenCity since the problem of the parking policy 0.1 with the need of less private cars were situated in Frihamnen. A deeper explanation of the 0.1 policy and DenCity can be read in chapter *1. Introduction*.

Topics and perspectives

In order to narrow the hot topics down, each hot topic was divided into smaller topics and different perspectives of what to focus on was created. Every student could thereafter vote for topics and perspectives of interest by spreading out points on post-its notes. The topics and perspectives with the most points were the ones that the students could choose among and based on interest, pairs were formed.

For this master thesis project, the topic chosen was 0.1 parking policy and the perspective chosen was behaviour of users. This was of high interest for the author since behaviour of people is perceived as very interesting combined with the possibility to explore how to increase motivation for sustainable behaviour. Norms and emotions connected to owning a private car is also perceived as highly interesting by both the author and Fernando Gomez Peregrina.

The author and Peregrina analysed their personal strengths and educational background and found that teaming up would bring a good balance between different knowledge, values and strengths. When combining the author's background in knowledge of user research and user experience (UX) and Fernando´s background in information and communication technology (ICT) (fig. 12) the pair found a possibility to create interesting concepts of how to enable the parking policy 0.1 in Frihamnen.

Figure 12 - Combining strength and knowledge

Stakeholder mapping

The next step was to explore who could be an interesting and engaged stakeholder for this project. Based on the dialogs, Viktoria RISE, involved in DenCity project in Frihamnen connected to MaaS and 0.1 parking policy, felt as the perfect stakeholder to engage with. This was confirmed as a perfect match when meeting Thomas Nyström, a researcher at Viktoria RISE. Nyström was present during the second dialogue and had a large personal interest in Challenge lab and sustainable transitions. In a first meeting with Nyström, the author and Peregrina discussed the topic of interest for this master thesis project. Together with Thomas,

the research question quickly started to form.

Research question

The challenge of reducing the number of private cars by the 0.1 parking policy was discussed further with Thomas Nyström to identify what could be a research question for the thesis. One main question that Viktoria RISE wanted to investigate that was in perfect line with the chosen topic and perspective of interest was if it is possible to provide the future habitats with a service that can fulfil the mobility needs to substitute the present need of private cars. This led to the formulation of the following research question:

How can a mobility service look like in a future DenCity area to act as an alternative to a private car?

In chapter 1. Introduction, the background of this problem is presented thoroughly.

PHASE 2 – Developing the solution

1. Introduction

In this introduction chapter the background, goal, purpose and research question of the master thesis project is described.

1.1 Background

In the central parts of Gothenburg, a new residential area called Frihamnen (fig. 13) is going to be built and it is planned to be finished in 2035. Frihamnen is an old harbour area and the main focus of the development of Frihamnen is to keep the old harbour heritage and to test new ideas of technology and urban development to challenge how we live today. Frihamnen will be a test arena for sustainable solutions from an ecological-, economical- and social perspective.

Figure 13 - Frihamnen today

Älvstranden utveckling is a municipal company with the mission to fulfil Vision Älvstranden and they have put up nine goals for the area (Älvstranden utveckling, 2015):

1. Frihamnen will be a neighbourhood open to the world and characterized by diversity
2. Frihamnen will be developed into a sustainable inner city with a great mix of venues, housing, trade, culture, offices and service
3. The public space of Frihamnen should be given major focus – by the water, in the water and between houses
4. Frihamnen will emerge through open and co-creation processes
5. Frihamnen development should take its lead from the existing by maintaining harbour basins, protecting the industrial heritage and develop existing buildings
6. Frihamnen should be inclusive through a socially mixed area and processes that allow for more people to get into work
7. In Frihamnen you should have a close distance to services and target points. There is a sustainable, small-scale goods and waste disposal and comfortable alternative to the private car
8. There, conditions are created for good accessibility and mobility solutions that make walking, cycling and public transport natural choice before the car
9. Frihamnen should be dynamic through a variety of activities with a mix of uses and tenures of housing in every neighbourhood

For this master thesis project, goal number seven and eight is of high relevance due to the mention of reduced usage of private cars. The design solutions in this thesis mainly aim to meet these goals, even though they also address some aspects of other goals as well such as principles for a sustainable future.

Älvstranden utveckling have also a manifest for Frihamnen (Älvstranden utveckling, 2015). In this master thesis project, manifest 1, 5, 6 and 9 have been main drivers; (1) Frihamnen is a test arena with the aim to test ideas in a small scale, evaluate and scale up. (5) Frihamnen economizes resources and act long-term to achieve the goal of social benefit. (6) To live sustainable should be easy. (9) The future of mobility is tested in the Frihamnen, supporting ideas to achieve lower use of private cars. The full descriptions of manifest 1,5,6 and 9 can be read in appendix I.

DenCity is a project group consisting of nineteen partners from academia, industry and society divided into five work packages. Each work package has the aim to find innovative solutions for the Frihamnen area to reach the goals described. Work package three is exploring solutions for personal mobility, goods and waste management that will satisfy the user needs of residents, workers and visitors of Frihamnen. This work package is divided into sub parts exploring mobility as a service (MaaS), digital platforms and "mobility hubs" to build a service and physical infrastructure that will function as an alternative to a private car.

> "*DenCity is a collaborative project that aims to find innovative solutions and services to reduce congestion, environmental impact and enhance the quality of life for those living and working in densely populated urban districts. The project is led by the Swedish arena for collaboration within transport efficiency, CLOSER, at Lindholmen Science Park.*"
>
> (DenCity. 2016)

During the spring of 2016 the DenCity project group have been using the backcasting method in four different workshops to find a common vision, understand the present, find solutions for the area and how to incorporate the ideas.

Figure 14 - One of the Frihamnen concept pictures (DenCity, 2016)

The main vision of Frihamnen is to build a city for the people instead of the cars (fig. 14) and a policy for parking lots, *parking policy 0.1*, is going to be implemented. This policy means that for ten apartments there is only going to be one available parking lot for private use. This is the lowest in the country since the lowest existing policy is on 0.4 in Malmö. The 0.1 policy is the key of how to change the mobility behaviour in the area and to encourage the people to use alternatives to the private car. The idea is that the parking policy in combination with a mobility service acting as an alternative to the car, will enable the vision of a city for the people.

1.2 Goal

The goal of this master thesis is to design a sustainable mobility service that can enable the 0.1 parking policy and function as an alternative to the use of a private car, building on future communication technology.

1.3 Purpose

The purpose of the master thesis is to challenge existing norms connected to mobility, analyse the user acceptance of the developed mobility solutions. An additional purpose is to prove that the author of the thesis has fulfilled the skills required for her master's degree.

1.4 Limitations

This report is only focusing on the design of a mobility concept from a user perspective including emotions and behavioural change and does not include knowledge of ICT and how the concepts is supposed to function on a technical level.

1.5 Research question

How can a mobility service look like in a future dense city area to act as an alternative to a private car?
(The process of defining the research question is described in in phase 1.)

2. Theory / Literature study

This chapter consist of a description of the theory and methods of the service design process and literature studies.

2.1 Theory and methods of the service design process

In this chapter, short explanations of the methods and theory used in the design process of this master thesis will be given. The theory and methods are listed in the order of which they were executed in the thesis.

A **Survey** is a form of questions handed out to the participants of a study without having any personal contact. It is important that the questions are structured in a way that the participants will give answer to them correctly according to what was intended. Surveys are used when data is to be collected from a large amount of people. (Bligård, 2011) In this master thesis, surveys were used to identify possible users of the mobility service, their needs and current behaviour.

Interviews are used to collect user information that creates an understanding of the user behaviour, needs and their motivations. Structured interviews consist of pre-defined questions and preferable to use when collecting quantitative data. Unstructured interviews are a free discussion about a certain subject with the participant and preferable to use when collecting qualitative data. Semi-structured interviews are something in between with pre-defined questions with room for probing and free discussion. (Bligård, 2011) Semi-structured interviews was used in this master thesis to collect both quantitative and qualitative data of the users' mobility needs and behaviour.

A **KJ analysis** is a method for understanding the big picture of a large amount of collected data. The result of the collected data is written on notes where each note only consists of one unit of data. The notes are later clustered into groups with different themes. (Bligård, 2011) In this master thesis, the method was used to analyse the answers of interviews by transcribe each interview answer on paper, cut each statement out and group similar answers or statements.

Users can be divided into three different categories; critical users, experts and novices. The critical users are those that have special needs that is hard to meet, examples could be users with disabilities, elderly. The experts are the ones who have a lot of experience of the service or product and the novices are the users that may not have been using the service or product before. The novices are often in a need of instructions or else they have to guess how to use the product or service (Bligård, 2011).

A **Persona** is a fictive user representing interests of a specific user group. The user group and their motivations and needs are found in user research, often results from surveys and interviews. The persona is used to shift focus from abstract demographics towards the interest of real people since their motivations and reactions are based in the result of research of the users of a product or service (Stickdorn and Schneider, 2011). The personas created in this master thesis was used as a tool of visualizing the user needs and their motivations in ideation processes and evaluations of concepts.

The **Value proposition canvas** (fig. 15) is a tool to understand the user and define how to create value for the user (Osterwalder et. al., 2014). The canvas consists of a *customer profile*

and a *value map;* when the value map meets all the requirements in the customer profile a so-called fit is achieved. The *customer profile* is a tool to understand a specific profile in a business model and it is divided into three different fields; *gains, pains* and *customer jobs*. The *gains* describe what the customers want to achieve or specific benefits they are seeking, the *pains* describe the risks and bad outcomes and the *customer jobs* describe specific tasks that the customers want to get done. The *value map* is a tool to describe how the value will be created and consists of three fields to match the *customer profile*; *gain creators, pain relievers* and *products and services.* The *gain creators* describe how the solution can create gain for the customer, the *pain relievers* describe how *pains* can be alleviated and the *products and services* is the actual product or service solutions that will meet the requirements of the customer.

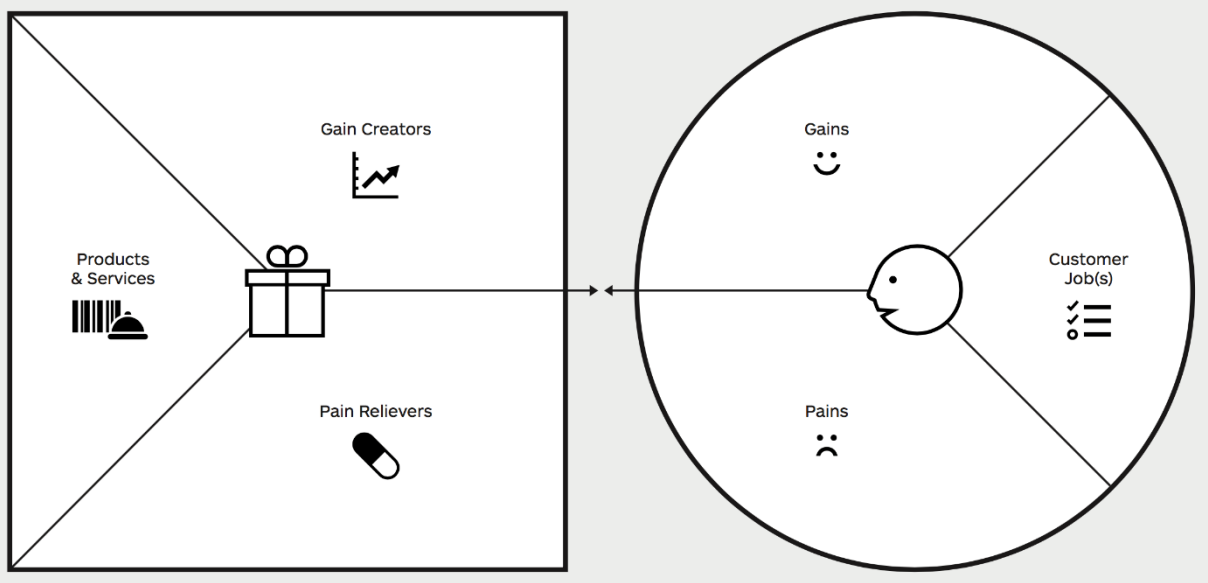


Figure 15 - Value proposition (Osterwalder et. al., 2014)

In this master thesis project the value proposition canvas was used in the ideation process in combination with brainstorming to define what the service should consist of to create value for the users.

Brainstorming is an ideation method with the purpose of generating as many ideas as possible without constraining the thinking process. This means that both good and bad ideas are welcome without being criticized since even the most unconventional ideas might turn up as a perfect solution to a problem with just a small modification. (Bligård, 2011)

A **Customer journey** is a path of touchpoints where the user interacts with a service, such as face to face contact, virtual interaction with website, physical trips or using a building. For each touch point, the user experience is evaluated. The customer journey enables identification of problem areas and a visual overview of the user experience. (Stickdorn and Schneider, 2011) In this master thesis, customer journeys was used to define touchpoints and as a visualization tool describing how the potential users will use the service.

A **Focus group** is a type of group interview with 6-12 participants discussing for example their experience of a product. A facilitator has the responsibility of letting all participants speak and that all questions are being discussed. (Bligård, 2011) In this thesis a modified version of focus group was used to evaluate the final concept. The focus group consisted of only three participants.

A **Service prototype** is a mock-up of the service system that participants can test, and it is used to simulate the experience of the service. The purpose is to generate deeper understanding of a service than what is possible with written descriptions. (Stickdorn and Schneider, 2011)

Service staging is a physical acting of using a service, where participant use roleplay and a service prototype. (Stickdorn and Schneider, 2011) In this master thesis, service staging and service prototype was used to evaluate the final service concept in a combined workshop and focus group setting.

2.2 Design strategies for sustainable behaviour

Researchers have suggested that design strategies can be used to influence sustainable behaviour (Lidman et al., 2011 refers to Lockton, Harrison and Stanton, 2008; Lilley, 2009; Dwyer et al. 1993; Wever, van Kuijk and Boks, 2008; Jelsma and Knot, 2002). Lidman et al. 2011 describes five possible strategies; Enlighten, Spur, Steer, Force and Match (fig. 16). The first four of them require the user to actually change behaviour. Enlighten and Spur motivates the user to change but allows the user to keep control over his or her behaviour while Steer and Force constrains the user more or less. This gives the designer control over how the user will actually behave. The fifth strategy Match let the user keep control over the behaviour while the designer controls the outcome of the behaviour.

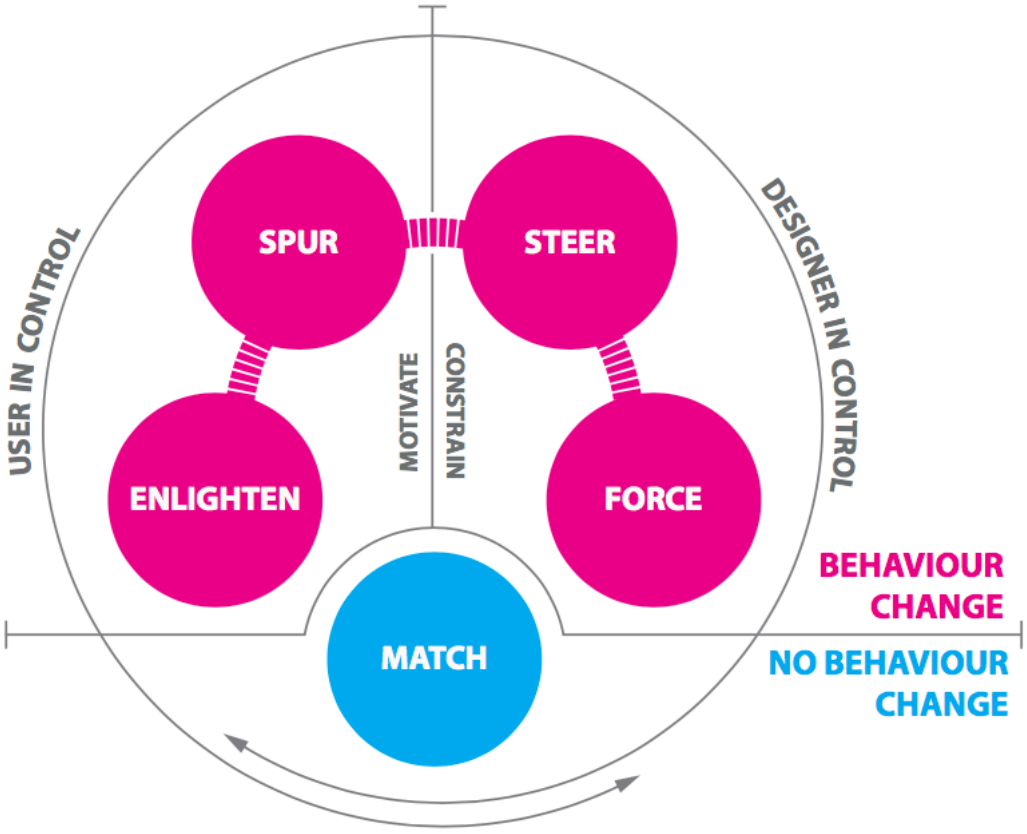


Figure 16 - The model for categorizing design strategies (Lidman et al, 2011)

Enlighten: The designer tries to motivate the user to change to a sustainable behaviour by influencing his or her knowledge, values, attitudes and norms through information, feedback or the possibility to reflect upon the behaviour and the outcome of it.

Spur: The designer encourages and tempt the user to behave in a certain way by focusing on the positive outcome of the behaviour or the behaviour itself. This can be done by incentives or to set goals for the user to accomplish.

Steer: This strategy is based in guiding the user and by making the sustainable behaviour obvious to the user by cognitive or physical constraints.

Force: This strategy forces the sustainable behaviour upon the user. This is done by limited functionality or by restraining the undesired behaviour.

Match: The designer adapts the product or services to the user's behaviour but design it in such way that the outcome of the behaviour is sustainable.

Zachrisson et al (2010) divides users into three groups; positive, neutral and negative depending on their willingness to make an effort to behave sustainable.
Positive users: Are willing to make an effort. Their values align with acting sustainable and may more or less already act sustainable.
Neutal users: Are not willing to act sustainable. They don't care if their behaviour is sustainable or not.
Negative users: Are not willing to make an effort because it doesn't align with their values, beliefs, or their priorities. They can be negative towards sustainability as a goal, the intended behaviour or they prioritize other things more, such as comfort or economy.

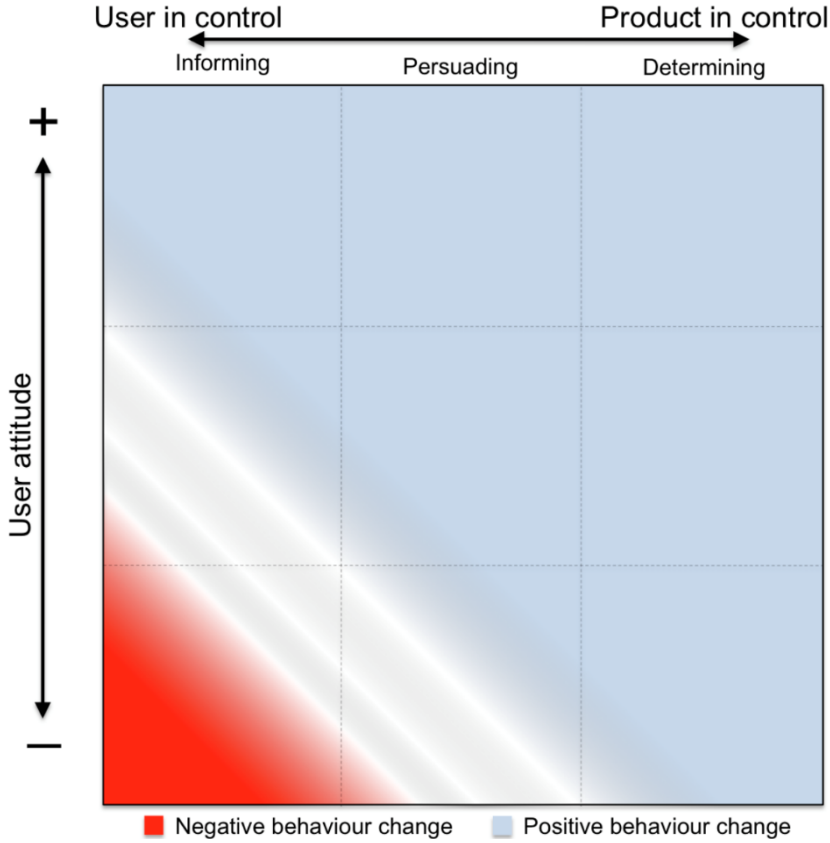


Figure 17 - Relation of user attitude and division of control (Zachrisson et al., 2010)

Figure 17 describe how user attitude and control affects the outcome of positive or negative behaviour change. If the user is negative and given a lot of control, the behaviour will most likely not change to a sustainable behaviour. It the user is positive towards the behaviour change, he or she will change independent of how much control he or she is given. Zachrisson et al (2010) concludes this as "the more a person's belief, attitudes and intentions are in line with the intended behaviour, the more control of the behaviour can be given to the user.".

If the user already has a positive behaviour, the product or service should encourage this and give positive feedback. Bad habits however can be broken by limiting the user's control over the behaviour and make it impossible or change the experienced outcome of the behaviour. Zachrisson et al (2010) describes that it is necessary to detect what brings the positive experience of the bad habit.

2.3 Sharing economy

Sharing economy is one of the ways we can improve sustainability, while still having access to many products and services. The main definition of sharing economy is that focus is shifted from private ownership of a thing or service into having access to it. Services such as libraries for clothes, tools and rental bikes provided by the city has grown and thanks to the digital platforms, sharing of cars and homes etc. has become much easier.

People have been sharing in all times so one may wonder why it is so much talking about it now. Sharing have been important in smaller communities where people have been dependent of each other but in the modern society, the middle class have been able to free themselves from the old need of sharing. Suddenly you could afford your own washing machine, your private car and things like trams and public washrooms got lower status. Today we own a lot of stuff, espresso machines, one or several TVs, drill etc. Now we are starting to learn about the negative aspects of mass consumption and private owning of all this stuff. Economic crises have forced people to start living on less resources and the digital era have made it easier to share and transfer money between individuals. Not only individuals knowing each other, but total strangers that have found a way to trust each other through the digital platforms. (Bradley, 2016)

The sharing economy is believed to continue growing. Matzler et al. (2015) refers to PricewaterhouseCoopers estimation that five main sectors of the sharing economy could represent 335 billion dollars of the worldwide revenue in 2025. The speed of growth of the sharing economy may however be a threat to industries established today. The reason is lower rate of consumption. For the users, the sharing economy can be a potential for cost reductions and increasing of environmental awareness (Matzler et al., 2015).

There is a huge potential for new business models and if the companies want to survive, they should start to understand and adapt to the sharing economy system. Matzler et al. (2015) suggest six ways in how companies can respond to the growth of the collaborative consumption patterns:

1. Sell the use of a product rather than the ownership of it.
2. Support the customers in their desire to resell goods.
3. Exploit unused resources and capacities.
4. Provide repair and maintenance services.
5. Use collaborative consumption to target new customers.
6. Develop entirely new business models enabled by collaborative consumption.

2.4 Mobility as a service (MaaS)

The private car fulfils many important transport needs, and the MaaS is a way to meet some of these needs but utilizing much fewer vehicles. There is no commonly agreed definition of MaaS yet but it is often described as a combined mobility service including public transportation and other transportations mods such as taxi, car-sharing, bike-sharing. According to Maas framework (Holmberg et al., 2016) some of the main drivers for why MaaS is needed in based in social trends; urbanization, climate change and sharing economy.

Societal drivers
Urbanization: 73% of the European population was considered urbanized in 2010. This means denser cities with higher population and a higher demand on housing, workplaces and open spaces. Many cities in Sweden have started to use parking places and road lanes to allow for this demand which leaves less room for cars and more room for the people.

Climate change: The idea is that a higher utilization rate of vehicles will lower the CO2 emissions but if the MaaS service is designed in the wrong way, it may also cause negative effects on the environment.

Sharing economy: The basics of sharing economy is to share services or products instead of private ownership and mass consumption. An example is AirBnB where people rent out their homes when they are not there themselves, creating trust between strangers by a rating system.

Millennials: Millennials have a high demand of personalized and on-demand services. They want flexible work hours and they have a declining consumption pattern.

Economical drivers
Holmberg, et al (2016) refers to Felländer et al. (2015) stating that a Swedish car is parked 95% of the time and the average occupancy is 1,5 people/car. Other economical drivers are the digital payment solutions such as Klarna and Swish that makes payment and transactions simple both for companies and between individuals.

Technological drivers
In 2015 93% of all Swedes had internet access and 76% use a smartphone (Internetstiftelsen i Sverige, 2015). Big data analysis gives understanding of behaviour such as mobility patterns and consumption patterns which gives the designers power to predict user behaviour when developing new MaaS services.

According to Holmberg, et al (2016) MaaS services can be divided into seven different levels:

- *Simplified car ownership:* Audi unite, BMWi.
- *Peer transportation services:* Uber.
- *Car-sharing:* Sunfleet, Moveabout, Car2Go.
- *Extended multimodal planner:* TripGo, Moovit.
- *Combined mobility services:* Ubigo, Maas.fi.
- *Integrated public transportation:* Ita:mo, Smile.
- *Mobility broker:* Mobility is offered as a part of the housing rent or as a subscription. The goal for this kind of MaaS service is to enable densification of cities without the need of a personal car. An example is the DenCity project in Frihamnen.

Caroline Cerfontaine describes her view of how to compete with the private ownership of a car:

"Combined mobility, meaning offering integrated mobility services with public transportation as a backbone complemented by other modes such as car-sharing, bike-sharing, taxis, cycling and on-demand services is the only mobility solution able to compete with the private car in terms of flexibility, convenience and cost-structure."

Caroline Cerfontaine, UITP Combined mobility expert

3. Process of concept development

The process of the development of the mobility service has its foundation in the Backcasting method, including the first three steps (see fig. 18). This chapter describes the process of the concept development, including defining principles for a sustainable concept and pre-study of users and emotions connected to the car.

An iteration of the first step of backcasting, described in phase one, was made to define a list of sustainability criteria for the specific project of developing of a mobility service in Frihamnen. In the second step of backcasting, a study was conducted to define who will be the future users of the mobility solution, what the users' mobility behaviours and needs are, and what meaning the car actually have in our society today. In the third step of backcasting, a value proposition tool called *value proposition canvas* was used to define what products and services may give value to the users identified in step two of backcasting. Based on the canvas, a first concept was designed. The final concept was designed based on an iteration, and improvement, of the first concept and it was later tested and evaluated. For a thorough description of the time plan of the project, see Gantt schedule in appendix II.

During the thesis process, the DenCity project was conducting four workshops based on the four steps of backcasting almost simultaneously. These workshops functioned in this project as an important source of knowledge and it was possible to create a good relationship with important stakeholders during the workshops. The workshops were also used to evaluate findings and concepts of the thesis project, enabling important insights from involved stakeholders.

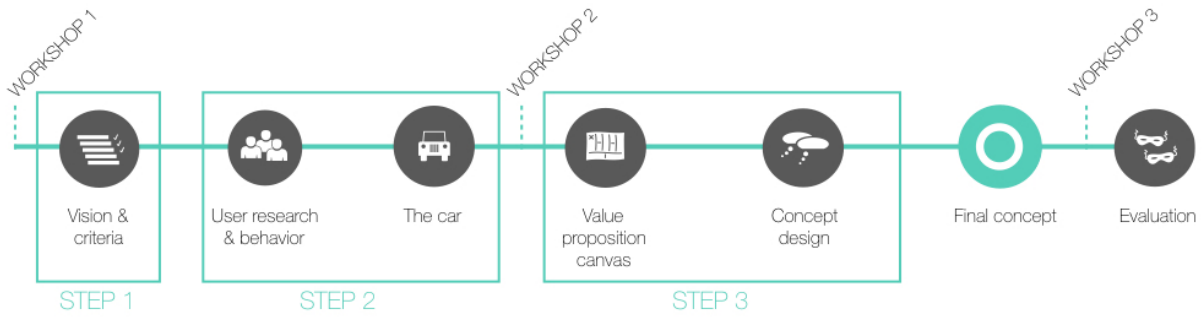


Figure 18 - Process of phase 2

3.1 Vision and criteria of a sustainable mobility solution

To really define what a sustainable mobility service in Frihamnen would look like, the first step of the backcasting method (Defining criteria for a sustainable future) was iterated. Criteria for sustainability was defined for the four pillars; societal-, economical-, ecological- and well-being perspectives (fig. 19). The criteria functioned as a requirement list or check list throughout the entire process to evaluate that the concept development fulfil them.

Figure 19 - Four perspectives for sustainability criteria; ecological-, economical-, societal and well-being perspective

In order to create well-being with the mobility service, the emotions of the service must be positive, preferable more positive than the emotions connected to the use of a private car.

In this project, the well-being has been defined by the following four requirements for the mobility service (fig. 20):
(1) **Freedom of choice** refers to freedom in general but also to freedom generated by feeling in control of your choices of how and when to travel.
(2) **interaction** with others is a basic requirement so that the service provide opportunities to meet and interact with others. There should always be a possibility to communicate between users and with the service provider.
(3) The users should also feel **inclusion** in the service. This means that the user can affect the service content, actually be able to use the system and to be able to fulfil the mobility needs they have.
(4) The users should experience **flexibility** compared to using a private car. The ability to use a private car whenever it suits the user is expected to be one of the key factors for why a private car is preferred before other mobility options today.

Figure 20 - The criteria for well-being

Three criteria were defined for the societal pillar (fig. 21):
(1 & 2) A key word when defining of the societal criteria is **accessibility**. Frihamnen aims to be inclusive for a number of different user groups. To make the Frihamnen area inclusive for all, access for critical users, easy travel access to school, work, health and hobbies, and easy access to deliveries and grocery shopping is necessary.
(3) **Trust** between the people and trust in the technology and services provided are important to enable the well-being in Frihamnen and create positive user experience and acceptance of the services that are provided in the area.

Figure 21 - The criteria for the societal pillar

Six criteria were defined for the economical pillar (fig. 22):
(1) the idea of **sharing economy** should be incorporated throughout the entire service system since the idea of having a private car is inefficient and unsustainable when looking at the high percentage of time the car is unused, the amount of space it takes and emissions (Felländer et. al, 2015)
(2) To make the service inclusive, Frihamnen must be economically **accessible** as well for all user groups.
(3 & 4) The Frihamnen area is not exclusively for persons with high income, it should be for students, elderly, immigrants as well. The difference in the income of the different user categories puts pressure on the price of the service to be **equitable** and **fair**.
(5) If the system is **transparent**, the users might have a greater understanding of why it is designed as it is and the acceptance will be higher.
(6) **Efficiency** is essential in the terms of how to use vehicles to reduce costs and emissions.

Figure 22 - The criteria for economy

Finally, two criteria for the ecological pillar were defined (fig. 23);
(1) **"zero" emission** The reason for the quotation marks for zero is that we will not by 100 percent be able to state that the mobility service will be completely emission free. The aim is to reach as near zero as possible.

(2) By **creating awareness** of the impact each user has by using the service instead of a private car it is believed that the user will be encouraged to change behaviour (based in literature described in chapter 2.2).

Figure 23 - The criteria of ecology

3.2 User research and mobility behaviours of today

In the second step of Backcasting (to describe the current situation in relation to the criteria for sustainability) a small research study was executed to identify who will be the future users of the mobility alternative in Frihamnen and what are their needs. In the DenCity project three main categories of users have been defined;
(1) People living in Frihamnen (inhabitants),
(2) people visiting Frihamnen (visitors) and
(3) people working in Frihamnen (workers).
As a starting point of identifying who these users will be, a survey was conducted.

3.2.1 Identification of users and behaviour

The main goal of the survey was to identify who could be potential users of the Frihamnen mobility service and if they could be potential visitors, inhabitants or workers. The survey

was also used to identify mobility needs, habits and expectations of a possible mobility service. The survey had 56 respondents between 18 and 70 years old. The respondents were found in various interest groups on Facebook, with interest in cars, environment and city planning. In this way, a hypothesis was that the respondents would bring different perspectives into the survey result. The questions asked and the results of the survey is presented in appendix III.

One of the results from the survey was how many had a car, or access to one. 14% of the respondents owned a private car, 10% had access to a car, 4% were members in a car-sharing service and 71% did not use a car at all. 95% of all the respondents were going by bus, 87% was using a tram and 60% used a bike.

One finding was that a majority (62%) of the participants that does not have a car today are thinking of getting a car in the future. Seen in figure 24, one reason for this was that they want to live in the suburbs where the public transportation is not equally available and accessible as in the central parts of Gothenburg. Another reason was that the participants picture that a life with children will be easier with a car, and a third reason was having the opportunity to go shopping at places like IKEA situated outside the city centre. A final reason was that they believe that they probably will have a long travel distance to work. A conclusion that was drawn out of this was that how our infrastructure is built, how far you live from work and how accessible bigger stores are is highly affecting the mobility needs of people and the likelihood that they will feel dependent of a car.

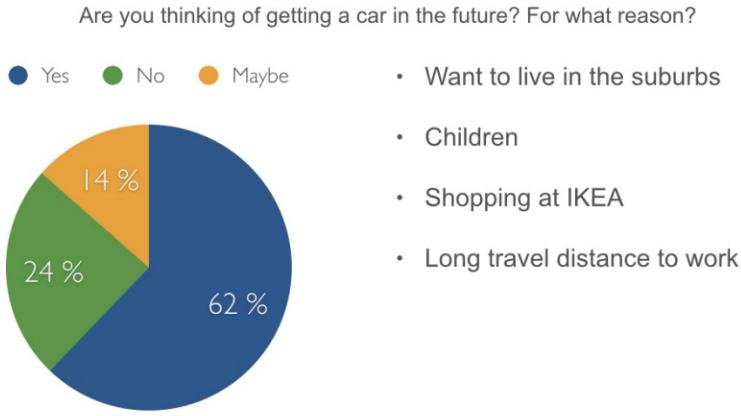


Figure 24 - Likelihood of getting a car in the future and the reasons why.

Another result from the survey connected to the previous, was that the majority (69%) of the participants that have a car would be willing to stop using their own private car if their three top needs could be satisfied with a service instead of a car (fig. 25). This shows a likelihood that users of private cars would be willing to use a service instead.

The reasons for not wanting to stop using the car was to a great extent connected to emotions connected to the car; it is fun to drive, it gives feeling of freedom and it is convenient when you want to travel longer distances (fig. 25). This shows that a future mobility service should provide the positive feelings of enjoyment and freedom to attract the negative car users as well.

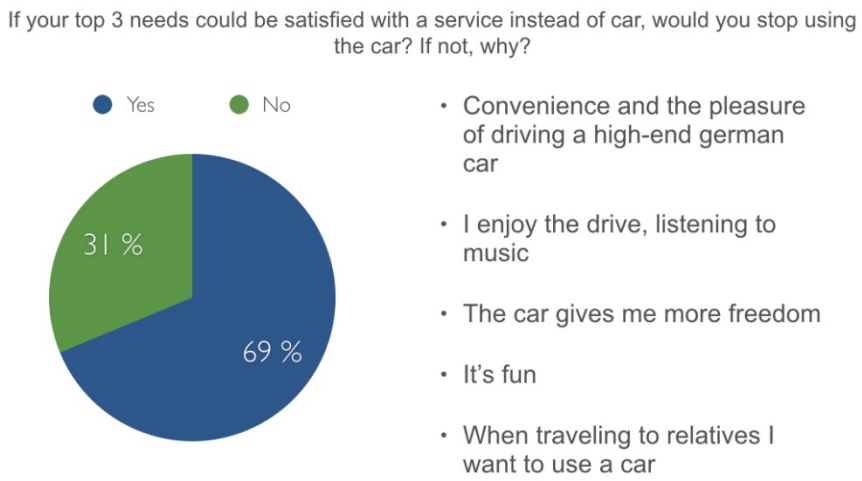


Figure 25 - Likelihood of that car owners would stop using their car if their top 3 needs could be satisfied without it.

The top needs for mobility according to the respondents of the survey was; to be able to go grocery shopping, to leave kids at day care and school, to go to work, and to go to recreation areas outside of the city. The respondents saying that they would not stop using the car explained that the main reasons were safety for children, convenience, habits and positive emotions connected to the car.

3.2.2 Analysing mobility needs

To analyse deeper what the mobility needs of potential users are and what could be possible problems and obstacles for them in the use of a potential mobility service, nine of the survey respondents were interviewed. The purpose of the interviews was also to find if there is an understanding of new technologies for communication and what the participants think of being tracked of a system in time and place. A pilot interview was made to check that the interview questions was not leading and that the answers was matching the intended type of answers. The interviews were semi structured to allow the users to freely explain their personal issues.

The interviewees were chosen to represent potential future inhabitants, visitors or workers in Frihamnen and to represent different ages. The age span was between 23 and 82 which will represent the future age span from 20-80 of the people living in Frihamnen when Frihamnen has been built.

The interviews were analysed with the KJ analysis method to see what are the most common problems and the most common demands and also to see what would be critical needs and demands to identify critical users. The interview guide is presented in appendix IV.

An interesting finding from the interviews was that for some of the interviewees, the public transportation was perceived as stressful and uneasy to use because of the need of constant planning, while it gave a lot of freedom and was seen as a place for relaxation for another. The interviewees that had children were in a greater extent unpleased by public transportation since they perceived it being complex and unsafe to bring a small child in the public transportation. They also felt that they needed the possibility of being totally flexible when bringing the child which they felt could be satisfied by a private or shared car to a larger extent than what public transportation can.

> *"My wife like to go outside the city into the forest and that is hard with public transportation with a baby" "In a car you feel safer not spreading infection to your baby"* IP1

> *"Sometimes I can feel limited because some things take so long time if you are going away with bus on excursions. Especially if you are travelling with children that needs to eat, sleep etc. […] it requires so much more planning when you take the bus instead of the car."* IP 3

A critical need connected to public transportation and car sharing found during the interviews was to know if there are animals in the public transportation or fur on car seats since one of the interviews was highly allergic.

> *"What can be really inflexible is for example like me if you are super allergic. If you travel longer distances, it is not possible. It will be me that have to get off because they have no obligation to get off. I have had to do that sometimes when it comes people with riding clothes etc."* IP 3

Two important mobility needs of teenagers and young adults was to visit friends and to be able to go home safe from parties. The elderly participants described needs for recreation and to be able to travel to summerhouses. This shows that a mobility alternative must satisfy a big variety of needs from different generation and that there must be a variety of mobility alternatives combined to satisfy all the needs.

The needs identified in the analysis of the interviews can be summarized as:

- Safety for yourself and children
- Possibility of flexible mobility when bringing a child
- Clean surfaces
- Be able to visit friends/family
- Travel home safe at night
- Go to work / groceries stores / shopping / school
- Go to recreation areas / summer- or winter houses

3.2.3 The Car and emotions connected to it

Göteborgs stad and Trafikkontoret (2014) found in a study of mobility habits that approximately 90 % of the people in the Gothenburg region have one or more private cars. This is a really good example of what was discussed in the dialog about mobility in phase 1: that the society we live in today is adapted after the car and this is causing an increased "need" of a car. The results of the survey also show that the society is in a so-called lock-in where we see the car as the perfect solution of our problems. To actually be able to enable the usage of a mobility alternative, the urban infrastructure must be changed. IKEA should maybe be moved to central parts and function as a showroom and provide delivery service instead of being in the outskirts of the city, facing a big parking lot with bad public transportation connections. This is why the parking policy of Frihamnen is of extreme importance to make it possible for a mobility alternative to function well.

Another study conducted by the SOM-institute (2013) for the Västra Götaland region, was found that the main problems with traffic perceived by the people in Västra Götaland 2013 is; car queues, delays in public transportation, bad air, noise, not so good bicycle infrastructure in

central parts and unsafe walking. This is an example that support that the current societies are built for the cars and not for the people.

Another interesting finding in the report was the reasons for not taking the car. 86% of the people living in central parts of Gothenburg and in Linnéstaden 2013 stated that parking fee was the biggest reason for why they choose not to take the car. Car queues was 82% for the same area while the gasoline price was the main reason for only 20% of the whole Gothenburg region in 2007. 63% of the people in the Gothenburg region answered environmental reasons. This could also give a hint of that the parking policy 0.1 actually could have a good impact of changing mobility behaviour of the inhabitants.

An interesting trend found by the SOM-institute (2013) was that the young generation sees themselves as environmentally aware and trust the society in providing sustainable solutions in the future such as fossil free vehicles. This could give a hint of that if Frihamnen is not providing the inhabitants with a sustainable mobility alternative, the mobility behaviour will not change. This is since the young generation that one day may be the adult inhabitants of Frihamnen, will probably not make an effort in changing if no other options is provided.

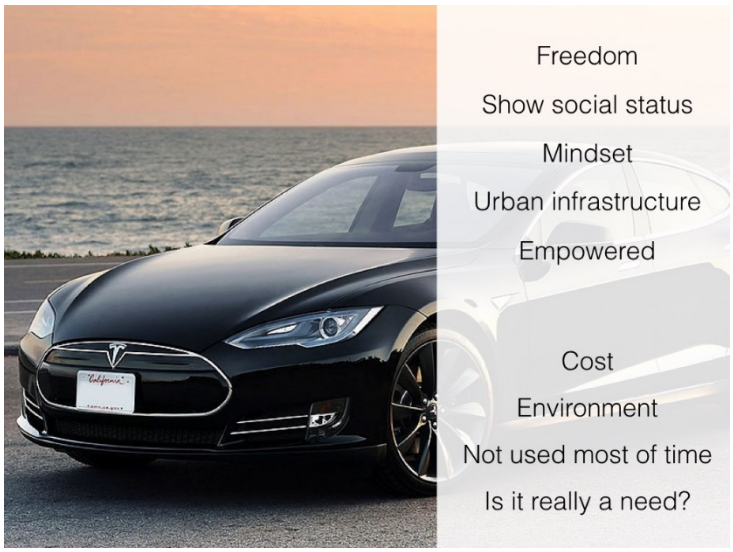


Figure 26 - Some important positive and negative aspects about cars

In the survey and the interviews, it was found that there are a lot of emotions connected to the car, both positive and negative (fig. 26). The positive feelings are that the car gives you freedom, that you can show social status, and that you can feel empowered by having the possibility to drive away whenever you feel for it. The present architecture of the urban infrastructure is also causing the car of being the most convenient choice. Negative aspects are on the other hand the costs of owning a car, environmental aspects of emissions and the inefficient use of the cars since the cars are standing still most of the time. Negative emotions that was found was worry about accidents, stress and irritation of other drivers and car queues.

The question one should ask is if it really is a need of a car we have? This short study of user mobility needs shows that we do not actually have a need of a private car, we have need of mobility that is dependent of the urban infrastructure and placement of important stores etc. There is also a need of positive emotions that is highly connected with the private car today such as freedom. If these mobility needs and emotions can be fulfilled by a mobility service, it will probably be a positive experience for the people using it.

3.3 Personas

Based on the survey and interviews two personas, Mia and Andreas, were created to embody the critical users of the mobility service and to highlight their critical needs. A third persona, Bodil, was created as a fiction character to cover the critical needs and perspectives of elderly and people with disabilities. These personas can be seen as a summarized version of the mobility needs found in the research. They were used to evaluate and test the ideas of a mobility service in the ideation phase. The three different personas were designed to fit the three user categories *inhabitant, worker* and *visitor.*

Figure 27 - Picture of the persona Mia

Mia is a 27 years old woman who lives with her boyfriend and their one-year-old son in the suburbs of Gothenburg in a small apartment. They are currently moving to a bigger apartment in Frihamnen to be closer to day-care, school and city centre. Mia works as a nurse at *Östra Sjukhuset* hospital and is very caring and nursing as a person. What makes Mia a critical user is that she is super allergic so if she goes into a bus where someone have a pet, she needs to get off immediately. Brining a baby around when traveling is a second reason why Mia have critical needs and a third reason is that Mia doesn't have a driver's license.

Mia loves to go to the sea and swim during hot summer days and during the autumn she loves to walk in the forest and look for lingonberries. Mia is really excited to go out in the forest with her child and show the wonders of nature. Mia belongs to the user category *inhabitant.*

Figure 28 - Picture of the persona Andreas

Andreas is a 42 years old man living in the countryside close to Gothenburg with his dog Rufus. He works as a 3D printing engineer in a newly started company in Frihamnen and he is very lucky to be able to bring Rufus to work. He really loves his dog and go nowhere without him. This is one of the reasons why Andreas is a critical user. The second reason of why Andreas is a critical user is that he is a real car fanatic. He loves to drive, he loves his car and he feel almost dysfunctional when he cannot have the opportunity to drive. It makes Andreas really irritated that the parking policy is so strict in Frihamnen. On the other hand, he hates car queues so he is also happy that there are not so many cars in the area. Finding a place to park the car can sometimes be hard. Andreas belongs to the user category *worker*.

Figure 29 - Picture of the persona Bodil

Bodil is an 82 years old lady who have been living in Gothenburg her whole life. She loves everything about Gothenburg and is especially excited about the new area Frihamnen where her son and grandchildren are living. Bodil lives in the inner city of Gothenburg and she is often visiting Frihamnen to see the development of the area and to see her son and grandchildren. Bodil needed to amputate her left leg a couple of years ago and is now dependent of a wheelchair to get around. Going by public transportation is not as easy as it used to be and she is sometimes feeling a lack of independency and feel like a burden to her family. Everything takes a long time with the wheelchair and the hectic tempo in the public transportation is a big source of worrying. Bodil belongs to the user category *visitor*.

3.4 Value proposition canvas

Based on the needs and emotions connected to mobility found in chapter 3.2, a *customer canvas* (fig. 30) was made for each persona where each persona's *customer jobs*, *gains* and *pains* were defined.

The *customer canvas* is the first part of the *value proposition canvas* (see chapter 2.3) that is used to identify what would bring value to future customers. Since the three personas is based on users with critical needs (so called critical users) the needs of all users should in theory be covered if the mobility service in Frihamnen can cover the need of the personas. This would also mean that if the service can bring value to the personas, it will also bring value to the other users of the service.

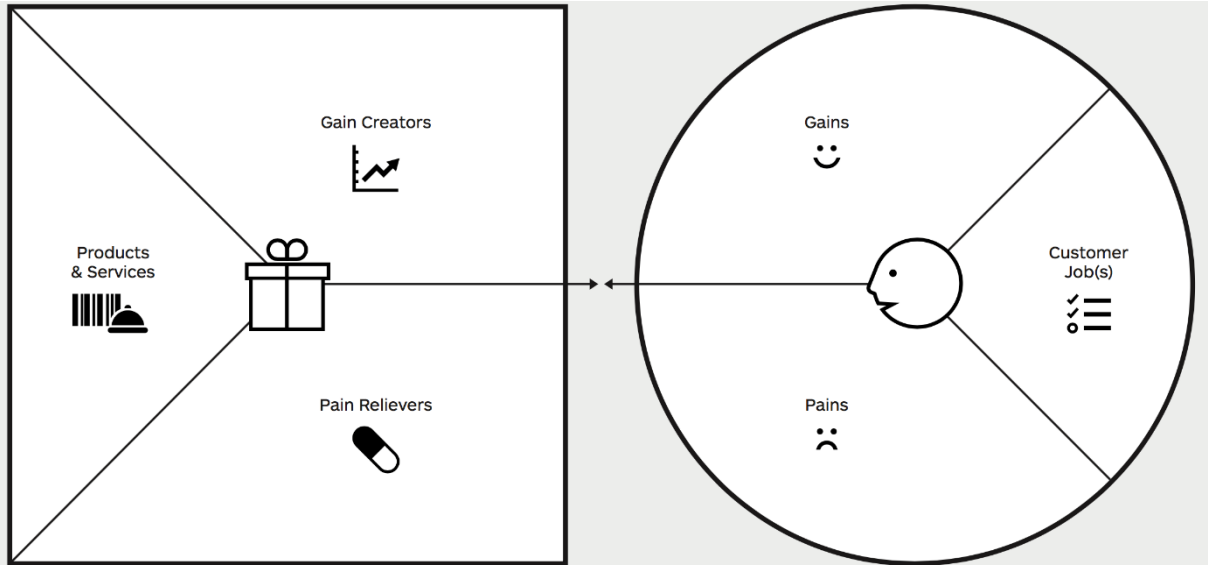


Figure 30 - Value proposition template (Ostwalder et al, 2014)

The second part of the value proposition canvas was used to ideate on what could be the values that would fit the customer jobs, gains and pains. Brainstorming was used as a main method of finding the possible values. The values that was selected for the canvas were those that had a so called *fit* with the customer canvas. For reading about the theory of the value proposition canvas method, see chapter 2.1.

Based on the sustainability criteria defined in chapter 3.1, jobs, pains and gains of each persona were selected. The selection was inserted into a separate value proposition canvas together with the best fit of products and services, gain creators and pain relievers of each persona (fig. 31). The complete value proposition canvas of Mia can be found in appendix V, for Andreas in appendix VI and for Bodil in appendix VII.

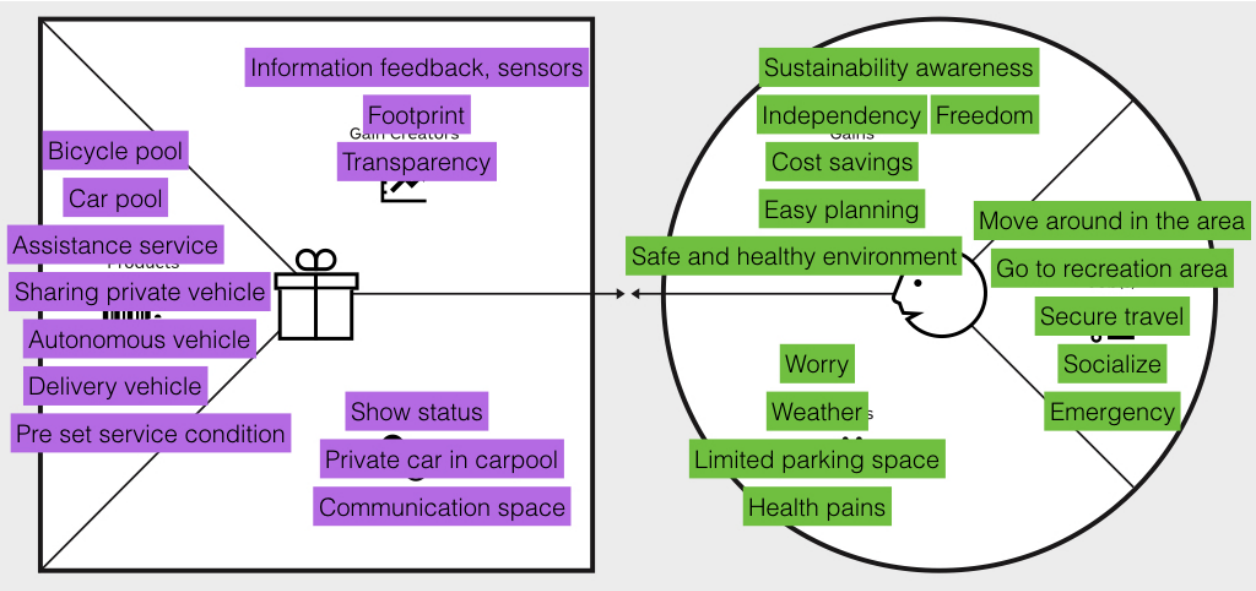


Figure 31 - A summary of the value proposition canvas for the three personas

The gains selected for the general value proposition canvas were:

- *Sustainability awareness*; To gain awareness of their own impact on emissions levels
- *Independency*; To feel independence when using the mobility alternative equal to the independency perceived when using a private car
- *Freedom;* To feel freedom when using the mobility alternative equal to the feeling of freedom perceived when using a private car
- *Cost savings;* Gain cost savings compared to the use of a private car
- *Safe and healthy environment;* That the Frihamnen area becomes a safe and healthy environment to live in

The pains were:

- *Worry;* Worry of safety and health
- *Weather*; Rain, wind, snow affect the convenience of almost every means of transportation.
- *Limited parking space;* Pain of not finding a parking space
- *Health pains;* Such as allergies or disabilities

Jobs selected for the general value proposition were:

- *Move around in the area;* Need of moving around in the area between home and important facilities such as day-care, groceries store, library or work
- *Go to recreation area;* Need of a flexible option to go to recreation areas inside and outside of the Frihamnen area
- *Secure travel;* Need of safety when travel
- *Socialize;* Need of meeting friends and family living in the area, in another part of Gothenburg or elsewhere
- *Emergency;* Need of feeling safe in emergency situations

The ideas to make the user accomplish the customer jobs were different types of transportation sharing services, the use of autonomous buses, assistance service for elderly,

sharing private vehicles to reduce costs, delivery vehicles and pre-set service conditions. The gain creators were information feedback and sensors, showing the users ecological footprint and have transparency between the users and the service providers to build trust between them. The pain relievers were to show status of autonomous vehicles or private vehicles in terms of location and who is using it, use private car in carpool and a communication space or platform between users.

In the following chapter *3.4 Concept design* the development of the concept of the mobility alternative will be described. The final concept is described in chapter *4. Final concept.*

3.5 Concept design

With the value proposition canvas as a base, a first concept was designed to fulfil the needs that was found and that aimed for the sustainability criteria that was defined in step 1 of the process. The concept was divided into three different parts; a service package, a communication system supporting the service, and interaction between the users and the system.

3.5.1 Service package

Based on the product & services defined in the value proposition canvas a package of services and product was designed (fig. 32). The concept was designed as a package instead of a singular service since it was not possible to find a singular service that alone would meet the needs of the three personas and act as a *fit*. The idea of a service package is based in the theory of mobility as a service (MaaS) and inspiration was taken from services such as Ubigo. The concept is also based in the idea of sharing economy to create an efficient use of the products that is part of the service package.

The service package (fig. 32) consists of bicycle sharing, car sharing, possibility to share your private car, delivery vehicles, public transportation and the possibility to access assistance service for elderly or users who are disabled in some way. Additional services could be connected to the car sharing such as a cleaning service to assure the users that there will be no allergy reactions. Another additional service could be the possibility to get products connected to the service package delivered to the door by autonomous delivery vehicles.

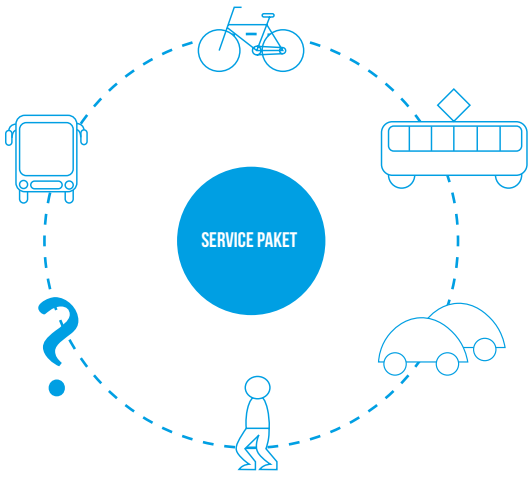


Figure 32 - The first service package

The content of the service package is based in the three personas and the main service for Andreas would be the car pool or private car sharing, for Mia it would be bicycle pool and the possibility to get a baby bicycle cart delivered, and for Bodil the idea is that she can use the public transportation and access assisting service when she enters the Frihamnen area and have the possibility to use an electric wheelchair to easily get around the area.

The ideas are dependent on the placement of parking house, bus stops, a possible hub for deliveries, and where to park car sharing cars. The ideas may or may not be discarded due to changes in the urban planning. By placing the parking lots for private cars further from the home, the users could also be encouraged to choose more sustainable mobility options for convenient travelling.

3.5.2 Interaction

For interaction, there could be several concepts implemented. In figure 33 concepts of information screens, applications and virtual reality is shown. The main purpose of the interaction is to let users communicate with each other, with the service provider and with the service system itself. If you are interest in the ideas of the communication system, please read the thesis report written by Fernando Gomez.

The ideas were a result of brainstorming based in the value proposition for Bodil (see appendix VII):

- Interactive screens that would feel Bodil's presence through signals from her phone and present valuable information to her when passing by.
- A mobile application where Bodil could ask where autonomous vehicles or other types of assistance is in the area of Frihamnen, see availability and book a vehicle.
- Big touchscreen at bus or tram stops where further assistance could be requested.
- Use of smart watches, VR, google glasses.
- Possible to unlock vehicles or wheelchairs with the phone.

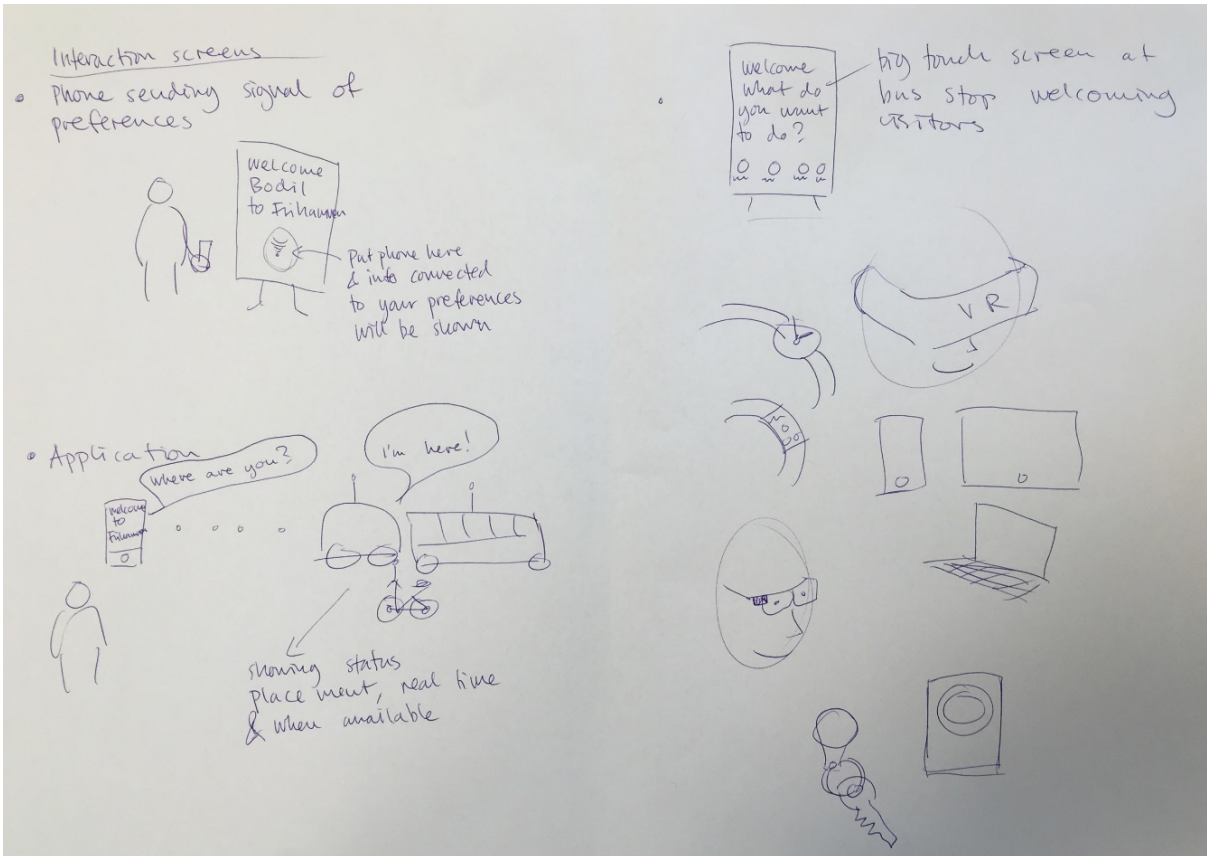


Figure 33 - Sketches of ideas of how the users interact with the service and the system

3.5.3 Customer journey

To visualize the ideas of how the personas would be using the service package, three sketches of customer journeys were made with additional story telling of what are the important touchpoints of the journeys.

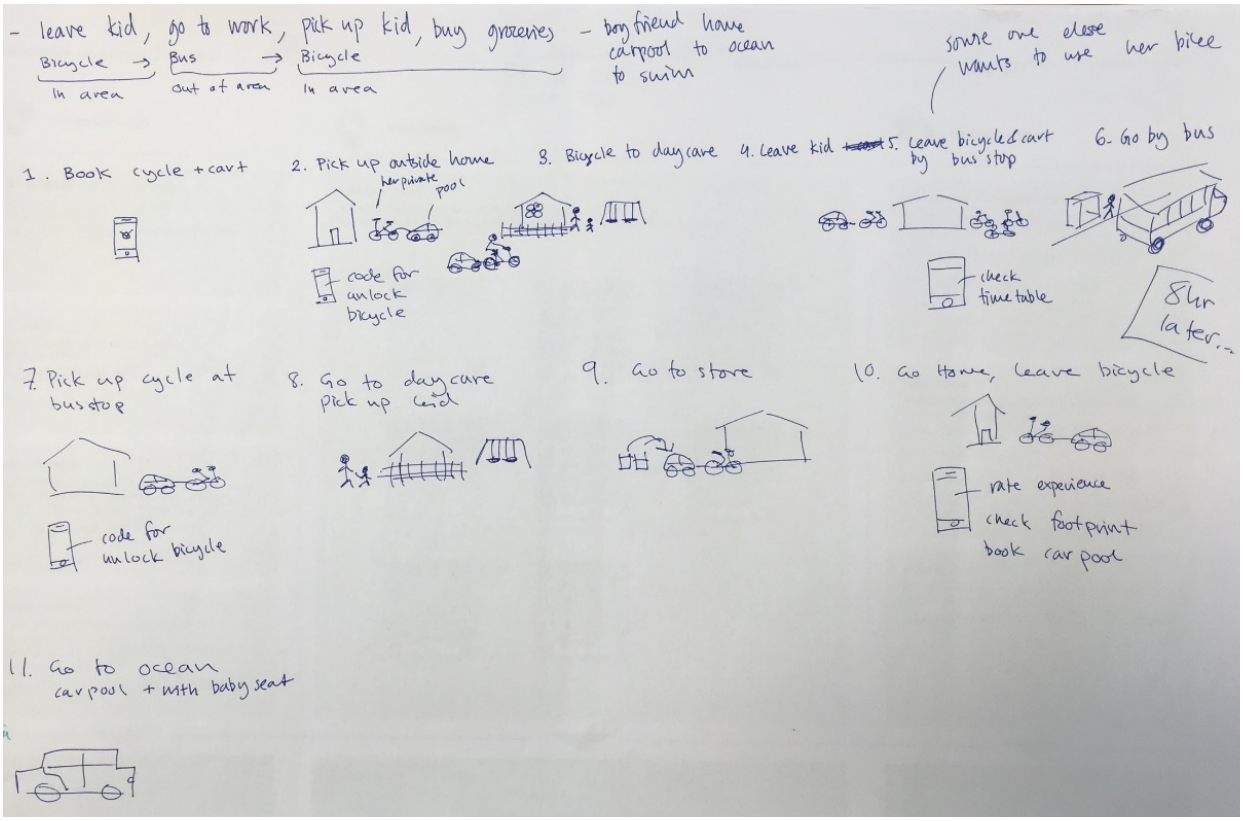


Figure 34 - Sketch of the customer journey of Mia

Mia:

The idea for Mia (fig. 34) was that she uses her own bicycle in the morning to leave her child at the kindergarten and she books a bicycle cart for her child to sit in. The baby bicycle wagon is delivered from the hub in the morning.

When Mia have left her child at kindergarten she leaves her bike and the baby cart at the hub near the bus stop so others can use the baby cart while she is away and takes the bus to work. In the service application on her phone, Mia can see if the bus she wants to take have any animals traveling with their owners on the bus. Mia can also make pre-settings in the application where she can state that she is allergic so the system will suggest suitable means of transportation for her.

When Mia comes back from work, she gets her bicycle and the cart at the hub and picks her baby up. Since it is really nice weather this day she decides to book a carpool and pack her and her baby's bath clothes. When her boyfriend gets back from work he can easily pick the car up with a baby car seat pre-installed and pick Mia and their child up.

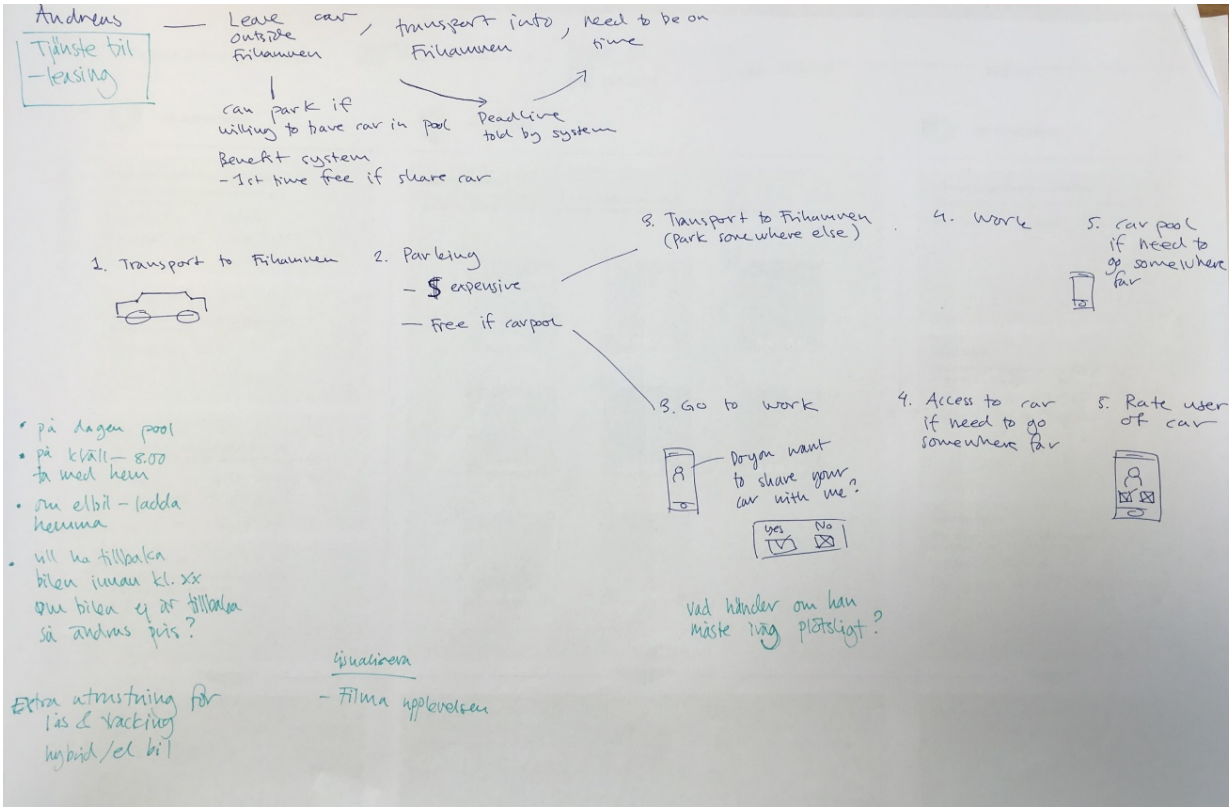


Figure 35 - Sketch of the customer journey of Andreas

Andreas:
There were two different possible customer journeys developed for Andreas (fig. 35):

1. Andreas takes his car to work in the morning and decides to let his car be part of the carpool. By doing this he can park his car closer to work and he gets compensation for when he lets his car be used by someone else. For this concept to work it is needed that Andreas can feel trust for the people using his private car and how this should be done needs to be explored further. An application makes it possible for Andreas to communicate with the person wanting to use his car and he can also see ratings of the person that other users have made.

2. The second alternative is that Andreas is no longer in need of his private car since the Frihamnen mobility service is offering him an electric carpool car to bring home during the night if he turns it back fully charged. During the day, it can be used by anyone else as a normal car pool.

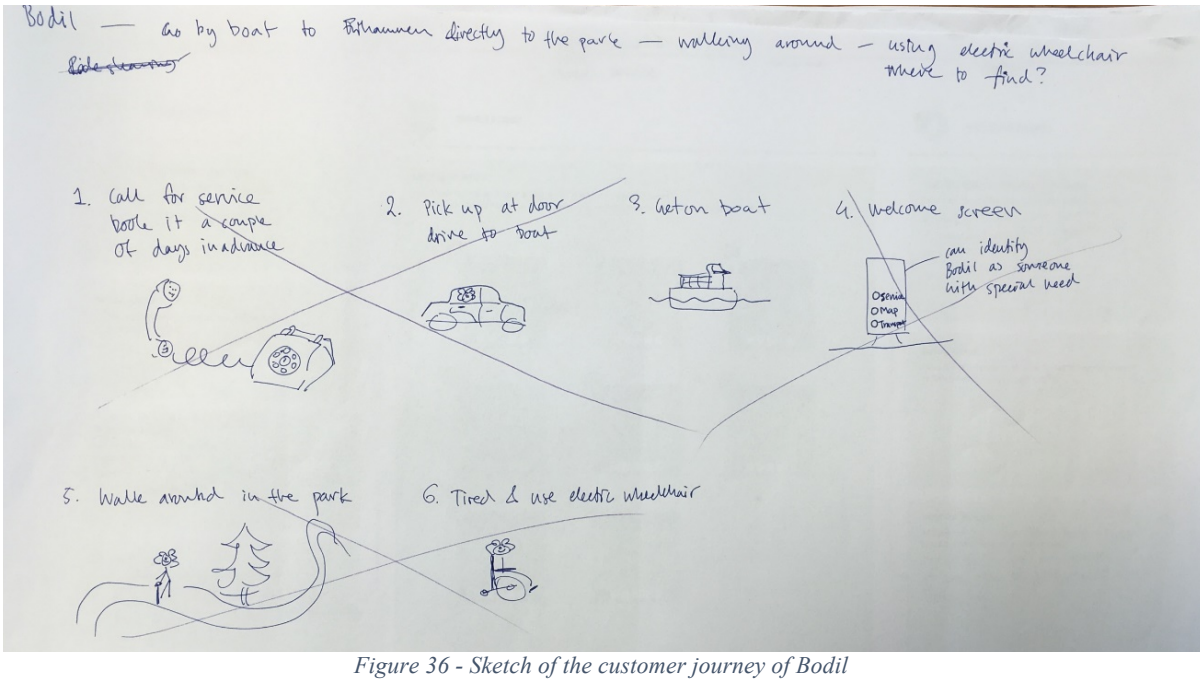


Figure 36 - Sketch of the customer journey of Bodil

Bodil:
Bodil arrives to Frihamnen by boat at the Jubilees park and is greeted by her grandchildren and by an interaction screen (fig. 36) that senses that Bodil is elderly and needs extra service by connecting to Bodil's phone. The screen asks Bodil if she needs any service and Bodil book an electric wheelchair that is delivered to her from the hub. Now Bodil can easily get around in Frihamnen without caring about bringing her own wheelchair.

3.6 Science fair workshop

During the science fair in Gothenburg in April 2016, Challenge Lab had a workshop area where the ideas of the theses were tested on the public. For this project, the workshop was used to collect feedback on the service package described in chapter 3.5 and to collect new ideas of how a service package could look like and what would be important values to incorporate in the service package. The participants were between 14-85 years old and there were approximately around 20-30 participants.

The participants were shown a printed copy of the service package and explanation of each part of it. They were thereafter encouraged to write down additional ideas on what the service package should include on post-its (see fig. 37). They were also asked to write down three words explaining what would be the most important features of such service package.

Findings were that the public had more futuristic thinking for 2035 than the service package suggested and a conclusion could be drawn that the service package was a creation of already existing services and products instead of challenge how it could be in the future. The ideas written down was among other things flying jet-packs, teleportation and flying buses. The most frequent used words to explain wanted features were; fast, low-cost, on time and secure.

The findings from the science fair led to some changes of the service by iterating the ideation, presented as the final concept in the next chapter.

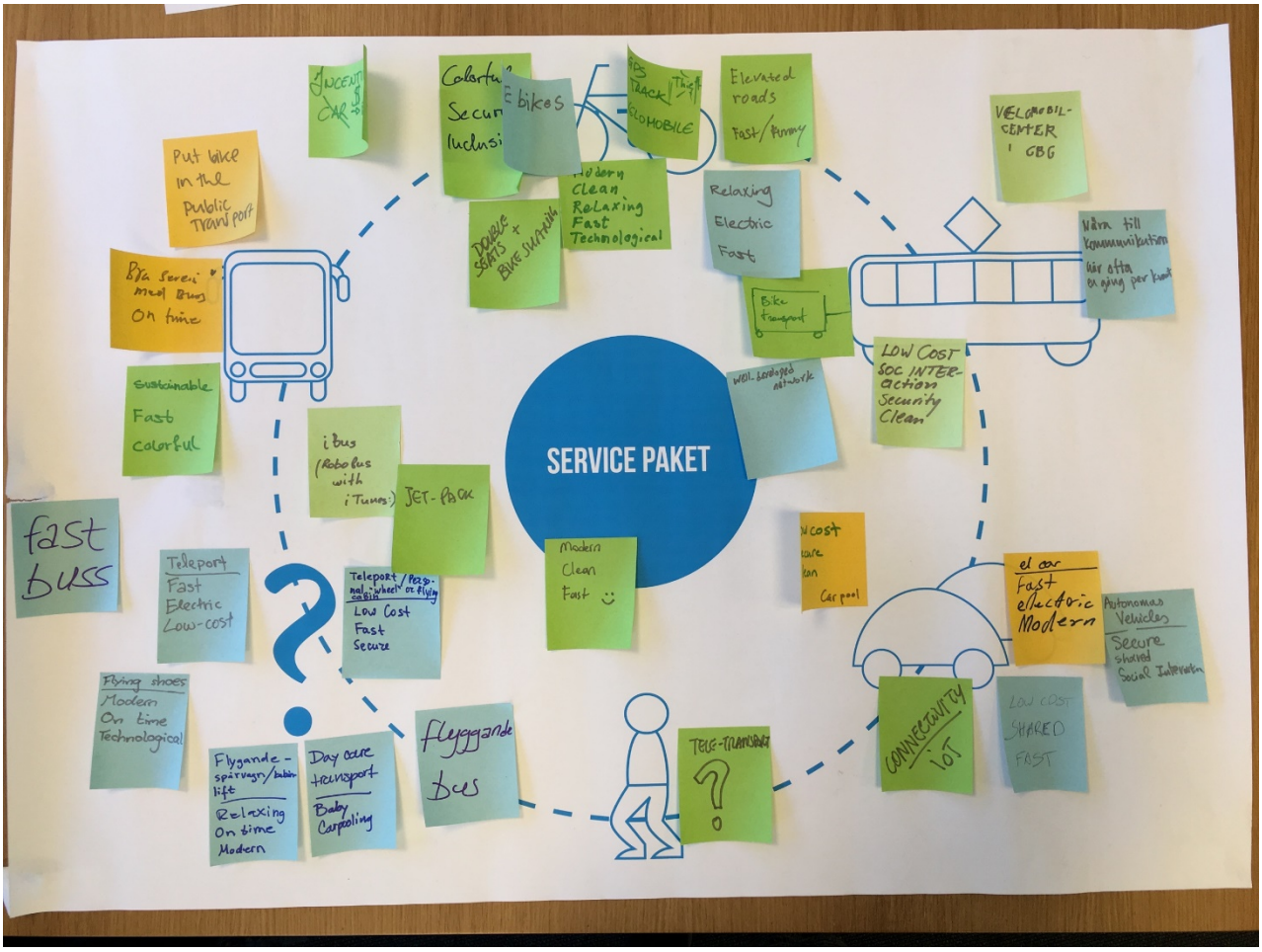


Figure 37 - Poster with post-it's at the Science fair festival

4. Final concept

In this chapter, the final concept is presented including a general description of the service package content, how to interact with the system supporting the service, payment and a detailed description of how the potential users are interacting with the service package.

4.1 Service package 2.0

The main idea of the final concept is to challenge the norms of ownership of a private car and current habits and behaviours connected to the ownership. The intention of the final concept is to offer an alternative to the private car, iterated from the previous service package explained in chapter 3.5.1, to fulfil the needs of people working, living and visiting Frihamnen.

The content of the final service package is (fig. 38):

- a bicycle sharing service consisting of private and public bicycles,
- an electric car sharing service of both private and public cars,
- autonomous buses following routes inside the area of Frihamnen,
- and a hub functioning as a smaller storage and a distribution area for bicycles, cars and autonomous buses.

Detailed descriptions of each part can be read in the following chapters 4.1.1, 4.1.2 and 4.1.3.

To build trust between the one letting their bike or car be a part of the pool and the one using it, the owner can decide who can use the bike/car or not. There will also be a rating system similar to services such as AirBnB which will let future users see the rating of a specific user and base their decision of letting the specific person use their private belonging. There will also be a GPS installed in every bike and car in the pool to make sure they are not stolen. The most important key to trust is however to be able to meet up in the hub, or chat live in an application on the phone which is also the place where the owner decides who can use the bike or car. The interactions between users of the service package is presented further in the customer journeys describing how Mia, Bodil and Andreas is using each part of the service package 2.0 in chapter *4.3. Customer journeys 2.0*.

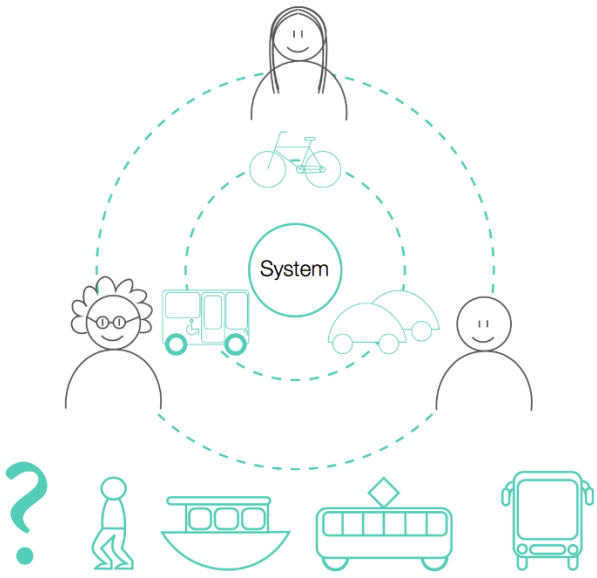


Figure 38 - Content of Service package 2.0

4.1.1 The Hub

The concept of the mobility service is based on the existence of a physical hub where people can fix their bike, lend a helmet, book a shared car, ask for help and even receive service in form of car wash or help adjust the height of the bicycle seat or similar.

The Hub should be located close to public transportation, roads passing the Frihamnen area and close to important social facilities such as library and grocery store (figure 39). If the concept of the hub is developed even more, important social facilities could be integrated into the hub to secure the social importance of the hub. The hub should be a place where people can meet, share their means of transportation with others, and socialize to increase the trust in the system and the trust of others using your private belongings. The hub is the physical space of the theory of shared economy.

Complementary to the hub, the concept consists of small delivery robots with the possibility to deliver smaller things such as bikes, baby carts, helmets and such directly to the front door of the user. Exactly how this could work is described in the customer journey of Mia (chapter 4.3).

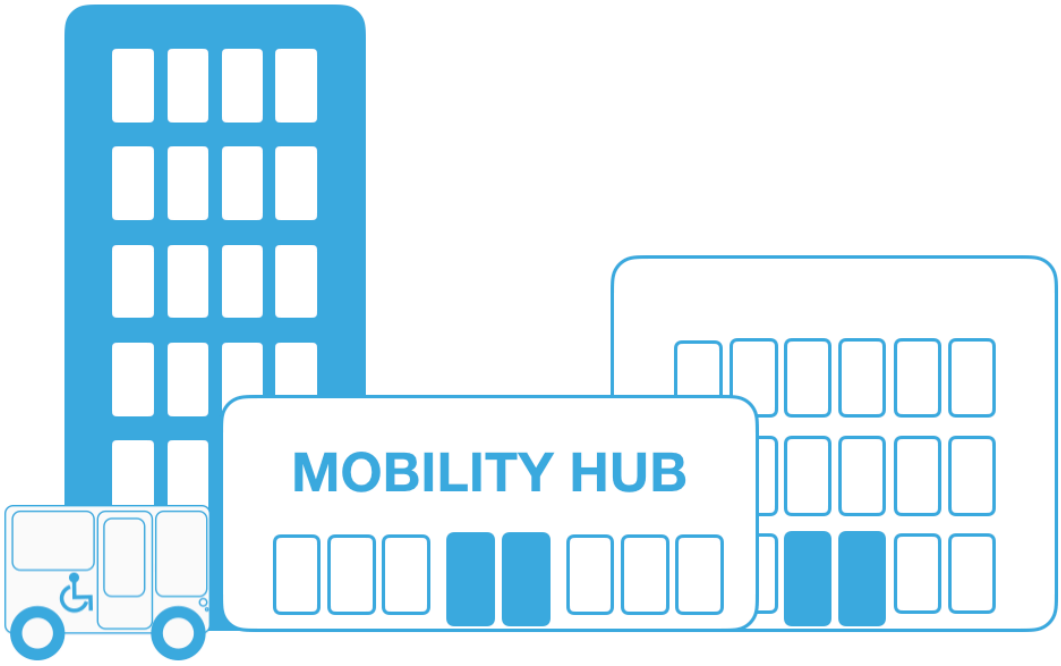


Figure 39 - The imagined location of the Hub

4.1.2 Bicycle sharing

The bicycle sharing service consists of public shared bicycles, electric bicycles, your own private bike and accessories such as baby cart and helmets.

To secure that only the right person has access to the bike, all bikes, including the private owned, have electronic lock with a code that is shared via the application.

A full description of how the bicycle sharing service works can be found in the customer journey of Mia in chapter 4.3.

- Bicycle pool
- Share private bike
- Baby cart etc
- Parking place
- Tracking system
- Code

4.1.3 Car sharing

The car sharing service is based on the use of electric cars to reduce the levels of emission in the Frihamnen area. There are public cars in the carpool as well as private owned cars. This will reduce the need of parking lots and is the main solution for how to enable the parking 0.1 policy for the Frihamnen area. If using your private car in the carpool you will have access to other car sharing cars.

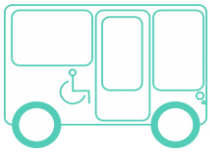
- Car pool
- Share private car
- Company car pool
- Tracking system

The car sharing service will be complemented with services such as if you work in Frihamnen and live far away, you can take the car home during the night with the condition that you will charge it.

Companies in the area can also use the car sharing service. This in combination with letting the private car be part of the service will make the visitor's parking space less crowded since you can park your private car in a space for shared cars instead.

4.1.4 Autonomous buses

The purpose of the autonomous buses is mainly for traveling within the area. The buses will follow routes and stop at important places such as public bus stops, school, grocery store and next to houses in areas where no car can go. Since the bus is rather small (fig. 40) it can travel on roads that will only be for pedestrians and bicycles. Since it is autonomous, the speed will be adjusted depending on which part of the area it is at or type of road it is traveling on. It can also be adjusted to the needs of users with special needs such as elderly. The idea is that elderly can ask the bus to come pick them up exactly where they are to reduce the need of walking far distances. This is further described in the customer journey of Bodil in chapter 4.3.



- Intelligent route
- Special buses for special needs
- Off route for special needs
- Platooning & modularity

The fact that it is autonomous will enable the buses to share information with each other and to platoon when rush hours. This and other features connected to the autonomy of the bus is further described in the report of Fernando Gomez.

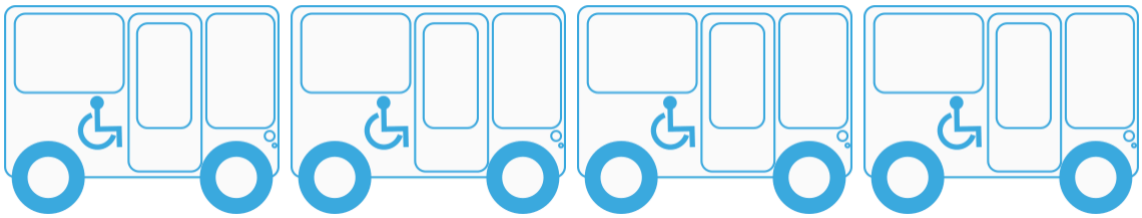


Figure 40 - Autonomous buses in a platoon

4.2 Payment & footprint

The highest level of a MaaS service is a so-called mobility broker (Holmberg, 2016). This is believed to be the best way to reduce the use of private cars. A mobility broker means in short terms that the payment of the service is a part of the rent. This is explained further in chapter *2.4 Mobility as a service*. This will also be the payment solution for the mobility service designed in this master thesis. However, the theory of sustainable behaviour describes that it is a good idea to encourage the user to act sustainable (Lidman et al, 2011). This is why the idea of sustainability points is introduced to the final concept of this mobility service.

The idea is based on the Swedish train company SJ prio system where points is received for every purchase at SJ. These points can later be used when buying new trips or to buy snacks or drinks from the train bistro. For the mobility service in Frihamnen, this would work in a similar way: When choosing a sustainable way of commuting, you get so called sustainability points. If you share your private car/bicycle you get even more sustainable points (fig. 41).

These points can be used within the system to book something from the hub. The users will not get sustainability points for using the autonomous buses since they are limited to the Frihamnen area and is not acting as a substitution to a private car. The autonomous buses are there to make it easy to travel to the bus/tram stops and parking house to limit the need of using a private car in the area.

It is believed that these sustainability points will be encouraging and educational, making the users of the service choosing the more sustainable alternative over another and enable a more and more sustainable behaviour.

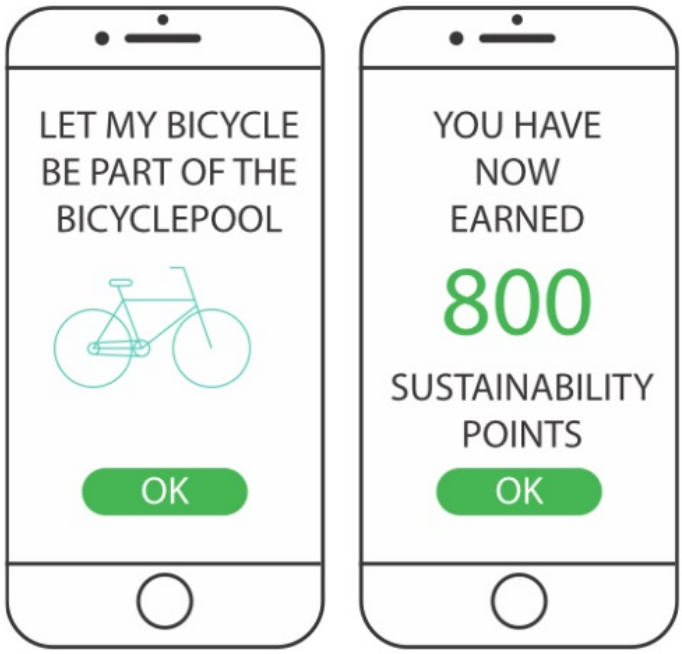


Figure 41 - Sustainability points

4.3 Customer journeys 2.0

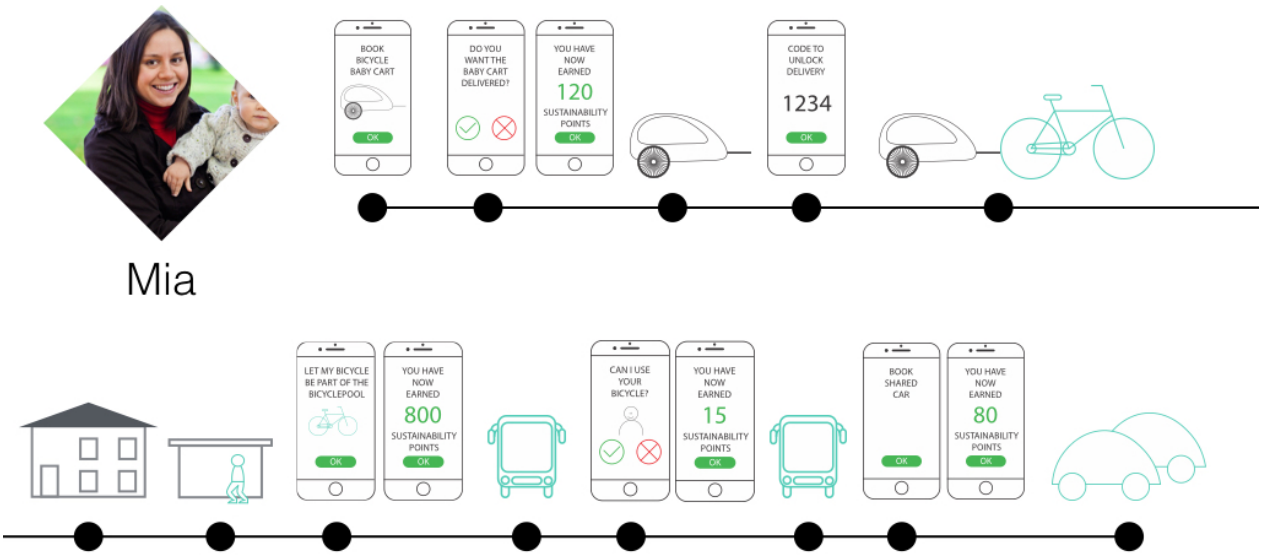


Figure 42 - Customer journey of Mia

The customer journey of Mia (fig. 42) begins with her using an application to book a bicycle baby cart the night before going to work a sunny summer's day. Mia receives a confirming message asking her if she wants the baby cart to be delivered to her door. Mia thinks it would be wonderful and press okay. Mia doesn't have to add any information about where she lives since she is already in the system and the signal from her phone provides the delivery robot with the location information it needs to deliver the baby cart. The system understands that Mia will use her own bicycle by booking only the baby cart and since this is a sustainable way of commuting, she will receive a certain amount of sustainability points as a reward.

In the morning, the delivery robot delivers the baby cart and Mia receives a message that it is outside and she also gets a code to unlock an electric lock that prevents the baby cart from being stolen or used by someone else than Mia. Now Mia can attach the baby cart to her bicycle and her first stop is the kindergarten where she leaves her son. Mia's second stop is the hub just by the bus stop where she leaves her bike and the baby cart. By doing so, her bicycle will be used in the bicycle pool and the baby cart can also be used by others in the neighbourhood. Mia only need to confirm her action by pressing okay in the application and by doing so, the system rewards her with sustainability points. When Mia is at her workplace, she receives a message from a neighbour is asking if he can use her bike that is stationed in the hub. Mia can see how other bike owners have been rating the neighbour and since he seems like someone that take care of the bikes properly, she let him use it.

When Mia is on her way home she is longing to go to the ocean to take a swim in the nice weather and book a shared car from the hub. The system knows of her allergies and provides Mia with a car that no pet has been in.

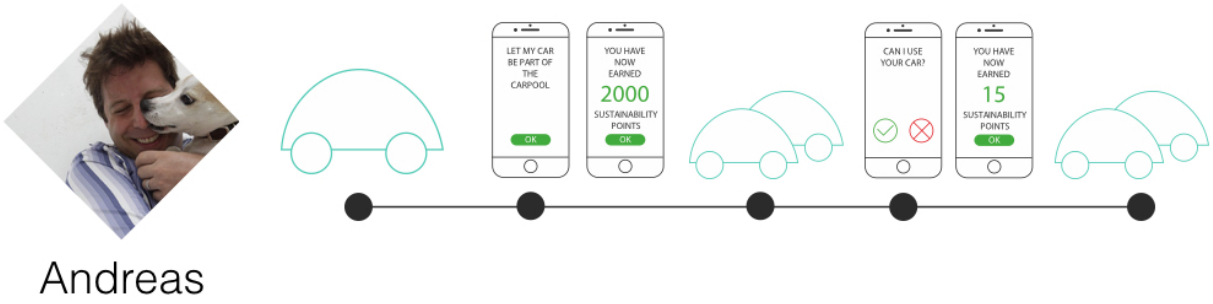


Figure 43 - Customer journey of Andreas

For the final concept, the idea of sharing private cars was chosen and therefore the customer journey of Andreas is based on only this idea instead of exploring both of the ideas described in chapter 3.5.3. The journey (fig. 43) begins with Andreas entering the Frihamnen driving his private car and there he realizes that there are very few parking lots available for visitors. Andreas decides to let his private car be part of the car sharing service during the day when he is at work. He got the idea when the app proposed it to him after circling the parking lot for a while. As a reward, Andreas receives a certain amount of sustainability points. During lunch Andreas receive a notification from the app asking if one of the other users of the mobility service package can use the car for a couple of hours. Andreas accept and earn some more sustainability points. Andreas can also check the profile of the user before accepting and see other people's rating.

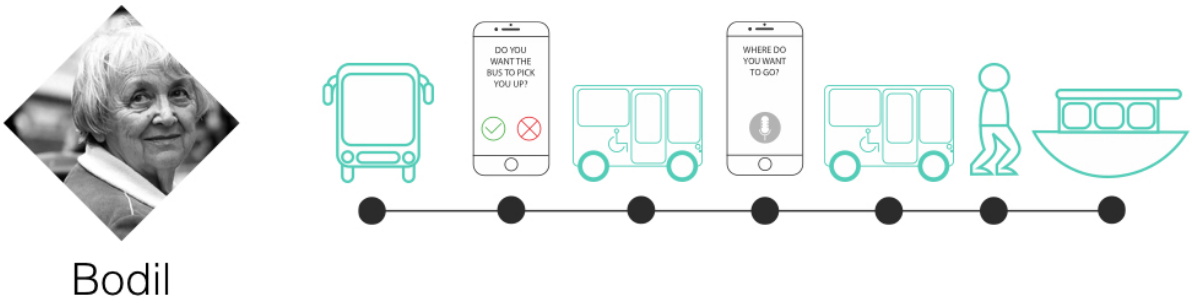


Figure 44 - Customer journey of Bodil

Bodil arrives to Frihamnen by bus (fig. 44) and she have brought her wheelchair with her. When she is at the bus stop she can ask the system to bring her a special autonomous vehicle for people with special needs by using the application. One of the autonomous bus will thereafter get out of its route and come to where Bodil is since it can sense her phone GPS signal. When Bodil and her wheelchair is safe placed on the bus she uses her phone to interact with the bus and ask it to let her off at the Jubilees park. When she arrives, she is greeted by her grandchildren and they help her get off the autonomous bus. When it is time to go home, Bodil decides to take the boat instead of the bus.

5. Evaluation and feedback

A focus group was used to evaluate potential user acceptance and what emotions could be connected to the final concept. The group used Service prototype, staging and role play as tools to understand the different personas and evaluate the concept. The theory of these methods is described in chapter 2.1.

5.1 Method of the evaluation

By using pictures of products and a prototype of interaction made of a cut-out of the iPhone screens from each customer journey, the Frihamnen area was built up in a room with different stations for the different touchpoints of the three customer journeys. Three participants were thereafter supposed to act as the different personas, going through the customer journeys and evaluate it by discussion and filling in a Geneva wheel of emotion.

Figure 45 - The participants learn about the personas

First the participants were introduced to the project and Frihamnen. Secondly, they were introduced to the three personas Mia, Andreas and Bodil and learning about their separate customer pain, gains and jobs (fig. 45) and they learned about the role play they were supposed to do. In the third step the service packages were presented before the interaction prototypes were handed out. The three participants were acting as one persona at the time going through the customer journey simultaneously (fig. 47). When a customer journey was finished, the participants filled in a private Geneva Wheel of emotion paper anonymously with the name of the persona and one of the numbers 1-3 to separate the answers between the participants. When the Geneva wheels were filled in there was an open discussion about service content and the general experience of the customer journey.

Figure 46 - Mediating objects like this prototype of delivery robot was used

Figure 47 - The participants acting as Bodil, using the chairs as wheelchairs to get around and reading from the application prototype

5.2 Outcome of the evaluation

The performing of focus group session went very well since the participants embodied the personas and understood the idea of the imaginary space of Frihamnen that was stationed in the room. All of the three participants could relate to how they imagined that the personas would think and act in the different situations. Two of the participants had been interviewed earlier which gave them an advantage when it came to understand what the service package was all about. The third participants could bring in new perspectives and thought that the explanation of the package and the personas given by the authors of this thesis, was well done in order to understand the task.

One big question discussed during the focus group was what you can get for the sustainability

points. The participants believed that they and the personas would prefer the sustainability points over money if the sustainability points could be traded to something not only within the Service package. One of the participants did however dislike getting coupons in stores etc. since the participant felt limited in what can be bought.

The overall emotions connected to the experience of the Service package were positive. The customer journey of Mia where she uses the bicycle sharing service was the one with the most positive result (fig. 48). As can be seen in the Geneva wheel figure, the lines that represent the respondents have a strong shift to the right-hand side. The positive result is most likely showing that the bicycle sharing service have a good chance of user acceptance if developed. The most negative emotion that the participants felt was worry. This was mainly due to the worry if the users of Mia's private bicycle would take care of it properly, what would happen if they change the height of the saddle and Mia doesn't have any tools to change it back. Another concern was if Mia uses her private helmet she doesn't want to leave it with the bike in the hub for someone else to use. The participants described Mia's fear of getting ill because of her allergies if someone with a dog uses the helmet and also that it would feel a bit disgusting for her overall to have someone else using her helmet.

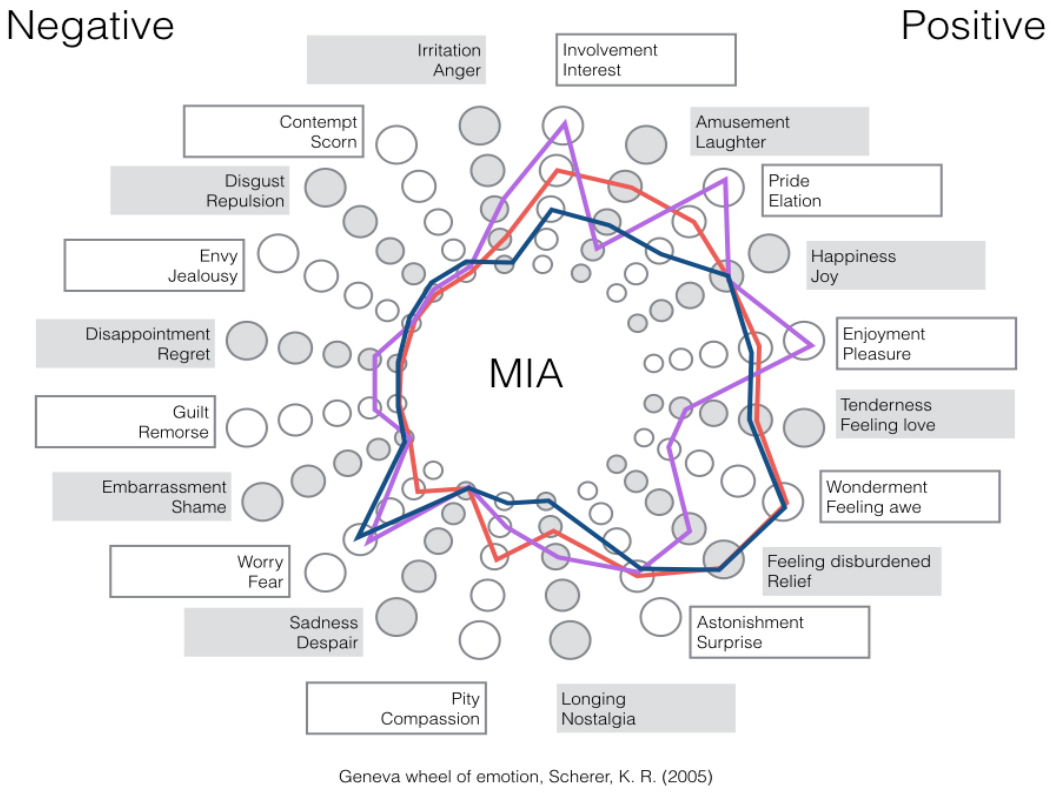


Figure 48 - Emotions connected to the customer journey of Mia

During the discussion session, the participants also spoke about ideas on how to solve the problems they encountered during experiencing the Mia customer journey. The issue with the helmet could be solved if she could store the helmet in a private locker in the hub and the issue with changing saddle height could be solved if there was a service for getting the bicycle restored to Mia's preferences included. This service could maybe be paid with sustainability points. The participants got very happy when they received the sustainability points because it encouraged them to collect even more of them. This proves that the sustainability points or

similar rewarding system could be accepted by future users of the service package.

The participants also got very happy when they found the delivery robot outside the house delivering the bicycle baby cart. They were all positive to the idea of receiving a code to their phone to unlock the deliver robot.

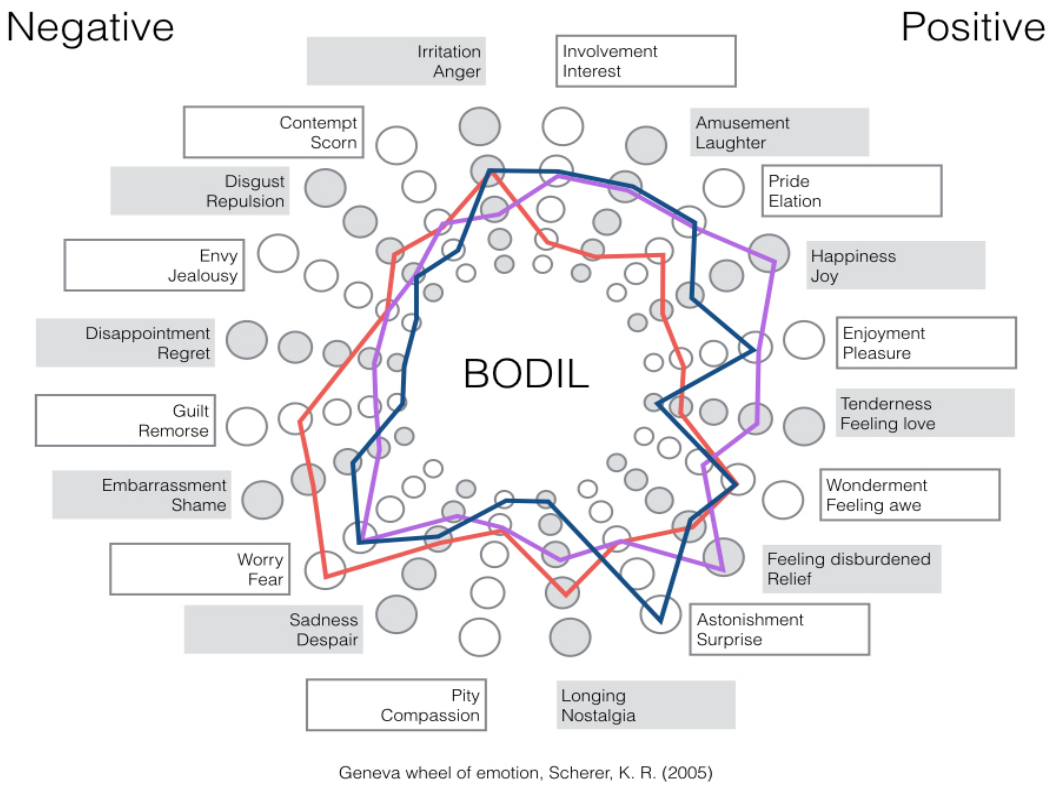


Figure 49 - Emotions connected to the customer journey of Bodil

The next customer journey evaluated was Bodil's when she arrives to Frihamnen to visit her grandchildren and uses the autonomous buses. As can be seen in figure 49, there were both positive and negative emotions connected to this journey. The most negative emotions were worry/fear and irritation/anger. The worry was mainly caused by the autonomous bus and the lack of a helping hand. When the participants act as Bodil they described that she worried about what would happen if she fell in the bus, would anyone help her? Does the wheelchair fit in the bus? Can the bus see or understand when she is not seated in the bus or does it start moving anyway so she might fall? Conclusions that could be drawn by these worries is that it is highly important that the bus is designed in a way that elderly feel secure when using it. Ideas such as having the possibility to get assistance was discussed with the participants. Assistance should not be mandatory since that might reduce Bodil's feeling of being independent. A solution could be a surveillance system or an assistance button that Bodil could easily reach so she can feel secure about that if something happens, she will receive help. An irritation was that the voice communication with the bus might not work if there are more people in the bus than just Bodil. What if the bus is full and the voice control doesn't register where she wants to go?

In the discussion session, the participants said they would have liked an electric wheelchair that you can rent in the area so you don't need to bring your own and be worried about the autonomous buses. This was highly interesting since it existed in the first service package. The insight about Bodil might prefer an electric wheelchair makes it questionable if the

autonomous buses really are the best solution for elderly in the area. It could however be a good solution in general for the area to provide the people living further from public transportation stops, the hub or the parking lots, with a comfortable way of moving around in the area safe from bad weather.

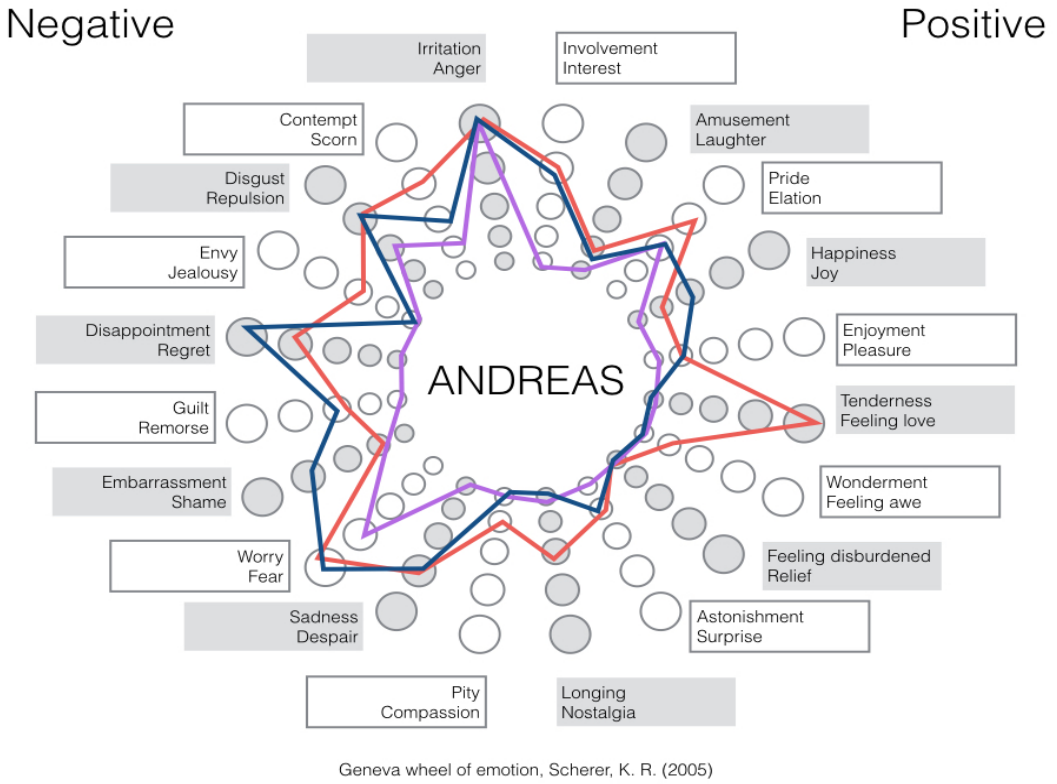


Figure 50 - Emotions connected to the customer journey of Andreas

The emotion wheel belonging to the experience of Andreas' customer journey (fig. 50) shows a lot of negative emotions. One of the respondents felt tenderness as a positive emotion but it was for the private car itself and not for the experience of the customer journey. The participants felt a lot of irritation, anger and disappointment when they couldn't find any free parking lot and felt forced to use the parking lots that only could be used if you agree on sharing your private car with others. They were also disappointed that they did receive such small amount of sustainability points when they accepted a user of the car to share it with. The sustainability points felt as a too small compensation for the risk of sharing a private car. In the discussion session, the participants described that they would favour a big reward such as free mechanical and washing service so they could be sure of getting the car back in a good or maybe even better condition than before. One of the participants told that she would rather park the car at another location in the city than using the car sharing parking lots if she still felt as the risk was bigger than the reward. The acceptance was higher among the participants when discussing the case of using a car that was owned by the company Andreas work for and could be shared by all employees. This scenario was however not evaluated any deeper.

A conclusion made of this is that the parking policy 0.1 will reduce the number of cars in the area but the risk with the visiting car users is that they will park somewhere else instead of letting their car be a part of the car sharing service if the reward for doing it is not big enough. One reason why Mia's customer journey was more positive could be that the journey was the

most well-developed of the three and that there are already existing services similar to it such as Styr&Ställ (source) in Gothenburg.

5.3 Fulfilment of criteria for a sustainable future and user needs

In this chapter, the final concept is compared to the criteria for sustainability defined for this project in table 1 (see chapter *3.1 Vision and criteria of a sustainable future*). The concept is also compared to the user needs (see chapter *3.2.2 Analysing mobility needs*) in table 2. The degree of fulfilment is based in the outcome of the evaluation workshop.

Criteria	Fulfilment Y/N	Comments
Ecological criteria		
Zero emission in the area	Yes	Electric cars, electric autonomous buses and bicycles are all emission free.
Create awareness	Yes	The sustainability points enable awareness of one's impact on earth.
Societal criteria		
Mobility access for critical users	Yes/No	Autonomous buses will do the work but the trust may not be there for the elderly.
Access to basic needs	Yes	The service package enables travel inside and out of the area which gives the users the possibility to access basics needs.
Trust	Yes/No	The possibility of rating users and having personal contact will hopefully increase the trust between the users but elderly may not have trust in the system.
Economic criteria		
Sharing economy	Yes	Sharing economy is implemented through the whole concept of the service package 2.0
Accessibility	Yes	The service is accessible independent on how much the user earn.
Fair price	Yes	The price model is based on sustainability points which allow users with lower income to afford all mobility options if they have a sustainable behaviour.
Equity price	Yes	Same as fair price.
Transparency	Yes	There is transparency in the system in terms of understanding how one's behaviour affects the environment.
Efficiency	Yes	The use autonomous buses and by sharing private and public vehicles, the efficiency in use of natural resources is increased.
Well-being		
Freedom of choice	Yes	The users can choose from different mobility alternatives.
Interaction	Yes	The users interact in the hub or through the application.
Inclusion	No	In the evaluation Bodil did not feel safe. The trust in the system did not exist for her which causes a feeling of exclusion.
Flexibility	Yes	The users can access the service package 24 hours a day.

Table 1 - Fulfilment of criteria for sustainability

User needs	Fulfilment Y/N	Comments
Safety	No	In the evaluation, the participants did not feel safe when acting as Bodil and they were scared something would happen to their car when acting as Andreas.
Flexible mobility	Yes	The service package offer flexibility in how to use it and when.
Clean surfaces	Yes	The system is designed to detect if the vehicles is not cleaned after use. For more details please read the complementary report by Fernando Gomez.
Visit friends/family	Yes	
Travel home safe at night	Yes	The system in the autonomous buses makes sure that the user is safe. For more details please read the complementary report by Fernando Gomez.
Go to recreation areas / summer- or winter houses	Yes	The bicycle- and car pool can be used to travel.
Go to work / groceries stores / shopping / school	Yes	The service package can be used for all types of mobility needs.

Table 2 - Fulfilment of user needs

6. Discussion

The service package developed in this thesis is dependent of new technology and products that has not yet been commercialized. Because of this, the conclusions drawn in this thesis can only be hypothetical since the actual service content and ICT technology structure cannot be tested and evaluated by the creator of this thesis. To actually evaluate if the service package solution will change the mobility behaviour of the people living in Frihamnen, an evaluation must be made with real products and communication interfaces. The likeliness of the service package being successful is dependent of the existence of parking policy 0.1 and also probably dependent of the location of workplace, day care, stores such as IKEA etc. especially if it ought to be successful in the long run. The possibility of changing the content of the service package in the future will probably affect the level of sustainability since the products existing today might be outdated in the future. Thus, the service package should not be dependent of the actual content of the package in terms of mobility options, but the connectivity and communication and service structure built around it.

There are some issues that need to be solved before the service package is ready for launch. A business model is missing and it is not yet clear who will be in charge of this service package and act as the service provider.

During the process of this thesis, both Amanda and Fernando participated in workshops with different stakeholders in Frihamnen. In the last workshop, the service package was presented and discussed with the stakeholders. Additional issues came up such as insurance for private owned vehicles used for public sharing and who is responsible if something goes wrong. No solutions came up during this workshop but if the service package is to be developed further and implemented, these are some questions that needs to be solved.

Another question that came up during the discussion was how inclusive the service package is for people coming from other cultures. In some cultures, owning a car can be an even stronger symbol of status than here in Sweden which must be taken into account when designing a service that should be inclusive for all. However, cultural differences must not be a lock-in for the progress of designing sustainable services and products since all countries need to do what is possible to prevent the global warming from increasing. With this in mind, the lack of exploration of cultural behaviour in this thesis is of a minor matter. Before implementing this service in Frihamnen, it need to be tested and evaluated which leave a perfect opportunity to test the service with users from different cultural backgrounds, with different income, in different ages and people with different disabilities. Since the service package only have been evaluated with three users acting as different user-types, the result can only give a hint of what could be working and not. It is important to highlight that both the user research and evaluated need to be complemented in order to verify that the service package is the right type of solution for a mobility service in Frihamnen.

7. Conclusion

In order to conclude the answer to the research question, six important elements were identified. These elements are related to each other and affect one another depending on how they are designed and this is why they are all important building blocks to consider when designing an alternative mobility option. The elements are as shown in figure 51; technical system, service package, user acceptance, criteria, interaction and behaviour.

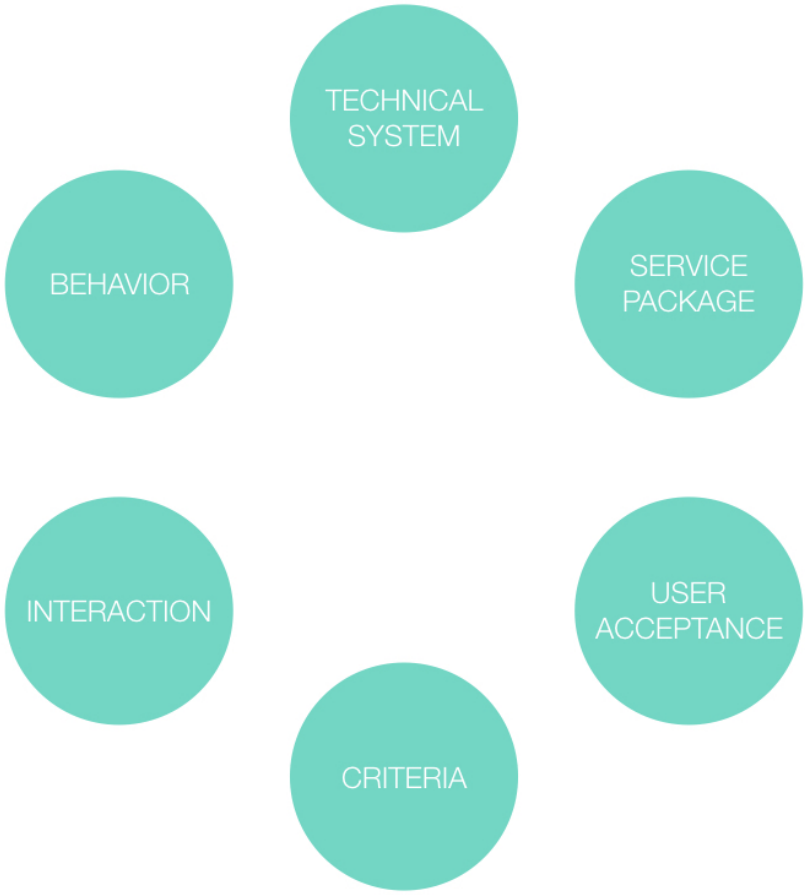


Figure 51 - The six critical elements needed to design a mobility service

Service Package: The mobility alternative to the use of a private car must have the same level of convenience and positive emotions such as freedom. To manage that, it was found during this project that the mobility alternative must be a package of solutions and services. This service package must be supported of a robust system and interaction with high usability to work and be accepted by the users.

To reach the sustainability criteria for all of the four pillars, the idea of sharing economy can enable the efficient use of resources that is required to enable the parking policy 0.1. Interaction between users is necessary to build the trust required for the idea of sharing economy to work well. Another requirement to reach the criteria is that the products used in the service package such as autonomous buses and carpooling cars must be emission free. To make the service package sustainable over time, the products needs to be able to be changed when new, better product with less environmental footprint exist on the market.

Technical system: Conclusions regarding the technical system can be read in the second report about this project written by Fernando Gomez.

Behaviour: To change behaviour, theory suggest that different strategies have their pro's and con's but they are all showing that design can affect the behaviour of people. In this project a combination of steering, forcing and encouraging was used to create awareness, make the private car less attractive and making sharing economy easier by designing ways of rating users and communication between users.

Interaction: Interaction with the system and between users is a key point in how to build trust. If the interaction is not functioning well, the trust will probably decrease. It is important that the way of interacting is accessible for everyone. In 20 years from now it is guessed that elderly will be used to smartphones but it is no guarantee that smartphones will be our main way of interacting in 20 years.

If the technical system is built in such way that it is learning the behaviour of the users, it is possible to decrease the amount of interaction the users must have with the system and this is believed to save time and cognitive workload of the users. This will make the interaction being mainly confirmative. Without the possibility to confirm, it is believed that the users will feel that they have no control of the system and this will affect the user acceptance negatively.

User acceptance: The focus group for evaluation showed that there is a resistance in sharing your private car since there are still issues to solve about insurance etc. The result of the evaluation showed on the other hand that the users can accept this service if the reward is big enough. This means that they were not against the idea per se. To use new technologies such as delivery robots and autonomous buses was also welcomed by the users as long as the users could communicate with the system or a supervisor of the system to reduce the risk of injuries. The awareness of environmental impact was perceived as increased by the use of the sustainability points. This is believed to affect user acceptance of the alternative mobility service in a positive way as well.

An additional important aspect for this service system to be used and accepted is that the urban infrastructure must enable new solutions to find their place. That is why the parking policy 0.1 is of such high importance because without it the alternatives presented will lose one of the strongest advantages before the private car. As long as the private car use is convenient, alternative mobility solutions will suffer in reduced user acceptance.

Criteria for sustainability: The criteria of sustainability should act as a lighthouse in the ocean to guide the development of the service and system forward. How these criteria are defined will have a big impact on how sustainable the service will be in the future. In this project, all of the criteria are not reached yet since the idea of the service package have not yet been tried in a real-life context with real products.

> *"Combined mobility, meaning offering integrated mobility services with public transportation as a backbone complemented by other modes such as car-sharing, bike-sharing, taxis, cycling and on-demand services is the only mobility solution able to compete with the private car in terms of flexibility, convenience and cost-structure."*
>
> Caroline Cerfontaine, UITP Combined mobility expert

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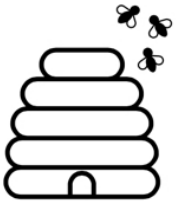
Appendix

Appendix I – Manifest of Frihamnen
Appendix II – Gantt schedule
Appendix III – Survey questions and answers
Appendix IV – Interview questions
Appendix V – Value proposition canvas of Mia
Appendix VI – Value proposition canvas of Andreas
Appendix VII – Value proposition canvas of Bodil

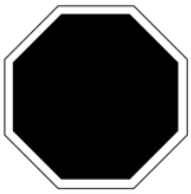
Appendix I – Manifest of Frihamnen

1. Frihamnen is a test arena.
Tests creates new shared knowledge and a bolder and freer approach. Focus areas of the Frihamnen as a test arena is socially mixed housing, mobility, variety in neighborhoods and climate adaptation. Innovation processes based on participation and learning ensures that the potential of ideas and proposals are released. Here we have already developed a method of building site: to test temporarily on a small scale and then evaluate and scale up. This will continue to occur in conversion work. For example, by floating bridges to try alternative locations for the new bridge connections before these states.

5. Frihamnen economizes resources.
Together, we who develop the Frihamnen has a responsibility to act long-term and with a greater social benefit as a goal. We will work for the development of the Frihamnen gives ripples on the water, which help to create jobs for people outside the labor market. To be financially prudent long-term can also mean to conserve resources and to use what is already there. It can also mean that through joint planning, pooling and creativity un attracts the funds we have available for additional value when we are planning and building schools, kindergartens and medical care.



6. To live sustainably should be easy.
Those who are children today will be those who live in Frihamnen. In a hopefully less segregated, safer, greener and more sustainable city. There, adaptation characterize the urban spaces where a socially mixed housing has become reality and where a holistic approach characterizes planning. By integrating energy in the design process the buildings will be extremely energy efficient. The low climate footprint can be reached by the district supply and produce renewable energy. In the Frihamnen many of the standards that affect the way we build and live is challenged. This minimizes waste through increased recycling. Here is the main goal: to live sustainably will be the easiest choice.



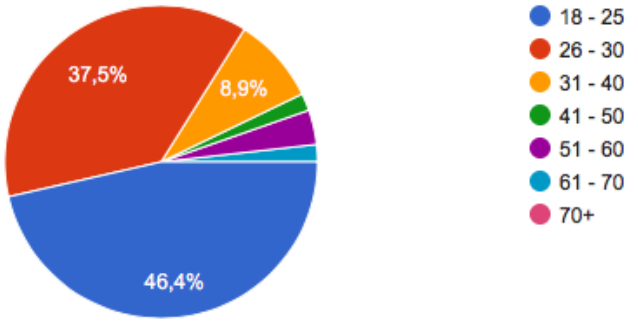
9.The Future of Mobility tested in the Frihamnen.
Frihamnen will support a low car ownership through very low parking rates, a mixed content and street areas where pedestrians and cyclists are given priority. There is limited street parking and visitors are a priority. Carpooling, good bicycle parking and parking houses in the area's fringes are together with a public transport loop of a maximum of 200 meters to stop, building an environment where it is easy to make the right choice. Smart city logistics provides frequent and pleasant urban environments; hubs reduces freight and waste within the area. In the Frihamnen many modes shares the spaces. Here we question slentrian traffic separation and create the future of mobility.

Appendix II – Gantt Schedule

Appendix III – Survey questions and answers

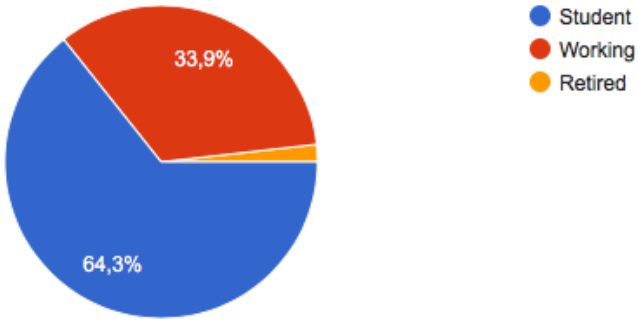
How old are you?

56 svar



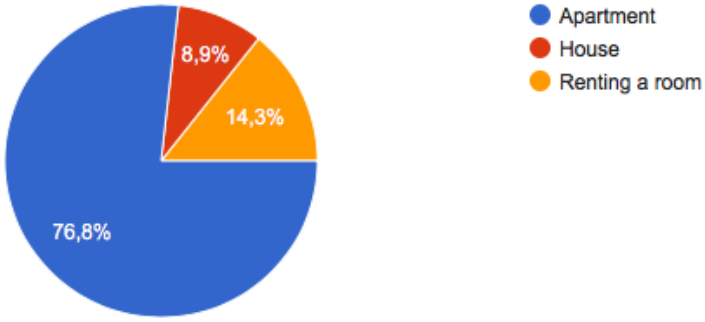
Are you:

56 svar



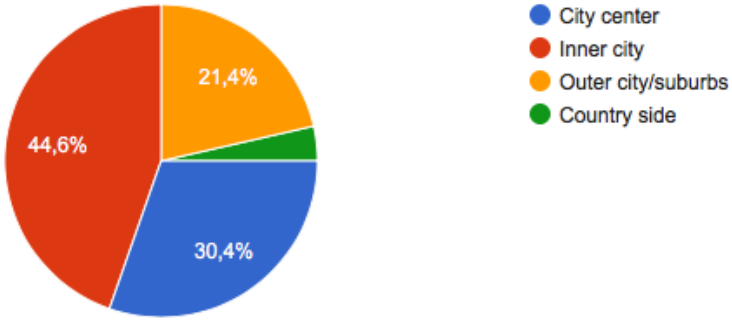
How do you live?

56 svar



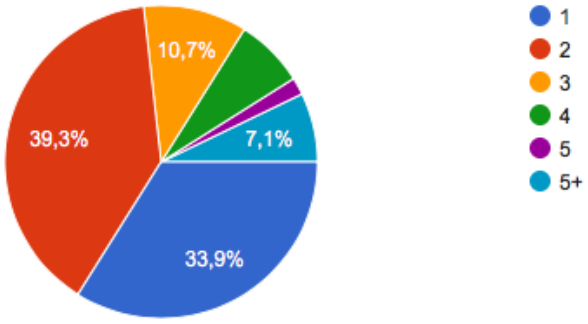
Where do you live?

56 svar



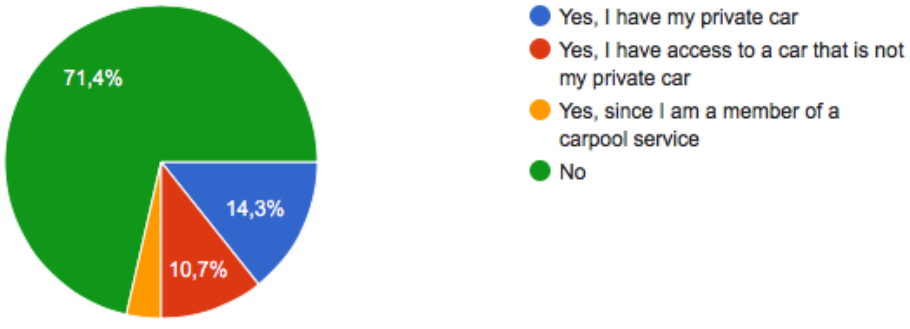
How many people live in your household?

56 svar

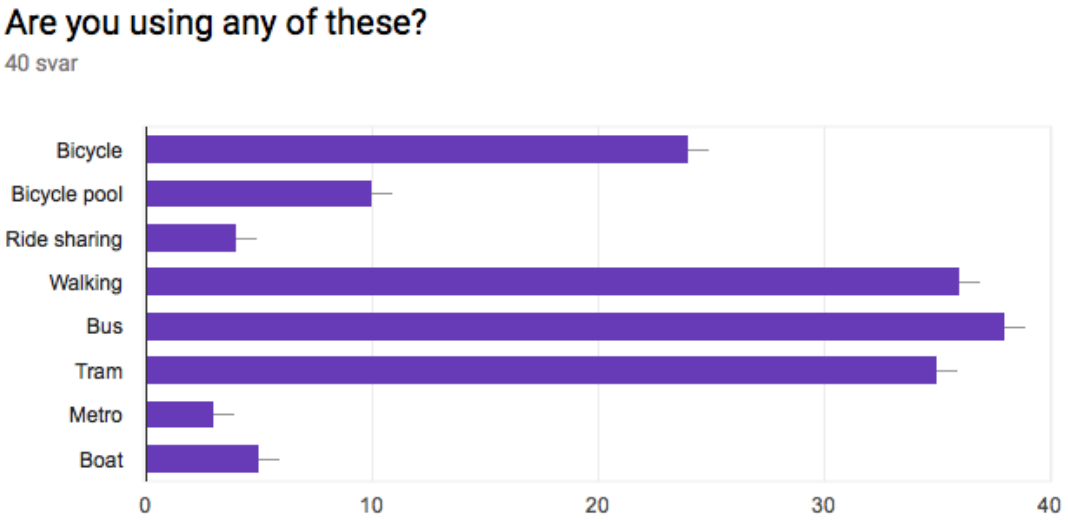


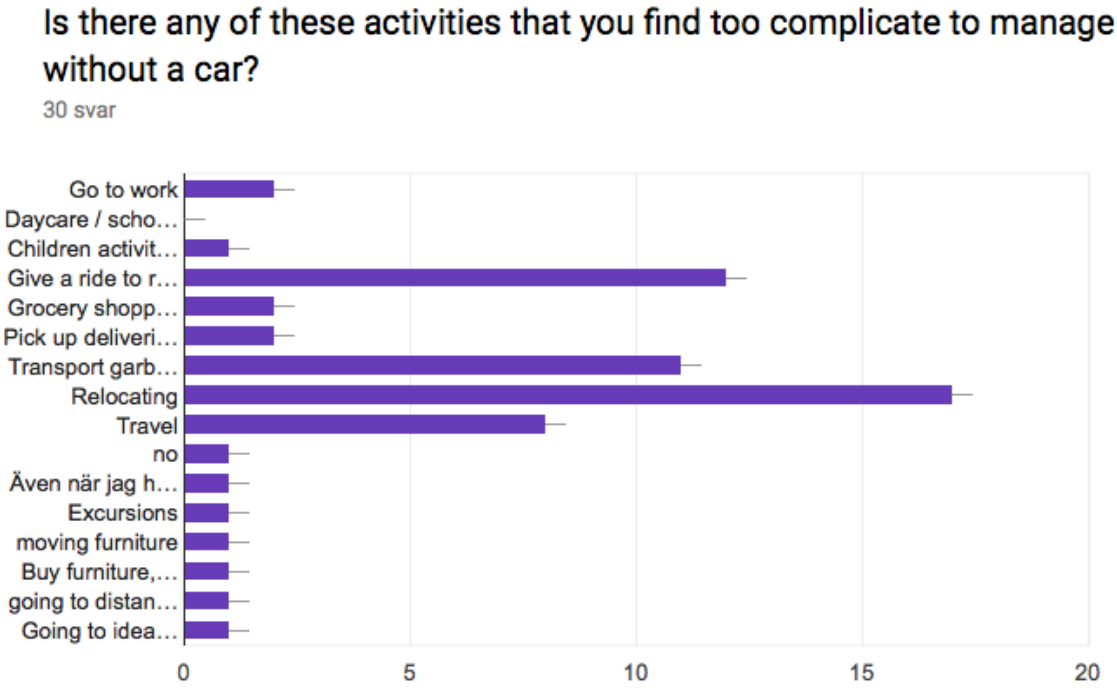
Do you use a car?

56 svar



For respondents that do not use a car





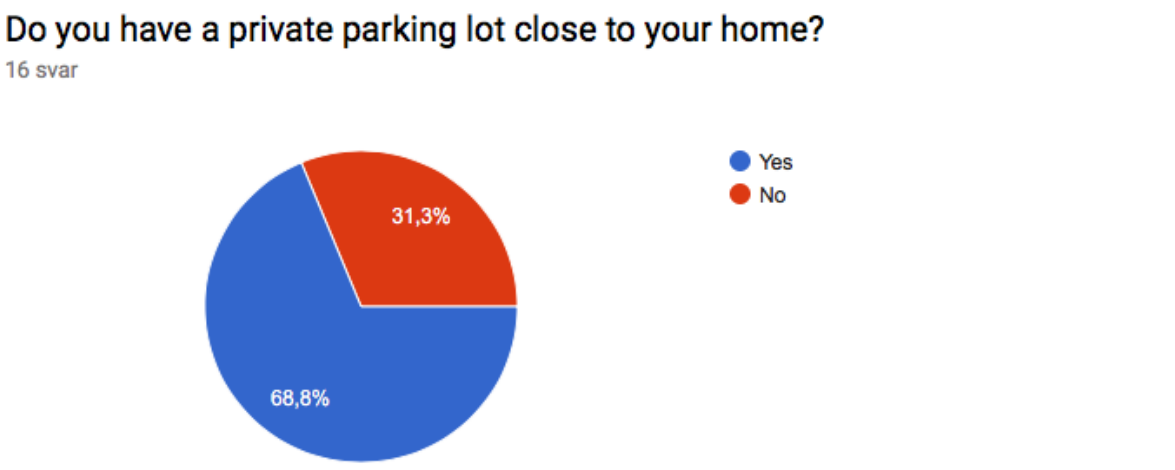
Are you considering using a car in the future and for what reason?

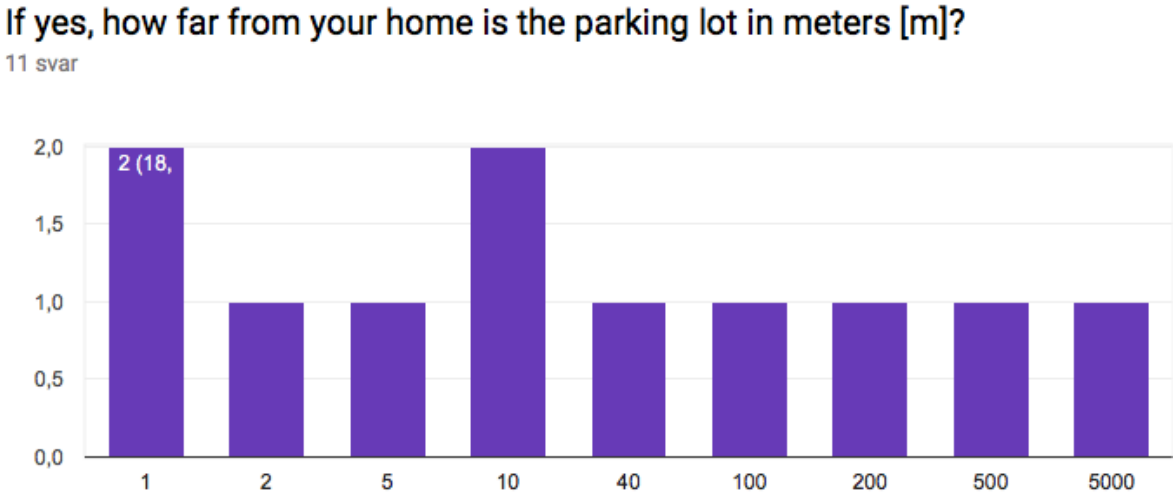
38 svar

No (2)
Spontana resor med dåliga förbindelser i kollektivtrafiken
There is no need. Public transportation is really good in Sweden.
Inte direkt.. Har inget körkort och har inga planer på att fixa det heller inom snar framtid! Känner att jag klarar mig hur bra som helst utan bil!
Yes, for Travellink to country house and ski-trips
Possibly, depending on where I will live
Yes, when I get a job I don't think that a high priority is to live near to my work place, so then I would probably need a car.
Yes, however not for daily commutes.
Yes, mostly for travel, easier grocery shopping and relocating/moving.
If i move out of the inner city, i still want to be flexible
To travel to the country
Transportation
Yes, to drive children to activities (and will the probably use it for other activities as well)
When we move to a house in the suburbs, have children etc. I think we will need a car.
Yes. It would be more convenient to do a lot stuff with a car for example go to far place, go to lakes, go IKEA and but a lot stuff.
Kanske. Blir lättare om vi skulle skaffa fler barn.
If I in the future move from the city to a suburb, I would likely purchase or lease a car out of necessity. To handle daily life.
No, because I don't like driving
easier to go out to the country side :)
Yes, for longer distances
For work. Since I work as a consultant my place of work might change
To transport big and heavy objects, for example when buying new furniture, and to travel to places where it is hard to get without a car, for example the recycling centrals.
If I move further from the city center, alternately working further from my home. Busses, trams and trains are great, but you cannot always rely on the timing which is important if you need to get to work. On the upside, trains offer the ability to work while commuting.
Yes. It is quite convenient to travel by own car and there is no need to wait if there is an emergency
Travelling

Yes, because I enjoy driving a car in the country side
Yes, hopefully not for daily trips, but rather to make larger purchases, travelling to a summer lodge or longer distances
Yes, I want to live in a house outside the city and then I would have more use of a car.
If bad connections to work
Maybe, to get out in the nature and if i buy a boat to get back and forth to that
Yes, for transportations out from the city to venues you cannot reach by public transport today.
Yes, to have more freedom for my planning.
Maybe a shared car
Yes, for construction works and transport of goods.
No, it is too expensive.
Convenience
Time travel to work

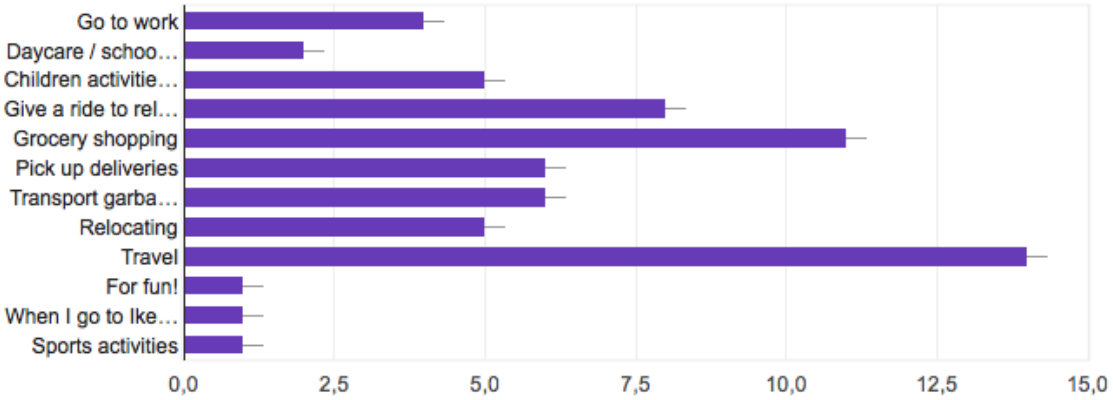
For respondents that use a car





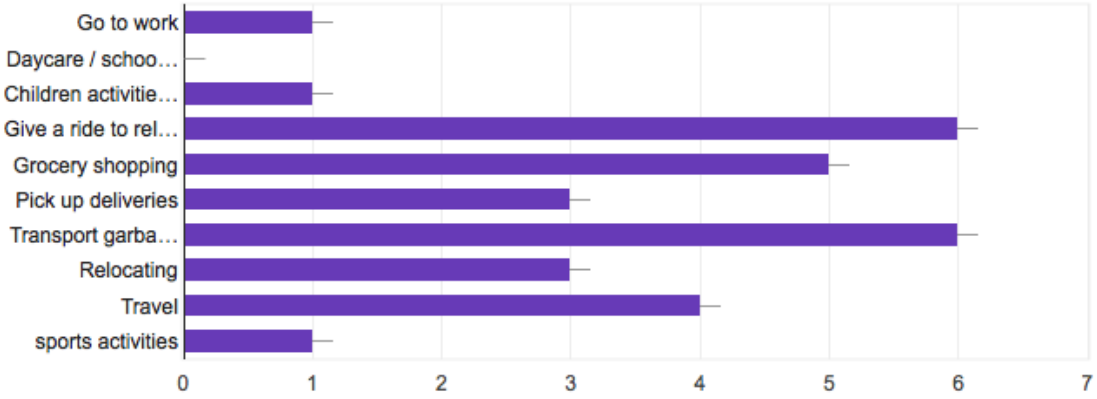
For what reason are you using the car?

16 svar



Choose three activities that you think is hard to manage without a car:

10 svar



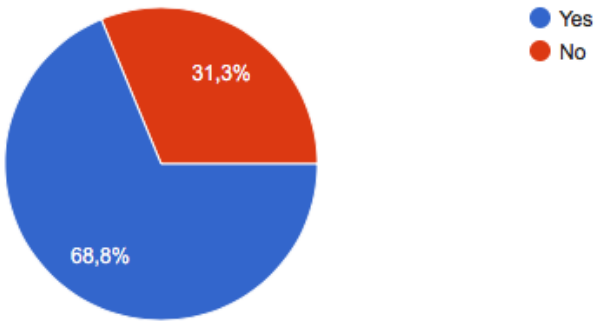
For the three activities, why is it so hard to manage without a car?

16 svar

Because of all the things I need to bring. It feels uncertain to bring stuff on the train or bus.
Well... it's hard to offer a ride without a car...
commuting to my job takes hours, using my car taks 20 minutes.
I can do it without car
Too much things to carry.
OBS: I don't have any children. There is no "other" I could think of.
You transport something big
The amount of stuff - too much to carry simply.
Difficult to give a ride if you don't have anything to give a ride in. Much easier to shop lots of food with a car. Easier to go to places pretty close by (1-2h) with a car than eg train.
far more time needed, luggage too big
No public transportation available
It is often impossible to go to placera I want to go to if I dont have s car.
We can't go by bus for example
Cause you can't transport much without a car.
Poor access to public transportation for these activities
Long distances without public transportation

Could you consider not using a car if your top 3 activities can be done using an alternative solution?

16 svar



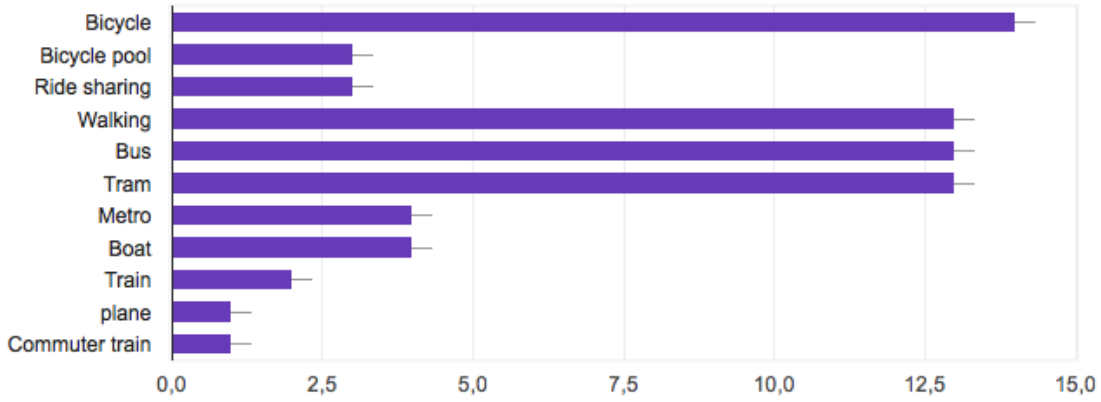
If not, why?

5 svar

Convenience and the pleasure of driving a high-end german car.
I enjoy the drive, listening to music.
car gives me more freedom
Its fun
When travelling to relatives I want to use a car

Are you also using any of these?

16 svar



Do you think that any of the other transportation alternatives can substitute your need of using a car? Please give a brief explanation of how and why.

16 svar

Maybe bus or train if going far..
Frankly, no. I usually park outside the city and take the bus from there, but I still need the car every day to drop off my kids.
no
yes. there is no need to use car in this city
Easy car pooling and shared electric bikes.
All of them could, but none currently do due to my alredy limited use of cars.
No since I need to carry stuff with me
Not really since you need to get everything to the door.
Partly, it is more or less a hardship to buy lots of food with tram/bus/bike, even though it is possible.
partly, but not all, because not available at right time and too much to transport.
Yes, if my work is less than 10km away from home
Ni not totally.
Ja, det skulle fungera bättre om kollektivtrafiken eller något annat transportsystem var väl uybyggt
Driving in to city with a car is stresfull. Riding a bike when possible is nice cause you do sports too.
Yes, if it was more convienent
No

Appendix IV - Interview questions

Introduction questions

How old are you?

What do you do? (work, study)

Where do you live?

Do you live in an apartment or a house?

Do you live with family or others?

How many live there?

How old are they?

Behaviour

How does a typical travel day look like for you?
- What means of transportation do you use and in what order?
- How do you feel about it?

Do you have a car?

Do you own/rent a parking space? How close is it to where you live?

(THE PARTICIPANT IS SHOWN A LIST OF TRANSPORTATION OPTIONS)
- Have you used it?
- What is your emotional experience of it?

What is your expectations on these options? Do the options fulfill the expectations?

In a normal day, how much time do you spend traveling?

What are you doing during the time you spend traveling?

How much time would you like to spend on traveling?

What is your most preferable option of travel?
- What is the advantage of your option of choice?
- What is the disadvantage compared to other travel options?
- What is the emotions you feel when you use this option?

Do you have a driving license / do you think of getting one?

Are you encouraged by your surroundings (friends, family) to get a driving license?

What would be most important for your traveling for you if you move to a place where you cannot use a private car?

Do you have a summer house?
- How often do you go there?
- How do you go there?
- Do you like the way you go there?

Have you ever used e-shopping services?
- Have you thought of use it?
- When?
- Why?

Technology

What kind of devices do you use in interaction with the mobility options you use?
- What do you think of it?

Have you been using google maps or similar map services?
- How do you use the map service?

How much time do you spend planning your traveling?
- What is it that you need to plan?

How do you book longer trips for example by train or bus or airplane?
- What do you think of it?
- Why?

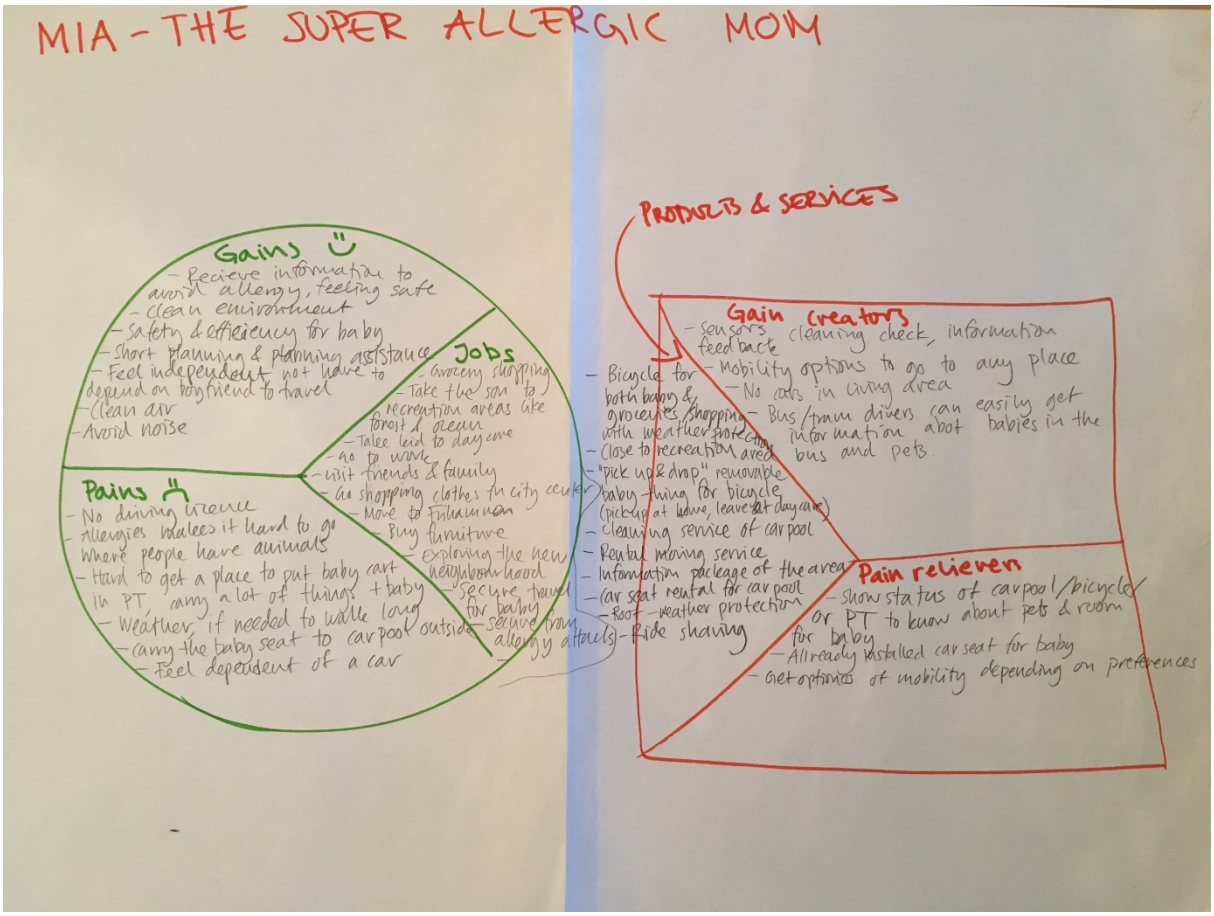
How do you feel when you need to share information with services, for example google maps and you need to share where you are?
- Why?

Have you heard of:
5G technology?
4G technology?
Internet of things?
GPS?
Autonomous cars?

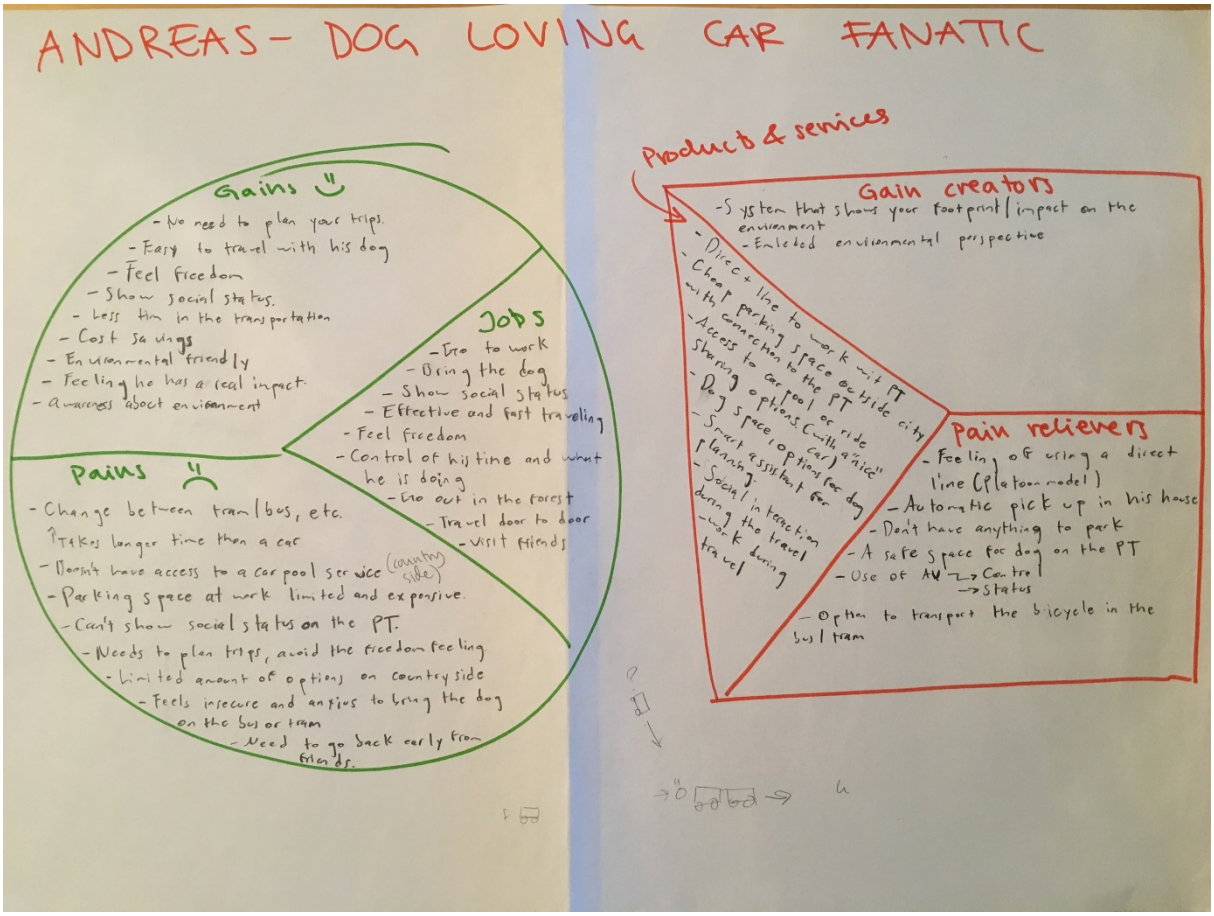
What do you know about this technology? What do you think of it?

How do you think that new technology will change the way we travel in the future?

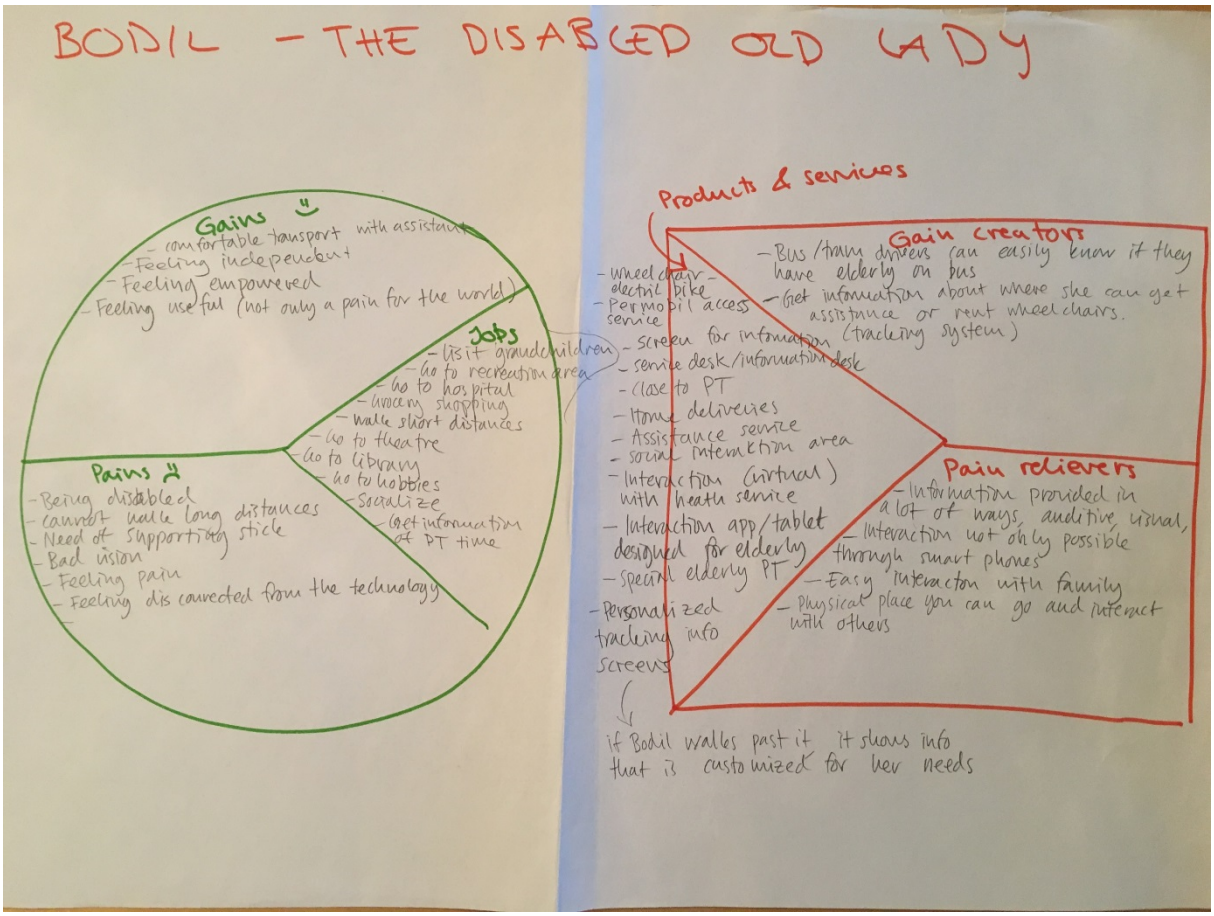
Appendix V – Value proposition canvas of Mia



Appendix VI – Value proposition canvas of Andreas



Appendix VII – Value proposition canvas of Bodil



To you who made it all the way: Thank you for reading my report. This is the end.

Amanda Blomqvist