DESIGN

AND REGULATION OF A SHARING SYSTEM FOR ELECTRIC VEHICLES

THE PURPOSE OF THIS REPORT

The purpose of this report is to give insight in how to
design and regulate a sharing system for Electric Vehicles
for LochemEnergie, Lochem and comparable cities.

This report has been written as part of the
High Tech Human Touch Minor called:
"From Science to Society: From Idea to Prototype"
at the University of Twente.
Its goal is to fulfill the requirements linked
to the organization of the minor and to serve
as an inspiration for LochemEnergie.

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INTRODUCTION

In the High Tech Human Touch minor called "Science 2 Society Module 1 "From Idea to Prototype" the goal according to the manual was as follows:

The focus of the minor lays on multidisciplinary teamwork and iterative design to design innovative solutions for real-life challenges. Six teams were confronted with different challenges in our society for which they had to find solutions, utilizing knowledge and research methods from multiple scientific domains. After our team chose for a project containing the subjects of energy and learning, we got an introduction to the foundations of different scientific disciplines and skills. In order to give a structure to the project work, the method of SCRUM was introduced and followed during the whole module.

This report is a description of the process through which different requirements the users and the product owner had for a car sharing system were determined and how these requirements have been used to design a fitting system. The main questions that were asked are: what the requirements are that the product owner and the users have for this kind of system, in which sort of system they can be met in the best way and how such a system can develop in the future. By working together with the citizens' initiative LochemEnergie and their members, it was possible to answer those questions and to design a car delivery system.

BRIEF SUMMARY

LochemEnergie is an initiative of citizens who want all the energy needed for the inhabitants of Lochem created by green energy resources in 2030. The mission of LochemEnergie is to become greener by implementing a car sharing system with electric cars. Car sharing is a great way to become greener. As long as the right system is implemented.

At the moment LochemEnergie has a car sharing system that is not working optimally. Only the members of LochemEnergie can use this system. But at the moment volunteers manage the system and the cars are for free, because Mercedes-Benz sponsors them. Also there are some constraints for the users. The users have to order the cars 36 hours in advance for example. In the future the system has to be working without volunteers and it should become more user-friendly.

To create a good concept, requirements have been made. Those requirements are based on the aims LochemEnergie has, a questionnaire that has been answered by their members and the different articles that have been analysed. With those requirements 5 different ideas were created, namely: Including an external car sharing company, green transition, improvement of Lochem's current car sharing and adoption system, a car delivery system and self-driving taxis.

Of those ideas there is chosen one final concept. The concept that was chosen was the car delivery concept. This concept met the requirements best. The idea is to set up a new system in which all cars are placed at one spot and are delivered to the users and afterwards picked up again by employees. The employees use a foldable scooter to go back from the car and to the car again. The user does not have to walk to the cars anymore, so the barrier to use the car sharing system will be lower.

Of this final concept a business plan, choice of location, scooter and cars, smart grid, financial plan, website and a promotion and marketing plan have been made.

Lochem is a municipality in Gelderland, a province which is located in the east of the Netherlands. The municipality consists of 8 villages: Barchem, Laren, the city of Lochem, Almen, Eefde, Epse, Gorssel and Harfsen. The total area of the municipality is 215 square kilometers. The most important roads that connect Lochem to the rest of the Netherlands are the N312, N332 and the N346. The distance to the capital, Amsterdam, is about 130 kilometers.
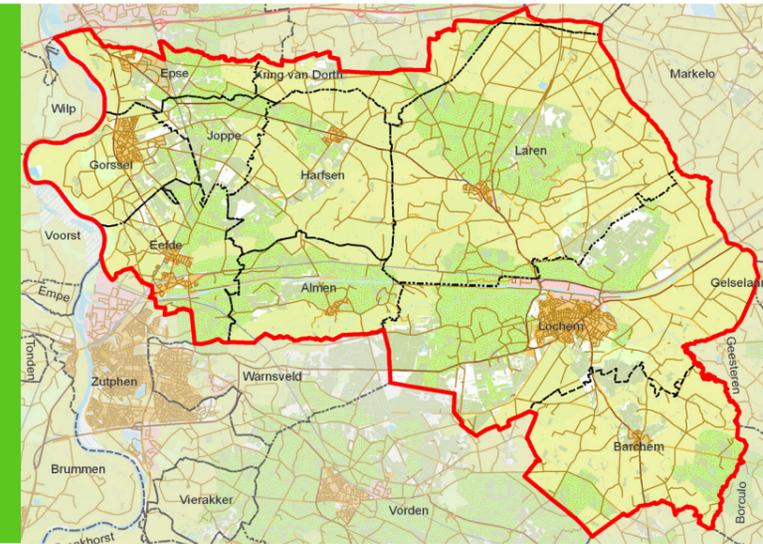
ANALYSIS

After a short problem statement, the following subjects will be covered in the analysis: The demography of Lochem, Stakeholders' goals and needs, a market analysis on EV sharing systems and to conclude a first statement of requirements.

PROBLEM STATEMENT

Nowadays, the change from fossil energy to renewable energy resources is a central concern of the European Union. Firstly, the fact that the use of fossil energy resources increases the greenhouse gas emission is an important reason for the EU to invest in renewable energy resources. Especially CO_2 is related to both the climate change and the fine particle pollution in several European cities (Allen et al., 2009; European Commission for Climate Action, 2014; Matthews, Gillett, Stott, & Zickfeld, 2009; Thiel, Perujo, & Mercier, 2010). Secondly, and this is a more recent development, the reason for this effort is to decrease the European dependency on oil and gas imports out of Russia and Arab countries, since the fossil energy deposits in Europe are limited and the political situation in and with these countries are difficult (Smith Stegen, 2011; Umbach, 2010). In order to develop effective strategies to decrease the CO_2-emission, the European commission for Energy and Transport did research on the main CO_2-sources in Europe. Their results show that vehicles with combustion engines are one of the main CO_2-contributors in Europe. This leads to the EU adopting new laws in order to define CO_2-limits for new vehicles. These new laws force the car manufacturers to decrease the average CO_2-emission level. Next to that, the EU introduced a system of financial penalties in order to punish car manufacturers that did not reach their CO_2-target level (European Commission for Climate Action, 2014). Due to these new restrictions, the development of electrical vehicles (EVs) becomes interesting for car manufacturers. The Dutch government even approved new laws in order to es

tablish tax advantages for citizens that are buying and using new EVs in place of combustion engine vehicles. The goal of the Dutch government is to reach one million EVs in the Netherlands before 2025 (Rijksoverheid, 2011).

LOCHEMENERGIE

This is where LochemEnergie comes into the picture. In order to develop a new concept of offering EVs in a cost efficient way, LochemEnergie introduced a car sharing system with a fleet of EVs. The primary idea is that the customers of LochemEnergie share the high acquisition costs while benefitting from the low running costs.
LochemEnergie is an initiative of citizens who wants to become energy independent by 2030. Both citizens and local businesses are involved.
Two different versions of this car sharing system have been tested. The first one is a traditional car sharing concept. In this version, customers can book an EV via a website. The prices range between ten euros for four hours and twenty euros for the whole day, including taxes, electricity and insurance.
The second concept of LochemEnergie is the so-called adopted electrical car (AEV). In this concept an EV is "adopted" by around 5 families that live closely together. The idea is that the families use the EV instead of buying a second car. All costs are split between the families. Therefore, the single families are not confronted with high acquisition cost and can furthermore benefit from the

low operating costs of an EV. The system LochemEnergie is currently using is not efficient, because reserving a car demands a lot of effort from customers. LochemEnergie plans to have 50 EVs in a timespan of 5 years. But will buying 50 electric cars help making Lochem greener? The mobility in Lochem is not the problem, the combustion engines are, so their amount needs to be reduced. Car sharing is a great way to become greener. As long as the right system is implemented. Herefore one needs to analyse the target group of the car sharing system and all of its stakeholders.

DEMOGRAPHY OF LOCHEM

On january 1st 2015, the city of Lochem counted 13.743 inhabitants. The town of Lochem, including 9 other villages, counted 33.249 inhabitants. In 2014 the population stayed constant. (Gemeente Lochem, 2015). The graph in Figure 1 shows the development of the population of Lochem. The numbers are indexed where 1990 is 100%. A value of 110 means a growth of the population of 10% since 1990. After having a look at the expected development of the population of Lochem in the years to come, it can be concluded that until 2025 there will probably only be a small decrease of the population, but after that, the population will increase again. This means that it is expected that the population of Lochem will be almost constant for at least 25 years (Rijksinstituut voor

Figure 1 Development of the population of Lochem
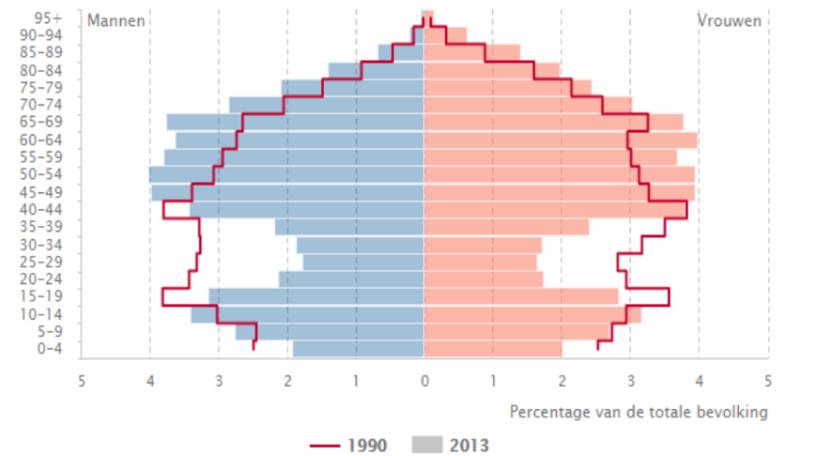
Figure 2 Demography of the population of Lochem

Volksgezondheid en Milieu, 2013). Next to the expected growth of the population in Lochem it is important to map the demography of the population in time (Figure 2). Out of the graph it can be concluded that between 1990 and 2013 the population

above 45 years has been increasing and the population younger than 45 years has been decreasing, which shows a combination of the aging of the population and the departure of younger people to bigger cities.

To show how high the influence and interest of stakeholders are, a power-interest grid has been made. In this grid one can easily identify the importance of every stakeholder. The stakeholders in the top right corner are the most important, so their needs will form the product most.

Figure 3 Power-interest grid for a car sharing system in Lochem

STAKEHOLDERS' GOALS AND NEEDS

For every stakeholder of a potential EV sharing system there is made a summary with their most important needs and their importance in the project.

THE END USERS

The end users are very important for the design of the car sharing system. We deduced 3 types of different personas out of the existing research papers about the members of LochemEnergie (Beltman, 2013). Their influence and interest are high.

THE ENVIRONMENTALIST
    Has a lot of energy related knowledge
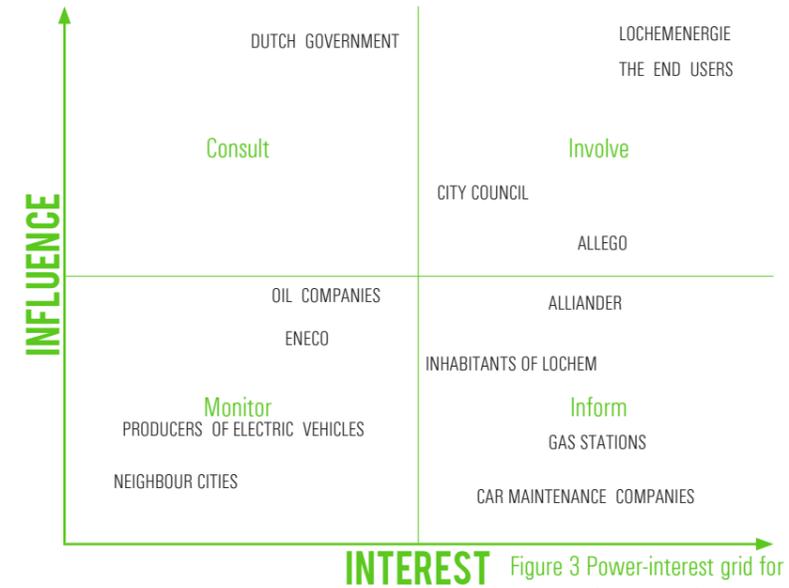   Doesn't have much technological knowledge
    Has energy saving habits
    Owns/Rents solar panels
TECHNOLOGY USER
    Likes technology
    Trusts in smart grids
    Less environmental knowledge and actions
    Likes to perform and then to let technology take it over
THE SAVER
    Least knowledge
    Ready to perform but does not know how and what
    Wants to gain knowledge
    Wants to save money and energy

LOCHEMENERGIE

LochemEnergie is an organization in Lochem who wants to make the city sustainable and energy independent by creating and using their own renewable energy sources. They also want Lochem to be an example for other cities. It is their goal to build a car sharing system with electric vehicles in Lochem, using green energy. They need an improvement of their already implemented design of that system. LochemEnergie is non-profit based.

ENECO

Eneco is an energy supplier in the Netherlands. They want to give people the possibility to produce their own renewable energy, for example through solar panels. They also produce renewable energy themselves and supply the members of LochemEnergie with it. Their goal is to go through the transition from fossil to renewable energy production by making the most profit. The initiative of LochemEnergie is positive for Eneco, because they will be able to sell more electric energy (Eneco, 2015).

ALLIANDER

Alliander is the net provider in Lochem. Their goal in general is to make the Dutch energy network more sustainable using renewable energy. Current initiatives are for example the LiveLab, SmartGrids, Allego and OpenData (Alliander, 2015a). They are interested in designing smart grids to avoid overcapacity which can be caused by EVs. They could thus be interested in the design of an EV sharing system that is already integrated into a smart grid and charging solutions (Alliander, 2015b).

GAS STATIONS

One can expect gas stations to not support EVs, because they won't be able to sell fuel anymore. But private gas station owners don't make that much money out of the fuels. The biggest part of their income is made through the sale of the products in their shops and car washes (The Associated Press, 2008). Once they offer the possibility to also charge your electric car, these money-making options are still there. Because EVs don't go as long without charging as normal cars go without refuelling, the gas stations could even make more money. Charging takes more time than refuelling, which gives the gas station owners more possibilities to earn money. An example would be a café where people can stay while waiting. Of course, one first has to invest in charging points. Before having taking that step, gas station owners are more likely to be opponents to the EV-movement. Gas stations along the highway can take most advantage of long distance charging.

CITY COUNCIL

The town of Lochem wants to make the people of Lochem aware of the possibilities of green energy and the need for it. Many different projects are started concerning the sustainable use of energy and producing energy yourself. Lochem has the goal to be carbon-neutral by 2030. This shows, that they are interested in the implementation of an EV sharing system that would reduce the number of normal cars and the frequency of their use (Gemeente Lochem, n.d.).

DUTCH GOVERNMENT

The Dutch government has different goals concerning the use of renewable energy. Through the EU, there are the 20-20-20- goals. By 2020 they want the EU greenhouse gas emissions to be reduced by 20% compared to the levels of 1990. Also, they want the share of EU energy consumption produced from renewable resources to raise to 20%. Also the EU's energy efficiency has to be improved by 20%. The Dutch government even wants the EU to commit itself internationally to a legally binding reduction goal of at least 40%, as soon as possible. This shows, that the government is interested in the use of renewable energy and could thus be interested in an EV sharing system that can be implemented in even more cities than Lochem. The goal of the government is to have 1 million electric vehicles on Dutch streets before 2025 (Government of the Netherlands, n.d.).

INHABITANTS OF LOCHEM

Inhabitants of Lochem who do not use the EV sharing system could experience disadvantages by parking lots which are reserved for EV-charging. People who are not used to silent EVs could be negatively surprised by not noticing them. Some people won't support the decision of the government to subsidise EVs. They could believe that less money would be available for other important things such as for example education or health. A positive point for them is that less cars would lead to more parking space and it will be better for their health, because of reduced CO2-emission.

OIL COMPANIES

Oil companies, of course, have an interest to delay the development of electric vehicles. They want to earn money by selling fossil fuels and are dependent on combustion engine cars. It is one of their biggest sources of income.

ALLEGO

Allego is an organization within the Alliander Group developing charging solutions and a charging infrastructure. Their goal is to make it possible to charge EVs anywhere and anytime. They work on user-friendly and futureproof charging points. They are interested in the designing of an EV sharing system and have an influence on the infrastructure of such a system. They already installed 7 charging points in Lochem (Allego, 2015).

PRODUCERS OF ELECTRIC VEHICLES

At the moment Mercedes is lending 6 Electric Smarts to LochemEnergie. Their goal is to gather experience about the usage of the EVs to improve their products. Another advantage is the promotional aspect because of the national popularity of Lochem. Furthermore they nudge the use of EVs to conquer a future market by raising EV acceptance and awareness.

CAR MAINTENANCE COMPANIES

Car Maintenance Companies have to adapt their tools and knowledge to be able to repair EVs. They might be sceptical about investing. EVs open a new market in the car maintenance domain which will attract new companies and increase the competition. EVs have less rotating engine parts than other vehicles. Not all companies will survive this change, because their maintenance costs are very low.

NEIGHBOUR CITIES

Lochem is a great example for the cities in the neighbourhood, because they can use the new knowledge and experience. They don't have any high influence, but they do have some interest.

MARKET ANALYSIS

Currently several car sharing companies are operating all around the world. Some of the companies use EVs, but in this chapter only the principles of the car sharing strategies and the possibilities of the services are determined. So it is not necessary for the companies to share EVs.

Car sharing businesses can be divided into three general subgroups: P2P, Peer-to-Peer, implies that a fleet of cars is owned by a community. The marketplace matches owners of cars that are available to other drivers to rent. A variant of P2P is carpooling. The only difference is that the owner of a car gives renters a ride.
B2C, Business-to-Consumer, implies that a company owns a fleet of cars and facilitates the sharing amongst members.
NFP stands for Not For Profit. A local organization or community facilitates car sharing with the goal of changing driving habits over making profit (The Bright Future of Car Sharing, n.d.)

PEER-TO-PEER

Peer-to-peer car sharing is a form of person-to-person lending. The business model is based on a "virtual" fleet made up of vehicles from participating car owners. Those owners are allowed to charge a fee to rent out their own vehicles when they are not using them. The owners and the renters are connected with each other in the form of a website or a mobile app. Via these websites or mobile apps rental bookings and collection of payments are managed. The business covers borrower/renter insurance, operating expenses and roadside assistance (Peer-to-peer car sharing, 2015).

EXAMPLE: GETAROUND
Getaround currently operates rentals in several big cities in the United States of America. The peer-to-peer rental model does not require Getaround to maintain their own vehicles. It works as follows: Owners create an online profile for their car and set hourly, daily and weekly rates. They can determine to whom they want to rent their vehicle, because Getaround uses a reputation management system with reviews and ratings, so that owners and renters can get a sense of who they are dealing with. Renters must verify that they have at least 2 years driving experience and a valid Facebook account. Getaround then cross-checks driving records with social identity through Facebook and several other points of reference. Renters and owners conduct rental transactions online or through their mobile phones. It is also possible for owners to install the Getaround Connect (Figure 4) as an alternative to standard key exchange. Using GPS, WiFi and Keyless remote technology, the Connect allows renters and owners to open and lock the car using a web enabled mobile phone (Getaround, n.d.).

EXAMPLE: SNAPPCAR
The Dutch peer-to-peer car sharing service SnappCar connects owners of a car to people in need of a car by using a website and an app on the basis of geographical location. So car owners can rent their car out to a user who lives close to them in the community, which makes the service safer. Owners can choose their own fees and availability in this process. After the payment is made, the owner gives the key of his car to the user. To make sure that everything is safe for the owner, SnappCar checks an upload of a driving license of the user. For every rental, the user also has to pay SnappCar for the insurance and assistance in case of a breakdown (SnappCar, 2015; Consumentenbond, 2013).

CARPOOLING

Carpooling is the sharing of car journeys so that more than one person travels in one car. By having more people using one vehicle, carpooling reduces each person's travel costs. It also is a sustainable way to travel as sharing reduces carbon emissions and traffic congestions on the road. Also the needed parking spaces will be reduced. The carpool commuting is more popular for people who work in places with more jobs nearby. For carpooling there are special pick-up places at the side of roads (Carpool, 2015).

EXAMPLE: BLABLACAR
BlaBlaCar is the world's largest long-distance ridesharing community. BlaBlaCar has 20 million members around the world. Members must register and create a personal online profile, which includes ratings and reviews by other members, social network verification and rate of response. The sharing process works as follows: Someone in need of a ride looks for rides that will cross the wished location of departure and arrival on the BlaBlaCar website or app. After a ride is found, the user has to contact the provider of the ride. De driver will then receive a notification e-mail and can accept the request of the user. After an agreement for the ride and the location is reached the driver will drive to this location to take the renter with him (BlaBlaCar, 2015).

BUSINESS-TO-CONSUMER

This way of sharing a car requires several businesses in order to reach the consumer. First a car manufacturer produces cars, then a rental company offers these cars for rent. Finally a company creates an app or a website that links the consumer to the cars that are offered for rent. There are different ways of how tasks are distributed. Traditional car rental companies and car manufacturers have introduced their own car sharing services.

EXAMPLE: ZIPCAR
ZipCar is an American car sharing company. Avis Budget Group is the parent company of ZipCar. Therefore ZipCar is a subsidiary of Avis. The company offers nearly 10.000 vehicles throughout the United States, Canada, and several European countries. Members can reserve ZipCars with the ZipCar Mobile App, online or by phone at any time, immediately or up to a year in advance. Members have automated access to ZipCars using an access card which works with the car's technology to unlock the door, where the keys are already located inside. The access card contains a wireless chip that will open the vehicle only at the time they have reserved it. ZipCar also offers an application that allows members to unlock the doors. Members pay a monthly or annual membership fee in addition to car reservation charges. For the application ZipCar charges a one-time fee. Fuel, parking, insurance and maintenance are included in the price. Each ZipCar records hours of usage and mileage, which are uploaded to a central computer via a wireless data link. The location of the vehicles is not tracked during a reservation for privacy issues, but is trackable. All cars are equipped with a function that can prevent the car from starting in case of theft (Zipcar, 2015).

EXAMPLE: CAR2GO
Car2Go is a subsidiary of Daimler AG and provides car sharing services in European and North American cities. Car2Go exclusively offers Smart Fortwo vehicles and features a free-floating structure, which implies a one-way point-to-point rental system. Car2Go is different from other B2C car sharing companies because Daimler AG is the manufacturer of the Smart Fortwo, so the car manufacturer is also the provider of the car sharing service. Car2Go is the largest car sharing company in the world with over 1 million members.
Car2Go charges a per minute rate. The rates are all-inclusive and cover gas, insurance, parking in authorized areas and maintenance. Sometimes a low fixed annual fee is charged. The vehicles can park in specially designated parking spots, but also in standard parking spots with permission from the local municipality.
Starting the car can be done by a smartphone app: when the vehicle is selected, the rental can be started in the app. After getting inside, a touchscreen in the car will be used. The user enters a PIN and after the PIN is accepted, the car can be started with the key that is already inside the car. In case of a booking via the website of Car2Go, it is possible in some countries to unlock a car by using a membercard. It works the same as unlocking the car by using the app (Car2Go, 2015).

EXAMPLE: AUTOLIB'
Autolib' is a key player in innovation with its self-service electric cars in order to lessen traffic in cities making travel easier and more fluid in France. It is operated by the Bolloré Industrial group. Autolib' maintains a fleet of all-electric Bolloré Bluecars for public use on a paid subscription basis.
The Bluecars are available to anyone with a valid European driving license. An available car can be collected for use from any rental station and returned to any other rental station.
For rental the user has to subscribe online, in a subscription kiosk of Autolib' or in a showroom. After paying the subscription fee the user will receive a badge that can be used to unlock a Bluecar. After the unlocking, the charging cable can be unplugged. An ignition key can be found in the car. After the rental, the Bluecar has to be connected to any rental station. These stations can be found via onboard GPS. After the car is parked, the user only has to plug the cable into the car (Autolib', 2015).

NOT FOR PROFIT

These companies do not operate to make profits. A consequence is that they have a hard time competing with bigger companies that make profit. In general their mission is to improve the environment, promising alternative transportation methods and a better quality of life in the communities by promoting innovative mobility options. These companies offer affordable access to car sharing, so that car dependency is reduced. Next to that, the non-profit car sharing companies are able to test the limits of car sharing for ideas that might not directly make money.

EXAMPLE: CITY CARSHARE
City CarShare is a nonprofit car sharing service in the Bay Area in the United States of America. The service has several partnerships with local organizations and businesses. City CarShare offers a wide variety of cars on its website and in its app. The owners save money because they do not have to pay for insurance and gas. The organization has several pricing programs that can fill the needs of every user. This is a part of the contract that they sign. The members pay an annual or monthly amount of money. On top of that, the users pay an additional hourly price for every hour of use (City CarShare, 2015).
The website and the app give information about the locations of cars that are not in use. Members only have to walk to the cars that are not in use after a reservation. In order to open the car, members have to use their key fob to open the cars. The ignition key is already inside (Aquino, 2012).

FIRST STATEMENT OF REQUIREMENTS

After a first analysis of different possible requirements for the system, a list of those was made. The requirements come from the aims LochemEnergie has, the three personas found by Beltman (2013) and the user evaluation of the system as found by Binnenmars (2015).

REQUIREMENTS BY LOCHEMENERGIE

In a first meeting with Albert Molderink, acting as the representative of the citizens' initiative LochemEnergie, some requirements the product owner has for the improvement of their car sharing system were made clear. After each mentioned aim LochemEnergie has, the number of the corresponding requirement is placed so that the link can be made easily.

LochemEnergie is an initiative founded to bring sustainability to Lochem. This was also one of the reasons for them to start a car sharing project and it should be taken into account when improving the system (1). Another big point that LochemEnergie is expecting from the system, is that it should be adaptable by other cities. Of course, they first want to bring sustainability to Lochem, but it is also important for them to set a good example to other cities and stimulate sustainability everywhere (2). Another aim LochemEnergie has, is for Lochem to become independent from big energy suppliers. To achieve this, they started to set up solar panels so they can produce and use their own generated energy (3). To make Lochem a sustainable city, LochemEnergie's big goal is to replace all combustion engine cars with electric cars. In order to achieve this, the inhabitants of Lochem have to be convinced to move over to electric cars (4). Moving over to electric cars can be expensive for Lochemers though, because of the high acquisition costs, but when an electric car is bought once, the running costs are quite low. In the car sharing system, LochemEnergie wants the people to share the high acquisition costs of the car while benefitting from the low running costs (5). LochemEnergie is a non-profit organization. However, to reach all their goals they cannot live only from subsidies. The system should at least make them earn

the money back they payed for the cars, and even some support to build more solar panels and support the city to become sustainable (6). When working as a citizens' initiative, of course one wants to get things done. The system should thus be implementable in the near future, so that the green transition can start earlier (7). Although this is true, it is also true that such a system should not break down in the next few years because it could not keep up with new developments. In their current car sharing system, the planning is made for five years already, but also developments that are even further in the future should be taken into account (8). The aim, LochemEnergie has for improving the system, is that the users have to be involved into its design. The citizens' initiative wants to find out what the users want, so that the system can be improved in a way that fits the users' needs (9). The requirements that were made out of these aims, are listed below.

REQUIREMENTS

1. Sustainability for Lochem
2. Adaptable by other cities
3. Becoming energy-independent
4. Convincing people to move over to electric cars
5. Sharing the high acquisition costs of the cars while benefitting from the low running costs
6. Profitability
7. Realizable in the near future
8. Futureproof
9. User-centred design

To specify the last of these requirements, the results from the personas and the users' evaluation of the system are used.

REQUIREMENTS FROM BINNENMARS (2015)

In a study by Binnenmars (2015), the opinion of users about the current car sharing system in Lochem, as discovered by a survey, is shown. Different positive, neutral and negative points are mentioned concerning the system. Below, a summary of those is given.

POSITIVE

The low renting costs in comparison to owning a car are seen as very positive by the users. Also the higher mobility through the possibility of renting a car for only part of the day is perceived as positive. The third positive point is the sustainability of the system.

NEUTRAL

The current reservation system is not perceived as very positive by the users. This is because they have to reserve the car two days in advance and only one day before the day the car is rented get to know, whether it will be available or not. This uncertainty is not positive. Also, the customers have to pick up the keys at a certain location and then have to get to the car. Also the fact that LochemEnergie only possesses Smart fortwos is seen as not that positive. Sometimes, a car with more than two seats is needed.

NEGATIVE

The range of the cars and its inconstancy is seen as a disadvantage of the system. The users also perceive the infrastructure of the charging system as very bad, because some areas are not that covered as other areas. This infuses the fear to strand somewhere with a low battery without having a charging station nearby. The picking up and bringing back of the cars is considered a major flaw of the system, because it is perceived as too inefficient and time-consuming.

Out of these positive, neutral and negative points, requirements for improving the system can be made. They are listed below:

1. The system should keep offering the low renting costs in comparison to owning a car.
2. The system should keep offering the possibility to rent a car for only a part of the day.
3. The system should keep being sustainable.
4. Reservation of a car should be able less than two days beforehand.
5. The system should give feedback about if a car is available directly after booking it or even before booking it.
6. In the system, the users should not have to pick up the keys somewhere.
7. The system should also offer cars with more than two seats.
8. The system should offer the possibility to rent a car with a higher range than the electric Smart fortwo.
9. The infrastructure of the charging stations should be improved.
10. In the system, the users should not have to pick up the car somewhere.

PERSONAS BY BELTMAN (2013)

In a study by Beltman (2013) three personas with different user requirements concerning the use of technology and devices were created. For our design concerning EVs it seemed appropriate to use these personas, because EVs are also a new technology. A summary of the important features of the three personas is given below. Out of these three personas, requirements concerning the system were generated. It would be nice to meet the requirements of all three personas to reach and satisfy as many people as possible with the system. After each characteristic that was found in the personas and that could be used for the system, the number of the corresponding requirement is placed so that the link can be made easily.

PERSONA 1: THE INNOVATOR ENVIRONMENTALIST

This persona includes people that are really interested and involved in energy saving, green energy and sustainable developments. They joined LochemEnergie in an early stage, have always been involved, attended meetings and have a lot of knowledge of LochemEnergie. They already changed to renewable energies and also monitor their energy generation and consumption to some extent and are really aware of their consumption. They would really like to give up their combustion engine car for an electric vehicle, but do not know yet if they would really be able to handle the new technology (1). A car sharing system would help them gather some experience with EVs. For the first persona, the people's reasons to behave energy efficiently are their worries about the environment and the depletion of fossil energy sources. They would have changed their lifestyle even if there would be no monetary benefits in the long run. Their goal is to become self-sufficient in energy-supply and to be no burden to the environment (2). To abandon their combustion engine car would be the next step for them into an environmental friendly life. Yet, they do not know if they could handle a new sort of car with all the new equipment, because they do not have much knowledge of technical systems. Also they do not know if they would be able to use the reservation system of car sharing without the help of their children (3).

Although the people in this persona are willing to make a lot of behavioural compromises, they also try to balance (in home) comfort and sustainable energy consumption. They own a computer, laptop and smartphone, because they simply want to go along with developments. For example, when they get a smartphone, they find it rather difficult to find out how it works and what its functions are. But after some time, they find it not that difficult to use the smartphone. On some occasions they use them for their own amusement, but mostly for communication and information. They expect to use these devices almost everywhere in the future (4).

REQUIREMENTS

- The system should be easy enough for people to use even if they do not know that much about new technologies.
- The system should enable people to be no or less of a burden

to the environment.
- The reservation system should be easy enough for people to use even if they do not know that much about new technologies.
- A website and smartphone application could be designed for the new system if it is easy enough for people to use even if they do not know that much about new technologies.

PERSONA 2: THE TECHNOLOGY USER

This persona includes people who are particularly interested in local energy generation, the smart grid and other technological developments LochemEnergie intends to employ. They joined LochemEnergie because they think it is a good local initiative that might help them to reach their goals to become self-sufficient in energy-supply, to be independent and to move away from large energy companies with too much power (1). In the second persona, people's main reason to want to generate their own local and green energy and to conserve other forms of energy, is sustaining the environment (2), although the monetary benefit also plays a role. They also think that with all their knowledge about energy saving and technologies, they still use too much fossil energy and do not perform consistent actions to conserve this energy. They think, that technology will help them to behave more energy-efficient and bring great advantages. Also they think, that as long as the energy is green, it will contribute to a sustainable environment (3).

The people in this persona use their iPad, smart phone and computer more for private consumption than work related consumption. They use these devices, because they make their life easier and more efficient. They think that they have a lot of skills and knowledge about these devices and that this influences their usage of these devices a lot. They have great curiosity, interest and trust in the smart grid and other future technical developments that they think will help them achieve their goals. When they were told that the smart grid will bring automation into the matching of energy generation and consumption, they responded enthusiastically, by stressing the fact that they want to be "users" of the system in the first place and that the system should support or even facilitate their energy consumption behaviour. They would really like for LochemEnergie to keep its members informed and updated about the success and progress of the cooperation. And this success can only be defined in term of the matching process of the entire cooperation and not just that of individual households (4).

REQUIREMENTS
- The system should give the opportunity to move away from large energy companies with too much power.
- The system should give the opportunity to sustain the environment.
- The cars in the system should use green energy.
- The system should offer information on how much energy is used by the cars.

PERSONA 3: THE SAVER

This persona includes people who joined LochemEnergie because they think it is a good initiative and that it will help them to reach their main goal: saving energy and money. The environment and contributing to sustainable energy consumption are important reasons for them to generate green energy and to save energy, but the most important reason is the monetary benefit that comes along with it.

Compared to the other two personas, people in this persona do not perform a whole lot of energy saving actions. They respond really positive about using a sharing system for electric vehicles, as long as it would lead to more financial benefits (1). They have not that much knowledge on how to save energy and behave energy-efficient, but are really motivated to gain more knowledge and insight and to learn how to save more energy (2).

In the third persona, people want to have an accurate picture of their current energy generation and consumption. They would also like to be taught to use energy in a smarter way. Because their knowledge is not optimal, they would like to receive energy saving tips and advice to really boost their knowledge and energy saving actions (2).

REQUIREMENTS
- The booking of the cars should yield monetary benefit for the users.
- The system should offer information on how to drive energy-efficiently with an EV.

OVERVIEW OF ALL REQUIREMENTS

FIRST STATEMENT OF REQUIREMENTS

1. Sustainability for Lochem
2. Adaptable by other cities
3. Becoming energy-independent
4. Convincing people to move over to electric cars
5. Sharing the high acquisition costs of the cars while benefitting from the low running costs
6. Profitability
7. Realizable in the near future
8. Futureproof
9. User-centred design

USERS OPINIONS BY BINNENMARS (2015):

1. The system should keep offering the low renting costs in comparison to owning a car.
2. The system should keep offering the possibility to rent a car for only a part of the day.
3. The system should keep being sustainable.
4. Reservation of a car should be able less than two days beforehand.
5. The system should give feedback about if a car is available directly after booking it or even before booking it.
6. In the system, the users should not have to pick up the keys somewhere.
7. The system should also offer cars with more than two seats.
8. The system should offer the possibility to rent a car with a higher range than the electric Smart fortwo.
9. The infrastructure of the charging stations should be improved.
10. In the system, the users should not have to pick up the car somewhere.

PERSONAS BY BELTMAN (2013)

1. The system should be easy enough for people to use even if they do not know that much about new technologies.
2. The system should enable people to be no or less of a burden to the environment.
3. The reservation system should be easy enough for people to use even if they do not know that much about new technologies.
4. A website and smartphone application could be designed for the new system if it is easy enough for people to use even if they do not know that much about new technologies.
5. The system should give the opportunity to move away from large energy companies with too much power.
6. The system should give the opportunity to sustain the environment.
7. The cars in the system should use green energy.
8. The system should offer information on how much energy is used by the cars.
9. The booking of the cars should yield monetary benefit for the users.
10. The system should offer information on how to drive energy-efficiently with an EV.

IDEATION

In the process of finding a solution for the problem, some ideas have been thought up. The six initial ideas that built the basis for further research, analysis and specification are described below.

It started as early as the 1939 New York World's Fair where visitors were presented a vision of automated highways. In the mid 2000s, the Defense Advanced Research Projects Agency (DARPA) organized the Grand Challenges where teams gathered to compete with self-driving vehicles. In 2009, Google started the self-driving car project, including team members who had already dedicated years to the technology.

IDEA 1 – EXTERNAL CAR SHARING COMPANY

Everywhere in the world, new car sharing companies are developing, while some are already experienced and spread all over the world. So why find a solution for a problem that has already been solved? The existing companies already have all the knowledge and infrastructure to set up a working car sharing system. Rather than investing in an own system, limited to Lochem and its surroundings, one could leave the task to experienced professionals. Because of its size Lochem might not be an existing car sharing company's first choice for expansion and investment. But with an elaborate business plan it can be possible to attract companies such as Car2Go, Greenwheels or Flinkster. An important advantage that could be a reason for a car sharing company to choose for setting up their system in Lochem, is the "Sustainable-Popularity" which can contribute to their marketing. The openness of Lochemers to try out something new will stimulate the company to test variations of their business model on a smaller scale. It would be possible for them to test different cars and variations in the price, research which marketing is attractive for rural areas and test smart grid solutions. Lochem could thus serve as a guinea pig for a big company that may only have experience with urban areas and may want to increase their outreach. This would let Lochem experience the advantages of EV-sharing by taking minimal risks.

IDEA 2 – GREEN TRANSITION

Developing a car sharing system with electric vehicles (EVs) is a step in the direction of reducing the emission of greenhouse gases and making the city of Lochem greener. However, to make the city completely green, all combustion engine vehicles (CEVs) would need to be abandoned or replaced by EVs. Further, car sharing might not even be feasible in small cities such as Lochem, because there is not such mobility/space problem as it exists in big cities. LochemEnergie could stimulate a smooth transition to a pure green electric transportation system. This can be realised through advertising and supporting the replacement of private CEVs and the purchase of private EVs. This could happen through rewards for replacing a CEV with an EV or through "punishments" when still driving a CEV (for example, the banning of CEVs inside the city). Also subsidised electric public transport such as busses or taxis would compensate the need of a second car. Combined charging stations would also support electric bikes to meet the need of mobility of the rather old population for local transport inside of Lochem. By facilitating and nudging the purchase of private EVs Lochem can eliminate polluting private combustion engine cars to become one of the first green cities.

IDEA 3A – LOCHEMENERGIE'S OWN CAR SHARING

LochemEnergie has been setting up a car sharing system. This system is however not as good as it could be and many users have suggestions on how to make the system better. Through looking for the users' opinions on how these suggestions can be implemented, an improved version of LochemEnergie's car sharing system limited to Lochem and its surroundings can be developed. Also the experience of existing car sharing companies could serve as inspiration. The investment in features such as keyless access, more charging stations (maybe even inductive charging), an appropriate reservation system and long distance traveling through stronger batteries would come from subsidies and LochemEnergie itself. The list of features reflects the desires of current users (Okur, 2015). Also it would be possible to give workshops or to make "How To"-videos on the use of EVs and on how to use the EVs battery more efficiently to reduce range anxiety. To ensure profitability after around 3 years (the average break-even time for car sharing companies (Arena et al., 2014)) a realistic business plan has to be developed.

IDEA 3B – LOCHEMENERGIE'S CAR ADOPTION

LochemEnergie has been setting up a car adoption system. Just as their car sharing system, this system can also be improved by the opinions of the users. Lochem facilitates the purchase of a car for e.g. five families who will buy or lease a car together. They will share this car, but at the moment the people need to get the key from someone else and the planning of when people want to use it is done by one person or through a WhatsApp group. An advantage of this idea is that the users will still have the idea that they own a car. For this system there is no application, so it would be nice if this would be made. This application can be made by using the opinions of the users. It would be great if there was a system for keyless access or a safe next to the car with the keys. Also it would be possible to give all of the users a key. There should also be invested in charging stations and an appropriate reservation system. It would be useful if the users can see on the application how to use the EVs and how to use the EVs battery more efficiently to reduce range anxiety.

IDEA 4 – EVS DELIVERED AT HOME

As already stated earlier, car sharing might not be feasible in small cities. Instead, LochemEnergie could set up a car rental company which offers different types of electric cars at a few central places. This would give the people of Lochem the opportunity to become experienced with EVs before purchasing one themselves. Through the variety of the vehicles, many people with different needs could be reached and may sell their second car. To fulfil the need of instant flexibility the cars can be ordered via an application or call and will be delivered in less than half an hour to the customer by a team of max. 2 drivers. This can be compared to the system of pizza delivery. If the delivery of a few pizzas is profitable, then the delivery of a car should be as well. A big advantage of this idea is that the client does not have to walk to the EVs on his own. After the client does not need the car anymore, the car will be retrieved. This removes a lot of barriers for the client and facilitates the use of EVs as a second car.

IDEA 5 – SELF DRIVING TAXIS

The technologies in this world develop exponentially. Google and other companies already started to test their self-driving cars on real streets to see how they act in real traffic. Until now, many positive results have been obtained (The Associated Press, 2015; Google, 2015) There are more and more companies engaging in projects concerning cars in which no human has to drive. Self-driving taxis could be ordered anywhere via an application, automatically manage their recharging cycle and would operate only in Lochem and its close surroundings. Companies working on the development or improvement of self-driving cars might be interested to explore the interaction between the cars and their users to further improve their product service combination. For example at the moment the German government is working on an augmentation of the speed limit of self-driving cars from 10 km/h to 130 km/h Such a project would offer them a great opportunity to gain more insight and make Lochem mobile, futureproof, and green (Verhulst, 2015).

ROADMAP

While developing the out-of-the-box ideas a roadmap evolved. This roadmap is shown in "Figure 5 Roadmap of all Ideas" on page 19. The roadmap structures the ideas chronologically and shows an evolution of electric transportation which passes different stages.

Idea 1, 3a, 3b and 4 are four possible starting points of the roadmap. Their realizability makes them possible candidates for the near future of 2015/2016.

Idea 3a and 3b sum up the initial assignment that was given at the beginning of the project. The assignement was about further developing the existing car sharing system to meet the needs the users have. This could either be the car sharing system with cars on specific spots which everyone can use or the car adoption system for a group of families.

Idea 1 and 4 are mainly focussed on replacing the second cars of the inhabitants of Lochem. When people get used to drive with EVs over the time the idea exists that they could become willing to replace their first cars as well on a larger timescale. Idea 1 is characterized by fixed spots all over the city in order to reduce the walking distance for users.

The approach of including an experienced car sharing company, like car2go, is proven in cities that have a similar ratio between potential users and available rental cars as in Lochem. For Idea 4, cars will be delivered directly to the actual location of the users. In this way the size of the fleet will be as small as possible.

Ideas 1, 3a, 3b and 4 will eventually lead to the projected green transition. This green transition is facilitated by a working car sharing system. People who are used to electric cars through the car sharing system are more likely to consider buying an electric car as their first car. The goal is to replace all (first and second) combustion engine cars in Lochem with EVs by the year 2025 as can be seen in Figure 1-4 Roadmap of all Ideas. An all-green public transport system including an electric bicycle rental service could then also be part of it.

For now it is assumed that in the year of 2035 self-driving cars will be available and legalised. One can use those cars for a taxi system, so the car can drive on its own to the houses of the inhabitants and bring them to their destination. After that, the car will drive off to another requested location. The ultimate goal is to have these cars in Lochem in the year of 2035, so that there are less cars needed.

CONCLUSION

In the end of the analysis part the most important requirements of the system were determined. Those requirements are as followed:

1. Sustainability for Lochem
2. Adaptable by other cities
3. Becoming energy-independent
4. Convincing people to move over to electric cars
5. Sharing the high acquisition costs of the cars while benefitting from the low running costs
6. Profitability
7. Realizable in the near future
8. Futureproof
9. User-centred design

With these requirements in mind six ideas were created. After the feedback of the groups and the teachers a choice was made to further compare ideas 1, 3a, 3b and 4.
The green transition (Idea2) and self-driving taxis (Idea5), were ideas which will only be executable in the distant future. But one of the requirements was to develop a system that is applicable in the near future. That is why the choice was made to further develop idea 1, 3a, 3b and 4 to compare them based on the requirements made by the product owner, LochemEnergie, and the needs of the users.

The goal of the following comparison is to choose for one final concept, that will be worth developing to a more detailed level.

ROADMAP

2015

IDEA 1   **IDEA 3A**   **IDEA 3B**   **IDEA 4**

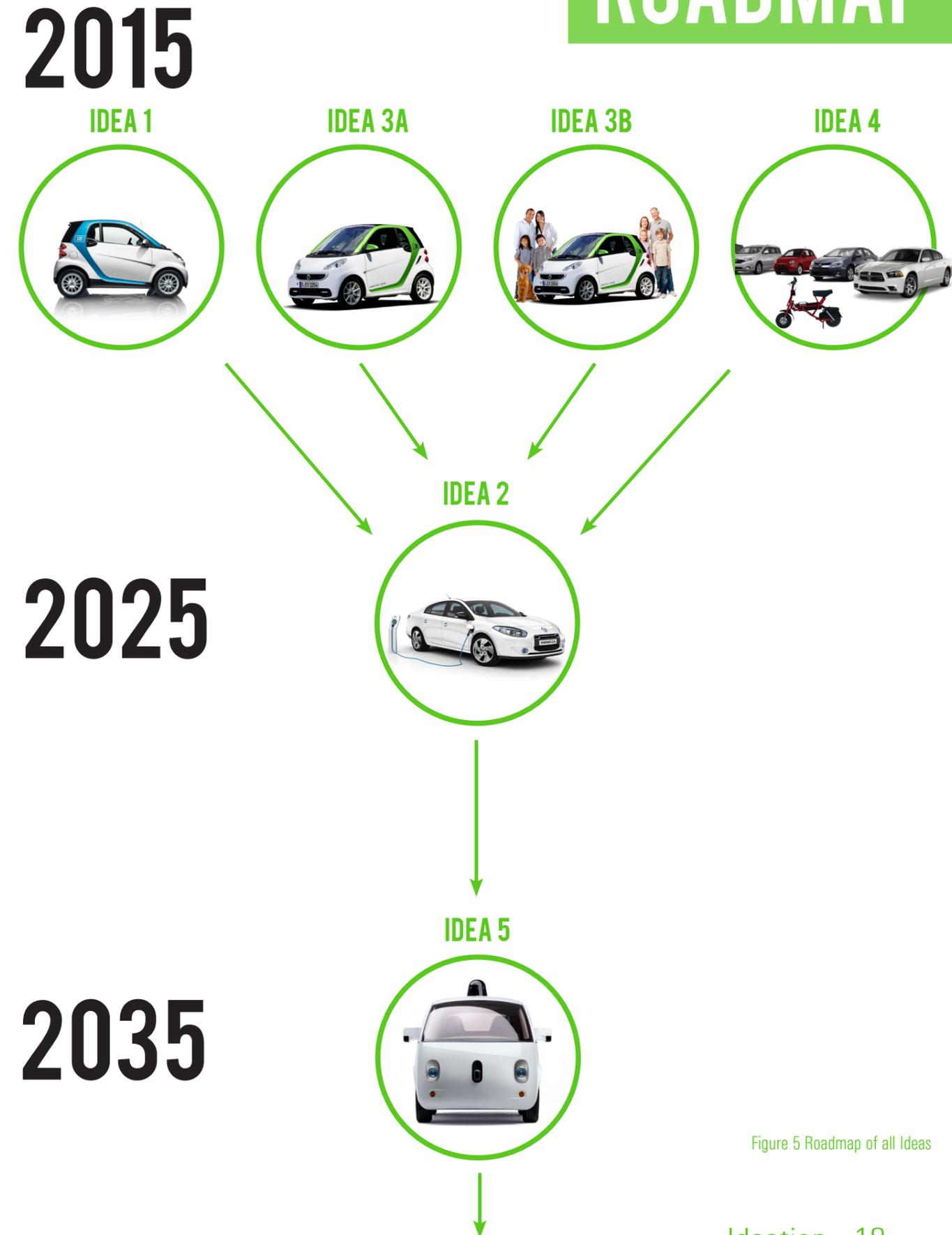**IDEA 2**

2025

IDEA 5

2035

Figure 5 Roadmap of all Ideas

CONCEPTS

All of the four ideas' (1, 3a, 3b and 4) advantages and disadvantages are further developed and compared in this chapter. The ideas are only described shortly as a reminder, because the more detailed descriptions have already been given (page 14,15). The advantages and disadvantages of each idea with regard to the two most impostant stakeholders, LochemEnergie and Lochemers, are presented in form of a table.

CONCEPT 1

Idea 1 was to ask an experienced car sharing company like Car2Go or Greenwheels to take over the car sharing in Lochem.

LOCHEMENERGIE	LOCHEMERS
Low Risk.	Spontaneous planning.
Low Costs.	Every member has access to all cars.
It's reliable and already working.	It's reliable and already working.
	You can park wherever you like
Low influence on the system.	Few different cars.
No Profit for LochemEnergie.	One has to search for cars and walk towards them.
The car sharing systems are developed for urban areas and may not work in rural areas.	The prices might be higher, due to commercial business.
	An external company gains money.

CONCEPT 3A

Idea 3a was to improve the already existing car sharing system that LochemEnergie has set up. This could also be possible in combination with idea 3b.

LOCHEMENERGIE	LOCHEMERS
High influence on the system.	Cheap renting.
Can be combined with LochemEnergie's car adoption.	Every member has access to all cars.
Key lockers or transformed cars are mandatory.	Few different cars during the start-up and after that the different cars may be spread so that the users have to go very far for a special kind of car.
Less flexible due to fixed key-/charging stations that have to be set up.	One has to walk to fixed spots.
Many cars are needed to make the system attractive	One has to park the cars at a specific spot.

CONCEPT 3B

Idea 3b was to improve the already existing car adoption system that LochemEnergie has set up. This could also be possible in combination with idea 3a.

LOCHEMENERGIE	LOCHEMERS
Good for the group dynamic for members of Lochem.	Social because of sharing groups.
Users lease their own cars: low investment.	Personal relation to the car and their owners.
Can be combined with LochemEnergie's car adoption.	Cheaper than individual cars.
Groups have to be formed and managed.	Few different cars.
Key problem.	Car sharing outside of the group is difficult.
A group application for car reservation and payment has to be build.	Good planning is required, because there is only one car for the group.

CONCEPT 4

Idea 4 was to set up a new system in which all cars are placed in one spot and are delivered to the users and afterwards picked up again by employees. The employees use a foldable scooter to go back from the car and again to the car.

LOCHEMENERGIE	LOCHEMERS
Maintenance and charging at a central place.	Broad variety of cars.
Userfriendly, thus more users.	Userfriendly (for elderly).
Creates jobs.	Very flexible / spontaneous.
No key problem, thus no investment in keylockers or keyless access technology.	Employees can help out.
Adjustable fleet.	No car pick up.
	No key problem.
A reservation website has to be set up.	Prices could be slightly higher due to employees and variety of cars.
Employees have to be paid.	One has to wait till the car is delivered
Electric scooters need to be bought.	
A parking lot and an office have to be rented.	

MEETING WITH TONNIE TEKELENBURG

On wednesday 7 october we met with our pruduct owner on behalf of LochemEnergie, Tonnie Tekelenburg. The meeting took place in the Stadhuus in the centre of Lochem and started at 13:00. During this meeting the four concepts (1, 3a, 3b, 4) were presented and discussed with Mr. Tekelenburg. Also, some aspects of the currently running concepts were clarified by him and he proposed a new possibility for a concept. Through the meeting a clearer view of possible next steps for the concepts was obtained, which means that choosing a concept or a combination of concepts was easier.

After presenting all of the concepts, Mr. Tekelenburg told what he thought about them. After the presentation of the first concept, he said that the idea of asking a big car sharing company, to start their car sharing system in Lochem was a good idea, but would not work out well. He told, that Greenwheels had already tried to gain ground in Lochem, but the system was not used enough, because of the differences between big and small cities. The first reason is, that in small cities, the amount of potential users within a certain range is lower than in a big city. Also, in rural areas nearly every family has at least one car, because they need it for the high distances and because of shortcomings in the public transport infrastructure. The third reason is, that in small cities, the lack of parking spots is not as high as in big cities. These are all reasons, why conventional car sharing systems do not work in Lochem or rural areas in general. A big car sharing company would have to develop a new system, just as LochemEnergie has to do that too, making it not very attractive to come to Lochem.

The idea of Lochem's own car sharing system is already in use combined with the car adoption system. Mr Tekelenburg told, that this idea is already working, but not optimal. This could also be seen in the survey from Binnenmars (2015).

The last idea that was presented was the idea to deliver the cars at home. Mr. Tekelenburg responded very positively and asked to further develop this idea. In detail, he asked to check all the costs and see if the users would have to pay a lot more.

He also liked it because their would not be a key problem.

Tonnie also added the possibility of another concept. This concept focuses on the fiscal aspects of driving EVs for companies and their employees. The main aspects are Total Added Value, additional liability and deductions. The main argument for this concept lies in the additional liability. Additional liability is the amount of money that has to be paid by the employee for the private usage of a business lease car.

In short the concept would work as follows: a company makes an employee lease an electric car, they share the lease-costs for the EV. The employee drives the car to work every day and during work shifts the car can be used for example for business trips or package delivery. At the end of the day, the employee drives the car back home, to charge the car and use it privately. The difference between leasing an EV and a vehicle that uses a combustion engine is that the additional liability for employees is equal to 4% of the catalog value of an EV per year. The additional liability for employees who use a car with a combustion engine is 20-25%. This means that the employees have to pay less for the car. The additional liability minus the contribution of the renter is the gross amount the renter has to pay for additional liability. This amount netto plus the renters contribution is what the renter has to pay in total. In this system, it also would be possible for the user in cooperation with LochemEnergie to rent the car to somebody else when it is not used, for example when the employee is on holiday by plane or in the weekends.

This concept is not further developed, because it focuses too much on the fiscal parts while our group is not experienced on the fiscal parts. Also the advantages for the companies are not very big. They could also rent electric vehicles from other companies who are specialized at it. The only advantage is that the car could be rented to other people in the weekend by LochemEnergie. This might work, but expected is that the car will not be used much in the weekend, because everyone still has a first car which is of course available in the weekend.

After the meeting, the city of Lochem was visited in order to look at charging units and the Smarts in the streetscape of a residential area of Lochem. Based on the results of the meeting, the main requirements the product owner has were completed with four new requirements:

- No high increase in price for the members of LochemEnergie
- Keep the customers satisfied
- Motivating more people to join LochemEnergie
- Making a system that is a good fit for a small city as Lochem

Figure 6 Gemeentehuis Lochem

QUESTIONNAIRE RESULTS

A questionnaire has been sent to the members of LochemEnergie. They received an email containing the link to the questionnaire in which they were told about its purpose and that their data would be processed anonymously. In the beginning of the questionnaire they had to give their informed consent before they started. Two of the 35 people did not give their consent and were sent to the end of the study. The detailed results per question can be seen in Appendix D. 27 male and 6 female participants from 22 to 75 years old (M: 56,55; SD: 10,03) filled in the questionnaire. The questionnaire was send to 163 members of LochemEnergie, 35 started the questionnaire, resulting in a response rate of 21,5 %. For an emailed questionnaire, this is a moderate response rate (Forshaw, 2013). Still it is possible, that certain types of respondents may be underrepresented due to non-response (Berg, 2005). The conclusions drawn from this study should be used with care.

On average, the respondents were slightly to highly interested in using electric vehicles (EVs). This shows that the interest in sharing or renting EVs could be quite high for this population. Of course, LochemEnergie is an initiative that wants to make the city more environmentally friendly and most members have the same wish, what explains this result. The other questions are split into two categories: characteristics of the cars and characteristics of the system. The results of the questionnaire are then translated into requirements for these two categories. After each result, the number of the corresponding requirement is placed so that the link can be made easily.

CHARACTERISTICS OF THE CARS

Multiple questions were asked to get to know which characteristics the shared or rented cars should have in the eyes of the members of LochemEnergie. The activities the users want to use the EVs for are very diverse. Nearly 50% of the users would use an EV for shopping in a different city. Regular use for work or school is demanded by 40%. More than half of the participants added an answer in the "Otherwise" field, naming spontaneous and planned activities, activities for which you go far away and activities for which you stay in your city. This shows the need for different types of cars (1). About one third of the users wants to travel further than 100 km with the EVs. This would exceed the range of the electric Smarts that are currently used in LochemEnergie's car sharing system. Two third of the users need the car to travel 100 km or less. This shows the requirement for at least two different types of cars. Two third of the users would only need to go 100 km far while one third would need to have a higher range. 75% of the participants say, that they want to transport up to two people with an EV. For these people, the currently used Smarts would be enough. The other 25 % would like to have the possibility to transport more than two people, showing the demand for bigger cars than the electric Smarts. In Figure 7, four different categories of cars and the need for them in percentages are shown, including the range and the number of persons to be transported (2, 3, 4, 5).

	Up to 100 km	More than 100 km
1-2 pers.	54,5 %	24,2 %
up to 5 pers.	15,2 %	6,1 %

There are different characteristics the people would like to have for the cars. More than half of the participants would like to use a car that uses little energy. Nearly half of the participants would like the car to be able to cover a certain range. This range differs from 90 to 300 kilometres. A third of the participants would like the car to be comfortable and 12% need the car to have a big trunk. Here it can be seen, that the characteristics of the needed cars differ a lot. 52% of the respondents would like to have the possibility to choose from different cars for each trip.

This shows, that choice between a lot of cars is a thing the users would really like. The results concerning the characteristics of the cars can be used to create a fleet for the system that fits the needs of the members of LochemEnergie and attracts other people to join the initiative. A list of requirements the users have for the fleet was made:

1. The new system has to offer different cars, fitting the differing needs of the users
2. It would be nice if around 55% of the cars are for 2 persons and have a range of around 100 kilometres
3. It would be nice if around 24% of the cars are for 2 persons and have a range of more than 100 kilometres
4. It would be nice if around 15% of the cars are for 5 persons and have a range of around 100 kilometres
5. It would be nice if around 6% of the cars are for 5 persons and have a range of more than 100 kilometres
6. It would be nice to have cars that are comfortable
7. It would be nice to have cars with a big trunk
8. The cars should use little energy

CHARACTERISTICS OF THE SYSTEM

Different questions were asked about which requirements there are for the whole booking system. As already mentioned, the activities that members of LochemEnergie would like to do with the EVs are very diverse. This shows the requirement for different sorts of booking possibilities, including abonnements and different booking lengths (1). Concerning the length of booking an EV, the participants had different needs. About 40% would like to book a car for a whole day, while 30% would need it for around three to five hours. Nobody gave the answer, that they would need the car for less than one hour. This shows, that giving the possibility to book the car in one-hour steps, would be nice (2). Booking for a whole day could be made less expensive (3). 70% of the people said that they would like it the most to go to a place in their neighbourhood to get a car. This shows, that they do not care if they have to walk or cycle somewhere to get to the car. Half of the participants would like to cover less than 900 metres to get to

the car and 90% are not willing to cover more than 1.3 kilometres. It would thus be nice to place cars in a way, that nobody has to cover more than 900 metres (4). 43% of the participants would either walk or go by bike to get to a car, while 27% would only like to walk and 30% would only like to cycle. So it would be nice to place bicycle racks next to charging stations (5).

Every participant wants to have either a website or a mobile application to look for the place and type of available cars. Also everybody would like to have either a website or an app to book an EV. 27% would also like to call somebody to book a car. These results show, that a website and an application are two mandatory requirements for the new system (6), but that a telephone hotline would also be nice for some users (7).

More than half of the participants would like to book a car one to two days before they want to use it, 45% would like to book more spontaneously (one to two hours before or completely spontaneously). This shows, that it should be possible to book a car two or more days beforehand, but that it should also be possible to book a car spontaneously (8). Nearly half of the respondents answered that they would always know beforehand how long they would need the car. 45% said, that this would depend on the activity they planned with the car. Thus, it would be nice to give users the possibility to book the car for an indefinite time (9).

Nearly half of the participants would be willing to share the car with everybody who wants to, 45% with people from the municipality of Lochem. 12% would like to share the car only with people they know well or within their near surroundings. It would thus be okay, if the people have to share the car with the whole municipality of Lochem.

There were different questions about what things, concerning EVs and the new system, the people would like to know more about. 70% of the participants would like to get information on how the reservation system works. These people would like to get this information via a website (96%) or talk to an experienced person (22%). 9% would also like to take a test to find out if they understood everything. Nearly half of the participants would like to get information on how they can charge the car at a charging station. 75% of these respondents would like to get this information on a website and 44% would like to talk to an experienced person. 30% of the participants would like to know how to use an EV-battery more efficiently to have a higher range. Most of the respondents would like to get this information on a website (90%), talk to an experienced person (40%) or have this information in the car (10%). 27% of the respondents are also interested in how an EV works in general. 78% of these participants would like to get this information on a website and 56% would like to talk to an experienced person about this. 22% would like to take a test to find out, if they understood everything. This shows, that information on the different things should be placed on a website (10), but that also an possibility where the people can talk to experienced persons would be nice (11). The participants would like to take a test about how the reservation system works and on how an EV works in general, to see if they understood everything (12). Also, the information on how to charge the car at a charging station should be in the car (13).

A list of requirements the users have for the new system has been made:

1. The system should offer different booking lengths
2. It would be nice to be able to book an EV in steps of one-hour
3. It would be nice if booking a car for a whole day would be less expensive than booking for 12 hours
4. The people who book a car should not have to walk/cycle more than 900 metres
5. It would be nice to have a bicycle rack where people want to get a car
6. The system should offer a website and a mobile application on which people can see which cars are available and to book the cars
7. It would be nice to also have a telephone hotline for people who would like to book a car via the phone
8. The system should offer the possibility to book a car some days in advance, but also spontaneously.
9. It would be nice if the users could book a car for an indefinite time
10. The system should offer information on a website about:
    - how the reservation system works
    - how to charge a car at a charging station
    - how to use an EV-battery to increase the range
    - how an EV works in general
11. It would be nice to give the people the opportunity to talk to an experienced person about:
    - how the reservation system works
    - how to charge a car at a charging station
    - how to use an EV-battery to increase the range
    - how an EV works in general
12. It would be nice to give the people the opportunity to take a test to see if they understood everything about:
    - how the reservation system works
    - how an EV works in general
13. It would be nice to have information in the car about how to charge the car at a charging station

CONCEPT CHOICE

We based our concept choice on 3 different pillars: the meeting with Tonnie Tekelenburg, the results of the questionnaire and our own analysis and insight. In order to make the project a success one needs to satisfy the most important stakeholders (page 6). The two most important stakeholders are LochemEnergie and the end-user. The benefits and drawbacks of the concepts will be elaborated for these two stakeholders.

INCLUDING AN EXTERNAL CAR SHARING COMPANY

DRAWBACKS FOR LOCHEMENERGIE

When an external car sharing system company like Car2Go gets asked to overtake the car sharing in Lochem, LochemEnergie would not have that much influence. Further, LochemEnergie would not earn any money. In our meeting with Tonnie Tekelenburg, it turned out that Greenwheels, a professional car sharing company, had already been stationed in Lochem some years ago. However, they already left some months later, because they did not have enough customers and it was not feasible for them. This example shows that the other car sharing companies would not easily be convinced to come to Lochem. Their concept is feasible in big cities, but not in rural areas. They would have to change their whole concept and adapt it to another kind of city. Professional car sharing companies' way of car sharing would not be practical in Lochem, due to the lower population density. In Amsterdam, for example, there are much more inhabitants living around one shared car. This means, that the cars never stand still for a long time, because there are more potential users per car. In Lochem the cars would not be used that often. In big cities a shared car would be a substitute for a first car, because people mostly have no first car, but go by bicycle or by public transport. In Lochem, most people do have a first and a second car, and some of them even own a third one, so a shared car would be used as a substitute for the second or the third car. Also, in Lochem there is no problem with free parking spots, which is another reason to use a shared car in a big city. These facts show, that a car sharing system as it is used in big cities is not practicable for Lochem.

BENEFITS FOR LOCHEMENERGIE

When an external car sharing company would be included in LochemEnergie's car sharing, LochemEnergie would have a low risk and lower costs. They could work together with the car sharing company, which could for example provide the cars while LochemEnergie provides the already prepared system. Together they could improve the system until it is perfect for rural areas. LochemEnergie could then work together with the company to get the system to other cities. This would, of course, only be possible, if a car sharing company would really agree to start such a project.

DRAWBACKS FOR THE END USER

With the inclusion of a professional car sharing company, most likely the prices for the users would increase. The car sharing company would want to make more profit than LochemEnergie does now. Maybe the users would not like to pay much more money to an external company after they gave money to an internal initiative before. Also, the users would have to walk to the cars and at the end of a trip park them at least in a certain area.

BENEFITS FOR THE END USER

When LochemEnergie would include a car sharing company, the users would not have to wait for a mobile application. The most car sharing companies already have a website and an app, while LochemEnergie will have to make an app first. This can take some time. Through the app, spontaneous planning is possible. The users would also have the assurance that they can rely on the system, because it is already working in other cities. Most of the car sharing companies work with a free-floating system within a certain range. This may also be possible in Lochem, with the help of employees, so that the users could park the cars wherever they want.

WHY WE DID NOT CHOOSE FOR THIS CONCEPT

In the meeting with Tonnie Tekelenburg it turned out, that there had already been another car sharing company in Lochem. They left after some time, because their concept, made for bigger cities, was not practicable in Lochem. When a car sharing company would get included into the system, this would have to be through close collaboration with LochemEnergie, who could provide their experience with car sharing in rural areas. It was concluded, that this would not be very attractive for a car sharing company, so that it would be difficult to convince them. Instead, it was decided to choose an option in which LochemEnergie does not have to rely on an external car sharing company.

IMPROVEMENT OF LOCHEM'S CURRENT CAR SHARING AND ADOPTION SYSTEM

DRAWBACKS FOR LOCHEMENERGIE

LochemEnergie has designed a car sharing system, including car adoption, that is currently in use. This means, that they have high risk, because they have invested a lot. This investment is for example that they have to buy or lease cars. Also, these cars have to be transformed for keyless access or key lockers have to be installed.

The system is not very flexible, because the cars are placed at fixed charging stations. These charging stations also have to be set up. Also, in rural areas, car sharing systems are not as tested. In the drawbacks for LochemEnergie when an external car sharing company is involved, it can be seen that car sharing in general

may not be feasible in a city like Lochem. LochemEnergie has already tried to make a more rural car sharing system, for example through subscriptions and through the adoption system, but maybe a completely different system would be even better.

BENEFITS FOR LOCHEMENERGIE

To design a car sharing system yourself, has also some benefits. LochemEnergie has a high influence on the system. They can control what is done with it, and can change it as they like. When they see, that something does not work the way it should, they can adjust the system in a way that it will work.

DRAWBACKS FOR THE END USER

In LochemEnergie's car sharing system, the cars are placed at fixed charging spots. This means, that the users always have to walk a distance to get to a car. Also, at the end of a trip, the users have to park at the same specific spot again. To make sure, that nobody has to walk that far, many cars have to be placed. From these cars, many cars would be unused a lot of the time. At the beginning, the system would offer the users only few different cars. Over time, more different cars could be placed, but not everybody may be able to reach all the different cars.

BENEFITS FOR THE END USER

The system that LochemEnergie has designed, has the benefit, that renting one of their cars is way cheaper than in most other car sharing systems. This can now be achieved because LochemEnergie has gotten some free electric Smarts from Mercedes-Benz. When they have to begin to lease cars for themselves, the prices will also increase. Another benefit, is the integrated adoption system. Users can adopt a car together with other users. They could also do this for themselves, but when they do it through LochemEnergie they can sometimes share their adopted car, when nobody needs it. Through this, they can get some money back.

WHY WE DID NOT CHOOSE FOR THIS CONCEPT

For the end user, the current system has many drawbacks. They have to walk to the fixed parking spots, and because of the low density it is not practicable to place a car every 2 kilometres. The system is not very flexible and maybe a normal car sharing system is not feasible in a rural city like Lochem. The system also has drawbacks for LochemEnergie. To satisfy all the users, too many money would have to be invested into cars to spread them evenly all over the city. This money would then not be earned back, because most of the cars would stand still most of the time. The system limits the users flexibility, because they would always have to look where a car is and then take the time to walk to the car. Hereby, spontaneous decisions to use a car are restricted. It was decided, to choose for a more user-friendly concept.

CAR DELIVERY

DRAWBACKS FOR LochemEnergie

For delivering the electric cars manpower is needed. When one uses students or volunteers for this job they will not be available all the time, so one needs a lot of people who can work part time on call basis. Easyway is a good example for this. This company uses students to bring cars to a place and they go back by using public transport, which is free for these students. The result is that the company does not have to pay for transport of employees. When more than one student is used for the delivery task, one needs a system to see which student is available at a certain time. Those students will not go back by using public transport, but by using a foldable scooter. Another drawback is that energy is needed to charge these scooters for the car delivery, which will result in a bigger load on the smart grid.

BENEFITS FOR LOCHEMENERGIE

If a car has to be delivered one would think that it would cost a lot more money than a car from a free floating system, but this is not true. A free floating car needs to be maintained and cleaned once in a while. This costs some time, because the cars are found at parking spots on different locations, which is not the ideal place for maintenance. When letting a car cleaning company clean the cars, it will cost money which in unnecessary, because it can be done by employees or volunteers. When a central parking lot for the fleet is located close to the headquarter it is easier to maintain and keep track of the status of all cars. This also means that the cleaning can be done for the whole fleet in one cleaning session. The car has to be delivered to the clients, which takes time. One will need employees for this job. This is an ideal task for a student or intern. It is a fun job for students and it will not cost a lot of money for the company. It also contributes to a higher employment rate when the fleet will grow as projected.

When a car is at a fixed parking spot only inhabitants who live within a reach of maximum 1km will use this car. Also their car choice is limited. In opposition to this, a delivery system will have a higher use ratio, because all of the cars can be used by the whole municipality. The amount of potential users is significantly higher and it is possible to offer a broad range of different cars. Another benefit for LochemEnergie is that the size of the fleet is easy to adapt to the needs of Lochemers. This would increase the use ratio even more. When the car is delivered it is possible to use more types of cars, for example a car for 2 or 4 persons or an expensive car like a Tesla. This is not possible when the car is at one specific spot, because the amount of potential users would be too limited. Another benefit is that there will not be a key problem, because when the driver delivers the car he will hand over the keys.

The software and hardware that is needed for a key system is costly. When this is not needed, this will lead to a quite big reduction in the costs compared to other systems.

DRAWBACKS FOR THE END USER
The user has to wait until the car is delivered, which can take up to half an hour. When he reserves the car at least one hour before using it, the car will be at his home at the time he reserved. When he comes home with the car, he has to stay in reach of the car until the car pick up, because the keys need to be handed over.

BENEFITS FOR THE END USER
For the clients the most important benefit is that they do not have to walk or cycle to the car. So they do not have to go through the rain or cold to get to the car. It is also possible for the client to call for the car. There are some people who would like to call for the car, because they do not like to fill in forms on a website or to use the internet at all.
Another benefit is that there are different types of cars to choose from. So the user can always pick the car he likes the most or the car that suits best for the task he wants to accomplish.

DRAWBACKS AND BENEFITS FOR THE OTHER STAKEHOLDERS
Allego, the company who places the charging stations, will not be included in the design of the car delivery concept but will be included in the set up of the smart Grid that will be needed to charge the fleet as efficiently as possible. For Eneco the idea is profitable, because they will sell more energy due to the higher amount of EVs.
Alliander will be satisfied, because they do not have to adapt the smart grid to the whole municipality, but only for the headquarter. The control over energy consumption is higher, because all cars are in one spot.
The car delivery concept is a great example for other cities. Those cities and the government can profit from a successful pilot of the concept. Their gained knowledge can improve the sustainability of rural areas.
The goal of the city council is to be carbon-neutral by 2030. This system will be a great start to become carbon-neutral and could attract more people than the current system.
The inhabitants of Lochem who do not want to use electric cars will be satisfied that only a small amount of normal parking spots will be replaced by "EV-only parking spots".
The idea to deliver the cars is disadvantageous for the maintenance companies, because a lot of the maintenance work will be done at the headquarter.

WHY WE DID CHOOSE FOR THIS CONCEPT
After deciding that we wanted to elaborate a concept in which LochemEnergie does not have to rely on an external car sharing company, but that is more user-friendly than the current concept, our choice fell on the car delivery concept. The reasoning for this choice are split in three parts:

- The results of our own analysis and insight.
- The meeting with Tonnie Tekelenburg.
- The users opinions.

Results of our own analysis and insight
The first part of the reasoning comes from the first statement of requirements that was written before the ideation-phase was started (page 10). The requirements were:
1. Sustainability for Lochem
2. Adaptable by other cities
3. Becoming energy-independent
4. Convincing people to move over to electric cars
5. Sharing the high acquisition costs of the cars while benefitting from the low running costs
6. Profitability
7. Realizable in the near future
8. Futureproof
9. User-centred design

The first requirement was met with every of the car sharing systems. Through letting people drive electric cars, they may see, that a second car may not be needed when they use the car sharing system. This can lead to a green transition, letting the users sell their cars and buy electric cars for themselves. Also, green energy is used in the system. LochemEnergie creates energy with their own solar panels. When the business location is not placed far away from these, it may be possible to place a cable from them to the charging stations for the EVs. Because of the centration of the cars at one place, it is possible to charge all the cars with this energy. The users would know, where the energy comes from, and Lochem would take another step into the direction of being sustainable.
The delivery system also meets the second requirement. Raising a car renting business is possible everywhere and in mostly every city it is possible to find for example students to drive the cars to their destination and pick them up again later. Lochem can be the place for a pilot study, showing if this system might be a substitute of a car sharing system for small cities.
Energy independence is an important goal for LochemEnergie. As said before, with the EV delivery system, all cars would be in one spot, making it possible to charge them with the energy that is produced by LochemEnergie's own solar panels. Using their own energy, they would not have to depend on big energy suppliers. Thus, the third requirement is also met.
The fourth requirement, convincing people to move over to electric cars, can be met by this system. With EV delivery, many different cars can be offered to the users. This gives them the opportunity to try out different EVs. When, for example, a Tesla is included in the fleet, it may be, that a user tries it and says that that is the ideal car for them. This can happen with all the cars. The system further gives the opportunity to adjust to electric cars, showing that they may not be that different. Through booking an EV one can practise and the people may feel more confident in buying an EV for themselves.
Sharing the cars' high acquisition costs while benefitting from the low running costs is a requirement that is met by all kinds of car sharing systems. However, this system is even more efficient in this sharing system, because less cars have to be bought in comparison to a normal car sharing system. This means, that the costs for the cars can be covered more easily than in other systems. The people do still have the benefits from the low running costs.
The car delivery system is profitable. It may be even more profitable than a normal car sharing system. Of course, LochemEnergie has to pay employees, but in the current car sharing system, many cars would be needed to reach every possible user. Most of these cars would then stand still, because of the low density of users in Lochem. This many cars are not necessary in the car delivery system. One would have less investment for the same income, or maybe even more income, because one attracts more people with this kind of system.
The seventh requirement, the realizability in the near future, is also met with this system. Of course LochemEnergie has to invest in new, different cars, but in the beginning it would be possible to use the cars that are currently available. Through subsidies it is possible to finance new cars, which would then attract new users. With more users, more money would be earned, making it possible to buy even more cars when needed.
The future-provability, can be seen in this concept in the way, that it can be changed into a system with self-driving cars easily. In the future, where self-driving cars will be everywhere on the streets, the employees are not necessary anymore, but the car will drive to customers by itself.
The car delivery concept is designed in a user-centred way. Through the questionnaire, the opinions of the users of the Lochemers were taking into account. A more detailed description of this can be found in the third part of the reasoning.
To sum up, it can be said that all of the first requirements are met by this system, making it a reasonable choice from the first part of the reasoning.

The meeting with Tonnie Tekelenburg
The second part of the reasoning comes from the meeting with Tonnie Tekelenburg (page 20). From this meeting, new requirements that the product owner has, emerged:

1. No high increase in price for the members of LochemEnergie
2. Keep the customers satisfied
3. Motivating more people to join LochemEnergie
4. Making a system that is a good fit for a small city as Lochem

In contrast to including an external car sharing company, with this system it is possible to keep the low prices and still make a more

Figure 8 Rural car sharing , a new concept.

user-friendly system. LochemEnergie is very keen to not increase the prices that much, because they know that then nobody would use their system. This requirement is met with the system.

The users would like to choose a car every time they want to use one. With the delivery system, it is possible to offer different cars, keeping the users satisfied. The users also do not have to walk or cycle to the cars anymore. They can stay at home, until the car is delivered, without having to increase the prices very much. With this system, also older people can be reached and kept satisfied.

The requirement to motivate more people to join LochemEnergie can also be met with this system. Through the amount of different cars offered, different people may be attracted by the system. There may, for example, be people in Lochem who always wanted to drive a Tesla. This may now be possible, making them join LochemEnergie to fulfill their dream. Also, as mentioned above, older people may be attracted by this system. There may, for example, be older people who can still drive a car, but do not need it that often anymore. For them, it would be practicable to order a car every now and then, so that they can sell their own car. They would not even have to go anywhere to take this opportunity.

In the meeting with Tonnie Tekelenburg it came up, that car sharing in the way it is done in big cities like Amsterdam, is not feasible in small cities like Lochem. To reach and satisfy every possible user, in the current system many cars would have to be placed all over the municipality of Lochem. Because in Lochem the people always need and thus have a second and sometimes third car, the need for a shared EV is not that high as in big cities, where the people decide not to have a car at all, because they can go everywhere by bike or bus. This shows, that the cars would stand still very often, because the people use their own cars. With the car delivery system, this problem would be solved, because the cars are all placed in one spot and are brought to the people who need them. Through more specific research on how many people would like to use the system and when, it can be calculated how many cars are needed. If the demand for cars increases, new cars can be leased or bought. In this way, it is possible to adapt to the market very easily.

To sum up, it can be said that the system meets all of LochemEnergie's requirements and would give LochemEnergie the possibility to take another step into the direction of making the city greener and next to it satisfy their customers with a user-friendly car sharing system.

The users' opinions
The third part of the reasoning comes from the users' opinions. These are again divided into two parts. The first part are the results of the literature analysis that was done in the beginning, including the articles by Beltman (2013) and Binnenmars (2015) (page 11). The requirements that came from these articles are listed below:

1. The system should be easy enough for people to use even if they do not know that much about new technologies.
2. The system should enable people to be no, or less of a burden to the environment.

3. The reservation system should be easy enough for people to use even if they do not know that much about new technologies.
4. A website and smartphone application could be designed for the new system if it is easy enough for people to use even if they do not know that much about new technologies.
5. The system should give the opportunity to move away from large energy companies with too much power.
6. The system should give the opportunity to sustain the environment.
7. The cars in the system should use green energy.
8. The system should offer information on how much energy is used by the cars.
9. The booking of the cars should yield monetary benefit for the users.
10. The system should offer information on how to drive energy-efficiently with an EV.
11. The system should keep offering the low renting costs in comparison to owning a car.
12. The system should keep offering the possibility to rent a car for only part of the day.
13. The system should stay sustainable.
14. Reserving a car should be able less than two days beforehand.
15. The system should give feedback about if a car is available directly after or before booking it.
16. In the system, the users should not have to pick up the keys somewhere.
17. The system should also offer cars with more than two seats.
18. The system should offer the possibility to rent a car with a higher range than the electric Smart fortwo.
19. The infrastructure of the charging stations should be improved.
20. In the system, the users should not have to pick up the car somewhere.

The first of these requirements can only be met by the system, when the cars are not that difficult to use. Because the cars cannot be influenced by the choice of the system, this requirement has to be approached in a different way. On the website that is under development, an explanation on EVs will be given. Also, there will always be an employee when one gets the car, whom one can ask questions. Also, through not setting up a key replacing system, at least this will not include a new technology.

In the system, the users will have the possibility to drive electric cars instead of their combustion engine cars. This gives them the opportunity to be less of a burden to the environment. Also, green energy will be used for the cars. With this, the second requirement will also be met.

Requirement three is met through the fact that users who want to reserve a car cannot only use the website that will be build, but can also call an employee to reserve a car. This will make it easier for people who are not very familiar with the use of a computer or smartphone. This may for example also include people who are older.

A website for the system is already under construction. On this website, it will be tried to make the reservation as easy as possible. When the people do not want to book a car through a website, they still have the chance to call an employee. The fourth requirement is thus also met.

The fifth requirement is already mentioned in the list of first requirements above. Through the usage of the energy from LochemEnergie's own solar panels, it can be made sure that large electric companies do not have that much power over the city anymore.

Sustaining of the environment is possible in this system through the possibility to use electric cars that are driven by green energy instead of combustion engine cars. By this, requirement six and seven are both met.

The eighth requirement cannot be met only through the choice of the system, but it has to be implemented into it. On the website, it may be possible to give a livestream of how many energy is used by the charging of the cars at that moment.

The booking of a car is less expensive than owning a second car. Of course, there may be families in which this is not true, because the second car is used very often. But then, they can at least use the system to find out, if an electric car would also fit their needs as a second car. With using an EV, the user has less running costs than by using a combustion engine car.

On the website, it is planned to add a section on how to drive energy-efficiently with an EV. With this, it is hoped that people's range anxiety may decrease, because they know how to increase their range and feel like they have more control about it. Also, on an information market in the beginning, such things could be explained to the users, meeting the tenth requirement.

In this system, in comparison to other systems, there are some more costs because of the employees. But in this system, less cars are needed to reach and satisfy everybody, so there are less leasing costs. Through balancing these two, it may be possible to keep offering the low renting costs that are also offered in the current system.

In the system, it is planned to have the possibility to rent a car for a day or per hour, so it can even be rented in smaller parts than in the current system. This increases the flexibility people have, because they are not bound to specific parts of the day. The twelfth requirement is also met.

The sustainability of the system has been specified by other requirements already, showing that requirement thirteen is also met.

In the new system, it is planned that users will be able to reserve

a car down to one hour beforehand. Flexibility is provided by the fact, that a car can also be booked two days beforehand, to make sure that the car is really available at the needed time. This fits the needs of different user groups and meets requirement fourteen.

Requirement fifteen will be met with the new system. Instead of getting a mail after reserving a car, on the website the users will be able to see which cars are available directly after selecting at which time a car is needed. With this, the user can be sure, that the car they need is available at the time they need it.

With the new system, the key pickup will not be needed anymore, because when the car gets delivered, the delivery guy gives the key to the user and when he picks up the car again later, he will also pick up the key again. This also makes sure, that no new hardware or software has to be used in the car to make a system without key pickup possible. By this, the sixteenth requirement is met.

The delivery system will offer very different cars that fit the needs of everybody. This will also include cars that have more than two seats (e.g. a Renault Zoe) and cars that have a higher range (e.g. a Tesla), meeting requirement seventeen and eighteen.

The choice of the system has no influence on the infrastructure of the charging points. The only thing, that can be said about charging points in this system is, that not many charging points for the shared cars are needed, because they are all placed in one spot. Also, because of the growing interest in electric cars, the infrastructure of charging points will improve automatically.

The delivery system is the only system, in which the twentieth requirement can be met. Here, a delivery guy will bring the car to the user and pick it up afterwards, so the user does not have to go anywhere. This is very user-friendly and cannot be met by conventional car sharing systems.

The second part of the reasoning that comes from the users' perspective are the results of the questionnaire that was filled in by the members of LochemEnergie (page 23). The requirements these end users have for the system are listed below:

1. The system should offer different booking lengths
2. It would be nice to be able to book an EV in steps of one-hour
3. It would be nice if booking a car for a whole day would be less expensive than booking for 12 hours
4. The people who book a car should not have to walk/cycle more than 900 metres
5. It would be nice to have a bicycle rack where people want to get a car
6. The system should offer a website and a mobile application on which people can see which cars are available and to book the cars
7. It would be nice to also have a telephone hotline for people who would like to book a car via the phone
8. The system should offer the possibility to book a car some days in advance, but also spontaneously.
9. It would be nice if the users could book a car for an indefinite time
10. The system should offer information on a website about:

- how the reservation system works
- how to charge a car at a charging station
- how to use an EV-battery to increase therange
- how an EV works in general
11. It would be nice to give the people the opportunity to talk to an experienced person about:
    - how the reservation system works
    - how to charge a car at a charging station
    - how to use an EV-battery to increase therange
    - how an EV works in general
12. It would be nice to give the people the opportunity to take a test to see if they understood everything about:
    - how the reservation system works
    - how an EV works in general
13. It would be nice to have information in the car about how to charge the car at a charging station

The first requirement made by the end users, that the system has to offer different types of cars, is easily met by the system. This system is the only one that gives the people the opportunity to decide between different cars for every trip. In a normal car sharing system, this would not be feasible, because one cannot place many different cars in every place where other cars are placed. This would not be efficient, because too few people in Lochem would use the system.

The EV delivery system, gives the opportunity to book a car in one-hour steps, meeting requirement two and three. The users are able to book a car for one hour, two hours, three hours, and so on, but also for a whole day. Booking for a whole day is even less expensive than booking for six hours, meeting requirement four.

Requirement five is met easily by the system. The users do not have to walk or cycle anywhere to get a car, they get it delivered to a place where they would like to have it. This is especially advantageous for older people, who do not want to walk anywhere, and also when it rains. One can decide, which car one needs or wants to have, and then one just has to order it to whatever place one likes (of course within the limits of the municipality of Lochem). With this, the sixth requirement is not applicable within this system, because the users do not have to cycle to a car anymore.

For this system, a website and a mobile application will be developed. Here, the people will be able to see, which sorts of cars are available at which time, and of course they can also book the cars through this website and application. By this, requirement seven is met. For people who do not want to use the online booking system, a hotline will be installed, with an employee on the other side, meeting requirement eight.

The system meets requirement nine, letting the people book a car some days in advance over the website, the mobile application, or by telephone. The only thing, that is not possible, is booking a car less than half an hour before they need it. The employees first have to bring the car to the people. This takes some time. The most people would like to book a car one to two hours or even one to two days in advance. This is met with this system.

With this system, just like with every other car sharing system, it is difficult to meet requirement ten. When one wants to rent out cars to more than one person, it is required, that one knows when one gets the car back. However, in this system it is possible to book a car for a whole day and pay less than one would pay for six hours of renting. It is thus possible, that when one does not know if one needs the car six or seven hours, to book the car for the whole day and extend the booking period without actually having to pay more money.

Requirement eleven is about a website again. The users want information about the booking system, how to charge an EV on a charging station, how to use an EV-battery more efficiently to have a higher range and how an EV works in general on a website. When the booking website for this system is build, it will have this information integrated into it. On this website, requirement 13 can also be met, through placing tests about each of the topics on the site.

The users also had the requirement to talk to an experienced person to get information about the booking system, how to charge an EV on a charging station, how to use an EV-battery more efficiently to have a higher range and how an EV works in general. The new system will be presented on an information day or evening. This will be planned as a promotion action so that users can get to know the new system already, but also to get information on other things they want to know more about. Further, when one gets a car delivered, there is always a person to talk to, when one has got questions. The users can thus talk to an experienced person every time before and after a ride with an EV. With this, requirement twelve would be met.

The last requirement is, that a description of how to charge an EV at a charging station, should lie in the car. To meet this, a piece of paper with the manual for the most used different charging stations will be placed inside the cars.

To sum up, it can be said, that the in the first statement of requirements mentioned user-friendliness of the system is met by the system very well, because nearly all of the users' requirements are met.

CONCLUSION
After taking the drawbacks and benefits of the three possible concepts under consideration and after looking for the three different sorts of requirements (initial list of requirements, LochemEnergie's requirements and the users' requirements), the EV Delivery concept was chosen to be worked out. The smart grid compatibility of this concept was not taken under consideration in this choice, because the users' opinions concerning the system had the higher priority for the product owner. It was chosen, to look for the smart grid compatibility at a later point of time (page 43).

FINAL CONCEPT

INTRODUCTION
Now that the concept, that is characterized by the delivery of EVs to the customers, is chosen, a final concept can be elaborated. First a business plan will be made in which a Business Model Canvas depicts all business aspects. Based on the cost structure and the value proposition, several aspects will be discussed. The main choices that are explained are the choices for the type and the amount of cars, the type and amount of scooters that are used by the employees to deliver the EVs, the location of the headquarter and the design for a smart grid that will ensure that green energy is used as efficiently as possible. On the basis of the chosen aspects, a financial business plan can be created in which the revenues and costs are explained and calculated for the first 5 years of the start up. Subsequently the risks and opportunities are described, so that a balance can be found in order to make use of the opportunities as much as possible. Thereafter the website that is used in order to get a connection with the customer and the reservation system are depicted, including the requirements that are stated for the website. After taking all things into consideration, a list of requirements for promotion in order to expand the business is summed up. Then recommendations for the launch of the system in Lochem are described, so that the delivery of EVs will contribute to the green transition with regard to transport in Lochem.

BUSINESS PLAN
The Business Model Canvas is a tool to visualize a business plan. The canvas depicts all business aspects in a clear and visual way. Based on nine blocks a description of the organization, earnings, customers, business partners and suppliers is displayed. In this way the essential business entities are mapped, so that adjustments can be applied easily. The Business Model Canvas for the EV delivery concept can be seen in Figure 9. The aspects that are shown per block will be shortly discussed, ranked by the number of the block.

CUSTOMER SEGMENTS
The customer segment of the car sharing system includes all people living in the municipality of Lochem. They are defined by their age and the fact that they own a driving license.
The demography of Lochem is mainly situated around the age of 40 up to 65. Younger inhabitants are less present.
(view "Figure 2 Demography of the population of Lochem" on page 7).

VALUE PROPOSITIONS
The value proposition describes the distinctive or added values that distinguish a concept from the competition. Affordable EVs are attractive for every user. This makes sure that people who do not have a lot of money can also become involved in being sustainable. A variety of EVs makes sure that all of the users' transport needs can be satisfied. The sustainable image that is created by using green energy will not only improve the users' reputation but also the image of the municipality of Lochem towards other municipalities. The good reputation will result in Lochem being seen as an example for other cities in the field of car sharing and sustainability. It can help to make Lochem a carbon neutral city before 2030. Simple and fast reservation, which is comparable to ordering a pizza, is one of the main values offered to the customers. This improves customer satisfaction compared to previous car sharing systems in Lochem.

CHANNELS
The channels that will serve as a connection between the customer and the headquarter are described by the third block. The web application and website will be a connection via internet, so that users who are used to the internet will be able to reserve an EV. Even customers that do not have a computer or smartphone can reach the headquarter by calling a manager. This mainly addresses the relatively old population of Lochem

CUSTOMER RELATIONSHIPS
The customer relationships depicts the way contact with customers is maintained. Print media are meant to let potential customers get acquainted with the EV delivery. In case the customer has questions about different aspects of EVs or the delivery a page on the website that contains frequently asked questions can be used to answer those questions in an early stage. For people that prefer to use a telephone, a manager or the staff could answer questions via the telephone. Customers can also have their questions answered by talking to the staff in person, while the keys are handed over.

REVENUE STREAMS
The revenue model reveals where the income of the concept comes from. In this case the income of the renting out of cars will be the primary revenue stream, because the renting out EVs is the service that is offered. Because of the use of green energy for the concept, subsidies can be expected. These subsidies can be seen as additional revenues for the years to come.

KEY RESOURCES
With key resources the most important business resources that are needed to achieve the value propositions are meant. Those resources require investments that can be financed in different ways. For delivering EVs a wide range of vehicles, flexible employees and a headquarter are needed. A permanent employee, a manager, is also needed to coordinate the delivery, the size of the fleet and the contact to customers. Because of the use of electric vehicles charging stations are also mandatory.

KEY ACTIVITIES
These are the core activities that are needed for the elaboration of the concept in order to add to the quality of it. There are of course the standard activities that are needed in order to deliver EVs. These are the answering of car requests that are done via telephone, application or website and the delivery while maintaining the EVs. Management is also an important activity because it will assure the efficiency of the whole delivery system.

KEY STAKEHOLDERS
LochemEnergie is the most important stakeholder (Figure 3 on page 9). They want to make Lochem carbon neutral before 2030, so they are very interested in solutions for transport problems. Alliander manages the power grid that makes sure that green energy produced by Eneco will be used for charging. For example the smart charging solution by Allego, called "ChargingPlaza" may be used. These three companies are crucial for the green energy that will make sure that Lochem is considered as a sustainable front-runner. Potential subsidy can be seen as an investment of the government of the Netherlands in the sustainable and fuel independent future of the country. Car companies are also interested to be a partner of the EV delivery concept. They are working on EVs and they like initiatives that want to make people use and get familiar with the EVs they produce. Because there will be used a building on the industrial area of Lochem where the headquarter is located, the relationship with landlord needs to be good. The competition around Lochem in the market of car rental is a company called Vega Auto Verhuur. They offer a variety of cars and trucks to their clients but they do not offer car delivery. The proposed value of simple and fast car reservation/delivery can add the required amount of uniqueness and attractiveness to stay ahead of the competition.

COST STRUCTURE
The last block, the cost structure, contains the most important costs that play a role in the concept. The biggest and most important costs are the costs that are connected to the leasing of EVs. The headquarter with additional parking spots for the leased EVs is needed automatically. Wages have to be paid to both permanent and flexible employees. Next to EVs also foldable scooters are needed to make sure that the deliverers can drive back to the headquarter in order to do the next delivery. The maintenance like the cleaning or the repair of EVs costs money, because it has to be done by car cleaning companies and car garages. The use of EVs also implicates that EVs need to be recharged, so there has to be paid for the charging stations and the green energy that is used. Finally there has to be paid for marketing events in order to increase the publicity of the EV delivery service to reach potential new customers. This marketing would include special events, print media and digital publishing.

For detailed information about the financial plan, go to page 48.

STAKEHOLDERS	KEY ACTIVITIES	VALUE PROPOSITIONS	CUSTOMER RELATIONSHIP	CUSTOMER SEGMENT
LochemEnergie	Deliver Cars	Affordable EVs	Website FAQ	Lochemers
Allego/Alliander	Maintain Cars	Variety of Cars	Friendly Staff	From 18-65 +
Eneco	Management	Sustainability	Printmedia	Driving Licence
Government		Simple and fast Reservation		
Car Leasing Companys	KEY RESOURCES		CHANNELS	
Landlord	Employees		Web - Reservation	
Vega Autoverhuur	EV - Fleet		Telephone - Orders	
	Headquarter			
	Charging Cost			

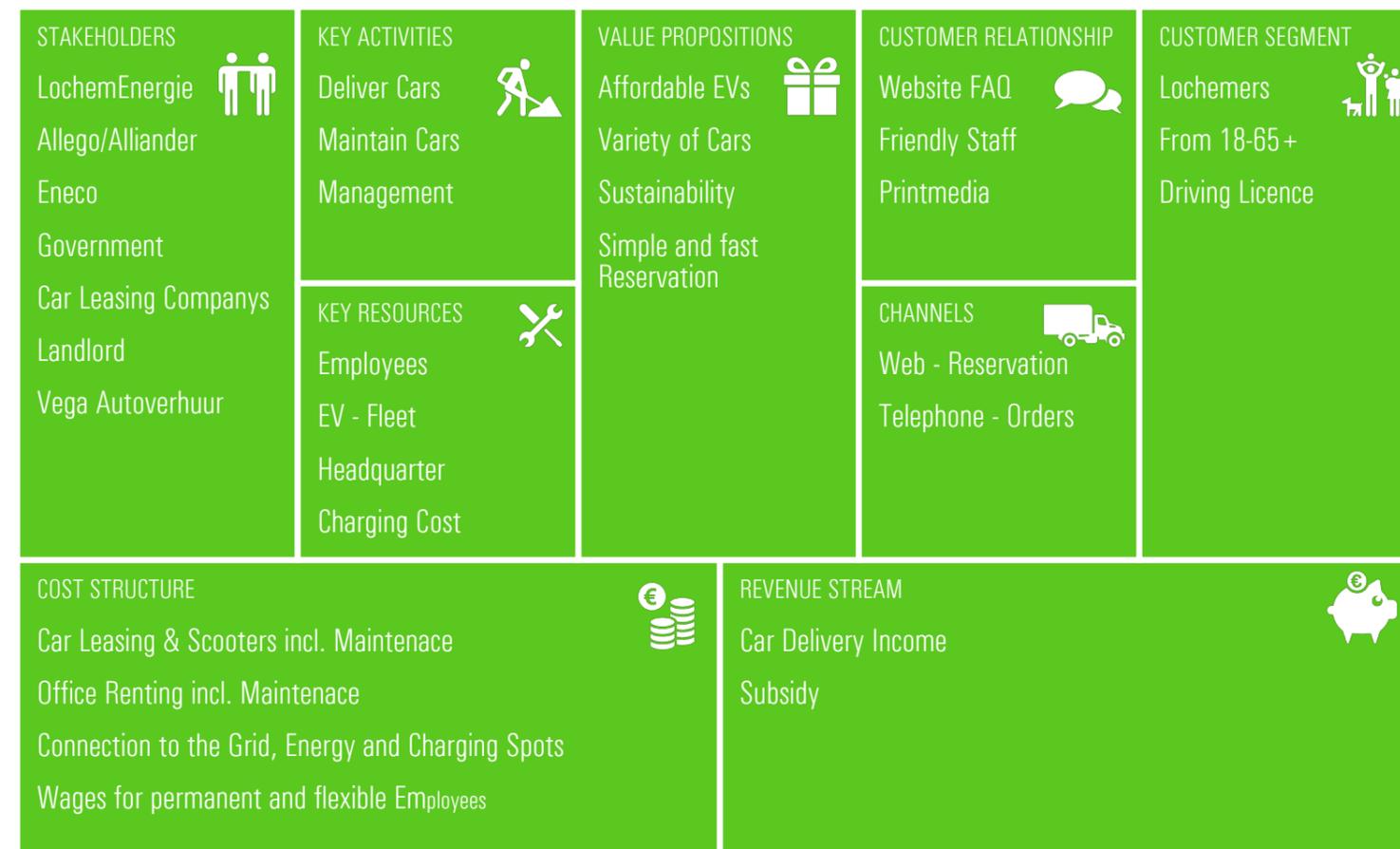| COST STRUCTURE	REVENUE STREAM
Car Leasing & Scooters incl. Maintenace	Car Delivery Income
Office Renting incl. Maintenace	Subsidy
Connection to the Grid, Energy and Charging Spots	
Wages for permanent and flexible Employees	

Figure 9 The Business Model Canvas of the EV delivery concept.

CAR CHOICE

A wide variety of electric cars can be found on the market. In order to decide which cars will be used in the delivery system, different aspects were taken into consideration. The first aspect is a list with the user's requirements that were formed out of the results of the questionnaire answered by the members of LochemEnergie.

These are the requirements:

1. The new system has to offer different cars, fitting the differing needs of the users:
2. It would be nice for around 55% of the cars to be for 2 persons and have a range of around 100 kilometres
3. It would be nice for around 24% of the cars to be for 2 persons and have a range above 100 kilometres
4. It would be nice for around 15% of the cars to be for 5 persons and have a range of around 100 kilometres
5. It would be nice for around 6% of the cars to be for 5 persons and have a range above 100 kilometres
6. It would be nice to have cars that are comfortable
7. It would be nice to have cars with a big trunk
8. The cars should use little energy

To respect these requirements, different cars were compared (Figure 10). LochemEnergie already has 7 Smart Fortwo Electric Drive that they may use for free at this moment for the period of one year. These seven Smarts fit the second requirement. Supposing that those 55% represent seven cars, the fleet would have a total size of around 12 cars. That leaves 5 cars for further decision.

Because no car except for the Tesla Roadster (101.000 euro) comes with two seats and a range above 100 km, a car with more seats, but a lower price, was searched to meet the third requirement. Also the Tesla Roadster is not available for lease in the Netherlands.

A Tesla Model S with four seats would fulfill requirement three instead. Because of its attractiveness it will have a high promotional value. Also it has the highest range of all available cars. This way it meets requirement three and can be used to convince users with high range anxiety.

The remaining four cars were chosen to be:
- One Nissan Leaf, that is already planned to be leased (according to Tonnie Tekelenburg) and two Renault Zoes. They have a better price/range ratio than the Nissan Leaf and a lower energy consumption per kilometre (Requirement 8)
- Finally one BYD e6 with a maximal range of 300 kilometres will meet requirement five.

It is not possible, to exactly represent the proposed car distribution that came out of the questionnaire in the first year. But by leasing those five different cars (requirement 1) one can be assured that all user groups can be satisfied. At an early stage users will try out different cars and will decide which car fits them best. After some time of usage, it would be the best to ask the users about their experiences with the cars. Here it would be required to ask them about what they thought about the cars, but also which kind of car they missed. It would be very helpful to track and analyse renting frequency of all cars, to make confident decisions about fleet growth/adaption. Figure 10 can be taken into account when searching for potential candidates to join the system. But presumably the market will change a lot in the next years. Thus it is recommended to update the list from time to time.

ELECTRIC CARS

BYD – E6

RENAULT – ZOE

NISSAN – LEAF

TESLA – MODEL S

SMART – FOR TWO ELECTRIC DRIVE

Brand and Car Name	Price/Range (euro/km)	Range Battery (km)	Seats	Top Speed (km/h)	Lease Price/Month from	Price €	Type Plug	Charging	Fast Charging? (DC)	Socket Charging (h:min)	Regular Charging (h:min)	Fast Charging (h:min)	Battery Capacity (kWh)	Energy per km (kWh/km)
Volkswagen E-Golf	2,11	190	5	140	400,00 €	35.000,00 €	Combo	AC 1-phase	Yes	10:26	6:32	0:23	24	0,125
Peugeot iOn	2,17	150	4	130	325,00 €	29.550,00 €	Type 1 (Yazaki)	AC 1-phase	Yes	6:57	4:21	0:15	16	0,107
Mitsubishi iMiEV	2,53	130	4	130	329,00 €	28.460,00 €	Type 1 (Yazaki)	AC 1-phase	Yes	6:57	4:21	0:15	16	0,107
Nissan Leaf	2,39	199	5	144	475,00 €	29.790,00 €	Type 1 (Yazaki)	AC 1-phase	Yes	10:26	6:32	0:23	24	0,137
Mercedes B Klasse	2,24	200	5	160	447,13 €	35.000,00 €	Type 2 (Mennekes)	AC 2-phase	No	12:10	3:49	-	28	0,156
Smart Fortwo Electric Drive	2,78	135	2	120	375,00 €	19.610,00 €	Type 2 (Mennekes)	AC 1-phase	No	7:39	4:48	-	17,6	0,121
Renault Zoe	2,38	210	5	135	500,00 €	20.690,00 €	Type 2 (Mennekes)	AC 3-phase	No	9:33	2:00	-	22	0,105
Citroen C-Zero	3,14	150	3	130	471,00 €	29.393,00 €	Type 1 (Yazaki)	AC 1-phase	Yes	6:57	4:21	0:15	16	0,123
Volkswagen E-Up	3,09	160	4	135	495,00 €	25.250,00 €	Combo	AC 1-phase	Yes	8:07	5:06	0:17	18,7	0,117
Kia Soul EV	2,64	212	5	145	559,00 €	32.995,00 €	Type 1 (Yazaki)	AC 1-phase	Yes	11:44	2:27	0:25	27	0,127
BMW i3	3,74	160	4	150	599,00 €	35.500,00 €	Type 2 (Mennekes)	AC 1-phase	Yes	9:33	6:00	0:21	22	0,152
BYD Build Your Dream E6	1,92	300	5	130	575,00 €	38.000,00 €	Type 2 (Mennekes)	AC 3-phase	No	3:49	5:49	-	64	0,160
Ford Focus Electric	3,80	160	5	135	608,00 €	39.995,00 €	Type 1 (Yazaki)	AC 1-phase	No	10:00	6:16	-	23	0,189
Tesla Model S 60	3,13	480	5	210	1.500,00 €	82.485,00 €	Type 2 (Mennekes)	AC 3-phase	Yes	12:57	7:43	1:21	85	0,175
Tesla Roadster	N.A.	390	2	212	N.A.	101.900,00 €	Type 2 (Mennekes)	AC-1-phase	No	23:02	14:27	-	53	0,142

Figure 10 Different electric cars and their characteristics

FOLDABLE SCOOTER

EV delivery would not be possible if the deliverer could not go back to the headquarter after the delivery. In order to save time and make it possible that there could be delivered at a higher rate, the idea of a foldable scooter came up. In London there is actually a working business that operates with these foldable scooters. It is called ScooterMAN and it provides a personal chauffeur that drives the client and his car home when the client is not able to drive safely due to drinking and partying. The ScooterMAN drives to the car of the client with a foldable scooter. Then the scooter is folded to a size that will fit in the trunk of the car. When the client and his car are safely brought to the target location, the ScooterMAN can drive to the next client. The elaboration of this system for the car delivery is slightly different, but the foldable scooter is crucial for the car delivery system.

After a short comparison of available foldable scooters, a foldable scooter that is called Di BLASI R70 was chosen.

This electric scooter can reach a speed of 40 km/h and has a range of 50 kilometers in case the battery is fully charged. Recharging takes 3 hours and can be done via sockets. The range is not really a problem, because the scooters will only be used to get from the location of the client to the headquarter. This will not be a big

distance because of the tactical location of the headquarter. A R70 can be bought for € 3.298 VAT exclusive. This price is a little high, but in comparison with other electric foldable scooters, the range, the possibility of charging the scooter on green energy and the maximum speed, this scooter is the best option.

The foldable scooter can be folded in 4 seconds according to the manual. After folding, the scooter has the following dimensions: 69x39x66 cm. This should be small enough to fit in any trunk of an EV. The scooter weighs 24,7 kg without battery and the battery itself weighs 11,5 kg. Seperately these masses are less heavy, so it will be better for the scooterman to do this when putting the scooter in the trunk of the car.

The folding will be easy and user friendly: First, the mirrors have to be folded down. Then the foldable scooter has to be pushed of the standard. After that a safety hook has to be unlocked. Then the saddle has to be pushed forward. Then the wheel has to be unlocked and winded down. After that, the R70 is ready to be placed in the trunk of the car (Holland-bikes, n.d.)
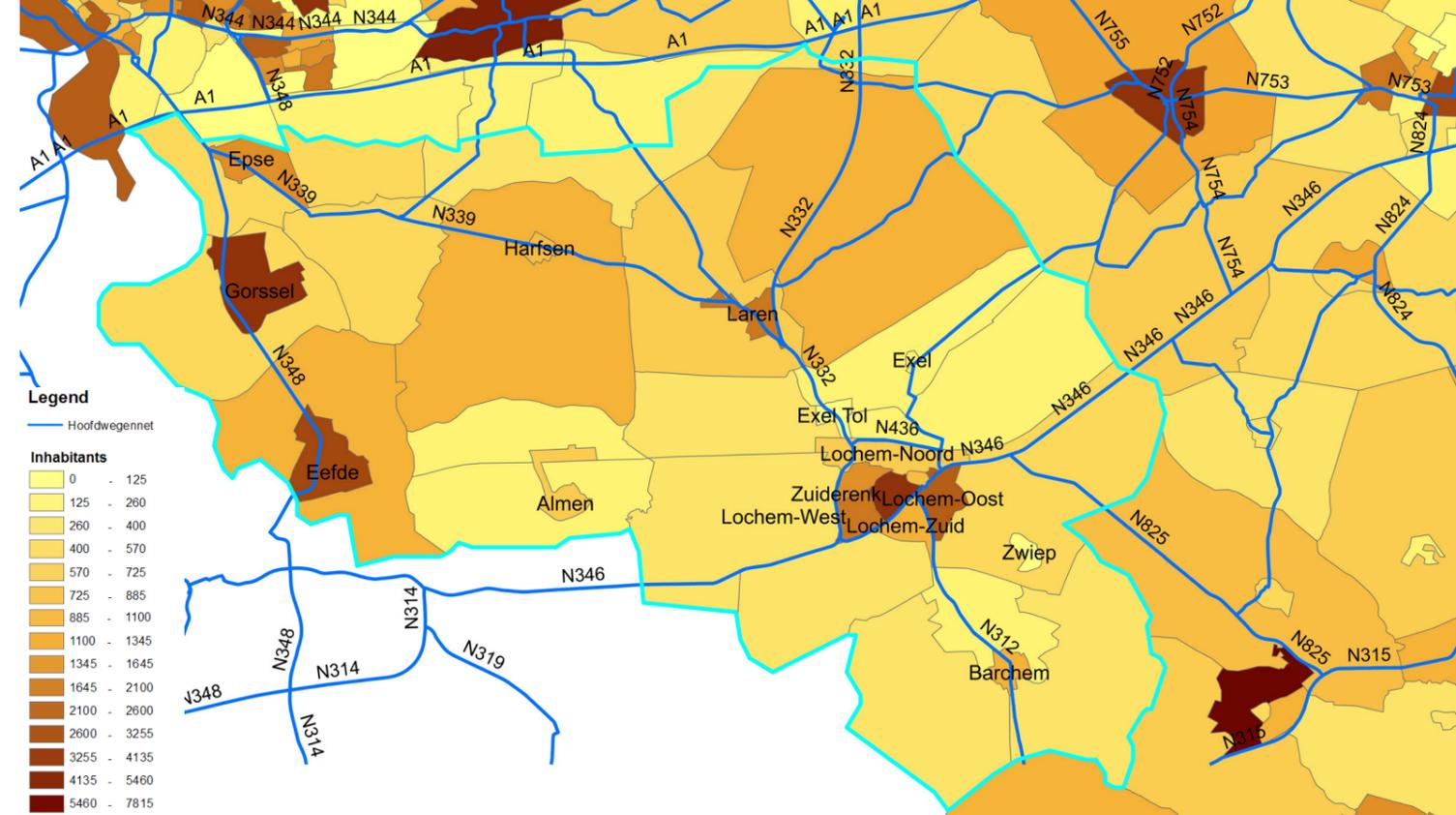

Figure 12 The Municipality of Lochem

LOCATION

The cars need to be parked and charged at a location, the headquarter. This headquarter needs to have enough space for the cars and the energy facilities should be sufficient. It is important to pick a location that it is in the middle of the municipality of Lochem, so more people can be reached within a certain time. To see how many inhabitants Lochem has, the program ArcGis was used. By using this program one can see the amount of inhabitants in every district and the main roads in this municipality. Figure 12 has been made with ArcGis.

The villages in Lochem with the highest population density, are shown in Figure 12. The most important villages are Gorssel, Eefde and Lochem, because in those villages there are more than 3000 inhabitants. Those villages are spread, which is seen by the distance of 18km from Lochem to Gorssel. A headquarter placed in

between those cities will have a maximum distance to both cities of around 9km. This distance is too big to reach, because it would take the driver too much time to deliver the car. So the best option is to place the headquarter in the city of Lochem, because the most inhabitants and most of the members of LochemEnergie live here. To increase the reachability it is important that the headquarter is close to a main road. The main roads are also shown in Figure 12. A suited location is for example Eekmolenweg 26-28. This location is close to N346 and is still located in the city of Lochem. The plot area is 712m², with a business hall of 400m² and an office of 100m². The cars can be placed inside the hall at night for protection. The manager can work in the office which can also be used for meetings. The price of this location is € 2.000 per month.

An advertisement for this location can be found on this website

Figure 11 Di Blasi, Foldable Scooter

Figure 13 Eekmolenweg 26-28, Copyright 2009 Google Maps

CHARGING WITH GREEN ENERGY

In order to recharge the EVs during the day, charging stations are needed for the parking spots at the headquarter. These charging stations will work on green energy, because LochemEnergie wants to get Lochem sustainable and carbon neutral. At the same time foldable scooters need to be recharged via sockets. In this chapter all aspects concerning the energy consumption of the EV delivery headquarter are treated. On the basis of this information all costs that are associated with the charging stations can be determined for the financial plan.

Firstly the key players that are important for the supply of green energy in Lochem are mapped. Then the possibilities for charging EVs that are currently available with the green energy from the suppliers are put in a row. Because of the fact that there are different types of charging cables, attention is paid to these types of cables. Subsequently the charging data for the different EVs the fleet will consist of will be sorted in a tabulation. Finally, when all information regarding energy is known the energy consumption can be calculated on the basis of several exemplified assumptions. By finding out every aspect that is involved in the charging of EVs, the starting values for the smart grid can be determined in the next chapter.

SUPPLY

Eneco and Alliander are key players in the realization of the smart grid that will be needed for a EV delivery company. In order to make the smart grid work, Eneco and Alliander have to work together.

Eneco is responsible for the production of green energy. The green energy is coming from solar and wind parks in the Netherlands. In the future though the green energy will only be produced in the area of Lochem. For this process Eneco invests in solar panels and wind turbines.Alliander on the other hand is responsible for the grid that will connect the delivery company to the already existing grid of Lochem. Alliander has to make sure that there is a thriving interaction in terms of the sharing of energy between the EV delivery company and other users of green energy. Alliander has a Mobility Services department that is changed to Allego since 2014. Allego provides smart charging solutions and manages charging stations for electric transport. They make it possible that green energy will be used for charging the EVs that will be used.

It also has to be noted that the suppliers Eneco and Alliander are in this specific case involved. For other locations these suppliers could be different, but Lochem which lies in Gelderland is bound to Eneco and Alliander.

CHARGING OF EVS

The charging stations are the most important part of the smart grid with respect to the recharging of empty batteries of the EVs. The charging stations recharge the vehicles and make sure that they are sufficiently charged when brought to a client.

There are several possibilities to recharge EVs compared on the basis of charging speeds. The possibilities are summed up below.

CHARGING VIA SOCKETS

Charging an EV via a socket in the wall is the slowest way of recharging a vehicle. Via the socket 3.7 kW is generated when using a 16A single-phase fuse group and when assuming a mains voltage of 230V. This way is only viable when the car has a whole night to be recharged because it can last up to 9 hours and 30 minutes to recharge, dependent on the capacity of the battery. This means that this option will not be used by an EV delivery company during day time.

SEMI-FAST CHARGING

There are different ways of doing this dependent on the fuse group that is installed. These ways of installing will lead to different charging speeds. The first difference comes to light when looking at the amount of amperes per phase: 16A and 32A. The second difference is the amount of phases: 1 or 3. A socket uses 16A x 1, but other fuse groups will be able to withstand higher loads. A 16A three-phase fuse group will charge at a rate of 11.0 kW, a 32A single-phase fuse group will charge at a rate of 7.4 kW and a 32A three-phase fuse group will charge at a rate of 22.1 kW. The more kilowatts, the faster the charging process will be. When using a 32A three-phase fuse group the charging will only take one to two hours. Then there is also an option to use power flow, which implies that the mains voltage is 400V, for a 3-phase 32A fuse group so that a rate of 38.4 kW is reached.

AC FAST CHARGING

Alternating current is the movement of electrical charge through a medium that changes direction periodically. A great example of AC fast charging is the Renault ZOE. This EV contains a flexible charging system, the Renault Chameleon charging unit, that works with any charge rate from 3 kW to 43 kW. 43 kW can be reached by using a 63A x 3 fuse group. An important aspect is that the charging is implemented entirely by on-board equipment. The ZOE can fully recharge in around 30 minutes.

DC FAST CHARGING

Direct current on the other hand is the constant movement of charge in only one direction. This method of charging requires its own charging infrastructure with a voltage of 400V in combination with a fuse group that can hold up around 125A and separate charging plugs. In order to reduce the costs of the EVs, because these chargers are expensive and large, these chargers are built in the fast charging stations. A great example of DC fast charging is the Tesla supercharger. These superchargers have a capacity of 100 kW.

CHARGING CABLES

An element of charging that is often forgotten is the fact that there are different types of charging cables for different car manufacturers. When renting out different EVs, it is important that clients have access to both types of charging cables. Charging cables can be subdivided into two groups.

The first type consists of two types of plug-ins: The plug-in with the car is called type 1 female and the plug-in with the charging station is called type 2 male. The type 1 plug-in is suitable for EVs with a connection from 16 to 32 Amps at the side of the car. On the other side, the type 2 plug-in will connect to all charging stations. Renault (Kangoo and Twizy) and Nissan produce cars that fit for this type of cable.

For the second type only type 2 plug-ins are used, both male and female. This type of cable is suitable for EVs with a connection varying between one-phase and three-phase at the side of the car. Car manufacturers that use this type of cable are Renault (Zoe), Smart, Mercedes and Tesla (S-model).

Figure 15 type 2 (female) and type 2 (male)

It has to be noted that when there are less charging stations than EVs, there still need to be as much charging cables as there are cars. The type will be determined by the car brand (De Laadkabel Shop, 2015a; De Laadkabel Shop, 2015b).

CHARGING DATA FOR THE EV FLEET

The size and composition of the fleet is important to find out the energy consumption that follows out of charging different EVs. These EVs differ in range, battery capacity and time to be fully charged. For every type of EV the different charging data are displayed.

The first year the fleet contains 6 Smart ForTwos. The radius of action of this model in optimal circumstances is 135 km. The battery capacity has an amount of 17.6 kWh. The Chinese BYD e6 in the fleet has an exceptional radius of action: 300 km. The battery capacity is 60 kWh. For the Tesla S-model the range is 370 km in combination with a battery capacity of 60 kWh. The two Renault Zoes have a range of 210 km and the battery has a capacity of 22 kWh. Lastly, the Nissan Leaf has a range of circa 160 km and the capacity of the battery is 24 kWh.

In Figure 16 on page 41 the charging times of the different EVs of the projected fleet are given for different types of charging. Not every EV can be charged at all possible rate. This is important when selecting suitable charging stations.

CHARGING TIMES (h:min)	Smart ForTwo	BYD e6	Tesla Model S	Renault ZOE	Nissan Leaf
3.7 kW	5	20	20	6	7
6.6 kW	n.a.	n.a.	n.a.	n.a.	3:30
7.4 kW	2:30	10	n.a.	3	n.a.
11 kW	1:45	7	6:30	2	n.a.
22 kW	1	3	3:15	1	n.a.
Socket	8	20	20	9:30	10
Supercharger (120 kW)	n.a.	0:40	0:45	n.a.	n.a.
AC Fastcharger (43 kW)	n.a.	n.a.	n.a.	0:30	n.a.
DC Fastcharger (50 kW)	n.a.	n.a.	n.a.	n.a.	0:30

It should be noted that the values in this paragraph only apply Figure 16 Charging time in hours for EVs for different type of charging. Numbers from Zerijden.nl (2015).

to the present state of the battery and EV sector. Because of an increasing interest of these sectors in recent years in order to improve the capacities of batteries, it is safe to assume that in the near future the battery capacities will increase and the charging times will decrease.

ENERGY CONSUMPTION

The energy consumption of the EV delivery headquarter including the charging stations will particularly be determined by the charging of EVs. It is assumed that the foldable scooters are negligible when looking at the overall energy consumption compared to the EVs. Charging is the activity that takes the most energy out of the grid. The charging can be done all day long when using wind and solar energy, but when using only a limited number of charging stations, the amount of energy that is used will be restricted. In order to determine the energy consumption in kWh, the best way is to determine the average number of kilometers the fleet will cover on an average day. Out of the capacity of the car the number of kWh/km can be found. After neglecting the private charging of clients, the number of kilowatt hours needed in a whole year can be calculated. Because it is difficult to look at a specific day the method of using an average day will make things easier. Next to an average day, it is possible to describe specific scenarios. Scenarios for a busy day can show issues in the system. In the end the energy consumption is calculated for a fleet of both 11 and 43 EVs. The distribution of the types of EVs will also be used to calculate the energy consumption of a fleet of 43 EVs.

So firstly the amount of kWh needed per year has to be deter-
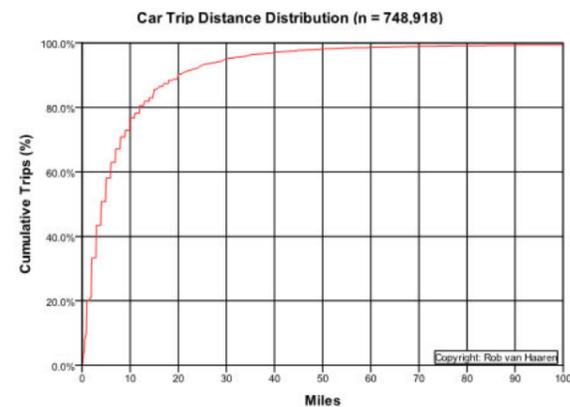

Figure 17 Car trip distribution over different mileages. Copyright 2012 by Rob van Haaren.

mined by looking at estimated values. A study of van Haaren (2012; Figure 17) who analyzed the travel data obtained from the Department of Transport's 2009 National Household Travel Survey, shows that almost 75% of all rides in the US are shorter than 10 km and that 95% of all rides are shorter than 50 km. These numbers also include rides to work, which is not the main purpose of the EV delivery system, since it will be used as a replacement for second cars. These data lead to an estimation that approximately 20 km is covered during a loan on average, because Lochem and its municipality are considered a rural area. Since a ride reciprocates, 40 km is covered during a full loan including the

drop off and pick up service. Assuming that every EV will be loaned twice a day during a period of 345 days (95% of a year) which is a reasonable estimation, the number of kilometers for the total fleet in one year can be approached. When multiplying these numbers the result is that a fleet of 11 EVs will travel 303.600 km a year. A fleet of 43 EVs will thus cover almost 1.2 million km a year (about 1.186.800 km).

The 303.600 km that the whole fleet will travel is the number of kilometers that has to be charged. One factor is not included: the possibility that users charge their EV during a loan at another place. Because of the short average distance covered during a loan it is unlikely that this will be needed a lot, but it sounds reasonable that 10% of the kilometers are charged at other locations. In conclusion, 273.240 kilometers need to be recharged for a fleet of 11 EVs. For a fleet of 43 EVs this means that about 1.068.120 km has to be recharged yearly.

Now the number of kilometers that need to be recharged is known, the average number of kWh per kilometer for the fleet is needed, in order to determine the energy that will be needed from the power grid to recharge the EVs. A way of calculating the number of kilowatt hours needed is by dividing the sum of the capacities of the batteries in the fleet by the sum of the radius of action of the EVs in the fleet. If the fleet consist of 11 EV models (6 Smart Fortwos, 1 Tesla S, 1 BYD e6, 2 Renault Zoes and 1 Nissan Leaf), the average battery capacity is 26,7 kWh and the average radius of action is 187,3 km. This results in an average consumption of 0,143 kWh/km. When multiplying the kWh/km by the approximated number of kilometers the fleet will cover, the consumption of energy in kWh needed per year can be calculated. In this case it turns out to be around 43.270 kWh. When repeating these steps for the projected fleet after 5 years (20 Smart Fortwos, 9 BYD e6s, 8 Renault Zoes, 4 Nissan Leafs and 2 Tesla S-models), the average energy consumption turns out to be 0,152 kWh/km. This means that almost 180.150 kWh of green energy will needed in the fifth year for the charging of the EVs.

Although the method of calculation is very schematical, the energy consumption could be used in order to predict energy costs for a financial plan. It is not the true price, but an indication of what the numbers could be in reality. It also should be noted that the energy consumption of the foldable scooters is not accounted in the calculation, because of the small amount of energy these scooters need compared to EVs.

SMART GRID

The term "smart grid" is a collective noun for all technologies that manage the power grid in an efficient way. The smart grid contains measuring and control systems that regulate the usage of energy. In this way the supply and demand of the energy can be adjusted to one another. For the design of a smart grid, especially peaks in the energy consumption are important parameters.

The goal of the design of a smart grid is to satisfy the needs when looking at the efficiency of the (green) energy usage. These needs are: Saving costs by staying under the maximum capacity of the grid connection, using green energy efficiently, saving energy for peak hours and minimising the amount of charging stations, which indirectly saves costs. First the green energy network that ensures that the charging stations will use green energy will be roughly explained. Then the requirements for what the smart grid should be able to do, will be explained. After sorting out the requirements, an elaborated concept for the desired smart grid will be explained in combination with the features the smart grid includes. Then the recommendations for the smart grid are given. In the end the costs for the construction of the whole smart grid could be estimated in order to be implemented in a financial plan.

GREEN ENERGY NETWORK

For LochemEnergie, it is important that the EVs and foldable scooters that are used for the EV delivery are driving on energy that is coming from renewable energy resources as solar and wind energy. The goal is to gain energy in the municipality in order to increase the efficiency and to decrease the energy losses. The green energy network of Lochem already contains several solar parks, for example on the town hall, and several households that have solar panels on their roofs. It will also be possible to place solar panels on the roof of the headquarter where the EVs are stored. Because of the fact that the distance between solar panels and the charging stations will be negligible, the losses will be incredibly low. In the future wind parks will also be a possibility. These solar- and wind parks are the responsibility of Eneco.

They have to prove that the energy that they sell is green energy, so that means that also other green energy that is produced elsewhere in the Netherlands is used in case the solar parks in Lochem can not provide enough energy during a busy charging period.

As can be seen in Figure 18, Alliander manages the power grid that uses energy that is produced by solar- and wind parks that are provided by Eneco. Eneco also provides energy via coal plants. This energy is not wanted in this situation. This is the reason why Alliander is important for the construction of the connection between the power grid and the charging stations at the headquarter.

The rates for the construction of a connection for large-scale consumers are sorted on the amount of kVA (Voltampère) the connection will be able to withstand. The amount of kVA is dependent on the size of the fleet. For the first year only 11 EVs are used. When the fleet increases according to plan, the fleet has to consist of at least 43 EVs after 5 years. This means that the connection should be able to resist much more load on the grid than is projected for 11 EVs. So it is smart to install a connection that is already capable of carrying the load that will occur in the future when assuming an increase in the size of the fleet.

For large-scale consumers the smallest connections are able to withstand an energy usage that ranges from 3x80A (55.2 kW) to 100 kVA (80 kW). When the connection should resist the load of a fleet of 43 EVs and even more, a connection of which its size ranges from 160 kVA (128 kW) to 630 kVA (504 kW) will definitely be needed. If this connection turns out to be too small, an even bigger connection could be constructed. Because of the fact that the costs rise dramatically when a bigger cable is connected to the power grid, it is smart to install a connection that is as cheap as possible (Liander, 2015).
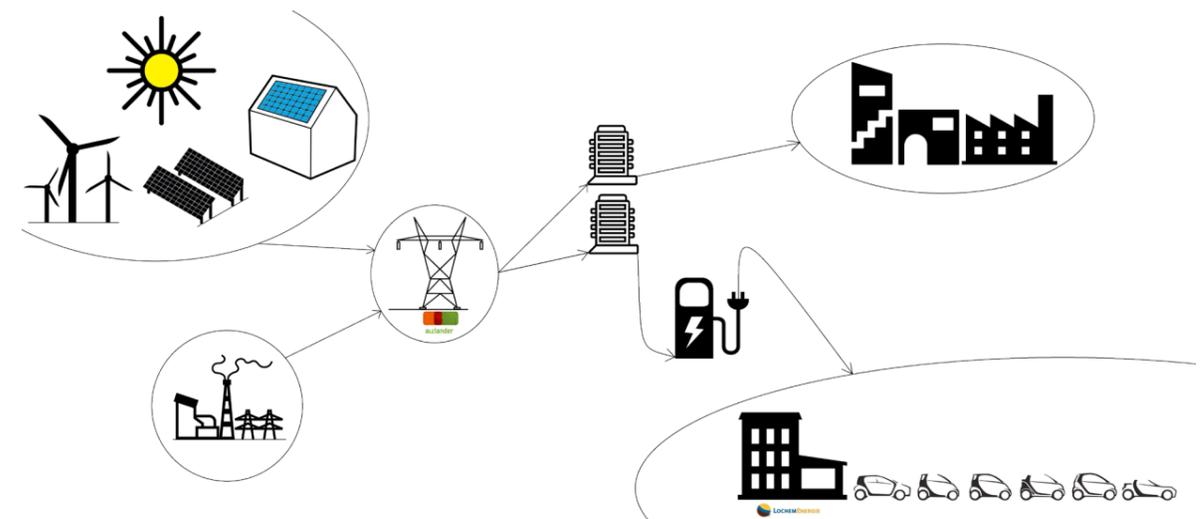

Figure 18 A simplified overview of the energy network.

ADVANTAGES OF THE SYSTEM

The EV delivery system has several advantages with regard to the smart charging grid on the parking lot. The most important advantages are:

- The high predictability because of the reservation system results in a controllable energy consumption of the charging grid. Usage peaks can be shaved off by a smart energy distribution.
- The EVs are stationed on a central location which even strengthens the controllability, because the energy use can be controlled at a single place.
- One big connection will be needed to connect the charging stations to the power grid. This will save costs on installment. It also results in large-scale consumption, which cuts the costs on energy in half.

REQUIREMENTS

The smart grid that will be used to charge the fleet of EVs of the delivery service has to fit several needs. The smart grid should be a big part of the green energy network for Lochem in the future, especially when the expected growth is reached. This also means that the smart grid should be designed in a way that it could run on energy produced by the municipality of Lochem alone. The requirements have to profit from the advantages named in the previous paragraph. In this paragraph all requirements that should be gratified will be summed up.

1. The energy supply should be fitted to the needs of the fleet. This means that cars that need to be charged sufficiently in a short period of time will get a higher priority than EVs that have enough time to be charged. This priority should cause a higher charging speed for the EVs in need of energy.
2. Charging should be possible on variable charging speeds. This follows out of the former requirement. This means that one charging station could be able to charge at a rate of 43 kW when needed, but also should be able to charge at a rate of 3.7 or even 0 kW when other cars have priority.
3. The batteries of the fleet should also be used as a way of storing energy when a lot of solar energy is generated but not used. In fact this means that the batteries of the EVs that are connected to charging stations should be charging at the maximum rate possible in order to save this green energy from not being used.
4. The stored energy in the batteries should be fed back to the grid in case of peaks in combination with limited energy production. After feeding back to the grid, the batteries of the EVs are exhausted, which implies that EVs that are needed after the peaks should not be exhausted too much.
5. The energy usage should always stay under the maximum capacity of the connection. The connection to the power grid always has a certain maximum capacity in kW, it is very important to stay under that capacity, because the energy that is used during overcapacity is very expensive. Not only the financial aspect is important, also the safety is at stake

during overuse, because a fire could be caused. In case this happens, the damage has to be repaired, which requires a costly reparation.

6. It is better to have a smart coordination center, that keeps track of all charging units instead of loose charging stations that are not coordinated by a central unit. This is for the simple reason that charging stations could easily adjust to each other. This will result in a more efficient usage of the energy that is produced in the municipality, so that the energy is only given to the smart grid of the parking location when needed.
7. A connection should be built that makes sure that charging units can easily be added in case of growth. For the first fleet of 11 EVs only several charging units should be sufficient, but when there are almost 43 EVs in 2020, the number of charging stations should be much larger. On the other hand, directly placing enough charging stations for a fleet of 43 EVs makes no sense. It also makes no sense when there need to be more charging stations on the parking lot and it is not possible to add some charging stations. This shows that there should already be a connection large enough to charge much more EVs than than there are needed in the beginning.
8. The smart grid should not overload the local grid. This will be relevant when the fleet is much bigger than at the start of the system. In the future the energy produced in Lochem will be limited. This means that the smart charging grid could attract too much of the available energy in Lochem. Overload on the grid of Lochem could result in a power cut. So in the future the charging stations should only use a certain percentage of the available energy at that specific time.

POSSIBLE CHARGING GRID: CHARGING PLAZA BY ALLEGO

Currently there is only one concept that responds to most of the requirements. It is called ChargingPlaza and it is a smart charging grid concept by Allego, the producer of the grid. The ChargingPlaza ensures that the charging of a fleet of EVs could be adjusted to the needs of the users, so that as little as possible energy should be used for charging the entire fleet. It is easy to expand the charging grid, because all smart technology and software is in a central place elsewhere in the grid, so that the charging stations are not complicated anymore. The central place that contains the technology and software is the distribution box that is able to withstand a load of 100 kW. The software allows a supervisor of the grid to give certain EVs priority on charging, which can be done easier because of the predictability that comes with the reservation system. The deadline for the EV to be charged to a certain percentage can be set by using the requested times and distances that are given by the user during the reservation. When looking at the bigger picture, even the maximum capacity of the system can be regulated.

The example of how the ChargingPlaza works can be found in Arnhem, Gelderland, on the industrial area Kleefse Waard. On this location, the headquarter of Allego is located. The ChargingPlaza is placed on the parking spot of the headquarter. This system contains 22 charging stations that can deliver different charging

speeds. This ChargingPlaza shows the possibilities of a smart charging grid. It would be great if the parking lot of the EV delivery headquarter could make use of a similar charging system. It has to be noted that a lot of parties are trying to design a similar system, but ChargingPlaza is currently the only system that is commercially available (Allego, 2015b)

So as a conclusion, the ChargingPlaza currently satisfies the following requirements: 1, 2, 5, 6, 7 and 8. The third and fourth requirement cannot be met currently by the ChargingPlaza as far as it is known. Alliander is already experimenting with charging stations that can feed back energy to the grid, but it is not available for the ChargingPlaza yet. When these charging stations are available, the ChargingPlaza will be able to make use of all advantages that come with the delivery system and thus satisfy all requirements that have been made.

ROADMAP FOR IMPLEMENTATION

Looking at the situation in Lochem, several recommendations can be made on how to implement a smart charging grid for LochemEnergie.

In the first year, the fleet consists of 11 EVs. This is a number that can be easily overseen. It is not necessary to directly use ChargingPlaza, placing 3 or 4 charging stations that can charge at variable charging speeds on a maximum capacity of around 80 kW (100 kVA) will do for the first year, so that money can be saved during the pilot. This pilot could last one year, and maybe even the second year, dependent on developments with charging stations that can feed energy back to the grid. This means that research has to be done on the usage in combination with the behaviour of users. Practical knowledge has to be taken from the experiences in the first year, in order to be able to optimize a smart charging grid.

As told earlier, in the second or third year, dependent on the developments of charging stations that can feed energy back to the grid, the amount of charging stations should be expanded according to a ratio between the number of EVs and charging stations. This number is dependent on the experiences with a 11:4 ratio (11 cars, 4 chargers) in the first year, as this first ratio will be evaluated.

After ChargingPlaza is ready to implement charging stations that can feed energy back to the grid, it is time to start building the ChargingPlaza in the parking lot of the headquarter. The usage information of the first two years can be used in order to optimize the working of the ChargingPlaza.

When looking on a bigger timescale, there will be a time that Lochem is completely independent and providing itself with green energy generated by solar- and wind parks in the area of Lochem. The amount of green energy will be restricted, which means that Lochem has to be careful with the green energy that it produces. Then the backfeeding will come out very handy during peaks, which makes the whole grid of Lochem even smarter than it already is. During a period of one year or so, the energy peaks can be identified, so that the charging grid can be adjusted to these peaks.

COMPONENTS OF SMART CHARGING GRID

Now that every important element of the smart charging grid is known the concluding list can be made of all components that require an investment.

- Green Energy of Eneco.
- Connection to the grid by Alliander.
- 8 Basic Charging Stations with Charging Cables (for the first and second year).
- ChargingPlaza that feeds energy back to the grid (when this is possible).
- Several Sockets (for the foldable scooters).

In the next chapter a rough estimation of the costs of the implementation of these elements will be made. The costs then could be used for the financial plan, in order to determine prices for charging packages.

COSTS OF THE SMART CHARGING GRID

In order to make the financial plan defined, the costs and investments needed for installing and using the smart charging grid needs to be included. It is already known that the green energy that will be used for charging has to be bought from Eneco. In order to be able to receive the green energy, a grid connection has to be installed by Alliander. The eight charging stations that are needed in the first years also require a certain investment. These charging stations have to be able to charge at different rates, but it is required that these stations can reach 43 kW. For the foldable scooters several sockets need to be installed inside of the headquarter, these costs for the chargers and the energy will not be high and could be considered negligible for the costs of the smart charging grid. After several years the ChargingPlaza will be implemented. The ChargingPlaza can be seen as an extension of the smart charging grid that will be used as a workaround for the first couple of years.

So now that all factors are known, for each of these factors an estimation for the costs could be made in order to get a picture of it for the financial plan.

GREEN ENRGY

In the chapter about green energy an estimation of the energy consumption has been made. It was concluded that in the first year around 43.270 kWh would be needed to keep the batteries of the EVs charged. Because of the great amount of energy needed, the parking lot will be considered as a large-scale consumer, which is beneficial, because the price will be cut in half. Normally the price is 0,22 euros/kWh, but for green energy on a large-scale the price will be around 0,11 euros/kWh. So in the first year the costs will be almost € 4.800 for the green energy.

The energy usage for the second, third and fourth year are not calculated, but using the same method that is used for the first year the result is that the following values apply for the different years:

- In the second year almost 74.140 kWh is needed,
  which results in € 8.160 of costs.
- In the third year almost 109.110 kWh is needed,
  which results in € 12.000 of costs.
- In the fourth year almost 139.110kWh is needed,
  which results in € 15.300 of costs.

In the fifth year it was projected that almost 180.150 kWh will be needed to keep the EVs charged. The costs attached to this amount of green is around € 19.820 , assuming the prices stay the same per kWh.

GRID CONNECTION

As seen on the website of Liander (2015), the grid administrator in Gelderland, there are several possibilities when looking at the capacity of the connection:

- A connection that could carry a load of 80 kW (100 kVA).
  This one will cost € 4.428 exclusive VAT.
- A connection that could carry a load of 128 kW (160 kVA).
  This will cost € 4.964 exclusive VAT.
- A connection that could carry a load of 504 kW (630 kVA).
  This will cost € 18.874 exclusive VAT.
- A connection that could carry a load of 800 kW (1 MVA).
  This will cost € 25.934 exclusive VAT.

Bigger connections than these will not be needed. Next to that, bigger connection will lead to dramatic increases in the costs. It is smart to directly invest in a connection that can support a charging grid that is needed for 43 EVs. This will save installment costs when every increase of the fleet also needs installment. The price per kW of capacity is lower for the biggest connection. This means that in the first year an investment of almost € 26.000 needs to be made.

CHARGING STATIONS

In the first year 4 charging stations that can charge at different speeds will only be needed. In the second year another 4 charging stations will be installed.

Because of the big connection, fast charging in not a problem on the capacity of the grid. So this means that 4 fast chargers will be more than enough for the first year. Because of the high costs of fast chargers it would be smart to only buy one DC fast charger of 43 kW, one AC fast charger and 2 chargers that have a capacity of 22 kW. The DC fast charger will cost around € 10.000 , the AC fast charger for the Renault ZOE will cost around € 2.000 (no transformation in charging station) and the fast charger will cost around € 800 . It is assumed that the installation of the charger will cost € 500 per installation on average.

When counting the investments needed for the first and second year, the yearly costs will be around € 15.600 for the charging stations.

CHARGINGPLAZA

After the first two years it is expected that the charging units of the ChargingPlaza will be able to feed energy back to the grid. The connection is already available for the ChargingPlaza. And the charging stations that are already on the parking lot are still usable. This means that the ChargingPlaza will be a little bit smaller in the beginning, but it could be expanded easily when the fleet will grow. Next to the charging units, the software and hardware that are needed to divide energy use in a smart way requires investments. Also the construction of the network requires an investment in some way.

The prizes for the required soft- and hardware are not clear at this moment. It could be very costly now, but in two years those technologies should be less expensive. In order to be safe, it is estimated that these technologies will have a total value of € 15.000 . In the third year the fleet will consist of 28 EVs. Then there are already 8 charging stations, so the basic ChargingPlaza should consist of around 15 charging units. It is assumed that in 2017 a charging unit will cost about € 1.000 when meeting all requirements. The installation for the whole ChargingPlaza will include the installation for both the charging network and the charging stations. The installation as a whole is expected to cost circa € 10.000 . The installation of the charging stations to the network will cost around € 300 per station and the remaining € 5.500 will be used for building the network itself.

Thus the ChargingPlaza has a projected total cost of € 40.000.

FINANCIAL PLAN

To see if the EV delivery system is profitable a financial plan for five years has been made. The costs and revenues of the fifth year are the standard costs and the revenues for the years after the fifth year. In the first four years some investments have to be made. LochemEnergie already made a financial plan for their car sharing concepts, from which some data are used.

AMOUNT OF CARS

In order to determine the amount of cars the delivery service will have, LochemEnergie's businessplan is used. Their goal was to have 50 cars after the fourth year, but because the cars in the delivery concept will have an higher use ratio, less cars are needed. The amount of cars is shown in Figure 19. This amount is estimated with respect to the amount LochemEnergie wants to have and the amount they used in their business plan.

GENERAL COSTS

As seen in Figure 20, for the headquarter of the company a place has to be rented. The rent will be around €2.000 per month (page 39), so €24.000 per year. The costs for the building development are the same costs as LochemEnergie used, those are the costs that are made by changing the building to a good place to rent and maintain cars. The costs of the material needed for promotion and other initial costs are the same amounts as LochemEnergie used in their business plan. The prices of the charging plaza, and the construction between power grid and chargers are described in the chapter Costs of the Smart Charging Grid on page 45.

OTHER INVESTMENT COSTS

There will be costs when you start the company which are not related to the headquarter. The costs for the chosen scooter is €3000 (page 38). The first year two scooters will be bought, the next year another two scooters will be bought. Four scooters are sufficient. The electricity costs to charge a car for a full year is approximately €500, this is described on page 42.
The software costs in Lochem's business plan for the first four years €48.000. This amount is lower in this business plan, because there is no system needed for the keys and no gps system to track the cars. Only a website and an application are needed. The other costs are the small costs, for example the coffee that the employees drink.

LEASE COSTS

The monthly costs of leasing a car are obtained by visiting leasing websites. The costs per year are calculated by multiplying the amount of cars by the costs of leasing the car for a year (Figure 22). Not every lease company will lease their cars to LochemEnergie, because they will rent the cars out to their members. The cars will be used more than when only one person uses them, but there are also companies that lease the cars to companies that rent them out, for example Athlon.

FLEET SIZE	Amount year 1	Amount year 2	Amount year 3	Amount year 4	Amount year 5
Smart fortwo	6	10	14	18	20
Renault ZOE	2	4	6	7	8
Tesla	1	1	1	1	2
Nissan Leaf	1	2	3	4	4
BYD	1	2	4	6	9
Total:	11	19	28	36	43

Figure 19 Size of the fleet per year

GENERAL COSTS	Year 1	Year 2	Year 3	Year 4	Year 5
Rental costs building and surrounding area (for charging)	€24.000,00	€24.000,00	€24.000,00	€24.000,00	€24.000,00
Charging plaza with fast chargers	€15.600,00	€15.600,00	€40.000,00	€0,00	€0,00
Building development	€3.750,00	€3.750,00	€3.750,00	€3.750,00	€0,00
Other initial costs	€2.500,00	€2.500,00	€2.500,00	€2.500,00	€0,00
Promotion	€9.000,00	€9.000,00	€9.000,00	€9.000,00	€0,00
Construction between power grid and chargers	€26.000,00	€0,00	€0,00	€0,00	€0,00
Total costs	€80.850,00	€54.850,00	€79.250,00	€39.250,00	€24.000,00

Figure 20 General Costs

OTHER INVESTMENT COSTS	Year 1	Year 2	Year 3	Year 4	Year 5
Scooter costs (€ 3000 per scooter)	€6.000,00	€6.000,00	€0,00	€0,00	€0,00
Electricity costs	€4.800,00	€8.160,00	€12.000,00	€15.300,00	€19.820,00
Software costs(site, application)	€50.000,00	€5.000,00	€5.000,00	€5.000,00	€5.000,00
Other costs	€3.000,00	€3.000,00	€3.000,00	€3.000,00	€3.000,00
Total other investment cost	€63.800,00	€22.160,00	€20.000,00	€23.300,00	€27.820,00

Figure 21 Other Investment Costs

LEASE COSTS	Monthly costs	Year 1	Year 2	Year 3	Year 4	Year 5
Smart fortwo	€375,00	€27.000,00	€45.000,00	€63.000,00	€81.000,00	€90.000,00
Renault ZOE	€500,00	€12.000,00	€24.000,00	€36.000,00	€42.000,00	€48.000,00
Tesla	€1.500,00	€18.000,00	€18.000,00	€18.000,00	€18.000,00	€36.000,00
Nissan Leaf	€475,00	€5.700,00	€11.400,00	€17.100,00	€22.800,00	€22.800,00
BYD	€575,00	€6.900,00	€13.800,00	€27.600,00	€41.400,00	€62.100,00
Total lease costs	€3.425,00	€69.600,00	€112.200,00	€161.700,00	€205.200,00	€258.900,00

Figure 22 Lease Costs

STAFF COSTS

The costs for the management staff (Figure 23) are the same as the ones LochemEnergie used in their business plan, because the work that the manager has to do will not change. The costs are calculated by multiplying the full time equivalent a manager is working by the yearly salary of him.

The yearly salary of the operational staff is the same as the one LochemEnergie used, but the full time equivalent changed from 1.1 to 1.0 because the operational staff can work more efficiently, because the cars are placed in one spot.

The yearly salary of a student is estimated at €22,000. The full time equivalent of the students changes every year, because there will be more cars and they will need to deliver more cars.

REVENUES

USE OF CARS

The use and the prices that will be charged for renting the cars are estimated (Figure 24). The price to rent a car for a full day is approximately 5 times the price to rent the car for an hour. The prices are estimated by checking the prices of the concurring car sharing companies and by the prices that LochemEnergie uses. In the financial plan of LochemEnergie they have a revenue of €14.000 per Smart fortwo. Our prices are a bit lower, so it is a little cheaper for the customer. The cars will be used for 8 days and 110 hours a month. So the days that the car isn't rented for a full day the car will be used for approximately 5 hours. Only the use of the Tesla is calculated differently. It can be expected that, because of its high reach, it will mostly be used for business trips and will then be rented for a full day.

LEASE REVENUES

The revenues of leasing the car are calculated by the time they are used, the prices of using the car and the amount of vehicles. The outcomes can be found in Figure 25.

SUBSIDY

LochemEnergie will get a subsidy from the government of 40% of the staff costs. This is good for the delivery concept, because the staff costs are a little higher than the staff costs in the old plan, because the cars need to be delivered. The total subsidy revenues per year are given in Figure 26.

INCOME

The income of the company is equal to the revenues minus the costs (Figure 27). In the first two years of the EV delivery service, a deficit has to be expected. This is because of the investments in the first four years. In the third and fourth year is is likely that profit will be made. The profit increases, because there are more cars used so the revenue increases. The fifth year the profit is the highest, because you have no investments and there are many cars in use. The more cars the higher the profit will become. The fifth year is a good example of how it will stay when LochemEnergie will use 43 cars, because there are no investment costs that year. The break-even point is reached after approximately 4 years. So after 4 years LochemEnergie will start making overall profit.

STAFF COSTS	Year 1	Year 2	Year 3	Year 4	Year 5
Management salary €89,000.00					
Full time equivalent	0.6	0.4	0.4	0.4	0.4
Yearly salary	€53,400.00	€35,600.00	€35,600.00	€35,600.00	€35,600.00
Operational fulltime salary €60,000.00					
Full time equivalent	1	1	1	1	1
Yearly salary	€60,000.00	€60,000.00	€60,000.00	€60,000.00	€60,000.00
Deliverer salary (student) €22,000.00					
Full time equivalent	0.6	1	1.4	1.8	2
Yearly salary	€13,200.00	€22,000.00	€30,800.00	€39,600.00	€44,000.00
Total staff costs	€126,600.00	€117,600.00	€126,400.00	€135,200.00	€139,600.00

Figure 23 Staff Costs

USE OF THE CARS	Price per day	Price per hour	Days rented per month	Hours rented per month	Revenue per car per month	Revenue per car per year
Smart fortwo	€30,00	€6,00	8	110	€900,00	€10.800,00
Renault ZOE	€35,00	€7,00	8	110	€1.050,00	€12.600,00
Tesla	€75,00	€15,00	12	80	€2.100,00	€25.200,00
Nissan Leaf	€35,00	€7,00	8	110	€1.050,00	€12.600,00
BYD	€45,00	€9,00	8	110	€1.350,00	€16.200,00

Figure 24 Use of the cars

LEASE REVENUES	Year 1	Year 2	Year 3	Year 4	Year 5
Smart fortwo	€64.800,00	€108.000,00	€151.200,00	194.400,00	€216.000,00
Renault ZOE	€25.200,00	€50.400,00	€75.600,00	€88.200,00	€100.800,00
Tesla	€25.200,00	€25.200,00	€25.200,00	€25.200,00	€50.400,00
Nissan Leaf	€12.600,00	€25.200,00	€37.800,00	€50.400,00	€50.400,00
BYD	€16.200,00	€32.400,00	€64.800,00	€97.200,00	€145.800,00
Total lease revenues	€144.000,00	€241.200,00	€354.600,00	€455.400,00	€563.400,00

Figure 25 Lease Revenues

Subsidy	Year 1	Year 2	Year 3	Year 4	Year 5
40% of salary costs	€50.640,00	€47.040,00	€50.560,00	€54.080,00	€55.840,00

Figure 26 Subsidy

TOTAL FINANCIAL PLAN	Year 1	Year 2	Year 4	Year 4	Year 5
Costs					
Total general costs	€80.850,00	€54.850,00	€79.250,00	€39.250,00	€24.000,00
Total other investments	€63.800,00	€22.160,00	€20.000,00	€23.300,00	€27.820,00
Total lease costs	€69.600,00	€112.200,00	€161.700,00	€205.200,00	€258.900,00
Total staff costs	€126.600,00	€117.600,00	€126.400,00	€135.200,00	€139.600,00
Revenues					
Total lease revenues	€144.000,00	€241.200,00	€354.600,00	€455.400,00	€563.400,00
Subsidy	€50.640,00	€47.040,00	€50.560,00	€54.080,00	€55.840,00
Income	€146.210,00	€18.570,00	€17.810,00	€106.530,00	€168.920,00

Figure 27 Total Financial Plan

Op bezoek bij vrienden?

6€ per uur

WEBSITE

In order to couple members of LochemEnergie to an EV that has to be delivered by an employee, a website will be needed, because it is a mainstream and easy reachable medium for the members. LochemEnergie already has a website that should be able to contain an EV delivery extension. So the available website is a good start to build upon. Ultimately the success of the website-extension will be determined by the marketing for the website and the product itself. The website has to be both functional and attractive and the effect of the website will be strengthened by the marketing and vice versa.

REQUIREMENTS OF THE WEBSITE
1. The website has to be accessible for mobile users.
2. The page for delivering EVs has to be an extension of the existing website.
3. The information about the available EVs and prices should be reachable for non-members of LochemEnergie.
4. In order to rent a car the member has to use his LochemEnergie account data.
5. Information about the operation of the delivery and rental system should be placed on the website.
6. The costs of the services should be given on the website.
7. An overview of the costs of the chosen services should be shown before the member accepts the costs.
8. Additional information should be given about charging stations, EVs, battery-efficient driving and orderable EVs.
9. Locations of charging stations should be shown including availability and percentage of the battery.
10. A FAQ has to be easily accessible by the members.
11. Members should be able to leave a review or reaction with suggestions for improvements.

12. Members should be able to go to the main page of LochemEnergie when they do not want to rent an EV.
13. Contact page with address and telephone numbers should be displayed.
14. There has to be a function where members can choose the duration of their rental.
15. Members should be able to only choose cars that are available for the duration of the rental.
16. Members should have the possibility to estimate the distance they are going to travel to give them useful tips on the range. (optional range check)
17. Users should receive an email with a confirmation after the order.
18. After the order, the user has to return to the main page of the EV rental.

REQUIREMENTS FOR THE WEBSITE COMING FROM THE QUESTIONNAIRE RESULTS:
1. Give information on the website about:
2. How the reservation system works.
3. How to charge a car at a charging station.
4. How to use an EV to increase the range.
5. How an EV works in general.
6. It would be nice to give the people the opportunity to take a test on the website to see if they understood everything about:
7. How the reservation system works.
8. How an EV works in general.

DESCRIPTION OF THE WEBSITE

When members of LochemEnergie want to have an EV delivered, they have to use a website in order to reserve their EV of choice. This website can be reached through www.LochemEnergie.net. The idea is to place a button on the main page of this website that will direct to a screen in which the member can login in order to reach the EV rental page. The website that has been made can be reached by clicking here.

Then they will reach the "Home" page in which several tabs are placed on a tab bar: "Home", "Reserveren", "Opladen", "Elektrisch Rijden", "FAQ" and "Contact". On this page general information about the EV rental service and the delivery of cars is placed. The page also includes all cars and there prices, a button "Reserveren" that will direct the user to a page on which a reservation of the available cars is possible and where the opinions from some users can be seen.

The reservation page can be reached through clicking on "Reserveren". Here, two possibilities are shown: the user can either reserve a car online or by calling an employee. There was chosen for this, because some of the respondents of the questionnaire had the wish to reserve a car by calling via a telephone. Also, in Lochem's population there are many older people, who might not be able to use a computer. The telephone number will of course also be shown on the printed media, so that the users do not have to get to the website first to get the telephone number.

The online reservation involves four steps: give the time a car is needed, choose the car, comparing car range and distance, and wrapping up the reservation. In the first step, a date and time, from and until which the user wants to reserve a car can be given. In the second step, the cars that are available at that time are shown and a choice has to be made through clicking on the picture of the car.

When the choice is made, a range check is offered. Here, the range that the chosen car has is given and a link to Google Maps, so that the person can search for the distance he or she wants to go with the car. After that, the person is asked to check, if he or she can travel the distance with the chosen car, or if the battery has to be charged during the trip. Here is also a link to the "Elektrisch rijden" page given, because the style of driving influences the range of the car. Below the range check, a map that shows all the available charging stations from www.oplaadpalen.nl is given, so that the person can check where to charge the car on the way when charging is needed. When the website gets developed further, it is planned to include an automatic range check. Here, the person would just have to fill in their destination and what he or she wants to do there, so that the approximated distance can be calculated. Then this will be compared automatically to the range of the chosen car and after that, charging units on the way will be shown. It was chosen to give the range check as a possibility, because there has been found out that most users of EVs have a sort of range anxiety where they are afraid, that they do not reach their destination. It is hoped, that this range anxiety can be decreased through the range check. Also, it is hoped that

the stranding of some users can be prevented, when they see on beforehand that the distance they want to cover is higher than the range of the car.

In the last step of the reservation, the entered time period of usage, the car, the price, and the address of delivery will be shown. Everything can then be checked by the user and, if needed, the address can be changed. Through clicking on "Reserveren", an automatic email will be send to the user. A real reservation can only be done, when the user is logged in as a LochemEnergie member. If this is not the case, this will be shown above the steps and in the last step again.

The next page which can be reached through clicking on "Opladen" gives information about the charging of an EV. This includes the description of how a charging station works, which types of charging stations there are, where charging stations can be found, what charging costs, how long charging takes and if charging is safe. It was chosen to put this information on the website based on the questionnaire results. The members of LochemEnergie wanted to get information about charging on a website.

The fourth page can be reached through clicking on "Elektrisch rijden" and gives tips about driving with an EV. It has information about One-Pedal-Drive, the gadgets in the car that also decrease the energy level of the battery, how speed influences the using of the battery and about cruisecontrol. It was chosen to place this information on the website, because the members of LochemEnergie told in the questionnaire, that they would like to get information about how to drive an EV battery-efficiently and the most of them wanted this information on a website.

The last two tabs, "FAQ" and "Contact", both lead to the respective tabs from the original LochemEnergie website. In the FAQs, questions and answers concerning the EV delivery system will be added. Through the possibility of contacting, the users can give their opinions and points of improvement.

APPLICATION

In order to improve the usability, an application should be introduced. The app should be a simplified version of the website. All the functions of the website with respect to the booking of the EV delivery should be left intact. With this application the people can easily reserve a car or search for information about electric vehicles or charging. An application is very handy for the users, because you can log in automatically and reserve a car very fast, because you do not need to start up your computer first. With an application the users can rent the car wherever they are. And with an application you can reach the client interactively for questions and feedback. The application can send notifications to the client at the time they reserved a car or send nice offers to the users. Because of those notifications the client will keep using the car sharing system. The requirements of the application are more or less the same as for the website. The application is not made, because it seemed more important to first make the website.

ONE DAY AT A CAR DELIVERY COMPANY

In this chapter, a general description of the activities that occur during an average day at the car delivery headquarter will be given. This will be done by following one of the employees (Henk-Jan) during all of his activities.

So at the start of the day, at 7:30, Henk-Jan arrives at the headquarter. At this moment the 11 EVs are 90 % charged. They completly charged over night but also refed some energy into the grid this morning. This had been done to reduce the risk of a grid overload and thus a black out. Because of the low temperatures and the public holidays Lochemers where able to consume more energy the last days. He will take a look at the board with reservations together with his colleague, Johan. The reservation system will make sure that only 2 EVs have to be delivered at the same time. This means that some deliveries will be 15 minutes later, so that there is enough time to go to the headquarter and deliver the next EV. The board shows the following scheme with reservations:

EV Code	Delivery 1	Return 1	Delivery 2	Return 2	etc...
Tesla	8:00 Henk-Jan	20:15 Thomas	-	-	
Fortwo 1	8:00 Johan	17:00 Thomas	18:00 Bernard	19:30 Thomas	
Fortwo 2	8:30 Henk-Jan	9:45 Henk-Jan	12:30 Henk-Jan	14:00 Bernard	
Fortwo 3	9:00 Henk-Jan	10:00 Henk-Jan	16:00 Bernard	20:00 Bernard	
Fortwo 4	9:15 Johan	12:00 Johan	18:00 Thomas	20:00 Thomas	
Fortwo 5	11:00 Johan	15:00 Bernard	-	-	
Fortwo 6	11:15 Henk-Jan	13:00 Henk-Jan	16:30 Bernard	18:30 Bernard	
Leaf	9:30 Henk-Jan	18:00 Bernard	-	-	
e6	9:00 Johan	19:00 Thomas	-	-	
ZOE 1	8:30 Johan	9:30 Johan	12:00 Henk-Jan	16:00 Bernard	
ZOE 2	8:45 Henk-Jan	10:30 Henk-Jan	15:00 Bernard	20:00 Bernard	

At 7:45 Henk-Jan will start to take the battery out of the foldable scooter. He will place the battery and the scooter in the trunk of the car. Henk-Jan will drive to the location of the person that reserved the Tesla for a whole day, 10 minutes before the deadline of the delivery. At the location of delivery he will meet Hilda. Her husband is working and she wants to meet a friend in Drenthe. Now Henk-Jan has delivered the EV to Hilda, he knows that he has to take the Tesla back at the end of the day (20:00) at Hilda's Location, which means that someone else has to take the car back at the end of the day. In this case it turns out that Thomas has to take the car back at 20:00.

After the delivery, he will take the battery and the folded scooter out of the trunk and connects them after unfolding the scooter. He will drive back to the headquarter on the foldable scooter.
Back at the headquarter he will fold the scooter again. He now has to deliver a Smart Fortwo at 8:30. He drives to the location of the next client, Maarten, who goes to Zutphen for a short meeting. He will return at 9:45. .

When he arrives at the headquarter he directly puts the folded scooter in a ZOE in order to be in time for the delivery of the EV at 8:45. He directly drives to the home of Inge, who has planned to go to the grocery store. She will be back at 10:30. Henk-Jan drives back to the headquarter and connects his scooter to the socket.

He has to deliver a Smart to Carolien at 9:00, because she wants to buy food in the local shopping mall. Therefore she will be back at 10:00. Henk-Jan directly drives back to the headquarter in order to recharge the foldable scooter for the next delivery.

At 9:30 he drives a Nissan Leaf to Nico who wants to go to a theme park in order to make use of a free day for his kids. He will be back home at 18:00.

After the delivery he drives directly to the pre-arranged location of Maarten with his foldable scooter. The reservation lasted until 9:45, so Maarten was ready. After a short conversation Henk-Jan takes the car back to the headquarter, with the scooter folded in the trunk.

After arriving at the headquarter he first connects the Smart to a fast charging station. After that he directly leaves in order to take the Smart which Carolien reserved back to the headquarter. He has to be at her home at 10:00. The standard procedure is followed and after that he returns to the headquarter. He connects this Smart to a charging station.

At 10:30 he arrives at the house where Inge lives. He takes the Renault ZOE back to the headquarter. Both charging stations are in use, but the first Smart is already charged to 100%. He disconnects the Smart and connects the ZOE to the charging station.

Now Henk-Jan has to wait until 12:00. In the meantime he can check the headquarter and the energy level of the EVs and look for tasks in the administration. When it is 11:55 he drives to Gerard with the Renault ZOE. He wants to meet with friends in the city of Apeldoorn and the ZOE will be available at around 16:00.

Henk-Jan finishes his last tasks until 13:00 and after that time his working day at the headquarter is over. He will return to his house and he will be working the next day.

RISKS

To make the project a success it is important to recognize the risks of the project on time, so that they can be minimised as far as possible beforehand. There are some risks that arise with the car delivery system. One risk is that the grid will be overloaded. This will mean that the power goes off for the whole city and the cars cannot be charged. To counteract this risk the implementation of a smart grid is needed. With the smart grid it may be possible to counteract the peaks in the needed power through the storing of energy in the cars when not all the energy is needed and using it when more energy is needed.

Another risk is that there is not the right amount of cars to fit the customers' needs. This could go into two directions: 1. More cars are needed than are available and 2. More cars are available than are needed. In the first possibility, the customers would not be satisfied because some of them may not have the possibility to book a car because they are all rented already. In the second possibility, some cars may stand around unused and with this will only cost and not bring in money. The cars need to be used as efficiently as possible. A solution to this problem is that the cars will be leased, so one can easily adjust the amount of cars. When there are not enough cars more can be leased. The exact amount of cars that is needed can be found out during a pilot of the system. Later this amount will increase, when more people start using the car sharing system.

Sick staff members are also be a risk that every business owner has to bear in mind. There will be students employed to deliver the vehicles, so when a student is sick this is no problem, because another student can deliver the cars then. But when the full time operational employee is sick a replacement would be needed. To solve this one could have some of the students trained for this situation what would not be that much work, because they already know how to use the chargers and how to maintain the cars.

There is a possibility that some users will empty their battery completely when they are driving. When this happens the ANWB needs to be called to get the vehicle off the road and to bring it back to the headquarter. Those costs would be on the user. To reduce this risk there is information on how to drive an EV efficiently on the website and also the places of chargers are given on the there. This will also reduce the users' range anxiety.

Unreliable customers are also a risk that the company will encounter. There may be users who bring back the car later than they planned. When this happens the user will have to pay for the full day, because if the cars are not brought back in time, the next user may not be able to use the car when reserved. When it happens once, because the user was caught up in a traffic jam the staff will not make a huge problem out of it.

OPPORTUNITIES

There will arise some opportunities aswell when one delivers cars at home. One opportunity is that one can easily adjust the size of the fleet. For example, one can easily lease more cars when they are needed. That is the reason why it is chosen to lease the cars. It is also easy to adjust the amount of employees, because students will be employed on an on-call contract, so that some days more and some days less of them have to work, depending on the amount of cars rented.

LochemEnergie will get a subsidy of 40 % of the staff costs. So when the staff costs are around € 140.000 in the 5th year, they will get € 56.000 back from the EFRO (Europees Fonds voor Regionale Ontwikkeling). This is to organize and accompany electric driving.

When the break-even point is reached LochemEnergie will start to make profit, but LochemEnergie is a cooperation, so they are non-profit based. With this profit they can lower the prices of renting the EVs to get more users or they can invest it into solar panels and the green transition in general. They could for example offer money to members of LochemEnergie that replace their combustion engine car with an electric car to stimulate them to participate in the green transition.

PROMOTION AND MARKETING

After the elaboration of the concept, a temporary plan concerning promotion and marketing was made. However, in this part of the "From Science to Society" module the aim was to design a prototype. It was chosen, to make only a possible guideline to use for the second part of the module "From Prototype to Society".

PROMOTION

To promote the new system, there is thought of different strategies that can be combined. An idea was to make an information market on the market place of Lochem. Here, information on the different things the people want to know more about according to the questionnaire results could be given. These things are: how the reservation system works, how to charge a car on a charging station, how to use an EV-battery more efficiently to have a higher range and how an EV works in general. The users told, that they wanted information about this given by an experienced person. This can be done at the market. Also it may be possible to give the users the possibility to test a Tesla and a foldable scooter and to practice how to plug-in a car to a charger. To remind the people of the system, it may also be possible to set up monthly events.
For the system, a website is already under construction. On this website, information is given and a reservation of a car can be done. It is also possible to develop a mobile application with the same functions so that a reservation can be done even faster.
The members of LochemEnergie have to make an account to use the car delivery system. In this account, their email address is used. These could also be used to send a monthly newsletter to the members with new developments in the delivery system. It would remind the not very active users that the system is still there. Print media advertisements with information about the system could also be sent to the members by mail. Other printed advertisements that could be used are posters that can be placed in the city or flyers that may be handed out.
It may also be possible to get the local news broadcaster to tell about the new car delivery system to raise awareness for the system. Also, a sponsorship of local sports club may be possible to raise the awareness of people who are not members of LochemEnergie. This may even stimulate them to become members.

The goal of LochemEnergie is to be a part of the green transition. They want Lochem to be as sustainable as possible and want people to replace their combustion engine cars with electric cars. To achieve this, it may be possible to give the people who do it a sort of car-scrap bonus. This could be through just giving money that was earned from the car delivery system or through buying the combustion engine cars of their members and giving them more money than they would get somewhere else.

It should be facilitated that people buy their own charging point access cards for when they want to charge the car themselves. Maybe some people know beforehand that they would not need this, because they only have to drive small distances that are in the range of one fully charged battery, but there will also be people who want to go further. On the website, when the distance the user wants to go is higher than the range of the car, the question about if the person has a charging point access card could be shown. Also, a link to where such a card can be bought could be placed underneath. It may also be possible for LochemEnergie to offer an extra service for members to buy an access card for them.

PRICING STRATEGY

The unique selling point the delivery system has is that cars are delivered at home and do not have to be picked up by the users. It could be possible to advertise with free delivery. This would mean, that the costs for the employees would have to be incorporated in the renting costs already, but the people would still think that the delivery service is free for them.

MARKETING STRATEGIES

In the analysis part, three different personas that were found by Beltman (2013) are mentioned. To get people from the different personas to use the system, different marketing actions were set up.

People from the first persona (the innovator environmentalists) are afraid that when buying an electric car they would not be able to handle the new technology. This can be used for marketing by

emphasizing that through using the system, they can easily gain knowledge on how to use the new technology without having to buy an EV first and that they can thus prepare themselves for buying their own electric car.

People from the second persona (the technology users) are very interested in technological developments that LochemEnergie intends to employ and think that they will help them achieve their goals. A marketing strategy to reach them could be to emphasize that in the future self-driving cars could be implemented into the delivery system and that a smart grid would be used on the central place where all the cars stand. Also, these people use technological devices, because those devices make their life easier and more efficient. To address this, it could be emphasized that the cars can be booked through a website and a mobile application in the system and the easiness of this.

The main reason of people from the third persona (the savers) to generate green energy and to save energy, is the monetary benefit that comes along with it. They would use a sharing system for electric vehicles, as long as it would lead to more financial benefits. It could be a strategy to emphasize that booking a car when needed is cheaper than owning a second car and that using EVs is in general cheaper than using combustion engine cars.

Out of these different strategies, different slogans could be made to advertise the new system. One could think of "Try one of our delivery EVs before purchasing your own - just to be sure", "Use our App - car delivery as easy as pizza delivery", "Moving towards the future - in a few years, a car could drive to you by itself", "You don't need your second car as often as you think - sharing a car is sharing the costs" and "Electricity is cheaper than oil - choose an EV and stay efficient". Posters with these sentences could be placed all over Lochem to draw the Lochemer's attention towards the project.

PACKAGES

There was thought of possible packages to convince people with different needs to use the system. For this, the three personas were used again. The first package for the innovator environmentalists could be focussed on environmentally-friendly aspects. Here, the cars with the least consumption could be included and it would be possible to give information on how the most energy could be saved through changing the driving style. Also, because most people from this persona do not know yet, if they would understand the new technologies, a brochure over the differences between combustion engine cars and electric cars would be a nice addition to this package.

A second package, for technology users, could include the use of the more technologically advanced cars (e.g. a Tesla). Also, a newsletter giving information on the newest developments in the car delivery system could be offered and information on how much energy is used by the cars in comparison to how much energy is produced.

A third package, for savers, might include only the cheapest cars. Also, a brochure with a comparison on how much money you save when using a shared EV instead of your own second car could be given, and how you pay the least money for electricity.

MONTHLY AND YEARLY PACKAGES

Other packages that are possible to make are packages based on the activities the users want to use the cars for. In the questionnaire, different activities were found. A part of the users wanted to use the cars to go to work or school in the morning and go back in the evening. Here, could be thought of a package that it is already arranged in the current car sharing system by LochemEnergie. These packages are for example that they may use a car once a week, either at a fixed time or more spontaneously. For people who need the car some fixed days in the week, a package could be made for this. Another package that could be used, are several fixed days in a month when the car is needed. Those packages are created to give LochemEnergie a higher security of revenues.

Prices could be determined through taking the price the person would have to pay for the days separately and give a discount. Four packages and examples are given below:

Monthly - Package 1: Fixed days in a month - pay 10% less than you would for booking the days separately.

Monthly - Package 2: Flexible days in a month - pay 15% less than you would for booking the days separately.

Yearly - Package 3: Fixed days in a year - pay 15% less than you would for booking the days separately.

Yearly - Package 4: Flexible days in a year - pay 20% less than you would for booking the days separately.

Person 1 needs a Smart every week on mondays and wednesdays in november. He choses for package 1. November has 5 mondays and 4 wednesdays, so all in all 9 days. Booking these days separately would cost person 1 € 270. With the 10% discount, he has to pay only € 243.

Person 2 needs a Tesla 6 days in december, but does not know yet when. Booking these days separately would cost person 2 € 450. With the 15% discount, he has to pay only € 382,50.

Person 3 needs a Renault Zoe every week on tuesdays for the whole year of 2016. He choses for package 3. There are 52 tuesdays in 2016. Booking all these days separately would cost person 3 € 1.820. With the 15% discount, he has to pay only € 1.547.

Person 4 needs a BYD one day every week in the year 2016, but does not know which days yet. In 2016 there are 52 weeks, resulting in 52 booking days. Booking these days separately would cost person 4 € 2.340. With the 20% discount, he has to pay only € 1.872.

CONCLUSION

In the chapter "Final Concept" the chosen concept was elaborated until all important aspects of the concept were worked out. This makes sure that every part of the concept is deliberate before it will be implemented.

The requirements that were used to choose for one of the concepts in the beginning, followed out of a lot of different sources and have been elaborated in the chapter "Concept Choice". The chosen concept fits the requirements the best. In the elaboration of the system it was then tried to meet all of them. A lot of things had to be done in order to design the concept in a way that it fits the users' needs the best. Therefore the reasoning behind the concept was enriched with a business plan, a financial plan, a location choice for the headquarter, an EV choice, a foldable scooter choice, a design of the smart charging grid that keeps the EVs

charged, risk- and opportunities analysis, a promotion plan and a prototype of a reservation website. These contributions make sure that all main aspects of the concept are covered. It can now serve as a strong foundation for further research and development and finally its implementation.

This connects the final concept to the roadmap that has been elaborated earlier. The realisation of the concept will be a big step towards CO2-neutral transport in Lochem. In fact the EV delivery system will be able to get things rolling for a green transition of the municipality of Lochem. The final concept can even be optimized to its projected final form by the implementation of self-driving cars. The EV delivery concept could then be fully automated, and would work without the help of car delivery staff.

APPENDIX A

**PROJECT MANAGEMENT AND CONTROL
SPRINT RESULTS
SPRINT CONCLUSION AND DISCUSSION**

PROJECT MANAGEMENT AND CONTROL
SPRINT #1

INTEGRATION MANAGEMENT
For the planning of all our tasks we decided as a group which tasks should be executed and how they should be ranked. Trello.com was a really handy tool to achieve this.
The tasks were mainly of such a size that they could be executed by one teammember. In some cases we formed pairs of two.
To make collaboration efficient, we made use of Google Drive. By consistently using the google docs format we were able to work in the same document at a time and directly give feedback.

SCOPE MANAGEMENT
First the scope of the project was limited to the improvement of an existing car sharing system without really considering the broader context. Due to our research we got some insight in the current situation and the intentions of LochemEnergie. We broadened our problem statement to be able to align our goals to LochemEnergie's mission of making Lochem greener, self-sustaining and being an example to other cities. This way we were able to question the current use of EVs and whether EVs should be implemented at all. This led to some "out of the box thinking" which generated attractive alternatives to the current EV sharing system.
We now hope to be able to make a choice and to focus our scope on the elaboration of one of the systems.

TIME MANAGEMENT

- Our daily time management generally looked like this:
- Daily group meeting in the morning around 9:00.
- Daily stand up.
- Define new tasks together.
- Distribute the tasks evenly among the team members.
- Work separately or in small groups.
- Share and present the results of the finished tasks.
- Give Feedback on each other's work.
- (repeat) Define new tasks together...

For the first sprint our goal was to gain a deeper understanding of the problem owner, the problem, its stakeholders and the users. We considered this an important and time consuming task. Therefore, we left the generation of first ideas open for the end of the sprint if time was left. Luckily we were able to rush through the analysis quite fast because of existing research papers on the subject. That made it possible for us to already start with the generation of ideas. Therefore we were happy about presenting a first version of a roadmap at the end of the sprint.

COST MANAGEMENT (VOUCHERS)
We didn't use any vouchers yet. Financial aspects of the concept we are developing were roughly evaluated by setting up business models of attractive alternatives. We will be able to go into further detail when it comes to a more elaborated concept.

QUALITY MANAGEMENT
Weekly meetings with our tutor Suzanne Vosslamber were planned to ensure the quality of our way of working as a group and to discuss general questions. Frequent meetings with Albert Molderink, the representative product owner, ensured the quality of our work with regard to the content and the needs of the product owner: LochemEnergie. Questions regarding the project management method SCRUM and the deliverables of the HTHT minor were answered by Guido Bruinsma to ensure the quality of our way of structuring our sprints and the report.

HR MANAGEMENT
In the beginning we shared our experiences about group work and the roles that did suit us most. By working on the OST-assignments we gained insight on how each of us wants to contribute to the project and on how we function as a team. Before the start of the first sprint we had understood each other's characteristics, skills and ambitions.

COMMUNICATION MANAGEMENT
We communicated with the following people:

- Thomas Hoppe, who has insight in regulation and financial aspects of green energy.
- Suzanne Vosslamber, our tutor who has insights in human factors and engineering.
- Albert Molderink is our representative product owner for our group. We can ask him questions about the car sharing part of LochemEnergie and he can also contact Tonnie Tekelenburg for us, who is the "real" product owner.
- Guido Bruinsma, the minor coordinator.

RISK MANAGEMENT

Opportunities:
We were able to think of our own solution to the problem without too much influence of the product owner in the beginning of the project.

Risks:
The product owner will not accept our solution.
User will not like our concept.

Response:
We want to contact Tonnie Tekelenburg for direct feedback on our concepts, although Albert Molderink was clearly in favor of our work.
We will send a questionnaire to Lochemers to be sure which concept suits them best.

SPRINT RESULTS
- Problem Statement
- Demography of Lochem
- Stakeholders goals and needs
- Beginning of the Market Analysis
- Personas by Beltman
- LochemEnergie's Requirements
- Out of the Box ideas
- Business Plan for idea 1 and 4
- The (schematic) roadmap

SPRINT CONCLUSION AND DISCUSSION
We want to continue our way of working as a group. Our main goal for the next sprint will be to reach the user and the problem owner to get valuable feedback.

SPRINT #2

INTEGRATION MANAGEMENT
We continued using trello.com for the second sprint.
Most of the tasks could be executed by one teammember. In some cases we formed pairs of two.
We also kept using Google Drive during the second sprint, which eases collaboration when working in groups.

SCOPE MANAGEMENT
In the first sprint, several out-of-the-box ideas were formed. We elaborated these ideas during the second sprint by making the description of each idea clearer. The ideas were compared on the basis of several aspects like realizability, sustainability and user-friendliness. These aspects were based on the advantages and disadvantages for Lochemers and LochemEnergie.
The roadmap that places the ideas chronologically was updated, because concept 3 could be split up in the concepts 3a and 3b.
In order to make a concept choice, we arranged a meeting with Tonnie Tekelenburg, our real product owner. The meeting will take place in Lochem in the third sprint.

TIME MANAGEMENT
For the second sprint our goal was to choose one of the out-of-the-box ideas for 2015. Because of the short time that was available during sprint 2, so this was the main goal.
We split up the main goal into several subgoals: advantages and disadvantages for LochemEnergie and Lochemers, statement of requirements based on researches of Okur and Beltman, market analysis and adding small changes to the Roadmap.
Our daily time management did not change.

COST MANAGEMENT (VOUCHERS)
We again did not use any vouchers. Financial aspects of the concept we are developing were roughly evaluated by setting up business models of attractive alternatives. We will be able to go into further detail when it comes to a more elaborated concept.

QUALITY MANAGEMENT
This did not change.

HR MANAGEMENT
Because of the fact that the second sprint mainly contained tasks that did not really require different subjects of the project, everybody was able to work on all tasks. Sometimes a group member was able to add some information from his or her area.

COMMUNICATION MANAGEMENT
- We communicated with the following people:
- Thomas Hoppe, who has insight in regulation and financial aspects of green energy.
- Suzanne Vosslamber, our tutor who has insights in human factors and engineering.
- Albert Molderink is our representative product owner for our group. We can ask him questions about the car sharing part of LochemEnergie and he can contact Tonnie Tekelenburg, who is the "real" product owner.
- Guido Bruinsma, the minor coordinator.

RISK MANAGEMENT

Opportunities:
Because of the advantages and disadvantages, we now have a good view on the important aspects in a car sharing system. This makes choices easier.

Risks:
The product owner looks different at our concept comparisons.

Response:
We want to contact Tonnie Tekelenburg (product owner) for direct feedback on our concepts, although Albert Molderink (representative product owner) was clearly in favor of our work.
We will send a questionnaire to Lochemers to be sure which concept suits them best.

SPRINT RESULTS
- First Statement of Requirements
- Conclusion of Ideation Phase
- Questionnaire for the members of LochemEnergie
- Further Market Analysis
- Concept Comparison

SPRINT CONCLUSION AND DISCUSSION
We want to continue our way of working as a group. Our main goal for the next sprint will be to reach the user and the problem owner to get valuable feedback. This was also the goal in the first sprint, but we chose to zoom-out and look from a different angle to the project, so we took a step back in order to progress two steps in the next sprint.

SPRINT #3

INTEGRATION MANAGEMENT
We continued using trello.com for the third sprint.
Most of the tasks could be executed by one teammember. In some cases we formed pairs of two.
We also kept using Google Drive during the third sprint, which eases collaboration when working in groups.

SCOPE MANAGEMENT
In the third sprint, we had a meeting with Tonnie Tekelenburg, our product owner in Lochem. His feedback was combined with other underpinnings in order to finalize the requirements.
We also sent a questionnaire to members of LochemEnergie. Also these results were used for the requirements.
The requirements made sure that we finally could choose a concept to elaborate. Out of the choice for concept 4 several things could be done.
These things include choices for the EVs, scooters and location. A conceptual financial plan was elaborated out of all costs that would be needed to make the concept working. Also a prototype of a website was made in order to show the working of the reservation system.

TIME MANAGEMENT
Our daily time management did not change.

COST MANAGEMENT (VOUCHERS)
We did not use any vouchers. We had contact with Albert and Suzanne, but we did not use vouchers for these meetings.
We made a financial plan with approximations of the costs and revenues, so the cashflows of the EV delivery. In this way it could be seen what the impact of different subsidies and investments were on the time to reach break-even.

QUALITY MANAGEMENT
This, again, did not change.

HR MANAGEMENT

Because of the fact that the third sprint mainly contained tasks that did not really required different areas of the project, everybody was able to work on all tasks. Sometimes a group member was able to add some information from his or her area. The psychology background of Jule was helpful for stating requirements to keep users satisfied.

COMMUNICATION MANAGEMENT
We communicated with the following people:
- Suzanne Vosslamber, our tutor who has insights in human factors and engineering.
- Albert Molderink our representative product owner.
- Tonnie Tekelenburg, the product owner
- Guido Bruinsma

RISK MANAGEMENT

Opportunities:
Tonnie Tekelenburg told during the meeting that he would receive subsidy in january 2016 and that he was prepared to test one of our concepts. Because we chose a concept that is different from all other car sharing concepts at the moment, we have the chance to really develop something new.

Risks:
The members of LochemEnergie are not willing to reserve EVs via the internet.
There are no verifications that the concept will work in reality.
The investment could be too high.

Response:
We send a questionnaire to the members of LochemEnergie to fit the concept to their needs.
We also tried to really lower the threshold for the customer in the prototype of the website.

SPRINT RESULTS

- Questionnaire Results
- Results from meeting with Tonnie Tekelenburg
- Concept Choice
- Website - Prototype
- Car Choice
- Scooter Choice
- Location Choice
- Financial Plan

SPRINT CONCLUSION AND DISCUSSION

We want to continue our way of working as a group. Our main goal for the next sprint is to deliver a report and a presentation about our elaborated EV delivery concept.

SPRINT #4

INTEGRATION MANAGEMENT
We continued using trello.com for the fourth sprint.
Most of the tasks could be executed by one teammember. In some cases we formed pairs of two.
We also kept using Google Drive during the fourth sprint, which eases collaboration when working in groups.

SCOPE MANAGEMENT
In the first week of the sprint we had to deliver a presentation that included information about all aspects of the concept. So the whole concept had to be ready for the presentation.
This meant that the financial and the business plan had to be ready. Also the Smart Charging chapter had to be elaborated. Also

a promotion and marketing plan had to be made, for the next minor module: Prototype2Society.

At the end of the sprint, the report has to be delivered. This means that all text had to be placed in Indesign. Also text that made sure that a logical build up of the report had to be provided.

TIME MANAGEMENT
Our daily time management did not change.

COST MANAGEMENT (VOUCHERS)
We used one voucher in order to meet Thomas Hoppe. He gave us tips about our financial plan and regulations. The financial plan has also been finalized.

QUALITY MANAGEMENT
We met Thomas Hoppe to talk about the financial plan, specifically about regulation and subsidy. He provided some valuable insights that helped with finalizing the financial plan.
For the rest we did the same as in the previous sprint.

HR MANAGEMENT
Because of the fact that the second sprint mainly contained tasks that did not really require different areas of the project, everybody was able to work on all tasks. Sometimes a group member was able to add some information from his or her area.
Working in Indesign was possible because Joachim, our industrial engineer, knew how to work with it. The smart grid text could be done by Daniel, who has a technical background because he studies mechanical engineering.

COMMUNICATION MANAGEMENT
We talked with the following people:
- Thomas Hoppe, who has insight in regulation and financial aspects of green energy.
- Suzanne Vosslamber, our tutor who has insights in human factors and engineering.
- Albert Molderink is our representative product owner
- Tonnie Tekelenburg via e-mail, to get some details straight
- Guido Bruinsma, the minor coordinator.

RISK MANAGEMENT

Opportunities:
In the presentation we could really explain our concept, so that the assessors of the report get familiar with our concept, before they have to read our report.

Risks:
The presentation could go wrong. The same counts for the report.

Response:
We kept our planning tight, so that there would be enough time in case of complication.

SPRINT RESULTS

- Green Energy and Smart Grid
- Risks and Opportunities
- Promotion and Marketing
- Evaluation of the concept
- Introduction to the report
- Brief summary of the report

SPRINT CONCLUSION AND DISCUSSION
We want to make sure that the project group that will bring the concept to society in the next module has a good basis to work on. The presentation and report have to be very clear in order to be a starting point for the continuation of the HTHT package. The presentation went really well and we are happy about our concept.

APPENDIX B

INDIVIDUAL PREFLECTIONS
INDIVIDUAL REFLECTIONS
GROUP REFLECTION

Preflection

Name: Paul van Wee
Date: 2-9-2015
Team: Group 1
Topic: Design and regulation of a sharing system for Electric Vehicles

What do you hope will be achieved by the process?

I hope that at the end of the project we will have a good product and I hope that Lochemenergie will use our idea. Normally the project is about something fictional, but now it really is for a company, so it would be great if the company will like our idea.

How strong do you think you and your team will hold onto these expectations?

I think we will make a great product, but I don't think that Lochemenergie will use it, but I think that Lochemenergie will get inspiration from our idea.

What strengths can you bring to the process?

I am very technical minded, so I think that I can see the problems that occur in the product and I think I can help researching the problems.

What concerns do you have about your skill base and the skill base of the team?

I think that I am a bit too technical minded, so I think I will have struggles to create an innovative idea, but I think the other members of the group are skilled on this subject.

What will you do to cope effectively with difficulties?

I think I can see the problems fast, so we than we can create ideas on how to improve the product and how to deal with the problems. Also we can contact the tutor when we need contact with experts.

What do you need to know to make the process more productive?

It will be handy to have contact with Lochemenergie, in order to know on what points we need to focus.

Preflection

Name: Daniel Nijhof
Date: 2-9-2015
Team: Group 1
Topic: Design and regulation of a sharing system for Electric Vehicles

What do you hope will be achieved by the process?

I hope that our team will design a sharing system in Lochem that will help LochemEnergie to optimize their current sharing system in the future.

How strong do you think you and your team will hold onto these expectations?

It is difficult to say that now, because we have to combine thinking out of the box with a realistic system. But I think that it is possible for our team to give Lochem new insights for their car sharing system of the future.

What strengths can you bring to the process?

Some skills I acquired during several projects of mechanical engineering will be useful for the group process. During one of the projects for Mechanical Engineering the subject included the environment and energy production in the future. Our topic resembles these things, so I can use the things I learnt in that project in our current project.

What concerns do you have about your skill base and the skill base of the team?

Maybe it could end up that we don't understand each other, because we all have different backgrounds. This project is very actual and is not really about one discipline, so the communication can be done easily in my opinion.

What will you do to cope effectively with difficulties?

We let people do what fits most to their discipline and after that, another one from another discipline will check the deliverables of the one who made the deliverables. In that way, everybody can add his or her look on the problem.

What do you need to know to make the process more productive?

First we need to know what our client wants us to achieve. When we know that, we can produce concepts to make the current car sharing system better than it is now. Next to that, by splitting up tasks, people will work much more effectively when they are working on their own.
Lastly making a planning for sprints keeps us going to the goal we set ourselves.

Preflection

Name: Jule Krüger
Date: 2. September 2015
Team: Team 1 – The E-Team
Topic: Design and regulation of a sharing system for electric vehicles.

What do you hope will be achieved by the process?

I hope that we find a good solution for the problem that may not only help LochemEnergie, but maybe also develop a concept that can be used by many. Further I hope that I will myself develop and learn new things about designing, finding solutions for real life challenges and about multidisciplinary working.

How strong do you think you and your team will hold onto these expectations?

I think, that my team and I are going to find a solution for the problem, but I can't say, if it will really be a groundbreaking thing or maybe just something to hold the expectations of LochemEnergie. I also think, that I will myself have the ability to develop and grow if I work in a motivated way and with my team. Because I'm always motivated to learn new things, I guess I can hold my expectations to learn new things out of this project.

What strengths can you bring to the process?

I can bring the strength that I'm always motivated to do things and enthusiastic and that I try to motivate other people. I will animate them to work, when they don't do it and so I think I can take of the organization and that we won't get stuck in endless conversations about working without really working. Another strength I can bring to the process is that I always try to view things from different angles. This way, I can see the good and the bad sides of the things. As a psychology student I always think about the people and thus the users of the system. This guarantees, that this point of view is also present in our team. In my study I have already worked on a design where the user perspective was very important, so I can let my experience with that flow into the process. Further I have some knowledge about some psychological models that can help us with the designing of such a system. I hope, that I can also bring a bit of my creativity into the process.

What concerns do you have about your skill base and the skill base of the team?

I haven't worked that often with designing something, so I couldn't develop a lot of skills. But that is why I'm here, I want to learn new things. The other team members have more training and therefore also more skills in designing things. But they maybe don't know that many things about the users. I guess, that the combination of the different skills in an interdisciplinary team is very important, so I don't have that many concerns about our skill base as long as we all work together.

What will you do to cope effectively with difficulties?

The most important thing is to talk about difficulties. For difficulties between the team members it is important to share everyone's point of view so that the people can try to empathize with the person and can try to understand their behavior that they maybe didn't understand before. Therefore I will try to always address difficulties that I feel are there and destroy the climate in our team. Also with difficulties with the task it is important to talk about them. When we come to a point, where we don't know what to do further it is important to see, what everybody thinks about the difficulty, maybe brainstorm new ideas and maybe even take a break to have a fresh start afterwards. When it is not possible to find out of the difficulties only with the team members, we still have a tutor who we can contact and ask questions and who can help us with the difficulty.

What do you need to know to make the process more productive?

I need to have more information about the technological background of the e-cars, more about the organization LochemEnergie, their plans and what they actually want us to do, and I need to know what the people of Lochem actually want the system to look like. Are they already happy with how the system is now? What would they want to have changed? Do they have some ideas for improvements of the system themselves? Further I guess I need to learn more about the methods and techniques to design something.

Preflection

Name: Joachim Batzke
Date: 2-9-2015
Team: Group 1
Topic: Design and regulation of a sharing system for Electric Vehicles

What do you hope will be achieved by the process?

> I hope that through good communication with Lochemenergie we will be able to fully understand the given problem. It is my goal to meet the given requirements by developing a realistic concept with our group. The concept should be realistic and something we can be proud of.

How strong do you think you and your team will hold onto these expectations?

> I think that our group is able to fulfil these expectations. We are a group of motivated students from different backgrounds and able to bring our personal knowledge into the process. This enables us to create a concept that works from different points of view.

What strengths can you bring to the process?

> As an industrial designer I have a broad background which overlaps with different studies such as WB and Psychology. My role could be to connect the strengths of my teammates which will ultimately lead to an effectively working group. Also visual aspects such as sketching and the layout of our report may be most suited to my skills.

What concerns do you have about your skill base and the skill base of the team?

> Right now I do not have any concerns. I think that missing skills can either be learned or 'outsourced'.

What will you do to cope effectively with difficulties?

> I think that good communication and organization is essential to cope with difficulties. There can be difficulties of many kinds. It is important to stick together and to tackle problems as a group.

What do you need to know to make the process more productive?

> The tasks should fit to the preferences and skills of each group member. It is important to stay motivated by executing tasks that are interesting and that fitting to ones level of skill. So to make the group process more productive I need to know what every team member's needs are to react accordingly. That is why I think that the daily stand up will be really useful to our way of communicating, working and staying productive.

Reflection

Name: Paul van Wee
Date: 4-11-2015
Team: Group 1
Topic: Design and regulation of a sharing system for Electric Vehicles

What did you eventually achieve by the process?

> At the end of the project we had an elaborated concept of an electric vehicle car sharing system. In this elaborated concept we made a choice of what car/scooter/location we want to use. With this information we could make a smart grid and a financial plan. At the end we made a risk and opportunities analyses. Also a website has been made to show how easy it will be to reserve a car. After that a promotion plan has been made. This promotion plan will be further elaborated in the next project.

How strong did you and your team hold onto these expectations?

> Tonnie Tekelenburg of LochemEnergie was very excited about our idea. He wanted to plan another meeting, but didn't have time for it yet, so next project a meeting with him will be planned to show our final result. I am very happy about the final product, because everything is elaborated.

What strengths did you eventually bring to the process?

> With the study civil engineering I had a module about sustainability, so I already knew a lot about sustainable materials, but mostly for houses, for example isolation and solar panels. Also I had a module about transport, this information was not needed, because we did not make a simulation model about the road in Lochem, because this takes too much time and is nearly impossible. Information about the program Arcgis was only used once, to determine a good location. Also I made a financial plan, I could make this, because I had a lot of management related subjects.

Did the concerns that you had about your skill base and the skill base of the team happen?

> Everyone of the group has followed another study, so the team was a perfect fit. There was always one member who knew something about a topic that had to be made. For example, I am not very creative, but Joachim is very creative, so I could give a technical view on the ideas and help create new ideas.

What will you do to cope effectively with difficulties?

> When the was a difficulty we first tried to cope with it ourselves. When this was impossible we contacted our tutor, Suzanne Vosslamber, or Albert Molderink. Mostly we could solve the problems ourselves, but it is always good to get feedback. We also got feedback from the other groups, after we presented.

What did you need to do in order to make the process more productive?

> It was very handy that we could always contact Suzanne Vosslamber or Albert Molderink when we had specific questions or questions about the structure of the report. Also it was great to visit LochemEnergie, to see how Tonnie Tekelenburg thinks about car sharing at what he would like us to do. We also made a questionnaire, to see the opinions of the members of LochemEnergie.

Reflection

Name: Daniel Nijhof
Date: 4-11-2015
Team: Group 1
Topic: Design and regulation of a sharing system for Electric Vehicles

What did you eventually achieve by the process?

In the end of the project we were able to design an electric car sharing system on the basis of different aspects like the concept comparison, the business plan, a smart charging grid, and a financial plan. I also learned that sometimes it is better to zoom out and start looking at totally different concepts in order to find an even better concept, instead of directly start designing without thorough thinking. I also learned to look at the needs of real potential clients in order to optimize the concept, instead of just assume some values, something technical students usually do. We also managed to keep close contact with both the real and representative (via UT) product owner, which lead us to a brighter view on the real situation in Lochem, the city that runs a pilot with two car sharing systems.

How strong did you and your team hold onto these expectations?

I think that we exceeded expectations as a group. With multidisciplinary teamwork we were able to design a concept version of a car sharing system that is really different from what it is now, but for rural areas like Lochem, there are no car sharing systems that really are fitted to the needs of the customer. I think that because we were totally different in some aspects from each other, which led to interesting discussions, we even improved our design.

What strengths did you eventually bring to the process?

The project for Mechanical Engineering about a solar plant was useful for a basic understanding of the project goals: Keeping the world working with energy out of renewable energy resources like solar- and wind energy. My technical experiences from my study made me able to design a smart grid by basic knowledge about charging EVs. From a project about the design of a robotic vacuum cleaner I also had to deal with the needs of customers, requirements to a concept and the elaboration of the chosen concept with regard to different aspects.

Did the concerns that you had about your skill base and the skill base of the team happen?

Not at all. Everybody has a different background with the associated knowledge, but it did not restrain us from working together efficiently. The interaction outside of the project was also good, which resulted in good teamwork.

What will you do to cope effectively with difficulties?

Sometimes we split up in smaller groups and sometimes we worked individually when specific knowledge was required. After that we presented the results during multiple standups so that everybody could shine his or her light on the elaboration of the task. In this way we were able to see things differently when talking about an elaboration together.

What did you need to do in order to make the process more productive?

First we took a step back and look at all other possibilities that could be elaborated. By doing this, we were able to take two steps forward, because of the zoomed out look we already had to think about all requirements and customers.
We also had a meeting with our tutor, Suzanne Vosslamber, every week so that questions could be answered quickly. Also instead of having contact with Tonnie Tekelenburg of LochemEnergie all the time, we decided to use Albert Molderink as representative product owner because he is familiar with the things LochemEnergie wants to achieve. This saved a lot of time.

Reflection

Name: Jule Krüger
Date: 5. November 2015
Team: Team 1 – The E-Team
Topic: Design and regulation of a sharing system for electric vehicles.

What has been achieved by the process? Were your hopes met?

In the preflection, I said that I hoped that we find a good solution for the problem that may not only help LochemEnergie, but maybe also develop a concept that can be used by many. With the EV delivery system, we developed a combination of things that do not exist in that combination. Through this, we found a car sharing system that is suited for rural areas and can also be used by other cities. So I think, that we reached, what I hoped for. Also in my second hope, that I will myself learn new things about designing, finding solutions for real life challenges and about multidisciplinary working, I was not disappointed. Through learning about SCRUM and working together in a multidisciplinary team, I learned a lot, also about myself and the way I work in a team that comes from different studies.

How strong did your team hold onto these expectations? Was it as you thought?

My expectations were met. We maybe did not invent something groundbreaking, but it is at least something that did not exist in that way before. I think, we satisfied the product owner LochemEnergie and in the meeting with Tonnie Tekelenburg he even said, that he would want to really try out our system. This is what I hoped for. I knew, that I would be motivated to learn new things, and because in my team, there was a very good atmosphere, everybody could develop in the way they wanted to.

What strengths did you bring to the process? Did this meet your expectations?

I guess, that I sometimes was the person who told the other team members that it might be nice to go on with working. This was exactly what I expected after I knew them only one week. I knew, that I would have to animate them sometimes. I was also one of the more active persons in the group when it came to discussing things. Sometimes, it took some time to resolve problems, because I held against the opinion of another member of the team. I think, that this came because I have a different angle on the problems, because I mainly see the side of the users. But I think, that through the discussion, it was later more easy for us to make the reasons for our choices clear, so that it was something good, although it first took some time to resolve it.

Where the concerns that you had about your skill base and the skill base of the team justified?

In the beginning, I did not think have many concerns about our skill base as long as we work together. This was proven to be true. Everybody had their special subjects in which they were kind of experts. I represented the users and their opinion. In the report, I also wrote the most things that concerned them. Another team member wrote all the financial aspects of the concepts and had his head in the matter. A third team member wrote all the texts concerning the energy use and smart grid. It was great, to split the tasks in this way, so that everybody could delve into the different topics and be an expert there. Through the combination of the different skills, a good project report could be written.

What did you do to cope effectively with difficulties?

There were no difficulties between team members and the atmosphere was very good, so no coping with this was needed. Difficulties with the tasks were coped with through talking about it, brainstorming and writing things down. Also, the experts in the fields in which the difficulties arose, were included and asked for help. This guaranteed that the problems were solved in the right manner.

What do you needed to know to make the process more productive? Did you get this knowledge?

Through an analysis in the beginning, I got the knowledge that I needed about LochemEnergie, Lochem and EVs. Through a questionnaire we sent to the members of LochemEnergie we learned more about the users' needs and wishes. This helped us a lot in designing the system.

Reflection

Name: Joachim Batzke
Date: 4-11-2015
Team: Group 1
Topic: Design and regulation of a sharing system for Electric Vehicles

What did you eventually achieve by the process?

What we achieved as a team was the development of a car sharing system for rural areas that has never been tested before. This exciting and promising concept is worth the work we committed into it and something we can be proud of. We laid a strong foundation for the next group which will hopefully be able to bring this concept to life.

How strong did you and your team hold onto these expectations?

Because of the two weeks of On Speaking Terms I was able to tell which kind of group members I had to work with. Thus the promising expectations I had in the beginning eventually came true. Every team member took an essential role and enriched the working process with his or her specific knowledge and insight.

What strengths did you eventually bring to the process?

I took the role of connecting and structuring the strength and knowledge of each member to eventually develop a product that we can all be proud of. Furthermore I designed an interactive prototype of a website, the presentations and the report. Presenting the work of our group during presentations and the pitch battle was also part of my activities.

Did the concerns that you had about your skill base and the skill base of the team happen?

As stated above, I did not have any concerns regarding the set of skills of our group. By closely communicating with specialists we were able to enrich our knowledge with facts about smart grid technology, financial details and electric vehicles. Thus, all of the missing knowledge could be acquired in the process of developing our concept.

What did you do to cope effectively with difficulties?

There were no difficulties regarding our way of working together as a team. We were able to maintain an amicable atmosphere throughout the whole project. Compared to previous group projects, I experienced our team as the most pleasant team I had ever worked with. Difficulties with regard to contents could thus easily be solved as a team.

What did you need to do in order to make the process more productive?

I tried to distribute tasks evenly among us, to keep up a constant workflow. Trello.com was a really helpful tool to reach this goal.

Group Reflection

Date: 5-11-2015
Team: Group 1
Topic: Design and regulation of a sharing system for Electric Vehicles

By delving into the state-of-the-art of the science behind present technologies, we were enabled to design an unique car sharing concept during a challenging project. It was a big, yet interesting challenge. We were able to create a concept that meets the needs of users and we hope that it will make Lochem and maybe even the world a little bit better.

All members of the group have a different study background. The different studies are: psychology, civil engineering, mechanical engineering and industrial design. Because of those different backgrounds we were able to solve multidisciplinary challenges. By communicating closely everyday we were able to set goals as a team. Achieving those goals together and with equally motivated commitment made us really stick together as a team.

Because the project had a lot of different aspects, sometimes expertise originating from the different studies would turn out to be useful. The psychology student could look at the problems from the view the users and could support the team from that direction, what resulted in a user-centred design of the system by satisfying their needs. The mechanical engineer was able to understand and attack current problems regarding the energy that is needed for the cars and the smart grid that will be implemented in the system. The civil engineering student could solve the problems regarding the financial, management and regulation part and made a financial plan in an excel table that can be used for further calculations. The industrial engineer made the presentations, the report and the prototype website look good by using a particular set of skills he acquired during his study. Also, he had the overview over everything.

The teamwork between the group members was outstanding. Not only because of the good match of our personalities but also because of the SCRUM methods we learned to apply during the module. This method enabled us to work efficiently on the different tasks the project counted. Everybody got new insights by working together with people with different thinking patterns.

APPENDIX C

DESIGN LAB REPORT

Introduction

Problem Analysis

In the DesignLab of the University of Twente, located in the building "The Gallery", it is all about working together in a group to create or design something. The staff of the DesignLab would like the groups to share their project with the other groups, so that they talk to each other about their projects and get the opportunity to help each other. At the moment, the groups have to fill in forms and pin them on a whiteboard when they are working in the DesignLab and get a numberplate to place on their table, so that the group can be recognized by other groups. For the staff of the DesignLab it is important that the groups get into contact with each other. The problem is, that the motivation of the students to fill in the forms is quite low.

Problem statement and research / design question

The problem that has to be solved is that the project groups are not motivated to fill in the project forms to give information about their project. The design question is thus: How can the system be designed to motivate the students to fill in project forms?

Theoretical underpinnings

Theoretical underpinnings that have been used for the design are divided into three categories: persuasion tools, game mechanics and how attention to the smart screen that should be used to show the platform can be attracted.

Persuasive design principles, as described in Oinas-Kukkonen and Harjumaa (2009), are design principles that support a desired behaviour in users. In this case, the desired behaviour is that the students fill in a project form with theirs project group. Below, you can see the list of the persuasive design principles that are used to make the students use the system (Table 1).

Table 1: Persuasive design principles and how they were used in the designing of the Share Id Board

Principle + Description	How applied
Reduction (A system that reduces complex behavior into simple tasks helps users perform the target behavior, and it may increase the benefit/cost ratio of a behavior)	The users can get in contact with and help from other groups with the same topics very easily, because only the most important information (e.g. the topic) is visible at a glance and contact information can be shown.
Personalization (A system that offers personalized content or services has a greater capability for persuasion)	Suggestions for other project groups to contact are shown in relation to the tags of the own project. One can also personalize a profile.
Self-monitoring (A system that keeps track of one's own performance or status supports the user in achieving goals)	The site shows how many achievements already have been unlocked and how far the project group is in the time they have for the project.

Praise (By offering praise, a system can make users more open to persuasion)	The other project groups can "like" your project when you helped them.
Rewards (Systems that reward target behaviors may have great persuasive powers)	If you use the system more often, you can unlock achievements. With more unlocked achievements you have a higher chance to win the monthly lottery.
Reminders (If a system reminds users of their target behavior, the users will more likely achieve their goals)	Once in a week, an e-mail is send to remind the group to update their project card to get more lottery tickets in the lottery.
Suggestion (Systems offering fitting suggestions will have greater persuasive powers)	Suggestions for other project groups to contact are shown in relation to the tags of the own project.
Liking (A system that is visually attractive for its users is likely to be more persuasive)	The system is designed in a visually attractive way.
Real-world feel (A system that highlights people or organization behind its content or services will have more credibility)	On the general screen, it says "DesignLab", showing that the system was made by the designlab team
Social learning (A person will be more motivated to perform a target behavior if (s)he can use a system to observe others performing the behavior)	The project groups can see that other groups have already filled in project cards.
Social comparison (System users will have a greater motivation to perform the target behavior if they can compare their performance with the performance of others)	The project groups can see the number of achievements unlocked by the other groups and compare themselves to them.
Social facilitation (System users are more likely to perform target behavior if they discern via the system that others are performing the behavior along with them)	On the general screen, the project groups can see all the other groups that have already filled in a project card.
Cooperation (A system can motivate users to adopt a target attitude or behavior by leveraging human beings' natural drive to co-operate)	When using the system, the project groups can "like" other project groups, helping them to unlock more achievements
Competition (A system can motivate users to adopt a target attitude or behavior by leveraging human beings' natural drive to compete)	The project groups compete with each other over how many achievements they unlock. By unlocking more achievements they further have a higher chance to win in the lottery against the other groups.
Recognition (By offering public recognition for an individual or group, a system can increase the likelihood that a person/group will adopt a target behavior)	There is a ranking of all the groups, from a high number of achievements to a low number. Also every month the winners of the lottery are uploaded to the site.

Game mechanics are "rules and mechanics that make games fun and addictive" (p.4, Fernandez, 2011). The game mechanics used in this system are used to persuade the students to start using the system, but also to go on using it after they began. The game mechanics used for the designing of the Share Id Board are list below (Table 2).

Table 2: Game mechanics and how they were used in the designing of the Share Id Board

Game Mechanic + Description	How applied
Achievement (A virtual or physical representation of having accomplished something. These are often viewed as rewards in and of themselves)	The project groups can unlock achievements in different ways.
Envy (The desire to have what others have. In order for this to be effective seeing what other people have (voyeurism) must be employed)	The project groups can see how many achievements have already been unlocked by the other groups and also want to unlock that many.
Fixed Ratio Reward Schedule (A fixed ratio schedule provides rewards after a fixed number of actions. This creates cyclical nadirs of engagement (because the first action will not create any reward so incentive is low) and then bursts of activity as the reward gets closer and closer)	The project group unlocks an achievement for fixed amounts of likes.
Lottery (A game dynamic in which the winner is determined solely by chance. This creates a high level of anticipation. The fairness is often suspect, however winners will generally continue to play indefinitely while losers will quickly abandon the game, despite the random nature of the distinction between the two)	This is not completely true with the system. There is a lottery, but is is not done "solely by chance": the groups have a higher chance with more achievements unlocked. This should make them even more motivated to do something, because they perceive themselves as in control.

When it comes to attracting attention to an object, visual conspicuity is an important term. Visual conspicuity refers to how well an object visually stands out from its environment (Wertheim, 2010). The touchscreen that is planned to be used to show the system in the DesignLab should stand out from its environment to attract attention. The wall behind the chosen place for the touchscreen is white, so the conspicuity should be high. Further it is planned to let the project cards on the screen move permanently, like they are floating. The movement should provide for an even higher conspicuity, letting the screen attract much attention.

Impact on society
In this case the society of the University of Twente that regularly visit the DesignLab will experience changes. Currently there is only a whiteboard on which forms are placed with magnets. Students are not triggered to fill in these these forms, unless they get a free cup of

coffee. By using the new method, students do not have to fill in paper forms. The touch screen will gather much more attention, which results in attraction of students who fill in a form about their project. Because of more projects on the board and more attention, students will communicate much more about their projects, which will result in an improvement of the projects, because some groups can use a boost of out-of-the box ideas when these groups are working too long on one idea.

And there is always a possibility that one of the ideas will be worth executing. So after the product is created, it can be used in the real society, so that means that a positive element in society has been added by this out-of-the-box idea.

Iterations

In the beginning, we put ourselves in the position of a project group in the DesignLab, letting our imagination flow on how we would like to fill in a project form. After the collection of ideas, we asked the designer of the current system for feedback and further input for what could be done. With many ideas, visualizations of how the system should look like and suggestions for improvement, we went back to our workplace and started "building" the ideas in Indesign. Here we ran into some problems that led us to continually improving the systems, until we were happy with the look and functions of it. At the same time the description of the system, FAQs, the list that should be placed next to the screen and the theoretical underpinnings that would be used for the systems were elaborated and documented. This led to another adjustment of the design of the system. Finally, the finished system was put into a presentation for the concept market.

Concept

Creating a Project Card, Main Page, Numbers and List

Share Id is a platform for the DesignLab where you can share the project you are currently working on in the DesignLab. This system is meant for students to be able to look at other projects and see if they can help each other. The main page is always shown on a big touchscreen in the DesignLab next to the entry. This is the only point where you can fill in a project card and change it. On the internet (with PC or mobile phone), the different project groups can be seen, but nothing can be edited or deleted. An overview over the active projects is also shown on a second non touch screen above the "kitchen".

When you start filling in a project card, there are different things you can fill in:
- the project title
- the description of the project
- the study backgrounds of the students involved
- the skills your team has
- what your team could need from other persons to improve your project
- a project number you can chose from all the free numbers
- a photo of your project group than can be taken with the camera placed on the screen
- contact information (e-mail address, phone number, facebook page,...)
- when your project started and when it will end

All this information is added up to a profile card of the project. Out of the filled in things, tags in the categories 'Topic', 'Needs', 'Skills' and 'Study' are automatically created through the system. These tags can be changed or deleted by the project group. At the beginning of every week, an e-mail is send to remind the groups to update their project with the newest changes and a description of what they are doing at that moment. In this e-mail, contact suggestions related to the group project's tags are also displayed.

On the general site, all active project groups and their projects are shown. They float across the screen, showing the picture of the group, a progress bar on how advanced the project is in time, the title of the project, the study backgrounds, the project number, the number of achievements and likes, and a button for contact. By clicking on one project card, it enlarges and you can read the other information (project description, what they are currently doing, skills and needs).

Next to the touch screen in the DesignLab, a table is placed with numbers standing on it. These numbers are divided in two categories. The first are used numbers. When you have already started a project, your number is between these numbers. Every time you start working, you take your number and place it on your table. When you stop working, you put it back to the other "used" numbers. The other category is unused numbers. When you start with a project and fill in a project card, you can chose one of these numbers, making it a used number.

Also next to the screen, a list with what the Share Id Board is and why you should use it, is placed to motivate the project groups to use it. It also contains a QR-code that you can scan with your phone to get to the site/the app directly. On the Share Id Board a list with FAQs can be shown.

Everybody who walks along the screen can see the active projects, for example also your supervisor, staff members, professors and members of organizations who may all be interested in what work is done. People who see themselves as experts on some topics can

create an expert profile so that they can be shown in the search. The aim is, that many experts on many different topics will fill in a profile, so that the students have the possibility to contact them.

<u>Contact, Tags, Search and Archive</u>
When you want to get in contact with a group, you can see if their project number is still standing next to the screen. If it is not, the group is sitting somewhere in the DesignLab, having their project number placed on their table. When it is between the other numbers, you can contact the group through the "Contact" button on their project card.

Every project has its own tags, automatically tagged to it by the system and completed by the project group. Through the tags, connections between different projects are made. When you create a new project, all related projects can be shown. This relation is made through the tags. When there is/are the same topic tag(s) in two projects, these projects get connected. When a skill of a project group fits the need of another project group, these two groups get a suggestion to contact the other group.

You can also search for projects. This works through the search bar. When you type something in, you get suggestions in five categories: topic, skills, needs, study and contacts. Search can also be done in an archive, where every project card that was ever filled in is stored. When you want to look for other projects that have been done before about your topic, you can do it here.

<u>Achievements, Likes and the Monthly Lottery</u>
For the students to fill in a project card and to stay motivated, achievements for different things can be unlocked. There are achievements for the mere filling in of the different parts of the project card and for specific numbers of likes the project receives. A ranking of the groups with high number of achievements to low can be shown.

Likes can be given by active groups to other active groups. Likes can be given for help or just if you like the other project group's topic. Only one like can be given per project group by one project group. To secure this, a group has to choose their group number out of all active groups when giving a like. When a like by that group has already been given to the other group, a message about that is shown. Every time a group gives a "like" to another group, they both get an email notification to prevent groups from lying which group they are and for the "liked" group to see who liked them.

At the end of every month, a lottery takes place. A small get-together is planned where the winning group is announced. The winning group is also uploaded on the Share Id Board. Every group gets as many lots as they have got unlocked achievements thrown into the lottery. Furthermore, a lottery ticket for every time they changed the project description (it gets checked by a staff member if the change is high in quality) in relation to what they are doing at that moment gets thrown into the lottery (max. 2 lottery tickets per week). This shows, that the groups can increase their chance of winning by using the Share Id Board more often. The prizes of the lottery are changed every month. they could for example be a gift voucher or a free meal/coffee for the team.

Share ID

What is it?
- With Share ID you can share your project with other groups in the DesignLab
- You can make a card for your project group with a picture of you
- You can fill in a description and your skills and needs
- Automatically, you get suggestions for tags that are related to your project; you can also add tags yourself
- Like other groups that helped you with your project
- Earn achievements for using the system more often

Why should you use it?
- When other project groups have a similar subject, you can help each other, sharing your ideas
- You can share your skills and look if other people's skills fit your needs (automatic search possible)
- Every now and then an expert may walk around these halls, sees your project and has a great idea to help you with it
- You can look in an archive for other people who have already worked on similar projects, giving you the opportunity to contact them with your questions
- Every month, there is a lottery; the more you use the program, the higher is your chance to win

FAQ

First Use

1. *How do I login to the site?*
   You don't have to login to the site. You can add your project on the screen in the DesignLab and can also see all the projects on your laptop or mobile phone. Next to the screen, there is a QR-code that you can scan with your phone and a link to the website. The projects can only be changed in the DesignLab.
2. *How can I insert text my project information in a box?*
   In the right bottom corner of the general view of all active projects on the screen in the DesignLab, you can see a button with a plus on it. Through clicking on the plus, you can add your project card.
3. *How do I take a picture with my group?*
   Above the screen, there is a webcam. When you want to make a new project, you can take a picture with your group through tapping the screen.
4. *How does the tagging work?*
   After you finished your project profile, the programme creates tags automatically. These tags are categorized in Topics, Study, Skills and Needs. You can add and delete tags. You get tag-related suggestions on other groups with similar topics, skills that fit your needs and needs that fit your skills. When you want to get relevant help, it is important to tag your project as precisely as possible.

General

1. *What will happen with my project card after the project period is over?*
   Project cards of finished projects are moved to the archive. The archive will contain all the projects that have ever been added to the programme. It is possible to search for archived projects to see if somebody has been working on a similar project before. Then it is possible to contact these groups for information or help.
2. *How do I make contact when a group is not in the DesignLab?*
   In the right bottom corner of each project card, a "Contact" icon is shown. When you click on this, you can see the contact information of the group so that you can contact them via mail. It also works this way with archived projects.
3. *How can I find groups that are working on a project that deals with the same subjects?*
   In the search-bar terms can be inserted and a dropdown list will appear with suggestions of earlier used tags. Projects in the archive that are tagged with the search-term can be found as results. Also different topics that are related to the search-term will be shown.
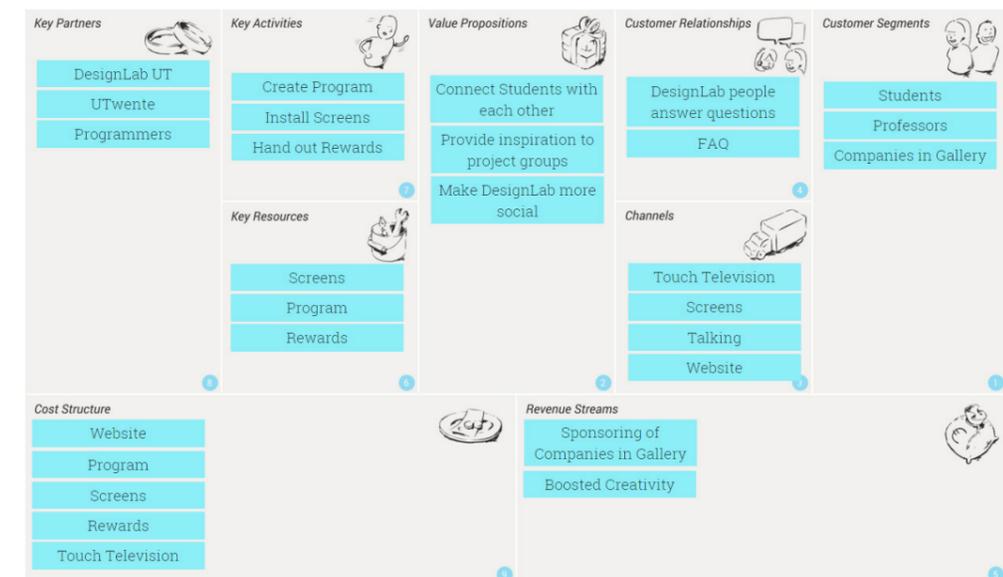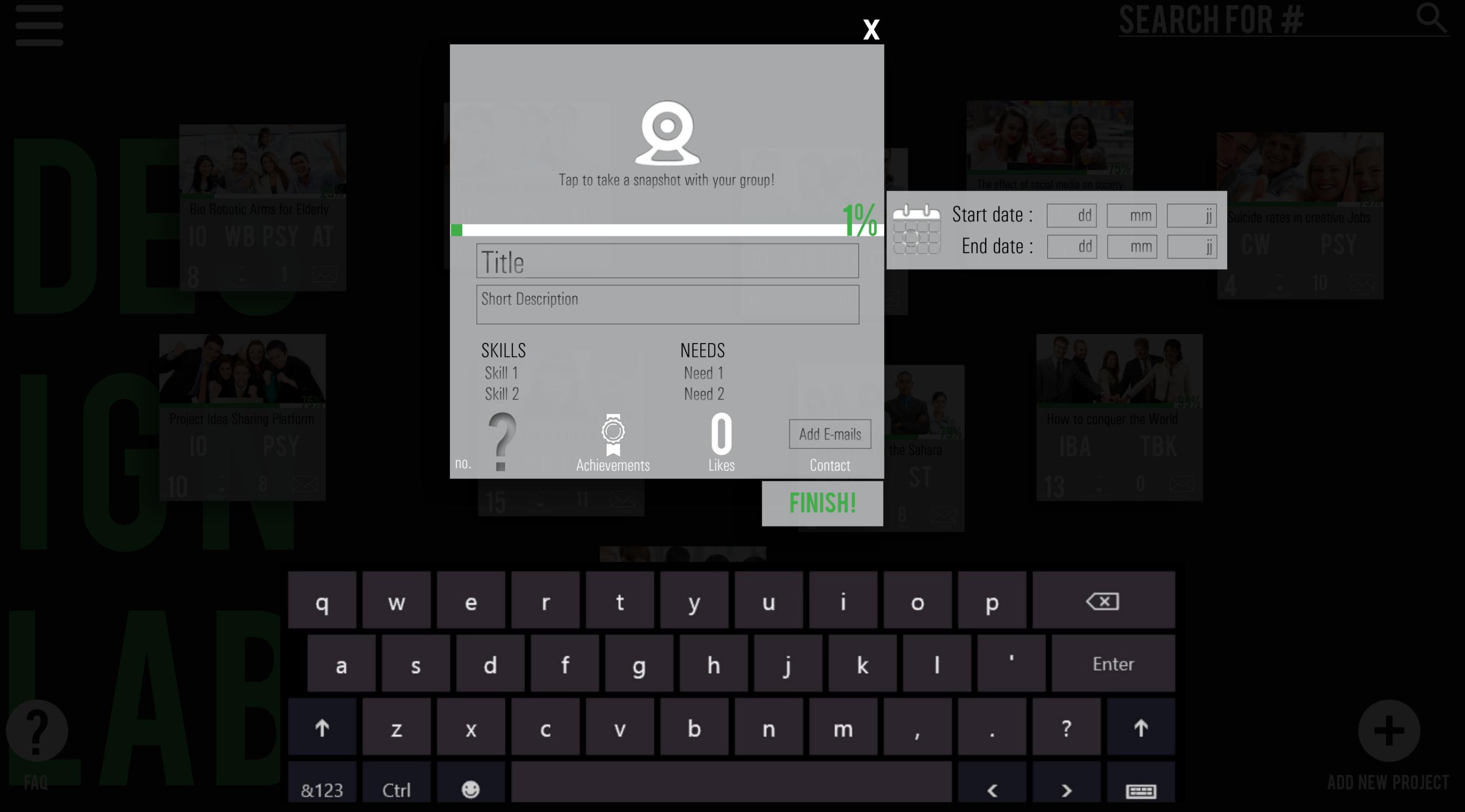
Achievements

1. *How can I unlock achievements?*
   There are different achievements to unlock. A complete list can be found under "Achievements" in your project profile, but there are also hidden achievements that you will earn for different actions. For example, you unlock an achievement for filling in the whole project description and when you reach specific amounts of likes.
2. *What can I do with my achievements?*
   Per unlocked achievement, another ticket is thrown into the monthly lottery for your group, increasing your chance of winning.

The Monthly Lottery

1. *How does the monthly lottery work?*
   Per month, one of the active project groups gets the chance to win a prize in the lottery. When you use the programme more often, your chance to win increases. At the end of the month, the winner is announced within the framework of a get-together (borrel) of all active groups.
2. *How do I increase my chance to win the lottery?*
   a. With every achievement: For every achievement you unlock, another lottery ticket gets thrown into the monthly lottery for your group.
   b. With every time you update what you are doing at that moment in your project description: For every time you update your project description, but max. 2 times a week, a staff member in the DesignLab checks if the new description is high in quality and throws another lottery ticket into the monthly lottery.
3. *When do I get to know, who won the monthly lottery?*
   At the end of every month, a get-together (borrel) of all active groups takes place. Here, the winning group is announced. It is also placed on the website.
4. *What is the prize for the monthly lottery?*
   Every month, another prize can be won. For example gift vouchers or free toasties for the team could be prizes.

BUSINESS MODEL CANVAS

Key Partners	Key Activities	Value Propositions	Customer Relationships	Customer Segments
DesignLab UT	Create Program	Connect Students with each other	DesignLab people answer questions	Students
UTwente	Install Screens	Provide inspiration to project groups	FAQ	Professors
Programmers	Hand out Rewards	Make DesignLab more social		Companies in Gallery

Key Resources	Channels
Screens	Touch Television
Program	Screens
Rewards	Talking
	Website

Cost Structure	Revenue Streams
Website	Sponsoring of Companies in Gallery
Program	Boosted Creativity
Screens	
Rewards	
Touch Television	

SEARCH FOR #

x

Tap to take a snapshot with your group!

1%

Start date : | dd | mm | jj |
End date : | dd | mm | jj |

Title

Short Description

SKILLS   NEEDS
Skill 1   Need 1
Skill 2   Need 2

?   🏅   0   Add E-mails
no.   Achievements   Likes   Contact

FINISH!

Bio Robotic Arms for Elderly
IO WB PSY AT

The effect of social media on society

Suicide rates in creative Jobs
CW   PSY

Project Idea Sharing Platform
IO   PSY

How to conquer the World
IBA   TBK

the Sahara
ST

FAQ

ADD NEW PROJECT

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a s d f g h j k l ' Enter
↑ z x c v b n m , . ? ↑
&123 Ctrl ☺ < > ⌨

IO WB PSY CIT

The effect of social media on society
PSY

Suicide rates in creative Jobs
CW   PSY

Bio Robotic Arms for Elderly
IO WB PSY AT

75%

Carsharing of Electric Vehicles

Development of a car sharing system for the citizens initiative LochemEnergie.Smart grid integration is optional

SKILLS
Graphic Design
System Analysis

NEEDS
Knowledge about smartgrids
Persona Analysis

no.**6**   Achievements   **10** 👍 Like!   Contact

Project Idea Sharing Platform
IO   PSY

How to conquer the World
IBA   TBK

Sustainable Housing
IO   CIT

Lab-on-a-chip appliances
NT WB IBA TN

DESIGN LAB

? FAQ

➕ ADD NEW PROJECT

IO WB PSY CIT

Carsharing of Electric Vehicles

Development of a car sharing system for the citizens initiative LochemEnergie.Smart grid integration is optional

75%

SKILLS
Graphic Design
System Analysis

NEEDS
Knowledge about smartgrids
Persona Analysis

j.m.krueger@student.utwente.nl
p.a.vanwee@student.utwente.nl
d.nijhof@student.utwente.nl
j.batzke@student.utwente.nl

no.6

Achievements

10 Like!

Contact

Bio Robotic Arms for Elderly
IO WB PSY AT
8 1

The effect of social media on society
PSY
7 14

Suicide rates in creative Jobs
CW PSY
4 10

Project Idea Sharing Platform
IO PSY
10 8

How to conquer the World
IBA TBK
13 0

Sustainable Housing
IO CIT
5 18

Lab-on-a-chip appliances
NT WB IBA TN
3 20

WB
1 0

DESIGN LAB

FAQ

ADD NEW PROJECT

PHILOSOPHY

Peter-Paul Verbeek

Professor of philosophy of technology and co-director of the DesignLab of the University of Twente.

 # SKILLS
Philosophy & Technology
Mediation Theory

 # NEEDS
Cup of Coffee
Motivated Students

no. **CU C311**

10 Like!

Contact

Bio Robotic Arms for Elderly
IO WB PSY AT
8 1

Project Idea Sharing Platform
IO PSY
10 8

Sustainable Housing
IO CIT
5 18

The effect of social media on society
PSY
14

Suicide rates in creative Jobs
CW PSY
4 10

How to conquer the World
IBA TBK
13 0

Lab-on-a-chip appliances
NT WB IBA TN
3 20

WB
1 0

FAQ

ADD NEW PROJECT

PHILOSOPHY

Peter-Paul Verbeek

Professor of philosophy of technology and co-director of the DesignLab of the University of Twente.

SKILLS
Philosophy & Technology
Mediation Theory

NEEDS
Cup of Coffee
Motivated Students

no. **CU C311**   **11** Like!   Contact

SEARCH FOR #

Bio Robotic Arms for Elderly
IO WB PSY AT
8   1

Project Idea Sharing Platform
IO   PSY
10   8

Sustainable Housing
IO   CIT
5   18

The effect of social media on society
PSY
14

Suicide rates in creative Jobs
CW   PSY
4   10

How to conquer the World
IBA   TBK
13   0

Lab-on-a-chip appliances
NT WB IBA TN
3   20

WB
1   0

? FAQ

+ ADD NEW PROJECT

DE
SIGN
LAB

Bio Robotic Arms for Elderly
IO WB PSY AT
25%
8 | 1
no. | Achievements | Likes | Contact

The Origin of Space and Time
IO WB AT
30%
9 | 5
no. | Achievements | Likes | Contact

Carsharing of Electric Vehicles
IO WB PSY CIT
75%
6 | 10
no. | Achievements | Likes | Contact

The effect of social media on society
PSY
75%
7 | 14
no. | Achievements | Likes | Contact

Suicide rates in creative Jobs
CW PSY
75%
4 | 10
no. | Achievements | Likes | Contact

Project Idea Sharing Platform
IO PSY
75%
10 | 8
no. | Achievements | Likes | Contact

Smart Clothing for Farmers
IO WB PSY CIT
75%
15 | 11
no. | Achievements | Likes | Contact

Tree Planting in the Sahara
BMT ST
75%
2 | 8
no. | Achievements | Likes | Contact

How to conquer the World
IBA TBK
99%
13 | 0
no. | Achievements | Likes | Contact

Sustainable Housing
IO CIT
75%
5 | 18
no. | Achievements | Likes | Contact

Peter-Paul Verbeek
PHILOSOPHY
CU C311 | 10
Likes | Contact

Lab-on-a-chip appliances
NT WB IBA TN
75%
3 | 20
no. | Achievements | Likes | Contact

? FAQ

+ ADD NEW PROJECT

MENU ☰

MOST
Popular
Recent
Achievements
Likes

SORT BY
Topic
Skills
Needs
Studies

View all Expert profiles

Archive

? FAQ

Lab-on-a-chip appliances	**Sustainable Housing**	**The effect of social media on society**
75%	75%	75%
NT WB IBA TN	IO CIT	PSY
3 20 ✉	5 18 ✉	7 14 ✉
Smart Clothing for Farmers	**Carsharing of Electric Vehicles**	**Suicide rates in creative Jobs**
75%	75%	75%
IO WB PSY CIT	IO WB PSY CIT	CW PSY
15 11 ✉	6 10 ✉	4 10 ✉
Project Idea Sharing Platform	**Tree Planting in the Sahara**	**The Origin of Space and Time**
75%	75%	30%
IO PSY	BMT ST	IO WB AT
10 8 ✉	2 8 ✉	9 5 ✉
Bio Robotic Arms for Elderly	**Robot teams to clean Cities**	**How to conquer the World**
25%	75%	99%
IO WB PSY AT	WB	IBA TBK
8 1 ✉	1 0 ✉	13 0 ✉

⊕ ADD NEW PROJECT

#TOPIC

Development of a **bio**mechanical arm

We are developing a **robot** arm to help elderly with....

#SKILLS

Control lego mindstorm **robot**s

Robot Human Interaction

#NEEDS

Knowledge about the **bio**logy of ants

STUDY

Biomechanical engineering

#CONTACTS

STEFANO STRAMIGIOLI **–** PC Member of **Robot**ics Science and Systems
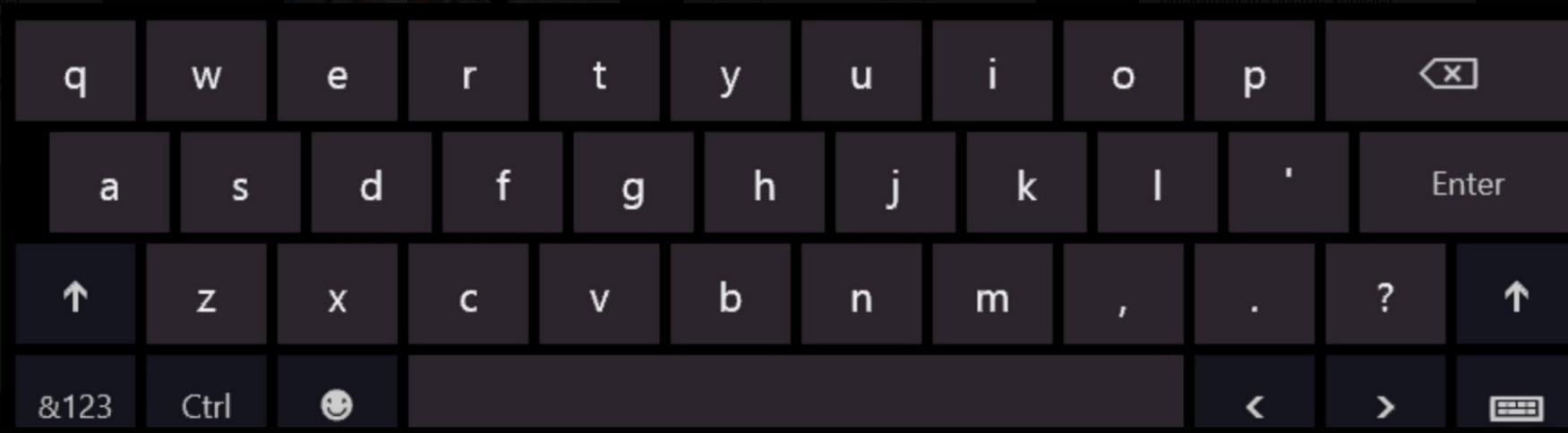
DESIGNLAB PLATFORM.

ENTERTAINMENT

HEALTHCARE

OTHER

SAFETY

SMART CITIES

SUSTAINABILITY

SEARCH

ABOUT

SIGN IN

Bio Robotic Arms for Elderly 25%
IO WB PSY AT
8 — Achievements · 1 Likes · Contact

The Origin of Space and Time 30%
IO WB AT
9 — Achievements · 5 Likes · Contact
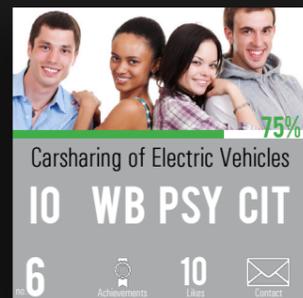
Carsharing of Electric Vehicles 75%
IO WB PSY CIT
6 — Achievements · 10 Likes · Contact

The effect of social media on society 75%
PSY
7 — Achievements · 14 Likes · Contact
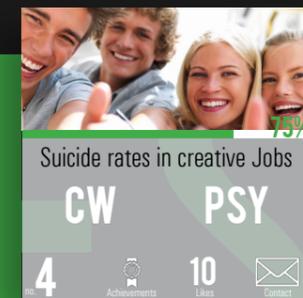
Suicide rates in creative Jobs 75%
CW PSY
4 — Achievements · 10 Likes · Contact

Project Idea Sharing Platform 75%
IO PSY
10 — Achievements · 8 Likes · Contact

Smart Clothing for Farmers 75%
IO WB PSY CIT
15 — Achievements · 11 Likes · Contact

Tree Planting in the Sahara 75%
BMT ST
2 — Achievements · 8 Likes · Contact

How to conquer the World 99%
IBA TBK
13 — Achievements · 0 Likes · Contact

Sustainable Housing 75%
IO CIT
5 — Achievements · 18 Likes · Contact

Robot teams to clean Cities 75%
WB
1 — Achievements · 0 Likes · Contact

Lab-on-a-chip appliances 75%
NT WB IBA TN
3 — Achievements · 20 Likes · Contact

DESIGNLAB

Introduction

Problem Analysis

In the Sport Center the University of Twente provides health checks for employees. They want more clients and employees of other companies to use their health checks. To get more clients they want something new in their approach on the aftercare. By implementing a new approach, the University of Twente wants to check employees of other companies on the Kennispark and surroundings.

Problem statement and research / design question

The problem that has to be solved is that the University of Twente wants something new in their approach to persuade people and companies to do their health checks at the Sport Centre. The design question is thus: How can the approach and aftercare of the health checks provided by the University of Twente be improved?

Theoretical underpinnings

Theoretical underpinnings that have been used for the design are divided into two categories: persuasion tools and game mechanics. With these, we hope that people can be motivated to use the health check and when companies see that the people are motivated, that they choose for the health check provided by the Sport Centre.

Persuasive design principles, as described in Oinas-Kukkonen and Harjumaa (2009), are design principles that support a desired behaviour in users. In this case, the desired behaviour is that employees are motivated to do the health check at the Sport Centre of the University of Twente so that their employers are motivated to use the health check more often. Below, you can see the list of the persuasive design principles that are used to get employees motivated (Table 3).

Table 3: Persuasive design principles and how they were used in the designing of the Health Week for employees

Principle + Description	How applied
Reduction (A system that reduces complex behavior into simple tasks helps users perform the target behavior, and it may increase the benefit/cost ratio of a behavior)	A "manual" to live in a healthy way is given. The people only have to follow the different instructions, divided into the different topics (food, sports, sleeping,...) and do not have to make their own planning.
Personalization (A system that offers personalized content or services has a greater capability for persuasion)	Personalized content at the end of the healthy week for the deficits that the person has. Also different levels can be chosen, depending on what the person thinks he or she is capable of.
Self-monitoring (A system that keeps track of one's own performance or status supports the user in achieving goals)	With the fit band, it is possible, that the person monitors their progress in the week.
Simulation (Systems that provide simulations can persuade by enabling users to observe immediately the link between cause and effect)	After the first health check, a simulation is done on the basis of the test results, showing how the patient's body will look like in some years when he/she goes on in the same way.
Rehearsal (A system providing means with which to rehearse a behavior can enable people to change their attitudes or behavior in the real world)	Through the food plan and training instructions in the health weeks, the person can see how he or she should behave (eat/do sports) after the 2 weeks.
Rewards (Systems that reward target behaviors may have great persuasive powers)	When the people decide to do the health check at the Sport Centre, they have the opportunity to use a Jawbone UP3 for 2 weeks for free.
Reminders (If a system reminds users of their target behavior, the users will more likely achieve their goals)	The application that is linked to the fit band will remind the person of what he or she should do.
Suggestion (Systems offering fitting suggestions will have greater persuasive powers)	After each health check, recommendations for how the person should behave to improve their (possibly bad) condition are made.
Trustworthiness (A system that is viewed as trustworthy will have increased powers of persuasion)	With using the Jawbone UP3, a tested fit band that seems trustworthy, the patient will trust that the information he or she gets is truthful, fair and unbiased. Because the Sport Centre is a part of a university, the most people would also trust them to be unbiased and fair.
Recognition (By offering public recognition for an individual or group, a system can increase the likelihood that a person/group will adopt a target behavior)	When using the Jawbone UP3 it is possible to share your success with other people (Facebook, Twitter,...).

Game mechanics are "rules and mechanics that make games fun and addictive" (p.4, Fernandez, 2011). The game mechanics used in the designing of a Health Week are used to persuade the employees to do a health check, but also to go on using it after they began. The game mechanics used for the designing of the Health Week are listed below (Table 4).

Table 4: Game mechanics and how they were used in the designing of the Health Week

Game Mechanic + Description	How applied
Status (The rank or level of a player. Players are often motivated by trying to reach a higher level or status)	For the two health weeks it is possible to choose a difficulty level, depending on the first health check and on what the person thinks he or she can do. When one level has been finished, another (higher) level can be started.

Iterations (brief)

One of our first ideas we had concerning a health check was to use the technical possibilities that exist already. We looked for different fitness trackers that are available and saw, which possibilities they had. We decided, that the Jawbone Up3 would be a nice thing to give a user of the health check for some time to offer something new. Then, we build a programme around this, looking for different persuasive and game mechanics elements to convince people to use the system and to continue using it.

Concept:

The healthcheck will be the same as it is right now, but the aftercare changes. First the people will get a healthcheck. The result of this health check will be the basis for the next step. The result will be shown on a body and with a picture of the person when he is 20 years older. This is to influence the client and show how bad or healthy they are living. After the result the user can choose to not change its lifestyle or join a health week. This health week means that you will live healthy and watch what you are eating and how much you are moving for two weeks. To get in control of this the Jawbone Up3 wristband will be used. This wristband can registrate how much you are moving and how many calories you burn. It also measures your amount of sleep and can can see if you are in REM-sleep or not. If you want you can also scan all the products you eat so it can see how much and what kind of food you eat. The wristband can even measure your heartbeat and with the smart coach it will motivate you to start training. This wristband costs around 180 euros (Jawbone, 2015) and when the user wants to keep it after the two weeks he can buy it. This is advertising for jawbone, so it might be possible that jawbone could give some wristbands for free to the organization.

The user can choose the difficulty of their health week. The possible difficulties are Beginner, Enthusiast, Expert and Legend. The harder the difficulty, the more healthy you need to live these two weeks.

When you choose "Beginner" you don't have to write down or scan what you eat, but when you choose the level "Enthusiast" you do. When you choose the level "Expert" you need to make changes in your life, for example eat other stuff. The level "Legend" means that you can only eat food that's healthy and you need to move a lot and do this for one year.

After the two weeks there will be another health check so you can see the difference. There will also be a picture of the user when when he is 20 years older and keeps living this healthy. This picture will motivate the users to continue living healthy.

Impact on society

Health checks and the JawBone wristband already exist and are used, so these things will not be new to society. The principle of health checks is controversial because companies can look whether an employee is healthy or can improve his health before this employee is accepted. But when this health check turns out bad and a potential employee turns out to be (very) ill, companies will not accept them anymore. This can save companies money, but for employees this means not getting the job and additionally getting bad news about being ill.

When assuming that these complications will not occur due to prohibition, health checks can be useful for companies and employees, because they can shape absence- and health policy and align these aspects to each other. Another big plus will be that health risks of a certain job can be detected early, so that results of these risks can be prevented and reduced.

BUSINESS MODEL CANVAS

HEALTH WEEK

Team 1
Jule Krüger
Daniel Nijhof
Paul van Wee
Joachim Batzke
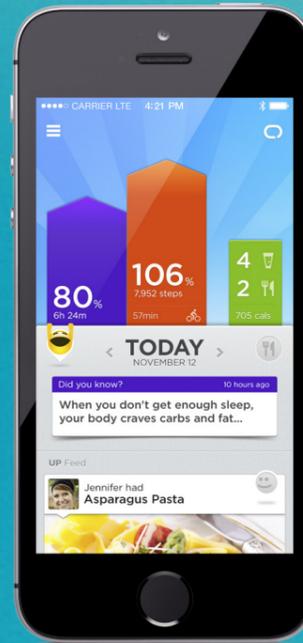
1

2 — 2 weeks

3

First Health Check
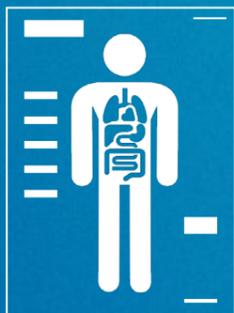
Results and Recommendations
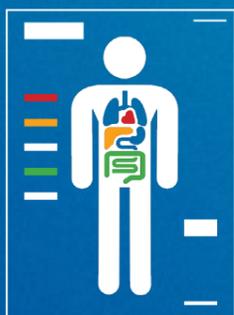
Future Body after 20 years

Choose Level

Beginner
Sleep Data
Heart Data
Activity Data
Self - determination

Enthousiast
Sleep Data
Heart Data
Activity Data
Food Logging

Expert
Sleep Data
Heart Data
Activity Data
Food Adaption
Activity Challenges

Legend
Sleep Data
Heart Data
Activity Data
Food Adaption
Activity Challenges
One year action plan

Or continue as before...

Heart Tracking

Knowing is the first step to get more active and stay motivated. Next to your general activity your heart activity is monitored. The bioimpedance sensors are able to give you a complete picture of your heart health.

Food Logging

Log your meals and track calories in no time with the UP® barcode scanner, restaurant menu search and food database. Smart Coach helps guide you to healthy habits and gives your meal a Food Score.

Sleep Tracking

The UP3 tracker uses advanced sensors to automatically track your sleep stages—Wake, REM, Light, and Deep. Using this data, Smart Coach gives you suggestions to maximize your sleep and improve the quality of your days.

Smart Coach

It gives you the motivation and personalized insights you need to reach your goals, no matter where your day takes you. Plus, it gets smarter over time—as Smart Coach gets to know you, insights and tips get better and better. And you will too.

Second Health Check
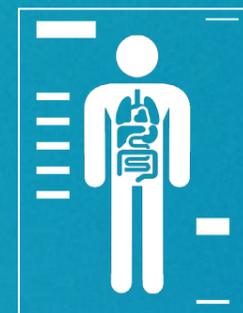
Results and Recommendations
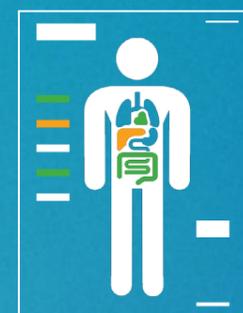
Future Body after 20 years

Buy Jawbone?

APPENDIX D

QUESTIONNAIRE – DATA

1. Wij willen u vragen de volgende informatie over de vertrouwelijkheid en de verwerking van de gegevens goed door te lezen, voordat u aan het onderzoek begint. De ontvangen gegevens worden vertrouwelijk en anoniem verwerkt en kunnen daarom niet bekend gemaakt worden op een individueel identificeerbare manier. Ook zullen de persoonsgegevens niet door derden worden ingezien. Omdat de deelname vrijwillig is, is het op elk moment toegestaan te stoppen met het invullen van de vragenlijst, zonder een reden hiervoor aan te geven. Als u instemt dat uw data voor onderzoek gebruikt mag worden, zullen we de gegevens gebruiken in onze analyses. Voor verdere informatie kunt u contact opnemen met: Jule Krüger (j.m.kruger@student.utwente.nl). Ik heb de voorafgaande informatie goed doorgelezen en stem toe dat mijn data voor wetenschappelijk onderzoek gebruikt mogen worden.

#	Answer		Response	%
1	Ja		33	94%
2	Nee		2	6%
	Total		35	100%

Statistic	Value
Min Value	1
Max Value	2
Mean	1.06
Variance	0.06
Standard Deviation	0.24
Total Responses	35

2. Wat is uw geslacht?

#	Answer		Response	%
1	Man		27	82%
2	Vrouw		6	18%
	Total		33	100%

Statistic	Value
Min Value	1
Max Value	2
Mean	1.18
Variance	0.15
Standard Deviation	0.39
Total Responses	33

3. Wat is uw leeftijd?

Text Response

55
50
53
68
54
51
60
52
66
75
63
43
65
56
58
61
22
58
61
51
50
50
54
55
73
49
58
51
66
66
43
68
61

Statistic	Value
Total Responses	33

4. Geef aan in hoeverre u geïnteresseerd bent in het gebruik van elektrisch vervoer.

#	Answer		Response	%
1	Erg ongeïnteresseerd		1	3%
2	Enigszins ongeïnteresseerd		1	3%
3	Niet ongeïnteresseerd, niet geïnteresseerd		0	0%
4	Enigszins geïnteresseerd		17	52%
5	Erg geïnteresseerd		14	42%
	Total		33	100%

Statistic	Value
Min Value	1
Max Value	5
Mean	4.27
Variance	0.77
Standard Deviation	0.88
Total Responses	33

5. Voor welke activiteiten zou u gebruik willen maken van een elektrische auto? (Meer dan één antwoord is mogelijk)

#	Answer		Response	%
1	Boodschappen doen binnen Lochem		9	27%
2	Shoppen in een andere stad		15	45%
3	In de ochtend naar het werk/school toe en 's avonds weer naar huis		14	42%
4	Op vakantie gaan		3	9%
5	Naar de sportschool of een andere activiteit gaan		2	6%
6	De kinderen naar hun sport of een andere activiteit brengen		3	9%
7	De kinderen in de ochtend naar school brengen		2	6%
8	Anders, namelijk...		19	58%

Anders, namelijk...

Incidenteel reizen als mijn eerste auto niet beschikbaar is
Deze vraag en vermoedelijk ook volgende zijn lastig te beantwoorden. We hebben in het verleden een paar keer een e-Smart gehuurd, omdat dat erg handig was. We hebben momenteel echter geen duidelijke vraag naar elektrisch vervoer, omdat we een eigen auto hebben. De auto hebben we een paar keer gebruikt voor een cursusavond in Doetinchem, omdat de eigen auto niet beschikbaar was.
incidentele dagaktiviteit
Bezoek van vrindn en familie in de regio
Op bezoek bij kinderen die in west nederland wonen
Op visite gaan in een andere plaats.
Bezoek familie in verpleeghuis
familie bezoek elders in Nederland
als 2e vervoermiddel indien eigen auto in gebruik is bij ander gezinslid
Af en toe gebruik voor wetk en prive
Mantelzorg
Werkbezoeken binnen lochem
familie ezoek
werk onregelmatig,
Alle andere vervoersbehoeften.
Niet specifiek activiteit gebonden. Inzet en gebruik zijn afhankelijk van actie radius mogelijkheden Ik kan bij volgende vraag niet invullen anders > zie eerder antwoord
bezoek aan diverse mensen
werk in straal 30 km rond lochem
bezoek

Statistic	Value
Min Value	1
Max Value	8
Total Responses	33

6. Hoeveel kilometer zou u normaal gesproken met een elektrische auto willen rijden?

#	Answer		Response	%
1	Tot 50 km (bijv. binnen de gemeente Lochem, naar Zutphen en weer terug)		4	12%
2	50 – 100 km (bijv. naar Enschede of Deventer en weer terug)		19	58%
3	100 – 200 km (bijv. naar Amersfoort of Zwolle en terug)		2	6%
4	200 – 300 km (bijv. naar Utrecht, Amsterdam, Eindhoven of Groningen en terug)		6	18%
5	Meer dan 300 km (bijv. naar Roermond, Maastricht of naar een stad in het buitenland en terug)		2	6%
	Total		33	100%

Statistic	Value
Min Value	1
Max Value	5
Mean	2.48
Variance	1.26
Standard Deviation	1.12
Total Responses	33

7. Hoe lang zou u een elektrische auto normaal gesproken willen huren?

#	Answer		Response	%
1	Minder dan 1 uur		0	0%
2	1-3 uur		2	6%
3	3-5 uur		10	30%
4	5-7 uur		5	15%
5	7-12 uur		1	3%
6	1 hele dag		13	39%
7	Langer dan 1 dag		1	3%
8	Anders, namelijk…		1	3%
	Total		33	100%

Statistic	Value
Min Value	2
Max Value	8
Mean	4.61
Variance	2.62
Standard Deviation	1.62
Total Responses	33

8. Wat lijkt u de meest aantrekkelijke manier om een auto op te halen?

#	Answer		Response	%
1	Ik zou het liefst naar een vast oplaadstation gaan om de auto op te halen		8	24%
2	Ik zou graag in afstemming met andere mensen besluiten waar ik de auto op kan halen		0	0%
3	Ik zou graag willen dat iemand de auto naar mij toe brengt		2	6%
4	Ik zou graag naar een plek in mijn buurt willen gaan, waarvan ik online gezien heb, dat er een auto staat		23	70%
	Total		33	100%

Statistic	Value
Min Value	1
Max Value	4
Mean	3.21
Variance	1.67
Standard Deviation	1.29
Total Responses	33

9. Als je naar een auto toe zou moeten gaan, wat is dan de maximale afstand die u af wilt leggen (lopend/fietsend/anders) om bij de auto te komen?

#	Answer		Response	%
1	Minder dan 100 meters		0	0%
2	100 - 299 meters		4	12%
3	300 - 499 meters		4	12%
4	500 - 699 meters		7	21%
5	700 - 899 meters		2	6%
6	900 - 1099 meters		10	30%
7	1100 - 1299 meters		3	9%
8	1300 - 1499 meters		0	0%
9	1500 - 1699 meters		0	0%
10	1700 - 1899 meters		0	0%
11	1900 - 2000 meters		1	3%
12	Meer dan 2000 meters		1	3%
13	Ik wil geen afstand afleggen		0	0%
14	Anders, namelijk...		1	3%
	Total		33	100%

Anders, namelijk...
best moeilijk in te schatten wat 350 meter is

Statistic	Value
Min Value	2
Max Value	14
Mean	5.33
Variance	7.60
Standard Deviation	2.76
Total Responses	33

10. Op welke manier zou u deze afstand af willen leggen? (Meer dan één antwoord mogelijk)

#	Answer		Response	%
1	Lopend		23	70%
2	Fietsend		24	73%
3	Met de bus		0	0%
4	Anders, namelijk...		0	0%

Anders, namelijk...

Statistic	Value
Min Value	1
Max Value	2
Total Responses	33

11. Hoe zou u graag te weten komen waar en welk type auto beschikbaar is? (Meer dan één antwoord mogelijk)

#	Answer		Response	%
1	Ik zou graag op een website willen kijken waar en welk type auto in mijn buurt beschikbaar is		22	67%
2	Ik zou graag een medewerker (bijv. van een verhuurbedrijf) willen bellen om te vragen waar en welk type auto beschikbaar is		1	3%
3	Ik zou graag via een mobiele applicatie willen kijken waar en welk type auto beschikbaar is		24	73%
4	Ik zou graag uit het raam willen kijken om te zien welk soort auto beschikbaar is		1	3%
5	Ik zou graag door communicatie met andere gebruikers (praten, via een gedeelde chat/agenda,...) te weten komen waar welk soort auto beschikbaar is		1	3%
6	Anders, namelijk...		2	6%

Anders, namelijk...
Geen mening
kan me niet schelen welk type auto

Statistic	Value
Min Value	1
Max Value	6
Total Responses	33

12. Op welke manier zou u een auto graag willen kunnen reserveren? (Meer dan één antwoord mogelijk)

#	Answer		Response	%
1	Via een mobiele applicatie		23	70%
2	Via een website		27	82%
3	Via de telefoon		9	27%
4	Via een papierenformulier		0	0%
5	Via communicatie met andere gebruikers (bijv. praten, via een gedeelde app/agenda,…)		1	3%
6	Anders, namelijk…		1	3%

Anders, namelijk…
Vaste momenten

Statistic	Value
Min Value	1
Max Value	6
Total Responses	33

13. Als u gebruik van een auto wilt maken, zou u het het liefst…

#	Answer		Response	%
1	…1 tot 2 weken van tevoren reserveren		0	0%
2	…1 tot 2 dagen van tevoren reserveren		17	52%
3	…1 tot 2 uur van tevoren reserveren		7	21%
4	…een half uur van tevoren reserveren		1	3%
5	…spontaan reserveren		6	18%
6	Anders, namelijk…		2	6%
	Total		33	100%

Anders, namelijk…
OOk last minute reserveren zou natuurlijk een optie moeten zijn, in geval er onverwacht extra vervoer nodig is.
Zie boven

Statistic	Value
Min Value	2
Max Value	6
Mean	3.06
Variance	1.87
Standard Deviation	1.37
Total Responses	33

14. Zou u tijdens het reserveren van een auto al aan kunnen geven, hoe lang u het auto nodig zou hebben?

#	Answer		Response	%
1	Jazeker, altijd		16	48%
2	Dat hangt van de activiteit die ik met de auto wil uitvoeren af		15	45%
3	Nee, ik wil de auto zo lang gebruiken als ik het nodig heb zonder het bij de reservering aan te moeten geven.		0	0%
4	Anders, namelijk...		2	6%
	Total		33	100%

Anders, namelijk...
Meestal zal wel een goede tijdsinschatting te maken zijn.
Zie boven

Statistic	Value
Min Value	1
Max Value	4
Mean	1.64
Variance	0.61
Standard Deviation	0.78
Total Responses	33

15. Hoeveel mensen zou u normaal gesproken met de auto willen transporteren?

#	Answer		Response	%
1	Alleen mijzelf		9	27%
2	Mijzelf en 1 ander persoon		16	48%
3	Mijzelf en 2 andere personen		5	15%
4	Mijzelf en 3 andere personen		1	3%
5	Mijzelf en 4 andere personen		0	0%
6	Mijzelf en 5 of meer andere personen		0	0%
7	Dit kan van keer tot keer verschillen		1	3%
8	Anders, namelijk …		1	3%
	Total		33	100%

Anders, namelijk …
af en toe 2 kan ook

Statistic	Value
Min Value	1
Max Value	8
Mean	2.27
Variance	2.39
Standard Deviation	1.55
Total Responses	33

16. Wat vindt u belangrijke eisen waar de EV aan zou moeten voldoen? (Meer dan één antwoord mogelijk)

#	Answer		Response	%
1	Ik zou vooral een auto met een grote kofferbak huren		4	12%
2	Ik zou graag veel mensen willen transporteren		2	6%
3	Het auto zou snel moeten kunnen rijden		1	3%
4	De auto moet weinig energie gebruiken		17	52%
5	De auto moet comfortabel zijn		11	33%
6	De auto moet minimaal x km kunnen afleggen (gebruik het tekstveld hieronder om een waarde voor x te geven)		16	48%
7	Ik zou graag de mogelijkheid hebben om per reis te bepalen, wat ik nodig heb en dat dan uit een aanbod van meerdere auto's kiezen		17	52%
8	Anders, namelijk…		0	0%

De auto moet minimaal x km kunnen afleggen (gebruik het tekstveld hieronder om een waarde voor x te geven)	Anders, namelijk...
120	
150	
300	
100	
2 × 170 km	
100	
100	
90	
150	
400	
120	
100	
150	
160	
130	
150	

Statistic	Value
Min Value	1
Max Value	7
Total Responses	33

17. Als u de auto met mensen zou moeten delen, met welke mensen zou u dit dan willen? (Meer dan één antwoord mogelijk)

#	Answer		Response	%
1	Met iedereen die het wil		16	48%
2	Met iedereen uit de gemeente Lochem		15	45%
3	Alleen met mensen die ik goed ken		3	9%
4	Met niemand		1	3%
5	Anders, namelijk…		2	6%

Anders, namelijk…
2 kinderen naar school
Liefst in de nabije omgeving

Statistic	Value
Min Value	1
Max Value	5
Total Responses	33

18. Welke dingen wilt u over het nieuwe reserveringssysteem en elektrische auto's weten? (Meer dan één antwoord mogelijk)

#	Answer		Response	%
1	Hoe het reserveringssysteem werkt		23	70%
2	Hoe een elektrische auto in het algemeen werkt (denk aan de mechanische delen, de accu, verschillen ten opzichte van een auto met een verbrandingsmotor en gevaren en voordelen van een elektrische auto)		9	27%
3	Hoe ik een elektrische auto aan een laadpaal kan opladen		16	48%
4	Hoe ik batterij-efficiënt met een elektrische auto kan rijden om mijn bereik te vergroten		10	30%
5	Ik heb geen nieuwe informatie nodig		6	18%
6	Anders, namelijk…		0	0%

Anders, namelijk…

Statistic	Value
Min Value	1
Max Value	5
Total Responses	33

19. Hoe zou u meer te weten willen komen over hoe het reserveringssysteem werkt? (Meer dan één antwoord mogelijk)

#	Answer		Response	%
1	Ik wil alle belangrijke informatie op een website.		22	96%
2	Ik zou graag willen praten met een ervaren persoon.		5	22%
3	Ik zou graag een cursus willen volgen.		0	0%
4	Ik zou graag een test (bijv. een vragenlijst met een score aan het eind of een praktische test zoals in de rijschool) willen doen om zeker te weten dat ik alles begrijp		2	9%
5	Ik wil deze informatie zelf opzoeken op het Internet		2	9%
6	Ik weet al voldoende		1	4%
7	Anders, namelijk...		0	0%

Anders, namelijk...

Statistic	Value
Min Value	1
Max Value	6
Total Responses	23

20. Hoe zou u meer te weten willen komen over hoe een elektrische auto in het algemeen werkt? (Meer dan één antwoord mogelijk)

#	Answer		Response	%
1	Ik wil alle belangrijke informatie op een website.		7	78%
2	Ik zou graag willen praten met een ervaren persoon.		5	56%
3	Ik zou graag een cursus willen volgen.		0	0%
4	Ik zou graag een test (bijv. een vragenlijst met een score aan het eind of een praktische test zoals in de rijschool) willen doen om zeker te weten dat ik alles begrijp		2	22%
5	Ik wil deze informatie zelf opzoeken op het Internet		0	0%
6	Ik weet al voldoende		0	0%
7	Anders, namelijk...		0	0%

Anders, namelijk...

Statistic	Value
Min Value	1
Max Value	4
Total Responses	9

21. Hoe zou u meer te weten willen komen over hoe u een elektrische auto aan een laadpaal kunt opladen? (Meer dan één antwoord mogelijk)

#	Answer		Response	%
1	Ik wil alle belangrijke informatie op een website.		12	75%
2	Ik zou graag willen praten met een ervaren persoon.		7	44%
3	Ik zou graag een cursus willen volgen.		0	0%
4	Ik zou graag een test (bijv. een vragenlijst met een score aan het eind of een praktische test zoals in de rijschool) willen doen om zeker te weten dat ik alles begrijp		1	6%
5	Ik wil deze informatie zelf opzoeken op het Internet		0	0%
6	Ik weet al voldoende		0	0%
7	Anders, namelijk...		3	19%

Anders, namelijk...
deze info moet in de auto liggen
Filmpje
Ik zou op mijn smartphone willen kunnen zien waar ik de auto op kan laden.

Statistic	Value
Min Value	1
Max Value	7
Total Responses	16

22. Hoe zou u meer te weten willen komen over hoe u batterij-efficiënt met een elektrische auto kunt rijden om uw bereik te vergroten? (Meer dan één antwoord mogelijk)

#	Answer		Response	%
1	Ik wil alle belangrijke informatie op een website.		9	90%
2	Ik zou graag willen praten met een ervaren persoon.		4	40%
3	Ik zou graag een cursus willen volgen.		0	0%
4	Ik zou graag een test (bijv. een vragenlijst met een score aan het eind of een praktische test zoals in de rijschool) willen doen om zeker te weten dat ik alles begrijp		0	0%
5	Ik wil deze informatie zelf opzoeken op het Internet		1	10%
6	Ik weet al voldoende		0	0%
7	Anders, namelijk...		1	10%

Anders, namelijk...
info in de auto

Statistic	Value
Min Value	1
Max Value	7
Total Responses	10

23. Heeft u nog andere wensen of behoeften voor het gebruik en reserveren van elektrische auto's?

Text Response
Een zelfrijdende elektrische deelauto zou op termijn helemaal ideaal zijn. Zeker als die na mijn spraakgestuurde boeking via mijn Apple Watch zelf voor komt rijden en nadat ik op mijn bestemming ben aangekomen ook weer zelf wegrijdt.
Geen
Ik zelf momenteel niet, maar hoop dat het gebruik van EV in Lochem goed van de grond zal komen
Duidelijke instructie voor het aan- en loskoppelen van de laadkabel
Het zou mooi zijn als het gebruik van elektrische deelauto's gecombineerd zou kunnen worden met met een eenvoudige en niet te kostbare mogelijkheid om in voorkomende gevallen een benzine of dieselauto te huren, bijvoorbeeld voor het trekken van een caravan in vakanties. Hiermee zou het bezit van een eigen auto niet meer nodig zijn.
Ben erg tevreden met en blij dat LE de huur/deelauto heeft opgepakt.
--
kostenplaatje mbt diverse auto's
Vormen van abonnementen
nee
nee,
--
Nee

Statistic	Value
Total Responses	13

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