Graduation thesis
Delft University of Technology
MSc. Strategic Product Design
Faculty of Industrial Design Engineering

Ford Motor Company
Livework Studio

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"Man is by nature a social animal"

- Aristotle

PREFACE

In precisely 100 days, I completely dove into the world of autonomous vehicles and their future users and delivered this thesis full of insights. Where at first, I thought that a graduation project was all about showing what you have learned in your master program, I found myself doing a project where almost everything was entirely new for me. Doing observational research in San Francisco, organising acting-out sessions and focussing on user interactions, are all far from the approaches I have used throughout my studies. This allowed me to learn additional skills and keep me motivated and challenged thought out the project.

Although I enjoyed the luxury to schedule as I please and work based on motivation instead of office hours, a fully individual project did feel a little lonely from time to time. The absence of study-buddies, groupmates or colleagues made me even more grateful for the people who supported me over the course of this project. Therefore I want to thank Nick for being a listing ear when I needed one, Mirte, Lot, Silke and my mom, for reading through some my work and Leonie, for helping out with the little things.

I also want to thank everyone involved in guiding me through this project.
To start with Dirk and Maaike, even with your cramped schedules and busy lives, I always felt that you were genuinely involved with this project.
A specific thanks to Dirk, because even though our conversations could start about sheep and end talking about failed artist communities, they always guided me to the strongest insights, for which I am very grateful.

I want to thank Maaike, first of all for providing me with the opportunity to go to San Francisco and giving me a head start to get around in that fantastic city and secondly for showing a great level of confidence in me.

Furthermore, I was lucky enough to get to work with Nicole from Ford again. Her enthusiasm for IDE and this graduation project gave me a lot of energy during the project, and I want to thank her as a company representative for giving me the liberty to pursue the paths I thought were right.

Lastly, I want to thank Jan for his coaching on behalf of Livework. His inclination to solemnly embrace sumptuous terminology combined with his 'theezakjes humor' made it very enjoyable to discuss the complicated matter of relational design.

With all that said and done, I hope you will enjoy looking at the results of this thesis as much as I enjoyed doing this project.

EXECUTIVE SUMMARY

Changing mobility

Mobility is one of the fundamentals of our society and for the first time since the introduction of the automobile in the 1900s, we face a disruptive change in our mobility ecosystem.
The rise of autonomous technology will allow us to get from a to b while being able to do other activities on the go.

Challenges in change

Although autonomous mobility will go hand in hand with many benefits, we still have challenges to overcome if we want to implement autonomous vehicles to their fullest potential.
If we want to get rid of all the mobility problems we have today, such as congestion, traffic accidents, air pollution and parking limitations, autonomous vehicle rides should be shared.
Ride-sharing will allow a larger part of our population to join the autonomous revolution, contributing to Ford's goal to democratize mobility and increase the ease and speed of implementation in society.

Ride-sharing

For this to succeed, it is essential to understand peoples motivations to share (or not share) rides. Today's mobility landscape in San Francisco allowed me to research current ride-sharing concepts.

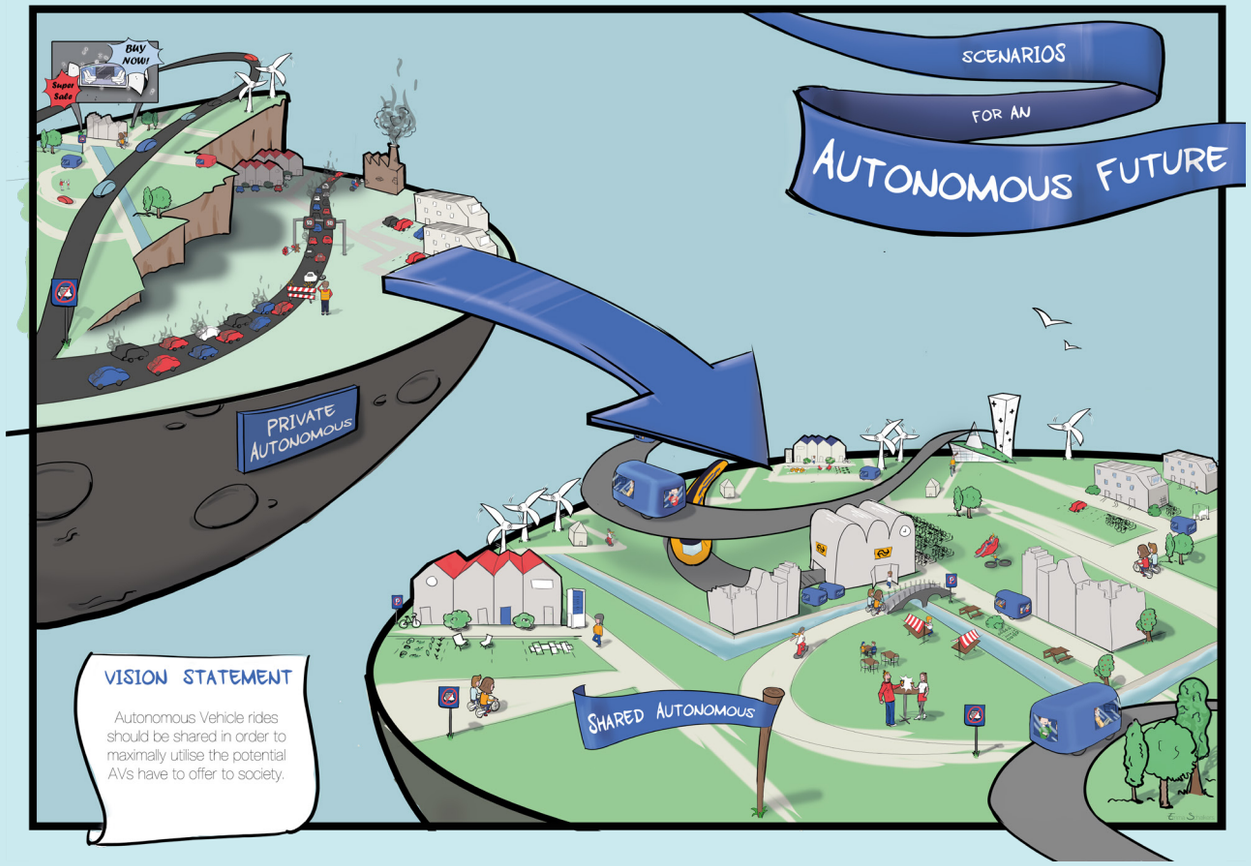
Here I experienced ride-sharing myself and interviewed relevant actors in the servicescape, to find that interpersonal contact is a substantial differentiator in the ride experience. Another main finding revolves around the drivers, whom we are trying to eliminate as we are moving towards an autonomous future. The roles the drivers take on besides enabling transport, bring essential values to the user experience.

Scope

After gathering extensive user insights during field research in San Francisco and learning about the potential positive effects of AV ride-sharing, I scoped the project to the daily commute in the Netherlands. This use case holds excellent potential for business, but more importantly, has the duration and frequency to make it worth to invest in the interpersonal relations amongst users. As well as diminishing the negative effects of human-driven vehciles (HDVs) on the daily commute in society.

Acting-out

By co-creating and acting-out shared concepts for the daily commute, I further explored the values and desires of future users. This has led to many insights, design qualities and a lot of funny moments. The raw insights are assembled in the additional deliverable: Session Booklet. The central findings are taken to the synthesis phase.



Synthesis

To bring all these insights together and make them communicable to Ford, this thesis holds multiple deliverables. Starting with the following vision statement:

Autonomous Vehicle rides should be shared to maximally utilise the potential AVs have to offer to society. To successfully design shared AV rides for the daily commute, the service provider should gain individual insights to facilitate a common understanding amongst co-riders & provide a sense of control for each user.

This vision is visualized in a communicative drawing, showing a little bit, about a lot information. Since the user insights go much deeper than what can be shown in the drawing, a set of criteria for designing shared AV rides for the daily commute, is created too, showing a lot about a little bit.

The criteria are accompanied with a user narrative. This narrative shows how users will experience their daily commute in an AV ride-sharing service, that is designed accordingly.

COMMON ABBREVIATIONS

AV:	Autonomous Vehicle
TNC:	Transportation Network Company
H-H:	Human to Human
U-S:	User to Service
U-U:	User to User
EV:	Electric Vehicle
FAVES:	Fleet of Autonomous Vehicles Electric & Shared
HDV:	Human Driven Vehicle
VMT:	Vehicle Miles Travelled
URP:	University Research Project
MaaS:	Mobility as a Service
MoD:	Mobility on Demand
AI:	Artificial Intelligence
CRX:	Customer Relationship Experience
CJM:	Customer Journey Map
OEM:	Original Equipment Manufacturer
ETA:	Estimated Time of Arrival

GLOSSARY

Deadmiles: Distances driven by TNCs or taxies or without a passenger. AVs that are driving deadmiles are called 'ghostcars'.

Co-rider: A co-rider is a fellow passenger on your ride, with whom you did not order the ride. Most likely someone you do not know, or did not know before using the ride-sharing service.

Ride-sharing: In this report, ride-sharing is defined as a trip where two or more individual ride-requests are paired in one vehicle. A shared ride is obtaining multiple people at the same time, while traveling to the destinations of all passengers.

I. Introduction

This graduation project is part of a larger collaboration between Ford Motor Company and Delft Technical University, the University Research Project (URP).
For this particular thesis Livework joined in the collaboration with Ford and the TU Delft.
The Introduction Phase will shed a light upon what I aim to deliver and how this fits in the URP between Ford and TU Delft. Furthermore, it will give insights into some of the methods I have used and what I value as a designer.

Picture: Aerial View Architecture
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RAISON D'ÊTRE

Ford is heavily investing in autonomous vehicles and is aiming to release fully autonomous vehicles in 2021(www.corporate.ford.com). Ford is stated to be one of the frontrunners in autonomous technology development (Navigant Research, 2017).
But in order to be successful in the mobility ecosystem of the future, Ford needs to get a deeper understanding of the motives and needs from their future users.
The shutdown of their shuttle services Chariot, illustrated their growing awareness on the essence of user and ecosystem understanding (Techcrunch, 2019).

"In today's mobility landscape, the wants and needs of customers and cities are changing rapidly"

- Chariot

Ford is currently in collaboration with the faculty of Industrial Design Engineering (IDE) at the Delft Technical University in a University Research Program (URP). This collaboration is titled: 'Service Innovation for Mobility; sensing deep customer insights and seizing creative opportunities for new mobility services'.
It aims to improve co-design activities for future services, with a focus on autonomous ride hailing and goods delivery.
This three-year program should answer how state of the art methods for generating deep customer insights inform the exploratory prototyping of solutions for future contexts.
This graduation assignment takes place at a later stage of the URP and is focused on the opportunities within the scope of ride-hailing (called ride-sharing in this thesis report), where sensing the deep customer insights has been the main focus. This is where the collaboration with Livework company becomes interesting.

Livework is a service design consultancy that since its establishment in 2001, has tried to push boundaries in the field of service design, regarding theoretical foundation, methodology and the impact on people's lives and work. In 2017 they encountered the following problem statement:
'Academics and practitioners alike recognize that practitioners lack both the tools and the knowledge to enable them to successfully design for relationships in a customers' experience.' (Koenders, 2018)
The lacking tools and insights on the subject were generated through the graduation thesis of Jan Koenders. This graduation thesis will put these tools into practise and evaluate their function when designing for relationships in a customers' experience in the scope of autonomous vehicle ride-sharing.

PROBLEM DEFINITION

Over the past years Ford has grown its core capabilities in technological development of the vehicle. The rise of autonomous vehicles is anticipated to have a disruptive impact on today mobility ecosystem and will spark new possibilities in our means of transportation. These new possibilities and technological advancement form the technology-push and market-pull that is moving today's car manufacturers in new directions.
A previous graduation project within the URP with Ford and IDE was completed with creating a holistic future vision and suggested possibilities within the future mobility ecosystem for Ford, by answering the research question: 'How can Ford prepare itself and design for the disruptive technology of autonomous vehicles within the mobility ecosystem of 2030?' (Verbaan, 2018)
The concerning thesis written by Ruben Verbaan unveiled (amongst other opportunities) the potential of ride-sharing. This thesis will provide a deeper understanding in the subject of ride-sharing, with a focus on the user desirability.
Throughout the course of this thesis, literature regarding relational design and interpersonal contact have formed the foundation for designing for User-to-User relations. This contributes to the expertise of Ford because their main expertise is centred around the technical development of vehicles.

I aim to gain a deep user understanding for the future context of AV ride-sharing and will do so by focussing on facilitation of interpersonal contact amongst riders.

Firstly, the importance of sharing is elaborated, followed by the effects of interpersonal contact on the service experience. Discovering the importance of interpersonal contact in an AV ride-sharing servicescape led to the following research question:

>> How can Ford facilitated a desired state of interpersonal contact amongst users in an autonomous vehicle ride-sharing service for the daily commute?

More detail on how this research question came to be, and the vision statement answering this question, will be explained throughout this thesis report.

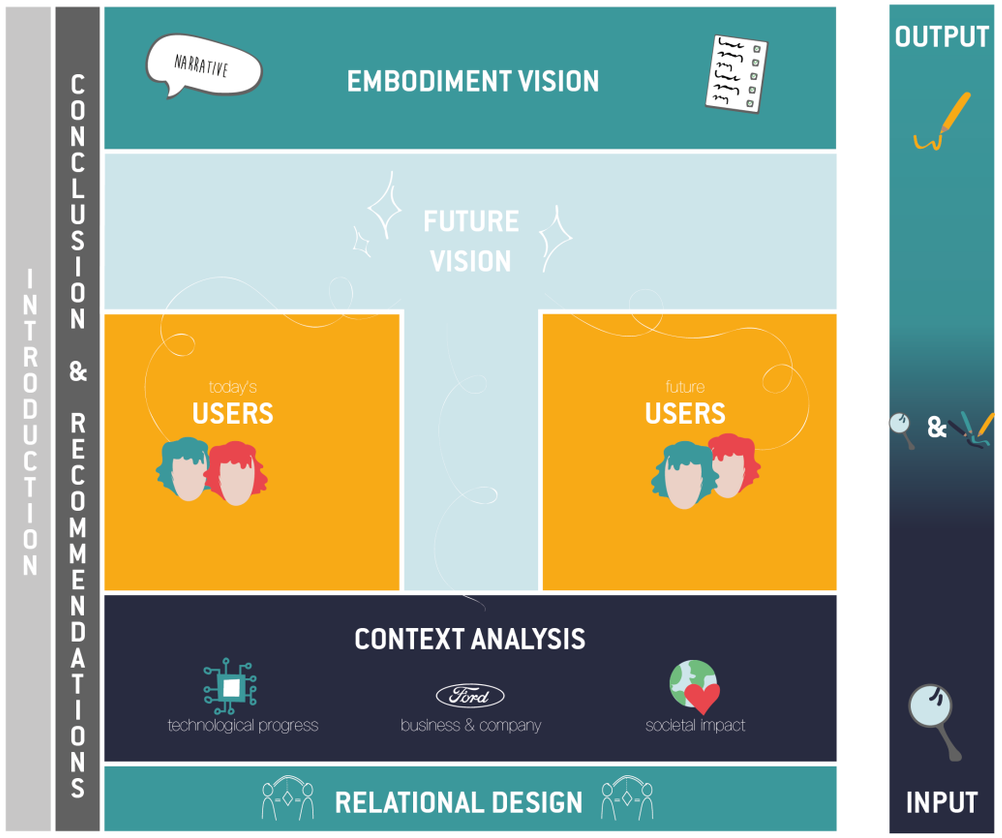
ASSIGNMENT

In order to launch a successful ride-sharing service, Ford needs to understand the values of AV ride-sharing from a consumers perspective. I have acquired knowledge on users' motivation in ride-sharing today, by interviewing drivers, riders and doing observations when experiencing such services myself. Also I involved the future users of such a service in several co-creating and acting-out sessions to translate the motives and values of today into a future mobility context where new forms of interactions amongst users will occur. By combining these insight with the field of relational design, I created the criteria for a future ride-sharing service from a users' perspective.

The scope of my project in terms of time is set around 2030 (depending on the exact time AVs will take over) and the use case of this thesis is the daily commute with the Netherlands as its base. Along the way I have gathered a lot of interesting information about user needs and requirements for AV ride-sharing. Most of these findings revolve around interpersonal contact amongst users, but some are more general influencers for an AV ride experience. With the raison d'etrê, problem definition and assignment explained I will elaborate I little more on my process.

PROCESS

The image on the next page is a visual representation of the content of this report. The built up does not represent the chronological order of the process, but the size and structure do symbolize the impact of each part in the whole.
As you can see, relational design has functioned as a foundation for this thesis and has provided me with a different lens to look at the context, users and vision. The context analysis, on technology and societal impact, forms the base of the future mobility vision and has given me the right directions to conduct the proper user research.
User research is split up in two parts, one focussed on today (field research) and the other on tomorrow (sessions) both giving essential insights to complete my vision on ride-sharing in an autonomous future.
Upon this vision I have built requirements to fulfil this as Ford, a narrative that makes it more tangible and last but not least implementation steps.
On the sides you see that the introduction, conclusion and recommendations are there to cover the entire story. Of course there are also some parts that did not make it in the final cut of this report, but are included in the appendix as reference work or enrichments.



Visualisation: Thesis built-up

READING TIPS

White text on the color of the current chapter indicates concluding or essential text. Be sure to read these texts!

White text on a grey back ground is enriching text (e.g. processes or examples). These texts do not have to be read to understand the final results, but give insight in where the results came from.

DESIGN METHODS

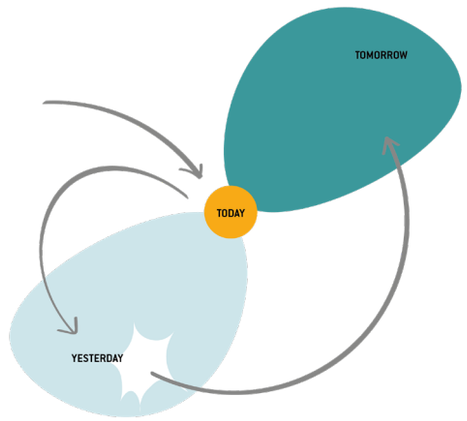
The graduation thesis is roughly divided into three content parts: (1)Input, (2) (Co)-creation and (3) Synthesis. The input phase entails the context analysis, literature research, field research and user findings. The co-creation phase is all about future user sessions and delivered both in- and output for the final results. In the last phase, all the insights have come together in different manifestations. This chapter briefly describes the main methods I have used in each phase.

Input phase

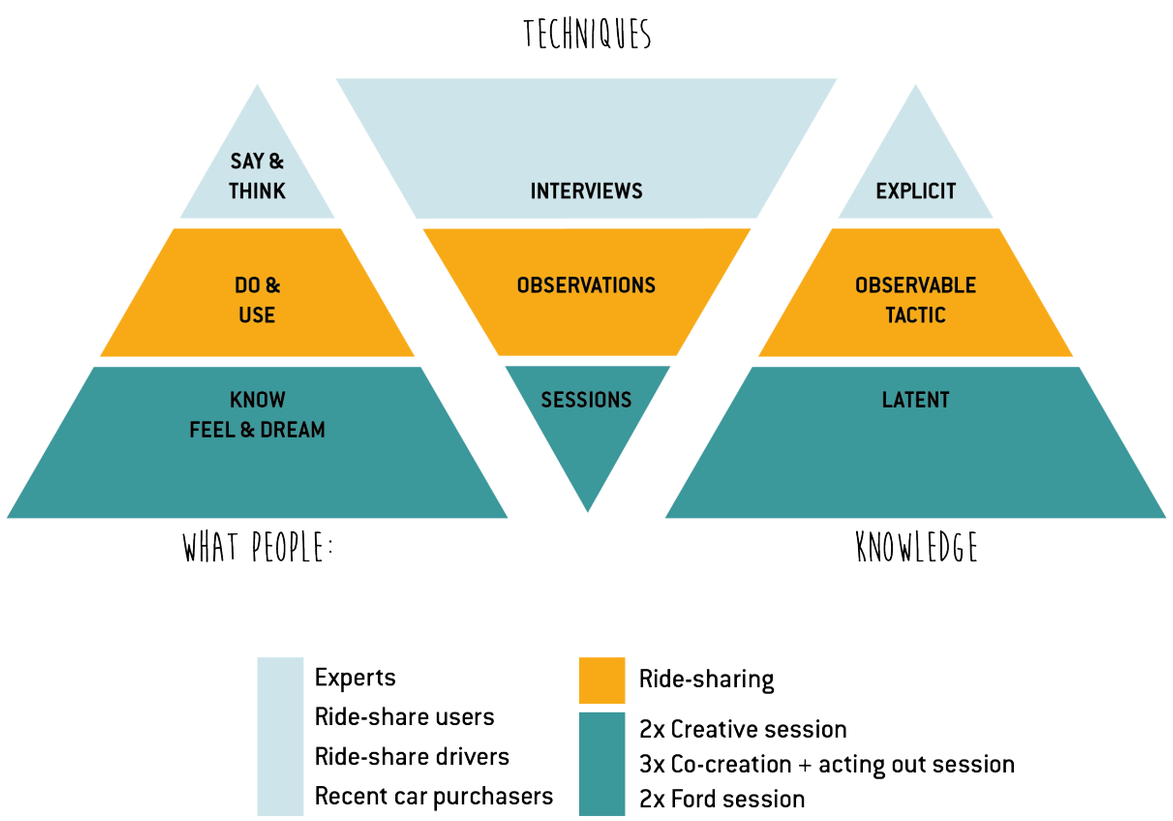
The design challenge of this thesis is one that requires a deep understanding of the needs of the user. The pyramids with types of knowledge and researching techniques visualise the different kinds of methods I used for what type of information (Sanders & Stappers, 2012). During this phase, explicit knowledge was gained through interviews (with TNC users, experts and TNC drivers). Observable & latent knowledge about ride-sharing were gathered through observations. Also, the last type of 'knowledge' was gained through becoming the user through autoethnographic research, or a so-called service safari (Stickdorn, 2010). To keep track of my experiences, since camera or microphone usage was mostly inappropriate, I design little sheets to keep track of all the experiences I had while being a ride-sharer.

(Co)-creation phase

On top of the need to gain deep user understanding about today, the design challenge is one set in a context that does not exist yet. To obtain insights on the requirements and desires of the future users for this AV ride-sharing concept, I have made use of different types of creative sessions. This provided me with insights on people's dreams and future desires. As a follow-up, the path of expression formed the base in al sessions, to use today's experiences to relive their past experiences and use those to envision the future (Sanders & Stappers, 2012). Furthermore, these sessions were designed and facilitated according to the theory and practices of creative facilitation (Tassoul, 2009). Last but certainly not least, these sessions made use of acting-out to experience concepts.



Path of Expression.
(adopted from: Sanders & Stappers, 2012)



Visualisation: Types of knowledge (adopted from: Sanders & Stappers, 2012)

Picture of acting-out session 3.

Synthesis phase
The last phase contains a visualised vision, of both the future of mobility and the facilitating role of the service, a set of criteria and a narrative to illustrate future use of the service. The coherence of these deliverables is shortly explained here.

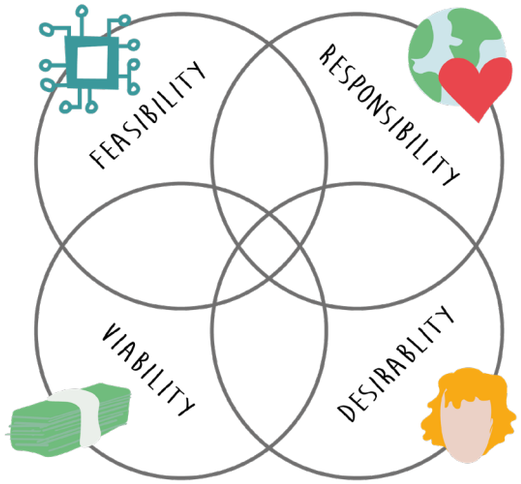
Vision building
The synthesis part of this thesis revolves around building a vision for the future ride-sharing service. A vision should have four characteristics: (1) clarity; (2) value drivers; (3) artefact; (4) magnetism, to be able to activate others (Simonse, 2017).
Clarity of the vision means that the vision expresses an immediate understanding of how someone would experience that future (Reid et al., 2015; Shipley, 2002), that is why the chosen artefact is a so-called 'praatplaat' (also known as a visualised vision). This type of deliverable allows for metaphors and little scenarios. It also gives the possibility to communicate a lot without much effort of the reader by applying the 3-30-300 rule, making it more engaging. The value drivers are explained in the context analysis phase, stating clearly why sharing is key to a desirable and responsible mobility ecosystem.

Criteria & Narrative
The visual is a great way to communicate a little bit about a lot. However, a visual does not entirely cover the dept nor the handles to design with all the user insight gain through the process of the graduation thesis.
These insights are translated into design criteria. Moreover, these criteria are illustrated through a user narrative. According to Schneider et al., requirements (or criteria) can be broken down into a set of user stories, summarising what customers or users want to be able to do; used to bridge design research with defining requirements (Schneider et al., 2019; Kimbell 2014).

DESIGNERS TAKE ON THE CHALLENGE

During this graduation project, I would like to design by the guidelines of my personal take on strategic design as I established during the course Strategic Value of Design. Here I positioned myself as a Social Strategic Design based on an adapted model for strategic design innovation (Calabretta, 2016). With the core belief that success in design and innovation should not be found in the centre of desirability for the users, feasibility through technology and viability for business, but should be located in the spot where these factors meet a certain responsibility for society.

"As a social strategic designer, I am capable of creating support for visionary ideas, by translating future visions into tangible ideas and strategies. I like to address complex societal problems by breaking them down into manageable issues and create viability trough commercializing sustainability and societal proplems."



Thought-out this report, the state of technology will function as building blocks, which will be stacked in such a way that it meets both the requirements for a viable business as a responsible design for society. The shape of the construction will be defined by the way people would wish to use this service to guarantee a desirable design.

II.
Input Phase

Picture: View from Doloris Mission Park

CONTENT

The first phase of this report, the input phase, contains the information that I have gathered to eventually create a mobility and interaction vision, design criteria and a user narrative.
This phase consists of four chapters, which contain both desk, field and literature research. Together they will provide a context analysis, insights of ride-sharing research and discloses relational design in this design context.
This phase is followed by the co-creation phase which resolves around the creative and acting-our sessions. The co-creation phase serves both as in- and output for the final results.

1. CONTEXT ANALYSIS

This chapter will combine the trend analyses for this thesis, leading towards my vision for an autonomous future. Starting with some insights into the mobility initiatives of Ford, followed by a short explanation regarding the state of autonomous technology, to end with the possibilities of autonomous vehicles and sharing-rides on our society. All the information gathered in this chapter leads to the initial vision statement.


Fig 1. Parking in Amsterdam

Fig 2. Congestion in traffic


Fig 3. Car emissions

Fig 4. Car crash

Fig 5. Protester against mobility poverty


Fig 6. On demand mobility


Fig 7. Overcrowded train platform

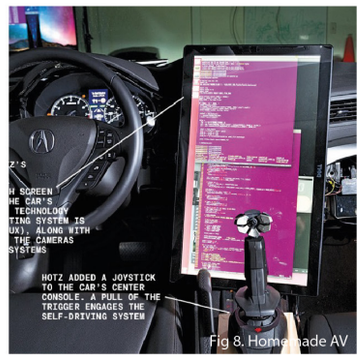


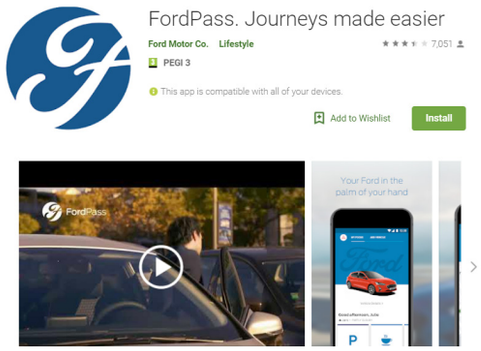
Fig 8. Homemade AV

Fig 9. AV by Ford

1. FORD MOTOR COMPANY

Ford is one of the oldest automotive businesses, with Henry Ford as its founding father. Henry Ford is famous for his invention of the first mass-produced vehicle, the Model T, in 1913. Ford envisioned the freedom of movement for society. In the early years (1900 – 1950), the automobile increased the quality of life for society (e.g., improved access to healthcare or cheaper housing because people could commute longer). Currently, automobiles dominate the streets, creating limitations in human freedom and their connection to society.
Jim Hackett, Ford's current CEO, has shown their will to change. With the rise of servitization, AI and autonomous and connected vehicles, he has described their ambition to change what the automobile means, both to its users and society.

Several Ford projects illustrate this ambition. The application FordPass, today operating as an amplification to improve ownership experience, but aimed to be transformed into a travel companion in the future of shared mobility (Seive, 2019), is a good example that shows Ford's ambition to grow beyond a traditional car manufacturer.



Screenshot: FordPass application

"Our company was founded on the promise that freedom of movement drives human progress. Now, with the power of AI and the rise of autonomous and connected vehicles, for the first time in a century, we have mobility technology that won't just incrementally improve the old system, but can completely disrupt it."

-Jim Hackett

Picture: Chariot van

Ford Chariot, however not in operation any longer, is a good example of shared mobility solutions. This concept operated on the principles of MaaS (Mobility as a Service) and was used as a commuter shuttle. The shutdown of Chariot has not been discussed openly but is most likely due to a lack of profitability (Logan, 2019). This is partially due to sustaining a lot of drivers and competition with Lyft and Uber (Korosec, 2019). There own statement about the shut down, included a the 'rapidly changing customer needs', showing the importance of a good user understanding when operating a mobility service.

Screenshot: the Living Streets

The Living Street is a perfect example of an initiative that is aimed at a positive impact on society and aims to illustrate the power of giving back the street to its residents.
And to quote their own words: "By creating a market demand for private automobiles, combined with policymaking in support of private auto-mobility, car companies have shaped cultural norms and design principles that still influence streets today. With a new perspective on mobility must come a new set of design principles for street stewardship, street design, and mobility creation. Ford created the National Street Service to ensure that new technologies and services it creates help carry streets forward to a future that puts people at the center of this vital public space." (Living Streets, 2019)
See appendix 3: Principles for the Living Streets, for a better understanding of these principles.

2. AUTONOMOUS TECHNOLOGY

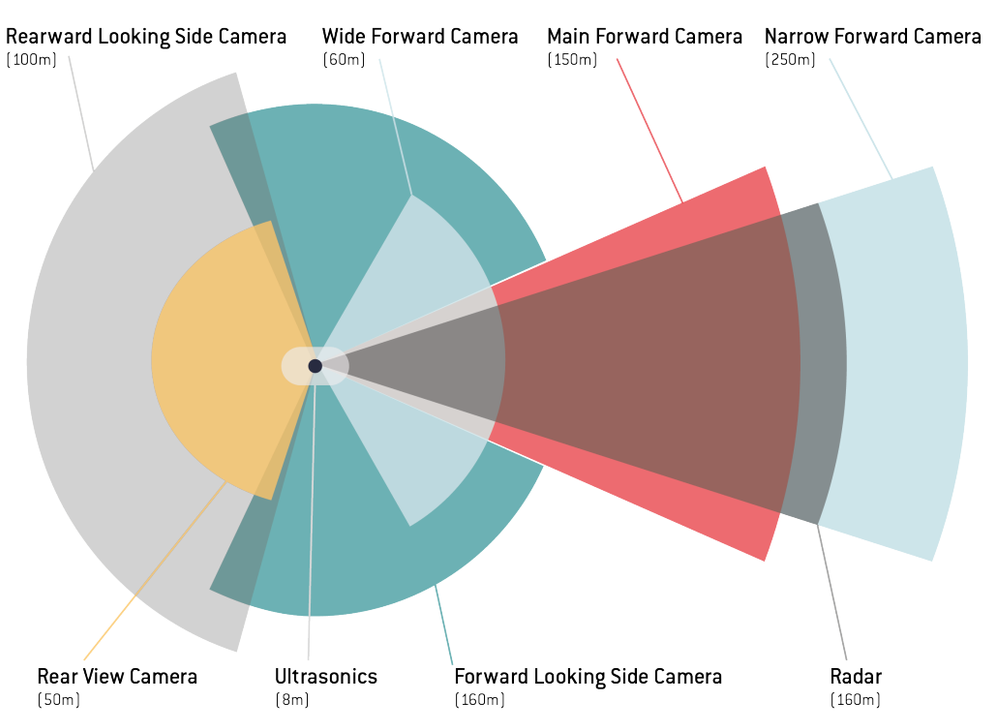
Mobility is one of the fundamentals in our society and on the verge of a disruption that we have not seen since the introduction of the Ford Model T in 1913. To understand what has sparked this possible disruption, I dove into the technological world around autonomous vehicles. This chapter will be a summary of the state of autonomous technology in the car industry. The information is required through expert interviews, previous work for Ford but mostly through literature and desk research. For a more comprehensive explanation, see Appendix 1: Autonomous Technology Trends

The state of autonomy

Fully autonomous cars hold great potential, today we are not quite there yet, but over the course of this thesis, the developments have already been significant. When level 5* in autonomy is reached, and cities have adapted to this mobility mode, ride-sharing will be possible since cars will be able to autonomously drive to and from a user's destination.

Superiority of autonomy

Well designed and adequately programmed AVs hold the potential of becoming far superior to human drivers. With better sensors than our senses (see illustration), swarm intelligence, learning in vacuums, interconnectivity and machine learning



Visalisation: Capabilities of sensors in AVs anno 2018. (addopted from Tesla)

together will create smarter and safer vehicles. AV technology is highly likely to become a reality in our daily lives and with the drivers becoming obsolete, the opportunity sparks to move away from car ownership to car usage, and to integrate different rides into one vehicle; ride-sharing. However, what will motivate us to share our AV rides? This will be explained in the next chapter.

"If we wait until these vehicles are nearly perfect, our research suggests the cost will be many thousands of needless vehicle crash deaths caused by human mistakes. It's the very definition of perfect being the enemy of good."

- Nidihi Kalra

3. IMPROVING OUR MOBILITY LANDSCAPE

In the Netherlands, we have a relatively good infrastructure and very decent mobility possibilities, but there are still many challenges we need to tackle. Moreover, there are many opportunities within our current state of mobility, that have been left unnoticed because they are taken for granted the way they are today. This chapter will delineate the possibilities that a Fleet of Autonomous Vehicles Electric and Shared (FAVES) has to offer to improve our mobility landscape.

Traffic Deaths
Yearly 1.25 million people die in traffic, and 90% of these deaths are to blame on human behaviour (WHO, 2016; Hariri, 2018). Unfortunately, this number is only increasing due to phone usage whilst driving (Raalte, 2017; CBS, 2017).

Parking
On average we use our cars for only 5% of the time, which means that 95% of the time our cars have to be parked (D. Morris, 2016). Having over 8.3 million cars in the Netherlands has led to the need for 15 million parking spots, by now occupying 5.1%* of our used land (NEN 2443; KIM, 2018; CROW, 2018). Also, the Netherlands is amongst the countries with the highest share in paid parking, leading to 1 billion euros of costs in 2010. With average rates of €2,61/h and a maximum of €10/h this accounts for a large cost for many car users (van Ommeren et al, 2011; Staalduine, 2017).

HOW FAVES HELP

Technological superiority over human flaws is the main reason for increased road safety when AVs will be integrated in society. Safe miles travelled is already higher in AVs than HDV (SFCTA, 2018), and Deloitte estimates the annual amount of lives saved at 1,24 million (Corwin et al, 2015).

As shared AVs will be driving around for a larger time of the day, since it will be used by multiple people a day. A ride-shared AV will also occupy more people at once. This will significantly increase the vehicle miles travelled (VMTs) per day and therefor decrease the time a car is parked and the need for parking spaces. Another positive influence of AV's in terms of parking is that the vehicles do not have to be parked nearby the users destination, since it could drive itself to the destination upon request (Metz, 2018).

Emissions
According to the Environmental Protection Agency (EPA), transportation is the second largest emitting sector of carbon dioxide (CO2) (Schrank, et al, 2012). In total it accounts for 19% of the worldwide CO2 emissions (Russell, 2015). Another burden to our environment is overproduction; having 8,3 million cars, in the Netherlands alone, that are only being used for 5% of the times, indicates the need to improve the use of these materials.

Congestion
The amount of motor vehicles has increased with 50,5% since 2000 (CBS, 2019). This is one of the reasons for the increase in congestion (Plicht, 2018), and we are facing an increase in travel time of 35% due to congested roads (Kim, 2018). Building more and wider roads has had the opposed effect as desired (Unen, 2018) and has led to an average increase in congestion of 20% in 2018 (Dinther, 2018).

Emission from car use alone, is expected to decrease between 40%-90% with a rise of AVs (Corwin et al, 2015). AVs still need energy and the estimation is that 4% of the total energy demand in the EU would be needed to power AVs. This might sound like a new way of pollution, but it also has the potential to push green energy markets to grow faster (Hannon et al, 2016).
If we create a society in which we would share our cars and rides, we could meet a mobility increase of up to 50% with the same number of vehicles we have today (Hannon et al, 2016).

The impact of autonomous vehicles on congestion is highly debated. Most research shows that there are many factors to take into account when making an educated projection; like the level of advancement of the AV's, whether they are shared vehicles, whether competing automakers will allow their cars to have V2V and V2I communication amongst one and another, the infrastructure, urban or suburban environment, and many more (World Economic Forum, 2018; Cox & Hart, 2017; the World Bank, 2002).
Assuming a system based on a FAVES within the most advanced stage of mobility, it will have a positive impact on the congestion on our highways. Where congestion in the city at first might increase, a higher level of advancement will solve this (Cox & Hart, 2017; World Economic Forum, 2018). And traffic jams outside of the city centres will already feel a decrease in congestion in the earlier stages of the integration of automation as a study for Boston by the World Economic Forum shows.

Costs
Providing and maintaining an effective mobility landscape does not go without costs, through taxes and fees paid by residents or road-users these costs are kept at a minimum, but today's traffic still requires a significant amount of money (Vermeulen et al, 2004); congestion alone costs €3,7 billion a year (van der Aa, 2017), and a €2,6 billion investment in expanding roads has had hardly any effect. Next to these costs there is a significant expenditure on accidents, counting up to over 11 million euros a year (Wijnen, 2012).

Urbanization
Urbanization is expected to grow with 30% over the next 15 years, this will put pressure on already crowded and popular places of residents (Hannon et al, 2016).

'Mobility poverty'
A problem of today's society is that a significant number of people do not have proper access to mobility (Kampert et al, 2018). In Dutch, this is called 'vervoersarmoede', which will be translated as mobility poverty. Mobility poverty is defined as the discrepancy between the travel needs and travel possibilities (Brouwer & Davidse, 2002). The limited mobility options result in people being unable to fully participate in society (Meert et al. 2003). A broad range of people is characterized as being at risk of mobility poverty, e.g. people who do not own a car or live in an area without public transport, but also people who a physically disabled or too old to travel.

HOW FAVES HELP

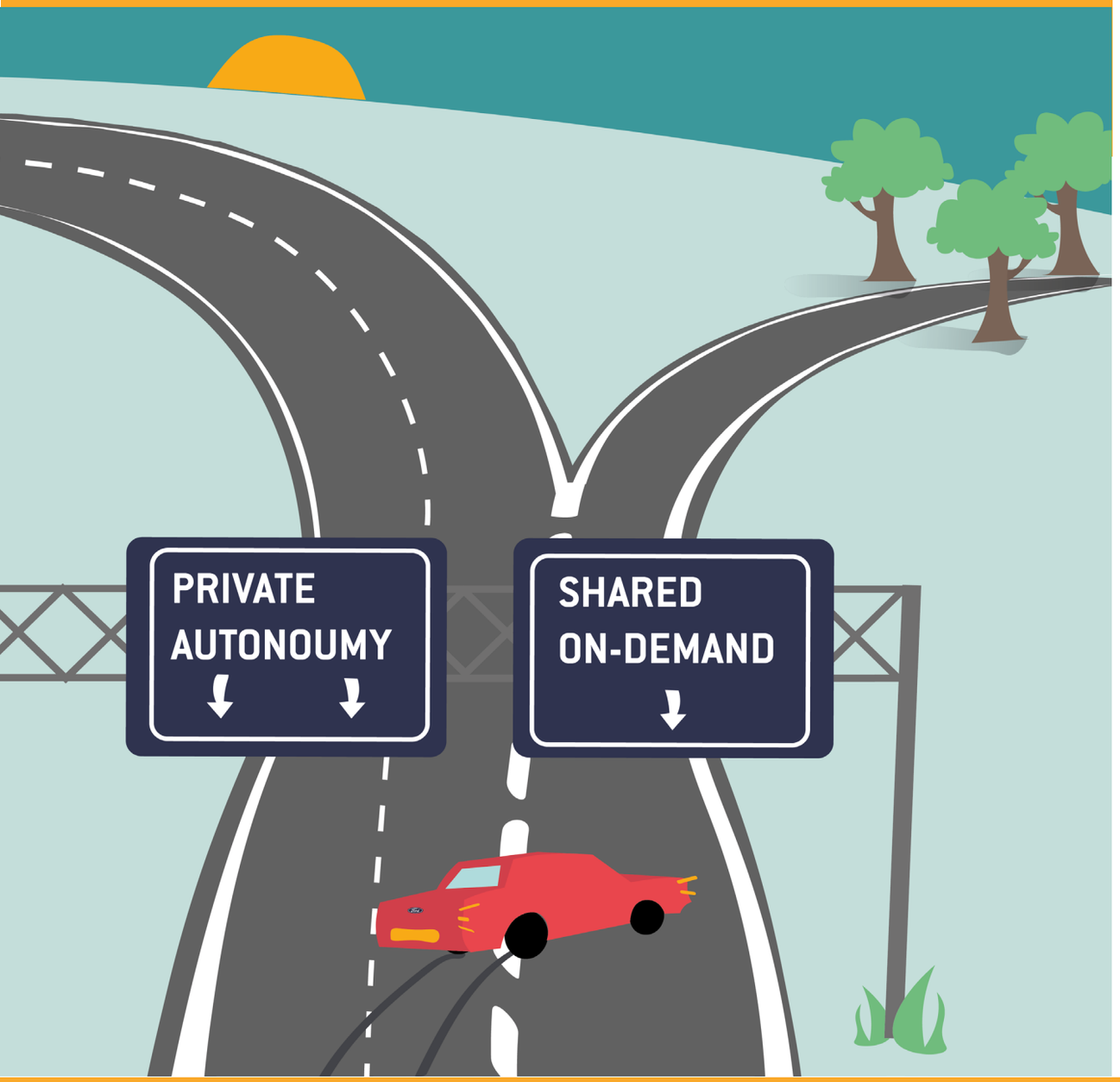
The initial costs for making infrastructure AV ready might be higher than what is being spent on road improvements today. These costs are very hard to estimate, but since the Netherlands is viewed as one of the most 'AV ready' countries, the forecasts are not too bad. McKinsey&Company quantify the possible cumulative societal benefits for a mobility future with shared automated mobility at ~ €6500 (converted from $7,400) per person (boosting 2030 GDP by 3.9%) (Hannon et al, 2016).

One of the few trends that might indicate a decrease in urbanization is the rise of AVs. Being able to spend your travel time in a more valuable way, and experiencing a seamless journey even if you live in a remote area, could potentially open up new areas of residents that are not viewed as desirable places to live today (Metz, 2018), And so decreasing pressure on the housing marking and demographic aging on the countryside.

FAVES pose a possible solution for some of the cases of mobility poverty. People who are physically unable to drive will benefits since they won't have to anymore. People who cannot afford a car could potentially benefit by taking away the initial cost of investment and the risk associated with car ownership. And lastly people in remote areas can benefit from shared AVs by being able to travel on demand to any location without having a high dependence on their car.

CONCLUSION CONTEXT ANALYSIS

The combination of AV technology and the switch from ownership to ride-sharing holds the potential to reshape our mobility landscape into a mobility ecosystem less burdensome to the environment and public space, safer, more efficient and on long term; cheaper. Offering such a service would contribute to the goals of Ford as it could give the street back to the people and further democratise mobility.



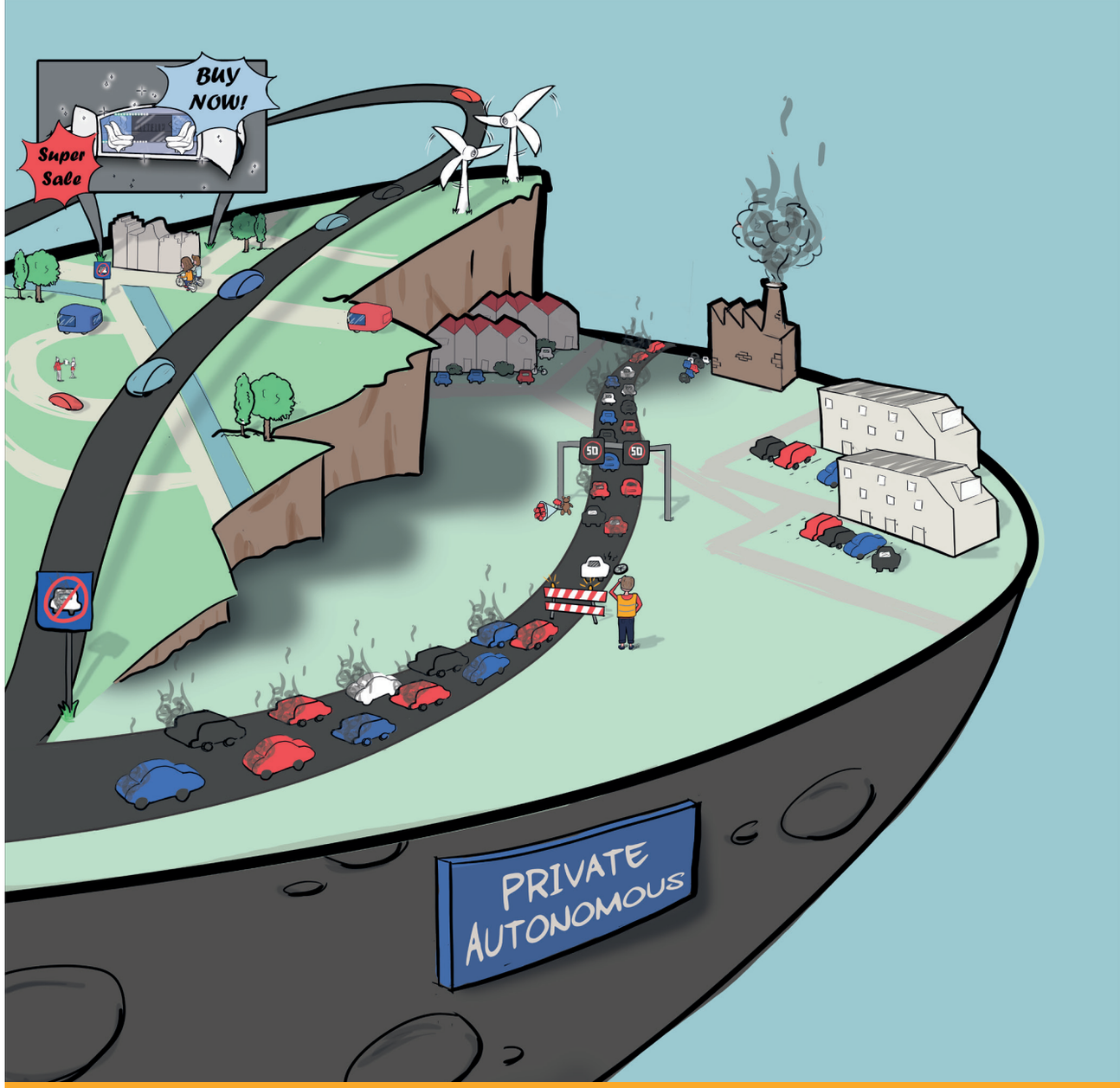
4. FUTURE MOBILITY VISION

As the sun sets in today's mobility landscape, where people own their vehicles and car manufacturers merely sell them, car companies should make a choice in what path to take. Private autonomous vehicles pose an attractive and simple iteration to the existing business models car companies are currently having. On the other hand, this is a critical moment when it comes to positioning your company in a new mobility ecosystem and the perfect moment to choose a path that might lead to new business opportunities and more responsible positioning.
From a users' perspective, tomorrows mobility landscape will inevitably have both private autonomous options as shared, on-demand systems. The previous chapter has clearly illustrated that an autonomous mobility ecosystem offers more significant benefits when it is combined with sharing systems, especially ride-sharing systems. The causes and effects of the elements together with the reports of two major consultancy firms (Deloitte, McKinsey Company) have provided me with the insights to sketch the desired vision for tomorrows mobility landscape. Also, to illustrate a likely future scenario that does not uphold all these benefits to demonstrate why I believe sharing to be essential for a positive mobility future.

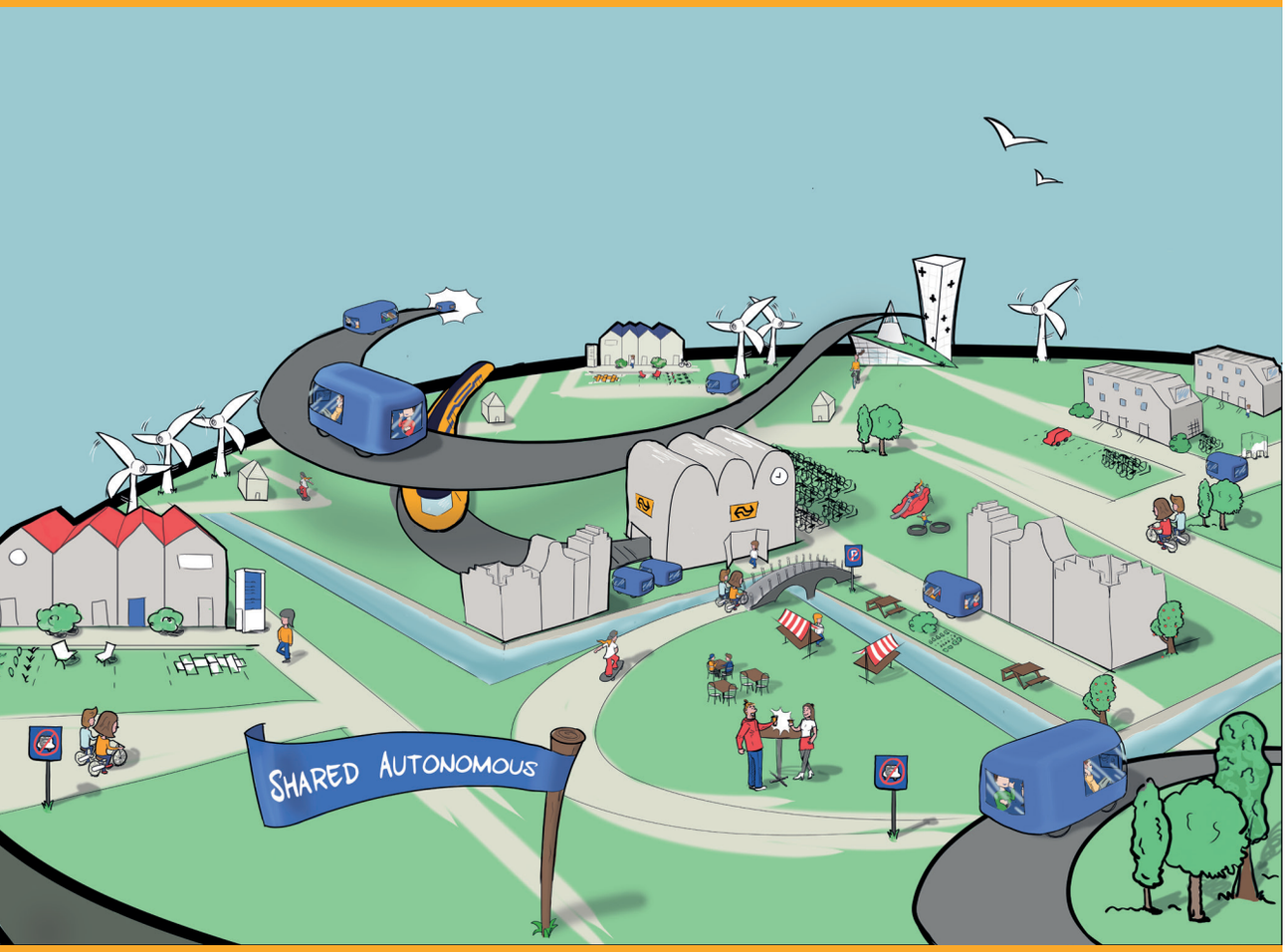
4.1 PRIVATE AUTONOMOUS

The first option; exclusive autonomous, or described as ‘private autonomy’ by Hannon et al. (2016) is more convenient to accomplish. It this would require society to consume mobility more or less as we are doing today. The people who can afford it can buy an AV for personal use, enjoying benefits like no parking, doing other activities during their commite, and being picked up at any desired location. AV ownership would still contribute to road safety, and some extend to pollution caused by emissions but also holds many downsides on a societal level. First of all, the demand in cars would be unlikely to decrease, since the ones who can afford it will have obvious benefits on offer, there is no reason to assume that the ongoing trend of increase in the number of cars sold in going to decrease. The integration of automation in mobility would slow down since the transition from HDV to AV is not affordable for all on a short term, assuming that you would have to purchase the vehicle. This would mean that the less fortunate in terms of wealth will slow down this mobility transition. And so, slowing down the benefits of AVs since AVs would perform best with lesser HDVs allowing infrastructure optimisation for automation. Furthermore, these HDVs owned by less wealthy people are likely to be older models, being less sustainable for lacking fuel-efficiency or electrification.

Another downside in this mobility scenario is the extra deadmiles driven by the AVs after dropping off, or before picking up their owners. In this mobility future, we would reduce the time a vehicle is parked, but increase the VMT without a passenger (deadmiles). This has adverse effects on congestion and emissions.
Lastly, but certainly important, private autonomy would increase the wealth gap in society. Firstly, because it would allow the more wealthy people to save much time by reallocating their commuting and travel time. Secondly, because wealthier people get to enjoy safer transportation, which will also influence insurance costs, for example. Thirdly, their vehicles will be more sustainable vehicles, resulting in paying fewer taxes and being able to use faster and newer AV designated lanes.



The future vision where individual autonomy will have the upper hand is visualised on this planet . The crack in the earth symbolises the gap in society, that is growing larger because of the difference in mobility options. The higher ground thrives with autonomous fast-lanes, and the AV promotion symbolising that consumerism and ownership mentality is maintained. Furthermore, we see restrictions in certain areas for car use, depriving people in older cars from accessibility. Lastly, the upper ground also contains ghost-cars (AVs driving without a passenger). On the lower level, we see traffic jams and old fashioned cars that still cause pollution. We also see that there is still a need for parking spaces, next to a factory that symbolises the overproduction that continues to exist. The traffic accident and the flowers at the speedsign illustrate the accidents that come with HDVs.



This planet symbolises an optimal future mobility scenario. This future mobility vision includes elements from the image created in 'The Transformation of Ford' (Verbaan, 2018), the Livingstreet principles (Appendix 10) and the visions of McKinsey and Deloitte (Hannon et al., 2016; Corwin et al., 2015). On this planet, sharing is the new normal, and this positively affects several types of locations. In the residential areas, you see parking spots being reallocated as places where people can enjoy being outside. The city centre could become parkingless and restricted for sharing and public space only, visualised trough people enjoying the street and the absence of cars. The highways that connect villages and cities are uncongested, and there won't be any emission coming from the vehicles anymore. The vehicles are shared and safer than they are today, and there will be far fewer ghostcars.

4.2 SHARED AUTONOMOUS

Luckily this second paints a prettier picture of an autonomous future. This vision is comparable to the so-called 'seamless mobility' scenario by McKinsey or the 'new era of accessibly autonomy' by Deloitte (Hannon et al, 2016; Corwin et al, 2015). Here we get to enjoy the additional possibilities that a ride-sharing system could bring to society. The results of these possibilities are shown through the manifestation of the living street principles in the city (Living Streets, 2019). These principles and there desired outcomes have functioned as guides in showing the additional opportunities in a new mobility system where individual mobility is no longer the dominant mode of transport.

All the downsides of the individual scenario don't hold-up anymore; this means that the VMT will increase without extreme amounts of deadmiles since other passengers can use the car. The integration of autonomous vehicles is likely to go more rapidly since sharing both the vehicle and the ride would mean way more affordable mobility prices, allowing a more substantial part of society to be part of this transition. This is a great way to democratise mobility, but also to sooner eliminate older, more polluting vehicles from the road. This on its own has the two benefits, the first is that a larger part of the vehicles is electrified which allows for the infrastructure to sooner adapt to AV's. This adaptation will open up the possibilities of the full potential of AV's (AVs optimised high ways, for example, could have more vehicles driving more densely together at a higher speed without risking crashes).

Another benefit of AVs directed in a system over personal use is the possibility to geofence (a certain amount of) vehicles. This could mean that, for example, cars cannot stand still for over 10 minutes in city centres, or that there are only 1000 vehicles allowed in the city centre of Delft at a time. By doing so promoting walking or biking as last mile solution.

Shared mobility rather than individually owned cars will also allow for the refurbishment of today's vehicles into AVs since companies would no longer sell the vehicle but mobility itself. With the effect that the outside of the car will matter less since it becomes less attached to you as an individual. This would allow people to sell back their cars and, for example, enjoy a mobility subscription in return, thus creating less pressure on the environment in terms of production.

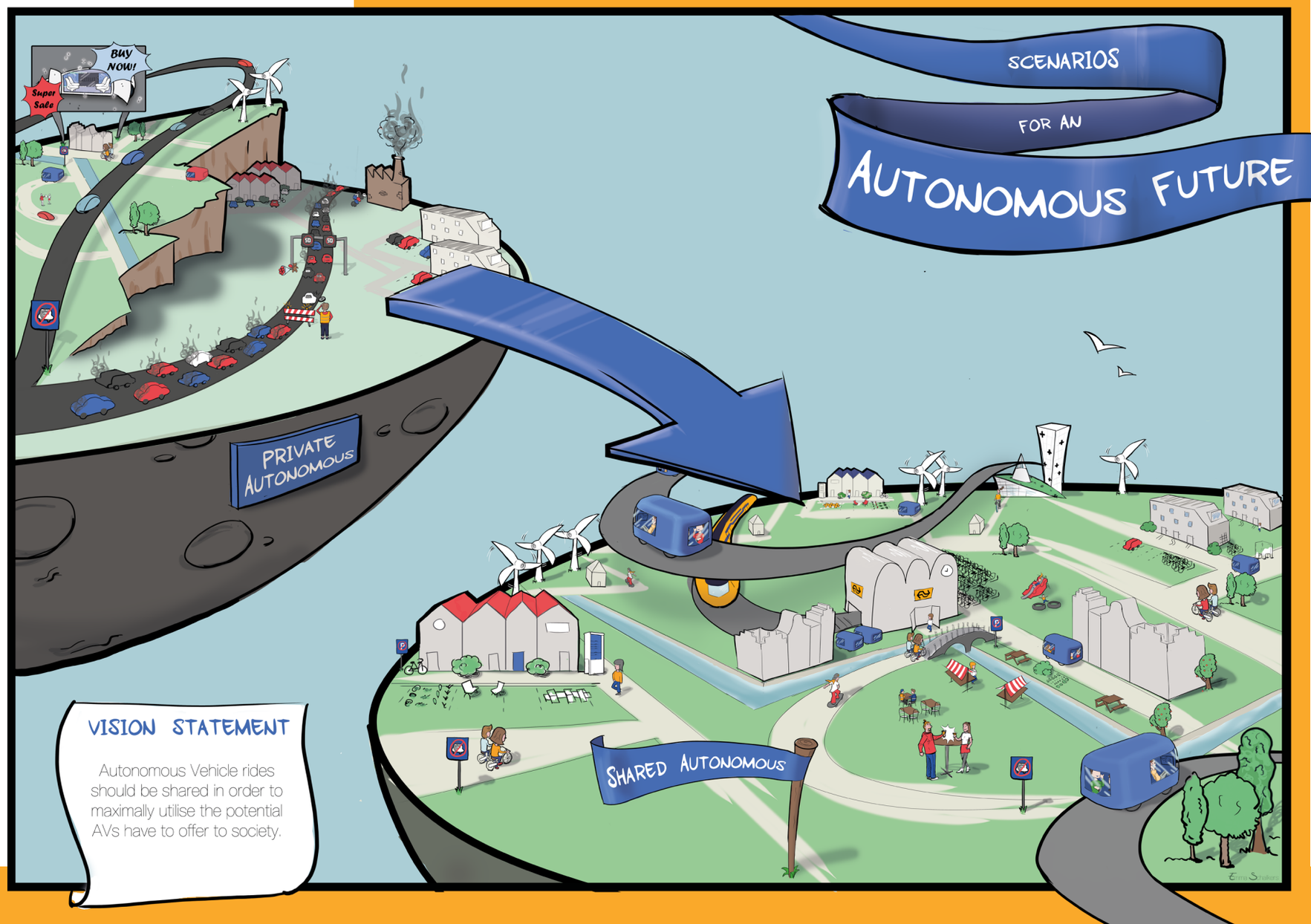
5. CONCLUSION

Making AV ride-sharing attractive is vital to utilise the potential AVs have to offer to society. The challenge in achieving the positive future of mobility is finding the sweet-spot in desirability without compromising societal responsibility nor viability for business.

The next chapter; Ride-Sharing Research, will look into peoples motivations (not to) share ride and strives to gain a better user understanding.

4.3 SCENARIOS FOR AN AUTONOMOUS FUTURE

Provate autonomous offerings are easier to accomplish compared to ride-sharing services. Since private options offers excellent benefits to people who can afford it and (high end) car manufacturers can continue their current businesses.
Luckily TNCs are showing a different possibility and have proven the power of shared on-demand mobility, which can grow with the rise of AVs. Society will most likely encounter a reality where both scenarios will exist next to each other. However, as a car manufacturer, you can position yourself in either one of them.
The company Ford, with its slogan; democratising mobility, fits far better in the shared future scenario, where on-demand ride-sharing would be a primary mode of transportation, living up to their vision of making mobility accessible for the many and giving the street back to the people. To make such a ride-sharing service, Ford needs to gain knowlegde about the future users of such a service. They need to understand how to motivate people to share their rides, and how to offer a nice shared ride experience.

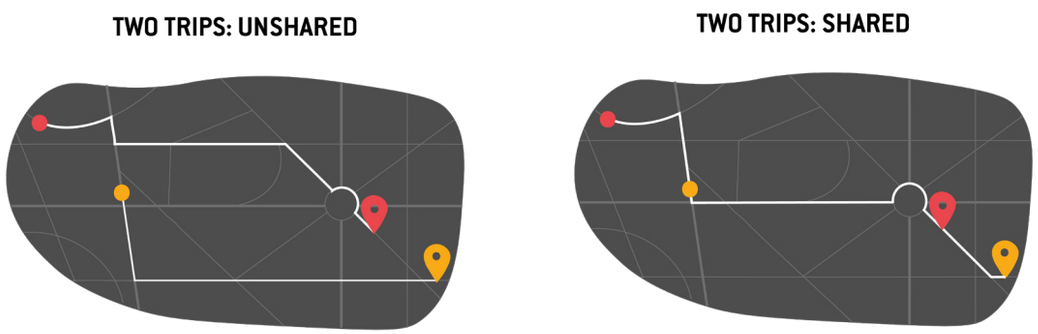


2. RIDE-SHARING RESEARCH

This chapter will explain people's motivations for ride-sharing, give insights in experiences on the go and aims to illustrate the profound differences between ride-sharing today and those in an autonomous future. First we start with an explanation of ride-sharing before going into the field research findings of San Francisco.

1. INTRODUCTION TO RIDE-SHARING

When two or more people share the same vehicle to get from their location to their destination, we speak of ride-sharing. There are multiple types of ride-sharing, joining your friends for a ride, travelling with public transportation or carpooling to work with a colleague are also considered to be shared-rides. During this thesis, the focus lies with on-demand ride-sharing services; this means that the service operator caters to your need, and you can request a pick up anywhere at any time(requiring no planning). This also means that it is uncertain with whom you will travel.
The essence of ride-sharing is illustrated in the images below. Via a platform, most likely to be a mobility service, two or more requests for rides from a nearby location to a nearby destination are being matched. By doing so significantly reducing the VMTs or vehicles needed to serve both requests to go from A to B.



Visualisation: Impact of Ride-Sharing

The rise of the internet, adaptation of the smart-phone and new mobility platforms have made ride-sharing a very easy and accessible option for travel. In the USA, we see ride-sharing services provided, by companies like Uber and Lyft, and in Amsterdam we have the company ViaVan with a ride-sharing service, all with a lot of daily users.
These services are still operated by human drivers, but in the near future we will start to see the first robot taxis driving in the streets. The autonomous vehicle is a great opportunity for the implementation and application of ride-sharing services, but it does come with a lot of challenges on its own, which will be discussed in great detail in upcoming chapters.

2. FIELD RESEARCH SAN FRANCISCO

As part of my research, I got to visit San Francisco. Here I studied how and why people use ride-sharing services, became a user of the services myself and learned a lot about new possibilities of San Francisco's mobility landscape.
Throughout this visit, I conducted expert interviews at the Centre of Automotive Research Stanford lab (CARS) at the University of Stanford. Met and discussed research with the students of the Berkeley Research for Autonomous Vehicle Opportunities (BRAVO) and Berkeley University. Visited, presented and conducted interviews at the Greenfield Labs in the Palo Alto office of Ford, and learned a lot about mobility from the San Francisco County Transportation Authority. All these opportunities taught me a lot about the industry, but even more interesting are the user insights gained through interviews.
I created the opportunity to interview European (mostly Dutch) people living in the bay area, who are using ride-sharing services. They provided me with insights into their motives and experiences. Furthermore, I interviewed TNC drivers who could provide me with more generalised information about their users.
Also, last but not least, I learned and experienced the most by actually using the ride-sharing services myself.


Fig 1. In the Greenfield labs


Fig 2. Testing Ford AV


Fig 3. View SFCTA

Fig 4. Ford GoBikes

Fig 5. Ford Greenfield Labs


Fig 6. CARS Lab at Stanford


Fig 7. Popularity Ford GoBikes

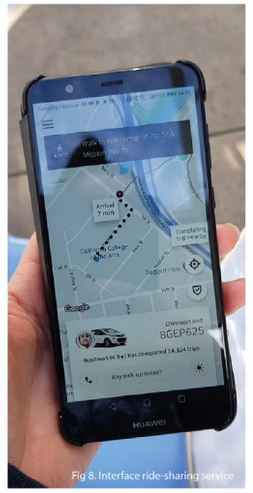
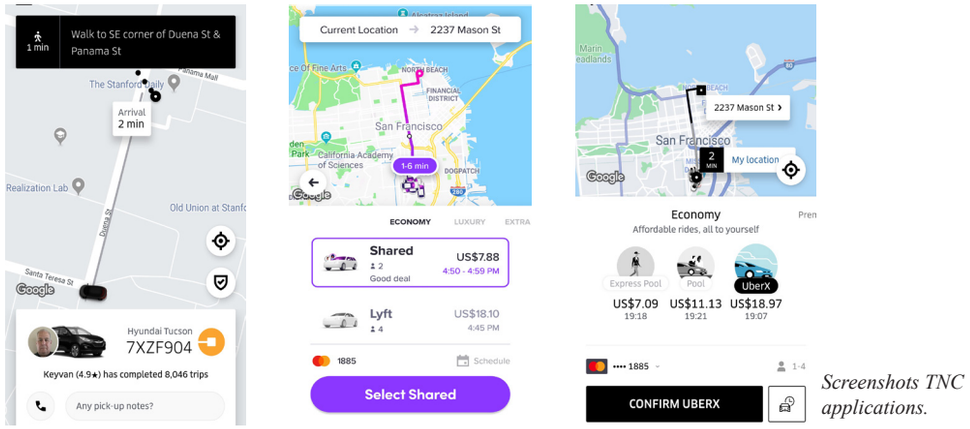


Fig 8. Interface ride-sharing service

3. MOBILITY LANDSCAPE SAN FRANCISCO

San Francisco is a very up to date city when it comes to new mobility solutions. Both Lyft and Uber are very popular services, just like the shared Ford GoBikes and the Scooters (stepjes). Besides these new mobility modes, San Francisco also has bus lines across the city, cable cars, the Caltrain, the BART and most of its residents are the owner of a car.
During my stay, I have made use of the Caltrain, BART, Cable car and Ford GoBikes, each of them is the best option for a specific circumstance, but I mostly used TNCs to get where I needed to be. Since this is also the mobility mode least known to us in the Netherlands, this chapter will briefly explain their most popular possibilities:

- Uber X & Lyft
- Uber Pool & Lyft Shared
- Uber Express Pool



Screenshots TNC applications.

These services are the most common options of TNCs, both the service providers offer a ride from location A to location B through an application that allows for an on-demand experience and seamless payment. When ordering a regular sized car, you are allowed to bring up to 4 people on your ride, and the total costs increase slightly per passenger.
Before ordering an UberX or Lyft, you get to see the price, your ETA and route. You also see the different possibilities that the service has to offer. On your phone, you can keep track of the driver location after ordering your ride, and you can see the model, colour and licence plate of the car to make it recognisable. You also see the face, name and rating of your driver.
Upon entering the vehicle, the driver is likely to confirm whether you're his passenger and to check your final destination. Your ETA and location are continuously available on your phone during the ride. After drop-off you are asked through the application to rate the driver and proposed with the opportunity to give a tip, three amounts, depending on the duration of your trip, will show to select easily, but it is also possible to enter a different number manually. The costs for the ride will be charged on your credit card automatically, and you will receive a receipt in your email right after arriving on your destination.

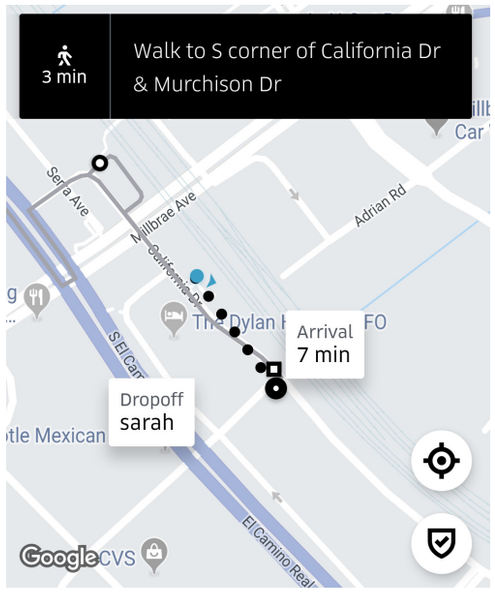
UberPool and Lyft Shared

The UberPool and Lyft Shared options within both applications are the more interesting ones concerning this thesis since it allows strangers to become co-riders.
Based on your pick-up and drop-off location, the TNC matches you with riders on a similar route. This newer service of Uber and Lyft requires a specific integration of the first service to properly function, for it needs to have enough users in an area to make the costs for sharing a ride so low (on average just half the price of the same ride solo).

Most of the user experience in terms of handling the application and the screens you will see are very similar or the same as you would experience when riding with UberX or Lyft. However, the most significant difference is that there either already are people (or a person) in your car upon entry, or that you might have to take a small detour to pick someone up along the way. These additional stops are displayed in your application in real-time. As soon as the driver accepted a new rider, you will be informed through your application when and where this pick up will take place and what impact this has on your route. On a functional level, this has benefits of lower costs and drawback of a less precise ETA. I did not experience an ETA that varied that much from the ETA initially displayed, but through interviews, I have learned that this can be very troublesome. The last possibility is that you request a shared ride, but that the service does not find anyone to partner you with. In this case, you get to enjoy the same trip as you would have when selecting the none-shared option, but paying a lot less.
On an emotional level, using a shared-service differs quite a lot. The social dynamics in a car, for example between you and a friend or between you and the driver, change when (a) new passenger(s) enter the vehicle. It can be experienced as awkward or rude to, for example, continue an ongoing conversation with a new person in the car. Most interaction between passengers is kept to a minimum with only greeting upon entry and saying goodbye when exiting.

Uber Express Pool

This last option, only offered by Uber at the moment, is both the cheapest and the newest. In terms of usage, it is precisely the same as the Lyft Shared or Uber Pool experience inside the vehicle and in terms of application screens. However, the user experience up front is quite different since this option gives you an offer in $ with the side note that it might require you to walk a few minutes. When ordering the ride you will not know what your exact pick-up spot will be nor where you will have to walk to, you one have the consolation that it will be a few minutes at most.
From a service provider and traffic perspective, this is a significant improvement, since it encourages people to walk to an easier or more on the route and safe pick up location. By doing so, avoiding one-way streets or congested parts of a city.
As a user, I personally liked this service a lot, mostly because the price reduction was quite significant, saving me up to half of the customarily shared option. From a co-riders perspective, it was less pleasant since the service was entirely new and some riders didn't understand what they had signed up for (or pretended to do so), making the driver picking them up or dropping them off at the exact location anyway.



Screenshot: Uber Express Pool

Others

Besides these services, both Uber and Lyft had a lot more to offer. There were possibilities to add additional stops, to book rides for others, to make a reservation up front and many more usability features. In terms of vehicles, you could also do many different luxurious requests, going from tinted windows to a limousine. There were also options for people with disabilities, offering them a service with assistance or wheelchair friendly vehicles for approximately the same price as a regular ride.

Realtime everything

The final information about the operating of these TNCs is the fact that it completely works on real-time data. This means that the prices, travel times, pick up times, chances of sharing or driving solo, are dependent from the time of day, your location, the weather, the traffic situation etcetera. This makes it hard to plan your details in advance as a user. From a business perspective, this is an excellent feature since it allows you to charge more when it is needed to maintain a 'profit' and from a system perspective, this allows for a quite sophisticated manner of traffic management, making the peak hours more expensive and quite hours more attractive for example.

Deadmiles

A significant drawback of today's mobility ecosystem in San Francisco is the number of deadmiles that are driven by TNCs and taxies. Deadmiles are the vehicle miles travelled without a passenger. Today this means that drivers are circling, and waiting for new passengers or that a driver is heading towards a pick-up point without a passenger. These VTMs are a negative development in our mobility ecosystem, especially in already crowded and densely occupied areas. In San Francisco, this poses a problem, since the amount of traffic has increased since the introduction of Uber and Lyft (SFCTA, 2019; Korosov, 2019).

Visualisation: Deadmiles

4. SERVICE SAFARI

The most valuable lesson I have learned in San Francisco was the ease of use of TNCs explained above. During my stay, I used both applications; Uber and Lyft, and I switched between both to experience the differences. Using TNCs as the primary mode of transportation allowed me to become a user and get valuable insights.
To keep track of all the rides, I used a little form to keep track of all the variables and write down noticeable activities see (Appendix 1.1). In total, I took 27 rides, varying from a few minutes to over an hour travel time. I took rides within the San Francisco city centre, but also rides starting, or taking me out of the city. I used the service to get to 'work' locations during rush hours and to get home after dark. I only ordered two unshared rides, but for all of the other trips, I used Lyft Shared, Uber Pool or Express Pool. The lessons learned can roughly be divided into the following categories:

1. Ease of use
2. Pricing & payment
3. Co-riders
4. Drivers
5. Objects

1. Ease of use and availability

As movie clip number 1 illustrates (USB Appendix 1: Lyft usage), the term on-demand mobility is no exaggeration! This unstaged movie shows how I am ordering a ride to Union Square from the hotel. Since I was actually in need of the ride, the movie is not great, but it shows that the process of opening the application and getting in the car is completed under three minutes!
The arrival of this car was faster than average, nevertheless, it plainly shows the comfort and on-demand quality of the service. Also, equally important, it shows that ordering a car does not have to take more time than getting in your personally owned car and entering your navigation data/finding your keys/walking to a parking spot, et cetera.

My personal experience with TNC services in the centre of San Francisco is backed up with user research by Forbes from 2014. Even though the research is relatively old for such an emerging market, it shows why people are using this service over other options, ease of payment, short waiting time and the fastest way to get there were mentioned by 30%+ of the respondents (Huet, 2014), and most reasons are related to ease of use.

2. Payment & Pricing

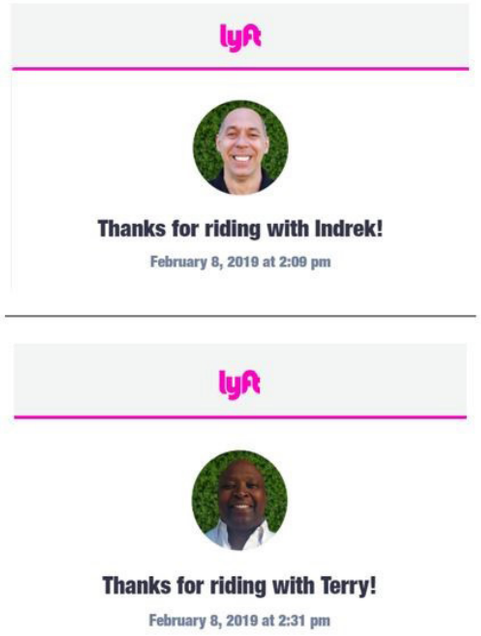
Experiencing a genuinely seamless transaction as payment was new for me, and I enjoyed it, and the graph above shows that I am not alone. The closest I have experienced in the Netherlands would be the OV-chipcard that recharges my balance automatically. However, the day to day experience is not seamless at all, since a check in, and out is required at every transit between mobility modes. Therefore the carefree experience of getting out of the car at your drop of location, without looking for cards of money was very convenient and, and my wallet could safely stay in my bag. Another positive thing about this automatic digital payment is that waiting for change from the driver, and the awkwardness around tipping is eliminated compared to taxis.
When it comes to pricing of TNC services, they are definitely competitive for public transportation in San Francisco. This I learned by weighing out my options through Google Maps, which showed the prices and the travel time of getting from A to B and also included the costs of Uber and Lyft.

3. Co-riders

Co-rides are the passengers driving in the same vehicle as you without booking a ride with them, therefore being likely to be strangers. I was especially interested in experiencing rides with strangers in such a small space compared to public transportation options. In general, I have experienced sharing as neutral to positive since the number of interactions between me and co-rides was quite low. After a few rides and some talks to drivers and residents of San Francisco, I learned that the norm is the say nothing at all to each other, to greet when entering, and leaving, and very occasionally have a conversation (usually orchestrated by the driver). I never had a bad experience with co-riders, at most being annoyed by their behaviour but never harmed, scared or endangered. Reasons for annoyance were little things heavy breathing from a heavily obese person, music I could hear through a headphone. A little more bothersome behaviour I encountered was rude behaviour towards the driver, asking him to drive a few blocks further or fighting about his incorrect pick-up location. I also had pleasant interactions with co-riders, for example when being picked up in Palo Alto where most people work in tech-firms, it was fun to have a conversation about where one another worked or a little later after dinner I had some fun conversations about where people were going for drinks.

4. Drivers

A critical insight gained through the usage of TNCs is the importance of the driver in both the functioning of the system as the social interactions and user experience. Before going to San Francisco, I decided to interview drivers since they would have had many passengers throughout their career and would be able to inform me on both the standard and extreme situations. These more generalised insights (some of the drivers have drover over 20.000 people) give me the possibility to compare what people say they do and what they would actually do. By talking to the drivers and the users, I learned a lot more about TNC drivers. This will be elaborated upon more thoroughly in the chapter; roles of the driver.



Screenshots: Lyft Drivers Field Reserach

5. Objects

Besides the actors in the services-scape, it was interesting to see the role of objects that help the service in its functioning. A self-explanatory one is the phone of the driver, on this phone, another interface, operating on the same service infrastructure. This application shows the driver the best routes, plus their current and expected passengers. These phones were visible to the passengers and often working with the sound on. Through observations and interviews, it became clear that this phone was intentionally positioned in such a way that the rider(s) could see and hear what was happening since many riders had indicated (both politely and very rude) to not trust the drivers' decisions without seeing that the application states that they should act in that manner.
A second interesting object is the Lyft Amp. The product makes the vehicle more easily to identify as a Lyft vehicle, especially in the circumstances such as rainy weather or after sundown when it is usually harder to locate the car that will pick you up. On the inside of the vehicle, the Amp offers a, very minimal, form of communication from the service directly to the riders (making the driver interactions less essential). It shows you what is happening to a certain extent, for example, indicating your drop-off. This might be a reaction to the monitored user need of being in control, and trusting the service over the driver. Alternatively, the first step towards a service without driver interaction, when thinking about AV TNCs.

Promotion Picture: Lyft Amp

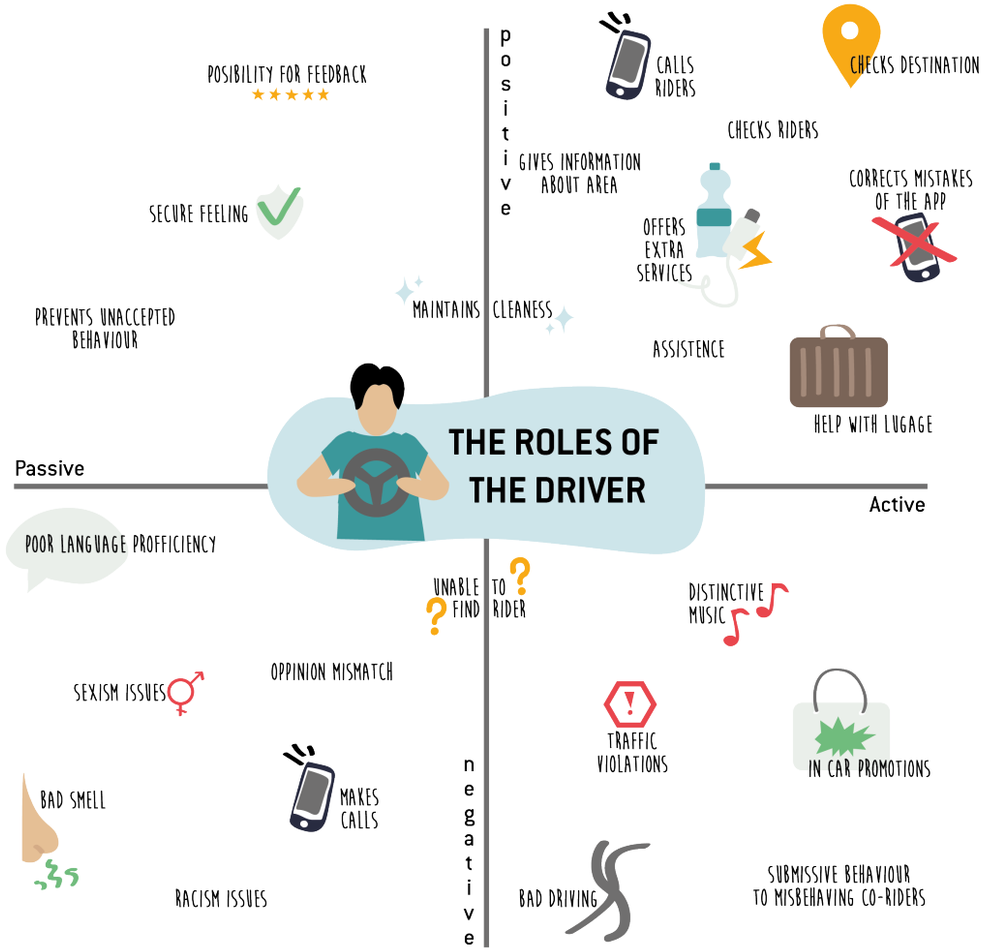
CONCLUSION SERVICE SAFARI

To shortly conclude my experiences with TNC ride-sharing are very positive. Using them was both comfortable and affordable, especially compared to the alternatives. Sharing a ride was a more neutral experience, then I would have expected it to be and became normal very quickly. The differentiating effect of the co-rider and the driver, however, were fascinating and will be elaborated upon in the following chapters. Lastly, it was interesting to see how many constant developments are going on in these mobility services, new service offerings, attributes, interfaces and fares are introduced monthly.

5. ROLES OF THE DRIVER

Except for bringing the passenger(s) from location A to location B, the driver*1 brings a lot more value to the experience. These qualities and activities of the driver have the potential of influencing the passengers' experience beyond the experience that the designed service brings. The effect of the behaviour of the driver can have a positive or negative impact on the passenger experience, and this behaviour of the driver can be both active (activities) and passive (qualities).
The way that the driver influences the effect on passenger experience is categorized over two axes; the vertical axe with a positive and negative side and the horizontal axe as the representation of passive versus active behaviour.
Within the scope of this thesis, the driver as a person is not an interesting actor in the servicescape, since the design will be based on an AV instead of a human-driven vehicle. However, the qualities of the driver and their effects on the passengers' experience, are essential to design an AV service that incorporates today's benefits that the driver brings. The behaviour that has a positive effect on the users' experience should be captured when designing future services that will not have a driver.
The behaviour that negatively influences the passengers' experience does not have to be designed into a service without a driver. Nevertheless, the quadrant passive/negative has to be taken into account, since these qualities are mostly due to being human and could occur in co-riders as well. The activities in the active/negative quadrant should not be designed into an AV service, and these negative influences on the passenger experiences can be easily overcome by programming the services responsibly.

**1: not every driver takes on all of these roles for all of its rides and might even never do some of them but it provides an overview of all the common roles drivers take on.*



1. Passive-Positive
These factors have a positive on the passenger experience, without the driver intentionally adapting or acting upon the situation.

- Providing a sense of comfort and security
- Presence of a human being
- Presence of a company representative
- Medium of feedback
- Means of interaction
- Prevents unwanted behaviour of passengers (from crumbling your breakfast to violence)

2. Active Positive
These activities of the driver are both pro-active behaviours and have a positive effect on the passengers' experience of the ride.

- Providing extra services (e.g. water bottles, chargers)
- Overrules mistakes in the app
- Calls to clarify
- Checks the boarding passengers
- Checks the destination
- Double checks traffic
- Helps with luggage
- Offers assistance
- Communication in unexpected events
- Maintenance of the car

3. Passive Negative
Passive negative behaviour is caused by the flaws of being human and are more dependent on the individual qualities of the passengers. Think about incidences concerning sexism or racism, whether this can influence peoples rides, is highly depended on the passengers' conditions.

- Poor language proficiency
- Bad smell (hygiene)
- Alone in the car with a stranger
- Unmatching opinions
- Racism and sexism struggles
- Unable to find the riders

4. Active-Negative
These activities are consciously performed by the driver but have a negative influence on the passengers' ride experience. They are mostly done because they bring personal benefits to the driver. For example, violating traffic rules such as stopping in the middle of a road, is done to drop off passengers on their desired spot, which might result in a higher tip or rating, but can cause feelings of unsafety for the co-riders.

- Violate traffic rules
- Poor driving skills
- In car promotions
- Making phone calls
- Adhere for misbehaving co-rider
- Distinctive music

To incorporate the behaviour that has a positive effect on the user, without having a driver, these have to be translated into passenger values, to understand why a particular action has a positive impact on the passenger instead of a negative one.

User values
1. Control

Having someone to address, giving you clarity & certainty and the means to intervene, (operational control).

2. **Safety**

Trust in system, technique and fellow riders. Feeling secure in terms of physical security.

3. **Hospitality**

Feeling welcome, being assisted, individual treatment.

These three core values will be investigated together with the passengers of the future in order to explore the needed elements for an AV ridesharing service that will make people feel in control, safe and welcome.

CONCLUSION ROLES OF THE DRIVER

The primary function of the driver is getting passengers from A to B. Besides this, he/she also takes on a lot of other roles. These roles are less operational, and are not taken on by every driver to the same extent, but can have a significant influence on the user experience. Most of the activities the driver does, besides driving, have a positive influence on the experience of the user, but some have a negative impact.

By eliminating the driver from the servicescape, we get rid of most negatives activities of the driver, but we will have some shoes to fill regarding the drivers' positive influences.

The user value gained through the activities the driver does will be shown in the Customer Journey Map (CJM) in the upcoming chapter, and will eventually translate into the interaction vision in the synthesis phase of this report.

6. USER INSIGHTS

"In today's mobility landscape, the wants and needs of customers and cities are changing rapidly"

- Chariot

Chariots quote on why they are shutting down their service illustrates the challenge mobility providers face today and will keep on facing in the future. The better you understand the deeper motivations of people, the more likely you are to design a service that fulfils their needs. Many smaller and personal insights have given me a broad perspective of user experiences, but two main themes provided me with the most valuable insights for Ford. The first one is the motives people have for sharing their rides, and the second one is the influence of human to human interaction on the experience on a shared ride.

"Ik doe meestal mijn ritjes delen, behalve als de baas betaalt, dan neem ik een privé ritje, want dan maakt het toch niet uit."

- TNC user

Motives for sharing
Interviewing users of TNCs shared option unveiled that people are willing to share and that they are doing so, based on rational benefits (mainly financial incentive and sometimes environmental concerns). They indicate that they would rather not share if these benefits would not be there.

"In that perspective it is better to take a lyft line(shared), because then you share a car and the environment impact would be less"

- TNC user

Influence of interpersonal contact
The interactions one has with others in the car, whether it is the driver or a co-rider, are highly influential for the customer experience of the shared-ride. When people do not, or barely, engage with other human beings during the ride, no special (dis)satisfiers came up. However, when discussing worst and best experiences, this was almost always related to interpersonal contact, either with the driver of the co-rider whereas negative interpersonal contact was stated to have a very negative influence on the customer experience and positive ones the other way around.

"One driver had like a cab karaoke, so people were like singing together in the car and having fun"

- TNC user

The negative influences people described were, in many cases, not even a real form of contact but forms of annoyance. Such as a bad smell, or loud music and awkward phone calls made by the co-rider. Positive experiences, however, were examples where co-riders happened to have things in commons, such a conference they were both attending. Alternatively, simple conversations with the drivers that turned out to be fun sparked peoples experiences to become their most positive ride share experiences.

Journey Map

The following customer journey map is created based on a combination of my own ride-sharing experiences and the ride-sharing experiences from interviewees. Its purpose is to give a general understanding of the steps people go through when using this service. The phases are based upon the formats provided in the book Service Design for Business from Livework (Reason et al., 2016). Starting with the before usage phase, the beginning, during (the actual a to b experience) and after.

On the vertical axis, the different user processes are plotted, starting with the activities (what do the users do at each stage), followed by their thoughts (what to people think while performing these activities) and their emotions (what to people feel and experience). As you can see on the emotion curve, there are two lines plotted since there is quite a lot of variation possible at some steps. The wider the coloured surface, the larger this variety, the more aligned the service, the more consequent people felt during this step. The bottom two rows in the journey map indicate the channels that people communicate through with the service and the bottom one represents the touchpoints that hold potential for a future ride-sharing service and show where the CRX (Customer Relationship Experience) opportunities lie for an autonomous vehicle ride-sharing service. These CRX touchpoints, strongly correlate with the interactions user have with the driver or co-riders and will be further elaborated upon.

The CRX denotations are moments in the CJM that can create a rational, emotional or supportive function for the relationship. This is the first step that should be taken according to the Design for Relationships Tooling of Koenders et al. (2017).
By looking at the customer journey, we should identify which interactions could be made into an encounter (non-transactional touchpoints between an organisation and a customer) these are marked with a CRX denotation.

The stars indicate other opportunities that could be improved in an AV ride-sharing service, either because the current situation is not designed optimally or because the new mobility situation possesses new opportunities.

CONCLUSION USER INSIGHTS

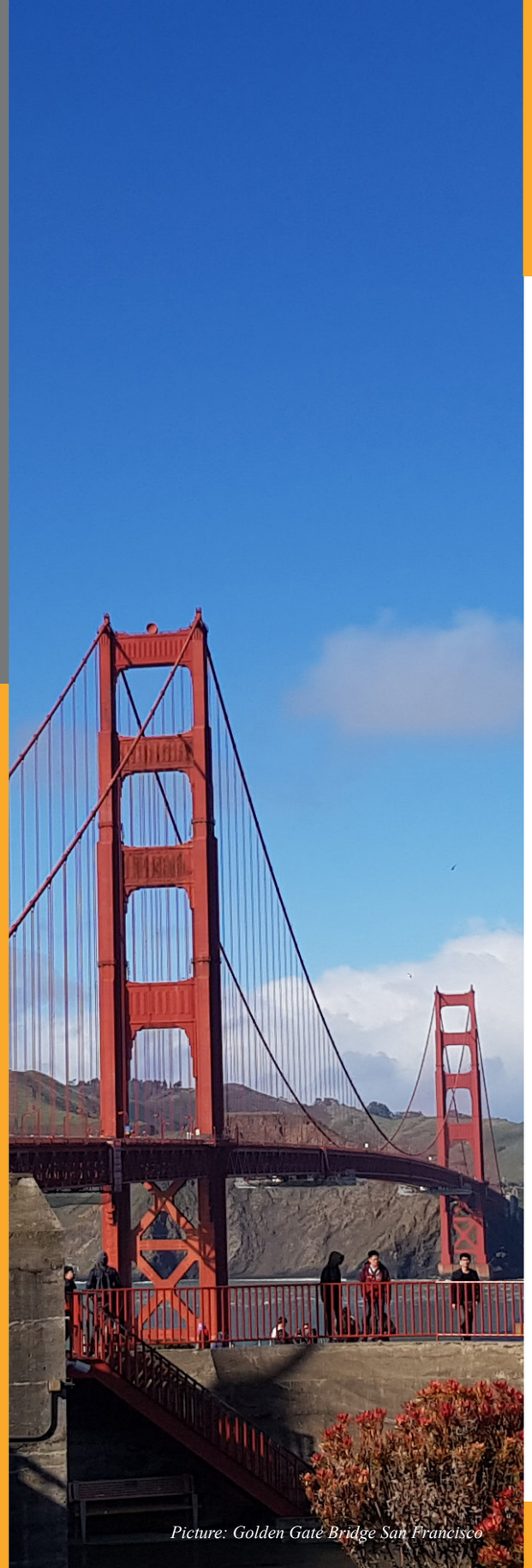
In general, people indicated to be very satisfied with the ride-sharing services. The reduced price was the primary motivator to use this service as opposed to private options, although environmental conscious behaviour also contributed to the decision to share a ride. The effects of interpersonal contact on the user experience were interesting findings. These will be further discussed through-out this thesis.

CJM

Thank you, San Francisco
Visiting San Francisco and being able to experience ride-sharing for myself have provided me with insights that would otherwise have left undiscovered. Using the different TNCs to get where I needed to be has literally enabled me to not only understand, but become the user. One of the most remarkable outcomes was the roles of the drivers, they have shown their use in the service system far beyond operating the vehicles and have played a crucial role when gathering user insights.

7. FIELD CONCLUSION FIELD RESEARCH

Ride-sharing has a lot to offer, and the current TNC services work well and are highly integrated in peoples daily lives in San Francisco. People are willing to share, but rational benefits (money and time) are highly influential in this decision-making process. The service experience is very seamless and frequently new offers such as Uber's Express Pool show that the field is constantly innovating. The in car experience is highly depending on the driver of the vehicle, and his/her qualities should not be underestimated. The next chapter: Relational Design will give more elaboration on the role of the driver and influence of interpersoanl contact.



Picture: Golden Gate Bridge San Francisco

3. RELATIONAL DESIGN

TNCs who offer ridesharing services do not seem to have given interpersonal contact much thought when launching their new service offer. The shared offer is based on efficiency. Other than extra people in your car the service does not differ from an individual ride, making it seem as if the service providers have not given much thought about interpersonal interactions. Today these interactions are almost all orchestrated by the driver, but when he won't be an actor in the servicescape anymore, the designerly control over human relations within the service becomes increasingly important.
This chapter will explain what relational design entails and in what ways it can contribute to a ride-sharing service. Starting with defining the meaning and intentions of relational design in the scope of this thesis and concluding with what I aim to deliver.

Picture: Working With Design For Relationships Card Deck

Men exchange their work by free, mutual consent to mutual advantage when their personal interests agree and they both desire the exchange. If they do not desire it, they are not forced to deal with each other. They seek further. This is the only possible form of relationship between equals."

- Howard Roark

Literature speaks of relational design, design for relationship and relational services. Some are focussing on the interpersonal relationships (human-to-human) as a fundament in the functioning of the service (Cipolla et al., 2009) others are describing a service relationship as something that can be established through using a service, either amongst the service provider and a user, or between users (Koenders et al., 2018). The last nuance is a service that, on its own does not pose a solution, but will offer a solution through the means of interpersonal contact amongst users (Snelders et al., 2014). These types of relations, however, are built on different fundamentals, one approaching interpersonal relationships as the desired result, an indispensable quality or an experience amplifier.

For this thesis, the main function of the service should remain to transport people from A to B. Relational qualities are aimed to positively differentiate the service experiences of its users, but should never pose a conflict with the main function of the service (bringing users from a to b).

Next to interpersonal relationships within a servicescape, each user has a degree of susceptibility to engage in a relationship with this service provider. When service providers reciprocate to this susceptibility, short-term results can be a better customer experience and could in the long-term result in User-to-Service relations (U-S). See appendix 5, more further elaboration of the possibible effects of these relations on each other.

This U-S contact can be through the means of a person, making this both a human-to-human interaction as a user-to-service interaction (Cipolla et al., 2009; Koenders et al., 2018). Today's context of ride-sharing poses an interesting servicescape for interpersonal relationships and interactions since it can contain two different types of H-H relationships simultaneously. Namely a form of user-to-user (U-U) and a user-to-service (U-S) interactions. The user-to-service interaction being embodied through the driver of the car and passenger. The role of the driver is an interesting one since he/she embodies both H-H and U-S.

This interpersonal interaction between a driver and a rider can therefore never be truly un-transactional in the way the interaction between two riders can be. The commercial core of user to service relationships precludes defining the relationship purely as friendship (Goodwin, 1996), whether it is embodied through a person or another channel. Since this commercial core is absent in a user to user relationship, a purely non-transactional relationship can originate.

"If goodness has causes, it is not goodness; if it has effects, a reward, it is not goodness either. Therefore goodness is outside the chain of cause and effect."

- Leo Tolstoy (Anna Karenina)

The importance of this distinction in H-H interaction between driver to rider(s), and amongst riders (U-U) derives from the changing roles in the servicescape of ride-sharing services. The currently investigated servicescape is one where people are acting as user and service-channels, but are both able to deliver H-H interaction. These types of interactions have stated to be of high influence for the user experience. However, the service-scape of this research project would become one where the driver is absent and the only form of H-H contact would be through U-U interaction.
This more 'pure' form of H-H interaction in the servicescape on itself would not be a bad development, it might even be a positive one since the interactions amongst two users is more likely to be equal, but they would be harder to control by the service. This desired designerly control over the occurrence of H-H relationships derives from the positive influence they have on the service experience, and the lack of pro-active engagement of people amongst strangers (Epley & Schroeder, 2014).
The following four statements have derived from observations, experiences in ride-sharing field research, found trough interview and supported by a research from the University of Chicago (Epley & Schroeder, 2014).

(1) people have more positive service experiences when they experience a form of human to human contact;

(2) people often do not pro-actively engage in social interaction with strangers;

(3) in today's ride-sharing services most H-H interactions occur between the rider and the driver;

(4) in today's ride-sharing services U-U interactions are facilitated by the driver.

MISTAKENLY SEEKING SOLITUDE

The university of Chicago has studied the desire for, and effects of, interpersonal contact on the train, bus and waiting rooms. The results show that people have a negative tendency towards engaging in contact but felt better when they did. Connecting with others increases happiness but strangers in close proximity routinely ignore each other (waiting room 93%, train 76%, airplane 68%, cab 51% are the percentages of people who indicated that they would avoid talking to a stranger). This mistaken preference for solitude stems partly from underestimating others' interest in connecting which in turn keeps people from learning the actual consequences of social interaction (Epley & Schroeder, 2014). This strong discouragement for interpersonal contact and the lack of engaging behaviour can be explained though the state of pluralistic ignorance (Pretice & Miller, 1993).

Pluralistic ignorance is a situation in which a majority of group members privately reject a norm, but go along with it because they incorrectly assume that most others accept it (Katz & Floyd, 1931). This is also described as "no one believes, but everyone thinks that everyone believes" (Krech & Scotshfield, 1948; Thaler & Sunstein, 2008). In short, pluralistic ignorance is a bias about a group, held by the members of that group. This effect amongst strangers causes a large reticence in engaging in social contact, for people believe their receptibility for social contact is larger than they believe the receptibility of others to be (Prentice & Miller, 1993). Simply said, they do not believe others are as interested in connecting as they are. This pluralistic ignorance causes people to believe that they would be intruding in someone's life, the fear of being rejected and the fear of not having

anything in common (Epley & Schroeder, 2014). And the other way around, if the silence of a person is interpreted as disinterested instead of politeness, a feeling of dissimilarity or politeness, engaging in conversation would also seem much more undesirable than attempting to connect would actually be (Miller & McFarland, 1991; Vorauer & Ratner, 1996).

In today's servicescape, we see that many of the interactions take place between the driver and the rider(s). First of all, the 51% likeliness to talk to a stranger in a cab was by far the highest score of all the other proposed conditions and was stated to be between the taxi driver and the passenger. Even though taxis and TNCs are not exactly the same setting, they have in common that the driver is fulfilling a function for the service provider and could, therefore, have a lower threshold to talk to. This supports the statement that people are more likely to engage in interpersonal contact with the driver than another rider. But secondly, through observation in the servicescape and interview with ride-sharing users, it became clear that the driver is not only the person that engages conversation most often but is also the actor that facilitates interpersonal contact amongst other riders. This facilitation of interaction can be compared to a so-called "ice-breaker". These ice-breakers are elements stated to be of positive influence and have allowed a participant in the studies of Epley & Schroeder to more easily engage in conversation than they might have done otherwise.

U-U TOUCHPOINTS

The roles of the actors in the servicescape define their meaning within the relational interactions. Eliminating a human driver from the ride-sharing service limits the H-H interactions in a standard user situation to solemnly user-to-user interactions. These have previously been declared as highly influential for the user experience of the service and are therefore necessary to properly facilitate as a service. The most important five moments for H-H contact have derived from one of the earliest moments of the graduation process, namely a session at Ford Aachen about on- and off boarding and the CRX moments defined in the CJM from San Francisco. Furthermore, the most common types of user-to-user interaction observed in shared-rides, or brought up during session (from public transport or ride-sharing experiences from participants) are used as examples. Examples of such moments are given on the next page, and will be shown in their bigger picture in the chapter User Narrative.

PRO-ACTIVE	PASSIVE
On-boarding	Additional passenger
Off-boarding	Leaving passenger
Engaging contact	Being contacted
Ceasing contact	Contact being ended
Requesting	Getting a request

CONCLUSION

Human-to-Human contact has positive influences on the service experience, but not all H-H interactions can be regarded as the same. Human-to-Human contact can occur both as User-to-User or as User-to-Service contact. This U-S contact has a higher susceptibility for designerly control but will cease to exist in the scope of AV ride-shares. User-to-User interactions will be the only form of Human-to-Human contact in the servicescape, but people are not likely to engage in interpersonal contact by themselves, even though it has proven to make a shared trip more enjoyable.

As a service provider for an AV ride-sharing service, you are challenged with facilitating the desired degree of interpersonal contact amongst co-rider to optimize the service experience.

To do so, the key moments where U-U interactions matter most have been defined and will be experimented with in the co-creation phase.

However, before moving on to the next phase of the report, we will scope this project, by finding a use-case that will allow for interpersonal contact to act as differentiator.

EXAMPLES U-U TOUCHPOINTS

1. ON-BOARDING
The moment of entering the vehicle with already existing passengers.

2. ADDITIONAL PASSENGER
The moment an additional passenger is entering the vehicle you are travelling in.

3. OFF-BOARDING
The moment of leaving the vehicle whilst a co-rider is still on board.

4. LEAVING PASSENGER
The moment your co-rider is leaving the vehicle you are travelling in.

5. ENGAGING/BEING ENGAGED CONTACT
Actively starting the interaction with a co-rider.

"Isn't the weather great today?"
"Did you see the game last night?"

6. CEASING CONTACT / CONTACT BEING ENDED
Actively ending the interaction with a co-rider.

"Sorry, but I really need to get back to this email"
"Uhu" *Puts headphones on*

7. REQUESTING / GETTING A REQUEST
A specific form of engaging contact where the co-rider is expected to cooperate to fulfil the need op the person making the request.

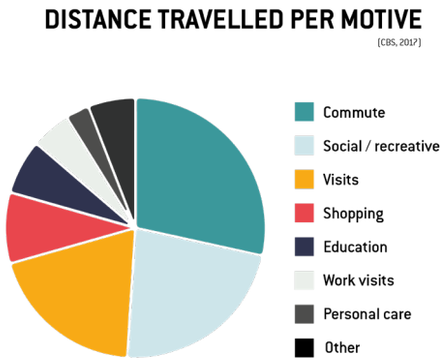
"Excuse me, but could you turn down your volume a little?"
"Could you help me with my luggage?"

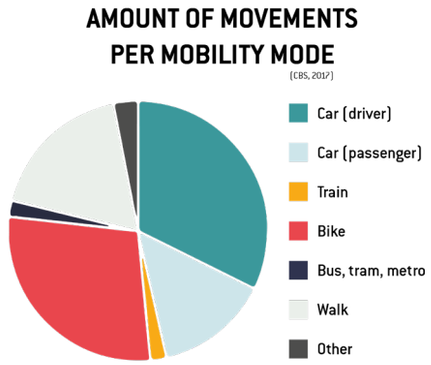
Picture: Aerial View Roads © Aleksejs Bergmanis

THE DAILY COMMUTE

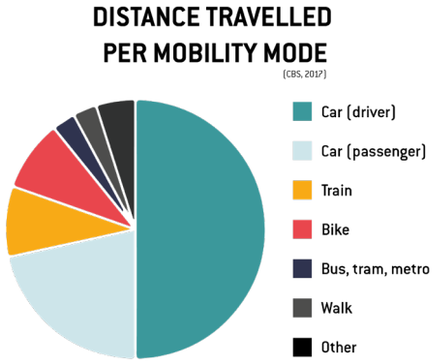
By combining all the information of the input fase into a use case, I landed on the daily commute. With the main challenge being; how can Ford facilitate positive user to user interactions within servicescape of the ride-sharing service? The daily commute has a great business opportunity, holds the potential to a significant positive impact on today mobility problems, and the daily commute is a trip where its users would actually value the qualities that result from relational design.

The initial use case provided by Ford would be the last mile solution within cities. Despite this being a seemingly profitable use case, with many short trips and many passengers, it is not the best use case to integrate relational design attributes. Interviewees indicated that short trips say 5 to 10 minutes or less are not worth getting comfortable nor performing specific activities. They would at most be doing small tasks at their phone, but would probably just be starring out of the windows with some music on. The relational aspects that people indicated to value during a shared-ride account for 'longer' trips only.
Despite, 'longer' being a very abstract periphrase, it illustrates that this use case might not be best. Adding up to the fact that within city transportation is relatively well provided and other mobility as service solutions, such as pay per use bikes or scooters, are occurring at a fast past in most European cities, being better for the city livelihoods compared to autonomous vehicles.
A more interesting use case for autonomous vehicle relational services designs within a mobility service might be located in rural areas or amongst immobile people. This, however, challenges the business case in multiple ways. Firstly through the ability to actually share your ride when your location is more distanced from other residents. Secondly, because the functional benefits of sharing decrease with a service where its demand and offering would not have a continues balance.





The most suitable use case for autonomous vehicle ride-sharing would be the daily commute. In the Netherlands, the average commute takes 34 minutes for a one-way trip. In total, we account for 10 million commutes back and forth each day. The car covers 73%* of all the distance that we travel and is there for the most dominant mode of transportation. Even though the train is mostly used on longer distances, the usage only takes up 9% of the total amount km in transit from and to work. On average, a commute to work is 24 kilometres and takes up to 34 minutes, and these commutes mostly take place between 07:00-08:00 and 17:00-18:00 (CBS, 2017).



4. RECAP INPUT PHASE

The future of mobility should be shared. Sharing space, vehicles and rides to optimise our usage of our communal areas. An impactful solution empowered by autonomous technology and connectivity of society is ride-sharing. Ride-sharing is defined as simultaneously occupying the same vehicle with other (previously) unknown passengers to get from your previous location to your desired destination.
By doing so, the needed vehicles to sustain our mobility needs could decrease drastically, positively influencing the environmental impact of mobility and our road usage and congestion. The self-driving ability also holds the potential of reducing the need and frequency of parking spaces. Governmental infrastructure costs will decrease in the longer term, and it could have an abated effect on urbanisation. Last but not least we will all benefit from a safer mobility mode and suffer lesser (lethal) traffic accidents.

From a user perspective, autonomous mobility opens doors to a more enjoyable commute and sharing these autonomous rides could make these benefits more accessible for the many by reducing the price per trip and subducting the investment cost of a vehicle.
Therefor ride-sharing holds great potential to reshape our mobility landscape. This utopian future mobility context has a significant challenge to overcome to live up to its promises. Namely, people's willingness to share their rides opposed choosing for an individual alternative.

People have a negative preconception towards engaging in interpersonal contact, even though it is proven to be more enjoyable than travelling in solitude (Eply & Schroeder, 2014). This tendency to mistakenly seek solitude, and car companies adhering to these desires, could potentially suppress the shared mobility vision. Therefore, Ford should facilitate interpersonal contact to its desired extend. Leading to the extended vision statement:

>> Autonomous vehicle rides should be shared to maximally utilise the potential AVs have to offer to society. To successfully design shared AV rides for the daily commute, the service provider should facilitate the desired degree of interpersonal contact.

This vision statements leads us to the research question for the co-creation phase:

>> How can Ford facilitated the desired state of interpersonal contact amongst users in an autonomous vehicle ride-sharing service for the daily commute?

To further understand what this desired degree of interpersonal contact is for the future users of the service, to create and experiment with service offerings, we will go to the next phase of this project; co-creation.

III.
(Co)-Creation Phase

Picture: A moment during the second acting out session

CONTENT

1. INTRODUCTION

Before entering the synthesis phase of this graduation process, the co-creation phase will shortly be discussed. This phase consists of 5 different sessions that were partially executed as a means of collecting future user data and partly to experiment with the solution space that a shared servicescape for the daily commute has to offer.
Gathering additional insights was done througout all the five sessions. The last three session were acting out sessions with (graduated) Industrial Design Engineering students. The insights of the session are shortly discussed at the end of this chapter and linked to the earlier findings of userreserach in the context analysis before the synthesis phase.

In total, I organised five different sessions, each with different intentions and outcomes. After coming to the conclusions that people are willing to share their rides, I took sharing as a given aspect during all the sessions and I focussed on the daily commute.

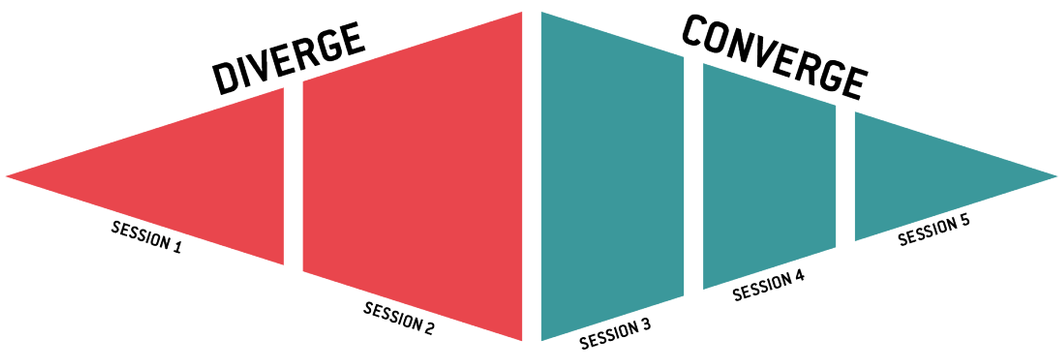
The first two sessions focused to get an understanding of the reactions of future users on an AV ride-sharing service. During the second session with a group of high school students, I got to study future users. With them, all the possibilities and difficulties that come along with a ride-sharing service came to light. This was done through a set of exercises built according to the path of expression (Sanders & Stappers, 2012), to get to future proof concepts that are not constrained by today's limitations.

The first two sessions helpt broaden my sense of solution space and the last three sessions were to narrow and improve the service concepts by acting out different scenarios that could occur in the daily commute.

Over the course of three weeks, I did an acting-out session every week, preparing a new session based on the learnings and findings of the previous one and so iterating the outcomes and working towards a more and more profound solution space.

For these sessions, I invited recently graduated or graduate students of Industrial Design Engineering, to create and act-out an AV ride-sharing scenario. These people are currently in the same stage of their lives as the future target group that Ford should offer their ride-sharing service to.

Besides acting out different scenarios that could occur during a service we started with co-creating the service, by doing so, both insights in their considerations and motives were gained as their reactions and reflections on moments of friction while acting out the service.



Visualisation: Intension per session

The acting-out method is based on the Service Design elective, working with minimal prototypes, situations are staged to act-out how a shared ride might be experienced. The insights gained during these sessions (and the previous co-creation sessions) are affluent and deep and some insights go beyond the scope of this project. To let these not go to waste, they can be found in the additional deliverable called: **Session Booklet**

This booklet includes the following information that is not in this report:

1. General description of each session
2. Participant information
3. Session planning
4. Formats used
5. Improvements and iterations
6. User quotes
7. Pictures of the sessions
8. Creations of the participants
9. (Method) evaluation

The formats used during the sessions can be found in appendix 6.
To keep this report more compressed, this chapter only includes the research questions, session goals and main insights.

"Ja maar Service, ik had toch om een sociaal ritje gevraagd!?"

Goals of the acting-out sessions:

1. Find ways to facilitate interpersonal interaction in the servicescape of a shared ride.

2. Get insights in user values during their commute.

3. a. Experience acting-out method. (session 1)
   b. Explore moments of friction by acting-out. (session 2)
   c. Resolve earlier found frictions with an improved service. (session 3)

Research questions:

1. What do people value during their commute?

2. To what extent, and how, would they like to interact with co-riders?

3. How can the service facilitate a positive shared environment?

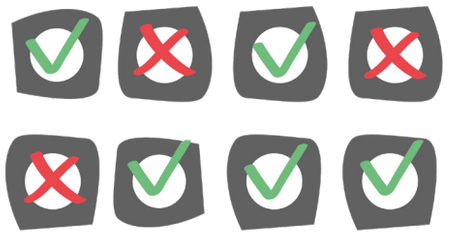
2. VALUES ON THE COMMUTE

The following outcomes are derived from the set of sessions. This chapter will briefly discuss their importance, and how they relate to the insights from San Francisco while answering research question 1: What do people value during their commute (in an AV ride-sharing service)?

Level of Autonomy

When discussing autonomous vehicles, we seem to be solemnly talking about autonomy regarding the vehicle, not the people riding them. The paradox in the level of autonomy granted to the vehicle is that it is a sense of autonomy taken away from its user. Sharing the vehicle and even the ride add to the sense of 'losing control' over your ride. During the creative sessions and interviews, people indicated to value their state of autonomy and a sense of empowerment dearly.

"Ik wil kunnen kiezen uit verschillende opties, want ik wil niet altijd hetzelfde"



Freedom of Choice

Offering people choices sounds liberating: Having the freedom to decide amongst different opportunities what you would want. The ability to choose different options was viewed as a mean to maintain autonomy and control by many, but the number of varieties in the stated preferences that I have encountered would add up to an extensive list of possibilities. This, however, is not desirable to offer to everyone at all times. The phenomenon of over-choice explains the drawback of providing too many choices. Overchoice has a twofold drawback; the first disadvantage of offering to many options is the risk of choice paralysis. This means that the scale of freedom becomes too large, leading to over-analysing the situation. Which can slow down or freeze the forward motion in decicion making, causing the user to become 'paralysed'.
The second drawback is called a choice paradox. Choice paradox means that the more options you offer someone, the less likely that person is to be satisfied with their final choice (Swartz, 2004). Reducing the number of choices is likely to improve the users' experience both during the decision-making process and after having experienced the service.

"Eigenlijk wil je dat de service je kent zodat alles wel gepersonaliseerd is, maar je niet bewust hoeft te kiezen"

Rating Systems

Another paradox in state of autonomy occurred when discussing rating systems. On the one hand, people liked the idea of maintaining a sense of control over whom they would travel with; on the other hand, the feared giving others the control over their rating. Today we see that TNCs apply a rating system so that drivers and riders can score each other, but when sharing a ride, the passengers do not rate their co-riders. This system has its obvious pros and cons, but during interviews and own experiences, I discovered some less evident drawbacks about this system.

First of all, you are asked 'how was your ride with (Name of the driver)?' This question implies that you are rating your ride ánd the driver at once. Causing people to rate high in case of a mediocre or rude driver but a fast ride, but also rating high if the ride was a bad experience due to traffic or other factors, but the driver was friendly. This makes the rating less about the driver him- or herself.

"If I get there safely I just give 5 stars."

The second drawback about the rating system is one that shows a level of empathy that on itself is positive, but makes the rating a lot less valuable, namely a sense of support or even pity towards the driver, wanting to make his- or her life a little bit better by giving a high rating.

"I was like, I do not want to give him three, because than his average is three and he will probably not get the next ride."

The rating for the driver will not matter in a driverless concept anymore, but the value that this rating system provides for its user is a sense of control and safety. Even though this might be a false sense of security, it is still a comforting feeling.
So when discussing the roles of the driver and how they can be substituted, it sounds like an easy solution to let riders rate each other instead of the driver. This, however, is stated to be highly undesirable during both the creative session and in interviews. The interesting thing is, that at first, it always comes up as a solution until someone mentions the 'black mirror effect'.

“The Black Mirror effect”

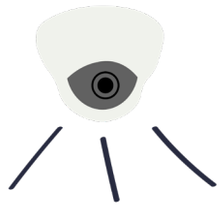
The black mirror effect is not an official term in literature, but it is used in day to day conversation to elaborate upon the negative sides of technological development. Black mirror is a sci-fi anthology series in which a twisted, high-tech near-future is staged, and humanity’s greatest innovations and darkest instincts collide. In one of these episodes, Nosedive, the possible consequences of socioeconomic status are illustrated in a world where everybody rates every interpersonal interaction with a 1 to 5 score.
People who have a high socioeconomic rating get to enjoy certain benefits that lower rated people do not get. This episode revolves around the spiralling effect of a young woman who starts with a high rating and ends up with a low one because she keeps encountering boundaries that she cannot overcome with her low score.

“Het is eigenlijk ook wel lekker om je af en toe te kunnen misdragen toch?”

The popularity of this TV show has raised high awareness of the drawbacks of such a rating system. So every time such a solution came up, this got shot down right after with the argument of the ‘Black Mirror effect’.
On its own, this could hold an argument against a rating system, but adding up with the possible hassle of having to rate every single passenger after every trip, this is not a fertile solution space. When discussing alternatives, people seem to grant more trust in an objective system controlled by ‘the service’ (however vague that might be) than to other passengers because of a level of subjectivity.

Trust in Technology

Contradictory to peoples statements about wanting to maintain control and autonomy, people design very technological solutions that would supervise and automate many aspects of the service.



Regarding safety issues, nearly all participants played with ideas of cameras or monitoring sensors to record what was going on in the car, to demotivate unwanted behaviour and have a source to claim this resource to prove them right in the case of wrongdoing.
Also, people seem to value personalization a lot. Of these people, some admitted not to have given privacy risk much thought when deciding and just picking on the benefits they had in mind. Others indicated that they were indeed aware of what it would mean for their data, but said not really to care about it anymore. Students stated that they did not believe in privacy anymore and that if their data was everywhere anyways that they might as well use it for their wellbeing.
This positive attitude towards technological possibilities and solutions can be debated ethically but opens up a large solution space in terms of ride-sharing services.

Picture: A moment during the third acting out session

Picture: Session Booklet containing additional results

3. CONNECTING TO A CO-RIDER & FACILITATING CONTACT

This paragraph will answer findings to research questions 2: To what extent, and how, would people like to interact with co-riders? and 3: How can the service facilitate a positive shared environment?

A previous conclusion stated that people are willing to share but would rather not. During the sessions, I found that the mindset to sharing depended greatly on the person involved and external factors in this person's life (morning vs. not a morning person, facing a deadline, good day at work etc.).
The conclusion that people are willing to share but prefer not to was mostly confirmed.

"At least say something like, Hi or Hello. At least acknowledge my existence."

When holding on to the subject, and diving into motivations for some initial reluctance to connect with a co-rider, a few reasons for hesitations came to light.
The motives to stay secluded are very much in line with the discussed paper; 'mistakenly seeking solitude' by Epley & Schroeder (2014). One of the reasons is the presumed discrepancy in interest to connect. Another one is the fear of rejection, and the last main motive was the sense of not knowing anything about the other person.
During the acting-out sessions, some of these fears were enacted, and some also resolved. These act-outs shed light on a solution space for overcoming these three main fears.

Interest discrepancy
People are likely to think that they are more interested in talking, then they consider the other to be. And they would deem themselves to be rude if they started a conversation. Simply stating to the service your interest to engage with others would be a simple way to give the service handles to mitigate initial contact amongst passengers.

Fear of rejection
People do not like the idea that someone might not answer to their attempt to engage. This can easily be solved by letting the service facilitate initial engagement like the driver does in the servicescape today. For example, by bringing up a shared destination or common interest. This would lower the threshold to engage and would make a possible rejection far less personal.

Not having anything in common
The fear of starting a conversation that you cannot uphold was also present amongst participants of the session. To overcome that, some participants even indicated to preferable know as much about the other rider. Providing some basic information each rider chooses to share about themselves would release this tension. Regarding this, people indicated to want to be able to have a two-way interaction. That, for example, if you choose to share your entire profile that it can only be viewed by people who also shared their entire profile and that users who have their account on private get to see only the essential information — making knowledge exchange more equal.
The first conclusion is that people need initial contact to build a relationship or gain a common understanding. The service trough ice-breakers can facilitate the initial contact (e.g. like the driver does today and sharing a common location or destination, or by objects in the servicescape such as screens showing the weather or news). Initial contact can also be formed more directly, which would be more suitable for reoccurring rides, by, for example, introducing new co-riders to one another. This can be done in the servicescape or in advance of the trip. Information about this other passenger is also considered to be desirable. Participants did show a large discrepancy in the amount and type of information they would like to know. Some are only interested in general information such as name and age and others indicating to prefer to know a little bit more, so they can more easily start a conversation about something. What everybody agreed upon, was that it would be good to know the preferred state of conversation of the other rider (in case it would not be possible to match people who need silence to (e.g.) work in advance).

4. FORSEEABLE ISSUES

This thesis focusses on interpersonal contact in a shared AV ride. However, besides the interpersonal interaction amongst riders, and the user to service interaction, other possible issues are likely to occur on the daily commute. These foreseeable issues are a by-product of the observation in San Francisco, interviews with the drivers and acting-out sessions. The 5 most significant ones are discussed below. The out of scope for the interaction vision for the user-service relationship or the interpersonal contact between co-riders on the daily commute, but they are integrated in the final criteria of the service, since setting satisfactory basis upon which the additional service offerings can be built. So, before the illustrated ride-sharing service could fully function, it is important for Ford to consider their statement and operation pertaining to these issues.

1. Consumption of food and beverages
Very likely to occur during the daily commute is the consumption of food and drinks. Food and drinks are named amongst the most desired factors for an ideal journey during the different sessions and especially for the morning commute, having breakfast was a common desire (see Session Booklet). Not allowing people to eat at all would be hard to supervise and consequent. However, allowing people to bring in a full meal, comes with consequences as handling trash, smells and stains. Also, it might disturb co-riders in the vehicle, and should therefore maybe be restricted to certain types of rides only.

2. Sexual Acts
The daily commute might not be the use case where sexual contact amongst rider is most likely to happen. However, it is inevitable that people are going to have sex in AV rides, especially since it is already a bit of an issue in manned Uber rides. Interpersonal contact and relational touchpoints get a whole different meaning in this context, and it would be wise to set boundaries or rules concerning these types of interpersonal contact. Mostly concerning the topics of hygiene and mutual consent.

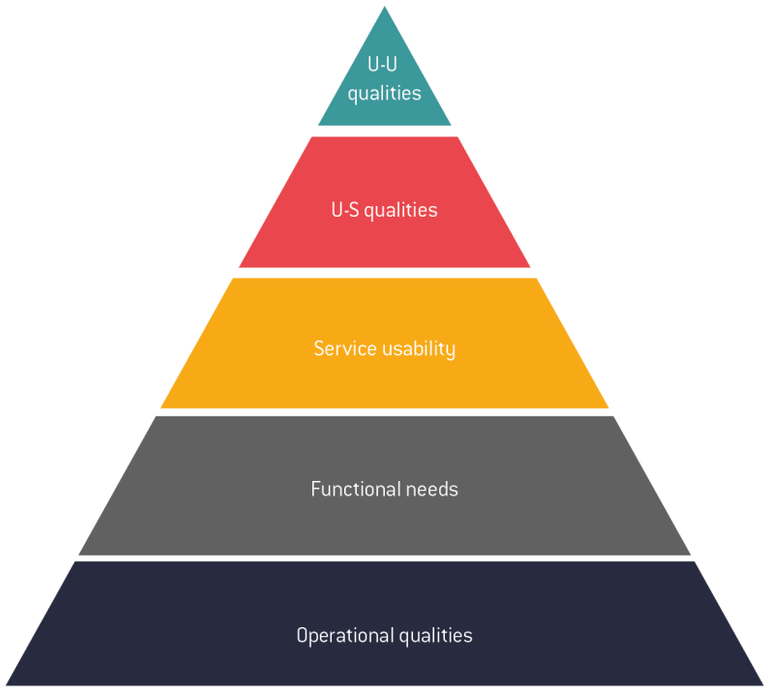
3. Pets
Probably not a large scale issue in the daily commute, but most certainly a use case to keep into account when envisioning shared car/rides as replacement of the personal vehicle. Can people with a dog (e.g.) travel with a ride-share or should the trip be private? How do you make sure that people are not secretly taking their dogs with them regardless? Also, could a vehicle be used for the next ride after transporting pets?

4. Smells
The three earlier stated issues could all have the consequents of a bad or distinctive and unwanted smell. Managing the scent in the vehicle is essential for delivering a positive user experience. Maintaining a pleasant scent is not only a challenge, but also a big branding opportunity. The smell is one of our most sensitive senses and has a strong emotional trigger. Applying a certain “Ford Sent” would most certainly contribute to building a strong brand experience. An excellent example of this is the Abercromby & Fitch stores.

5. Hygiene
Strongly related to smell and the consequences of sexual acts, food and beverage consumption and pets, is hygiene. It is crucial to design the vehicles in such a way that they are easily cleaned but still comfortable. The frequency of cleaning is essential to determine as well as deciding on how people should report a filthy vehicle and how the service would fix that. Is it possible to offer a new vehicle? Do people get a discount for riding regardless? Is the complained legitimate? Also, how would you determine the boundaries of legitimate complains and overreactions? In TNCs today, the aspect of the hygiene is managed by the drivers. In Lyft, you even have ‘cleanness of the car’ as a standardized feedback option.

5. HIERARCHY OF USER NEEDS

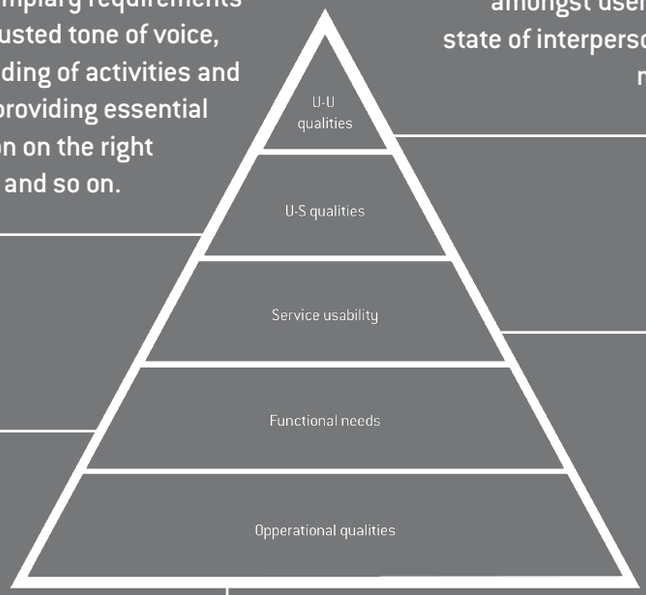
The previous chapter described in detail what people value during the commute while looking at the service from a user-service an user-user perspective. However, this does not represent the full spectrum of what people require or value during their daily commute.
In this chapter, I want to shortly zoom-out and make the distinction between different levels of importance of a ride-sharing service from a users' perspective.
The order of elements is visualised in a pyramid, comparable to Maslow's hierarchy of human needs (Maslow, 1943), showing the fundamentals at the bottom, on which the less essential but more experience exceeding qualities are stacked.
These are the valued qualities assuming that the ride is autonomous and shared.
This pyramids scheme illustrates that a properly operational service is the base.
Coming next are functional needs, such as affordability and a comfortable ride. The third layer of the pyramid represents the usability of the service. Usability needs relate to issues such as a proper interface, suitable subscriptions, and being on time.
The red layer represents the U-S relationship. These qualities represent more subtle criteria the service should uphold, and are to a high extent comparable to roles that are taken on by the driver in today's TNCs. The top of the pyramid is dedicated to U-U qualities. They are on top of the pyramid because they start to matter when all else is properly designed. This makes for a good differentiator compared to other future ride-sharing services.
The next page goes further in-depth to the hierarchy pyramid and the pages after providing insights in foreseeable issues for a ride-share service. These pages are intended as enriching information and are not essential before continuing to the synthesis phase.



Visualiation: Hierarchy Pyramid

U-S values
The user to service values cover the qualities for good user-service interaction, and these qualities are more relational than the service usability qualities. Some of these things are offered by the drivers today, others go beyond the possibilities the driver can do today. Exemplary requirements are an adjusted tone of voice, understanding of activities and routines, providing essential information on the right moments, and so on.

U-U values
The top set of values goes into the qualities that are derived from properly facilitating interpersonal contact. These values will be enjoyable when all other aspects of the service are accomplished but can have a decisive effect on the user experience. U-U values can be gained through sparking initial contact and facilitating a common understanding amongst users on the desired state of interpersonal contact and maintaining this.



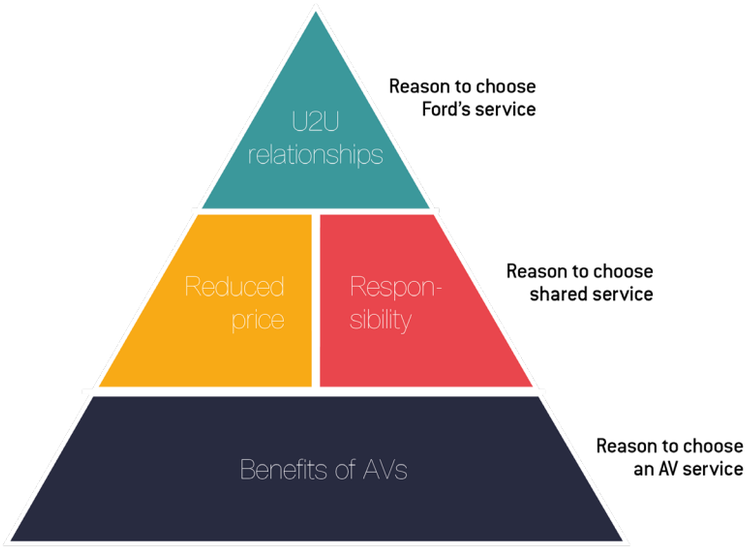
Funtional needs
Amongst the functional needs, we see that people value very rational things, such as the price of the trips. Other very practical requirements vehicle-related needs, such as being able to sit comfortably. It should offer a competitive service

Service usability
The ease of use is the third layer of importance. These user values include subscription models, ease of payment, whether it would be possible to bring your dog and whether the service is easy to use in general,

Operational requirements
The first need is that the service should be fully operational. It has to operate with safe vehicles and a decent service interface. The service should also be reliable to bring you to and from work daily and operate on time. Saying in short; the service should work.

6. HIERARCHY OF REASONS TO CHOOSE

The previous chapter has made a distinction in the hierarchy of user needs for AV ride-sharing. Relating hierarchy in needs back to the reasons people gave for charing today (Ride Sharing Research - User Insights) it is important to include to key factor on which people make their desicions today.
The firstly reason to choose would be for the benefits of AVs (e.g. picked up at home, additional time to do activities, no parking et cetera).
The second layer symbolyses the reason to choose for a shared ride over an individual AV ride. The two main reasons today are a reduced fee, or the feeling of making a responsible choice for the environment. The participants of the creative session, who are between 16 and 18 years old today, indicated to see the environmental impact as one of the more significant drawbacks of cars and will be the first generations to be able to use this service for their commute. As explained in the input phase, sharing AV rides will lower the impact our commute has on the environment. Lastly and most importantly, they should emphasise the positive effects on sharing your commuting experience with other riders. Focus on experiencing reallife interpersonal contact and enjoying a common understanding during the commute. This last factor should be a differentiator for Ford since other service providers will also offer shared rides, but have not shown indications to focus on interpersonal experiences.
These four aspects are stacked in a pyramid showing the hierarchy of users needs, just as Maslow's pyramid of needs as a human. Symbolizing the built up of reasons to choose. for a certain AV ride-sharing serivce.



Hierarchy of reasons to choose AV ride-sharing services.

4. RECAP CO-CREATION

The co-creation phase started with the following research question:

>> How can Ford facilitated the desired state of interpersonal contact amongst users in an autonomous vehicle ride-sharing service for the daily commute?

By acting-out different scenarios, ways of facilitating interpersonal contact were explored. This lead both to situations that were highly undesirable to very comfortable for all involved.

However, next to interpersonal contact many qualities for the individual experience came to light. This led to the conclusion that:

>> The desired degree of interpersonal contact is extensively interdependent with the individual service experience and commuting values.

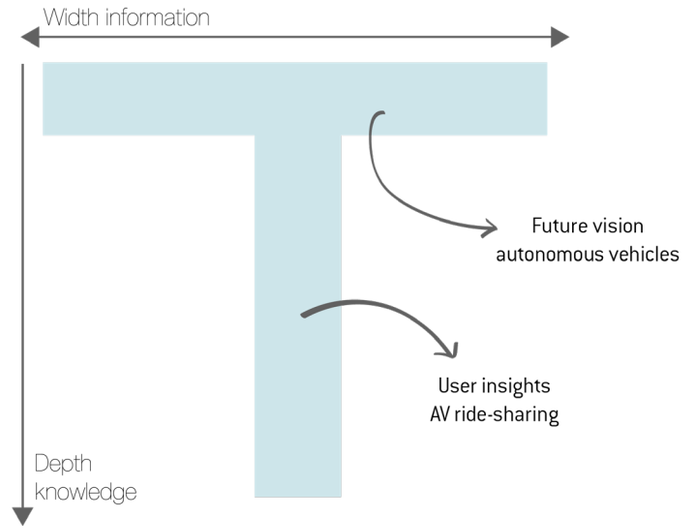
Concluding the co-creation phase with the findings that people want to experience an extent of individual control and before enjoying interpersonal interactions.

The next phase, the synthesis phase, will bring all the insights together. Starting with an interaction vision, that addresses both the individual as the user-user values.

IV. Synthesis Phase

CONTENT

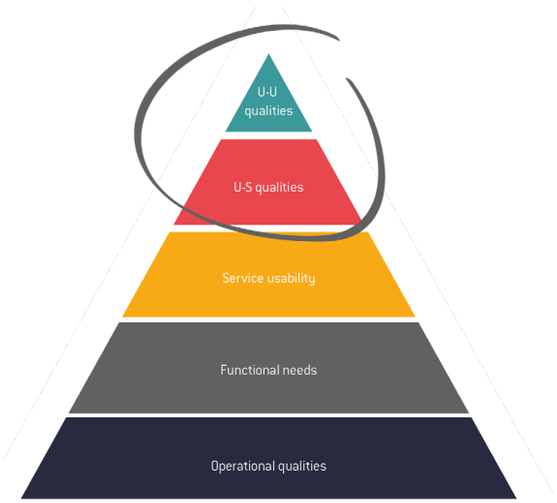
In this phase all the insighte will be brought together. The synthesis phase will deliver a the final vision statement and design criteria. These criteria will facilitate a design helping to achieve the overall vision. The combined criteria will be illustrated through the means of a user narrative that demonstrates how the service could work in practice.
These different deliverables can be addressed separately, but make more sense as a whole. The combined deliverables could be viewed as a T-profile of information. The top part of the T, saying a little bit about a lot and the leg staying a lot about a little bit. The top section represents the complete future mobility vision, and the criteria, based on in-depth user insights, are represented by the leg. The intersection of the two is the interaction vision, bringing together how the future mobility vision should be manifested. Alternatively, looking the other way around; why the criteria are relevant in a broader context.



Visualiation T-profile insights

1. INTERACTION VISION

Since one of the critical developments in the automation of mobility is the elimination of the driver, it is assumed that the service channel, through which the service provider reaches the user, is artificial. This entails that interactions cannot be left to chance nor human sanity and improvisation. Artificial intelligence would play a significant role in delivering the intended service qualities to the users. These artificial interactions require a large extent of designerly control since service would need to be programmed and therefor the desired interaction qualities need to be designed.
This chapter will not focus on the physical manifestation these interactions, since the conventional means of interfaces and interactions are likely to change within the years to come. However, this chapter will focus on the specific service qualities that should be delivered to the user. Starting with the individual user-service interaction qualities and adding to that with the user-user interaction qualities, that answers to the reserach question of how Ford should faciltate the desired extent of interpseronal contact.



Visualiation: Hierarchy Pyramid Priority

U-S EXPERIENCES

People need to learn to trust both autonomous technology and artificial assistance. Having a feeling that you do not know where to get your information, ask a question, or intervene ,is intimidating to many. The service should avoid this. By being approachable the service can give people a sense of empowerment they can act up on when needed.

enjoy a sense of empowerment

Users like to know what to expect, but do not want an over flow of constant notifications. On a daily commute, where timing is necessary and on-the-go activities might be essential, the service should not leave the user in the dark when it comes to expectations about their commute. Providing the information each passenger deems necessary should provide clarity and certainty on the daily commute.

experience certainty & clarity when it matters most

When entering the vehicle the user should experience a sense of autonomy over its activities, by entering a servicescape that is designed to understand and support you in your desires. Like a mother preparing your favourite meal after a hard day. It knows what you like, and it knows how to react to your needs. When one has the idea that it is understood what one wants (needs), he/she gets the feeling that he/she is in control over what he/she wants to do on his/her commute.

experience autonomy over your activities

These three values that each user should experience relate to the all-embracing need for control. Control is a quality people enjoy to have but do not like to exercise constantly. The following interaction statement is combining the three U-S qualities:

People should experience control, without having to take it.

This overarching quality is discussed as the three earlier stated separate ones because each quality entails a different role for the service at different times: see roles of the service.

U-U EXPERIENCE

The earlier stated fears, that lead to hesitancy to engeage, should be overcome, so people can enjoy a common understanding with their co-riders. Whether they would work in silence next to each other or have friendly conversations on a daily basis, they should not be in a state of pluralistic ignorance, but enjoy a common understanding through an initial engagement.

engage & experience a common understanding

If you are interested to see the analogies that inspired these statements, you can check the next pages. To continue to the full vision statement and the roles the service should take on to deliver this, continue to page 94.

Kitchen machine: This kitchen machine form the movie Hitchhikers Guide to the Galaxy senses what people would like to eat and automatically prepares it for you. This sense of human desires and the ability to put this into practice is a utopian example of how the vehicle could adapt to the needs of the boarding passengers.

Flying Carpet: A character/object in the movie Aladdin. Takes you where you want to go, whenver you want. If Aladdin wishes to pursue an unwise path, he will prevent this from happening. He also has an understanding of both Jasmine and Aladdin to get them together and helps them fall in love. Symbolising values of engagement but mostly applicable for being approachable and accessible for Aladdin at all times.

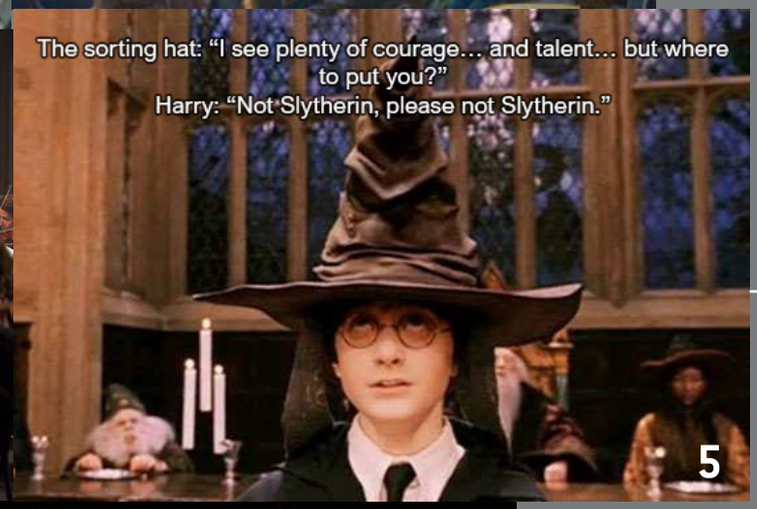
R2D2: A robot from the Star Wars universe. Trough out the movies R2D2 is the co-pilot and reliable partner of several Star Wars characters. He symbolizes a deep form of trust that people grant to a robot, from guiding them through a war zone to storing and ensuring an essential secret message.


2


3

Sorting hat: An object/ character from the Harry Potter series that is sorting the new students into their houses on the first day of school. The sorting hat understands which qualities are valued by what people and matches them in groups to assure friendships. The sorting hat is capable of sorting people autonomously but does allow for people to take in to account their personal preferences.


4



5

The service should orchestrate like a music conductor. Someone who knows the qualities of each individual like no other and can make combinations, which will make the outcome excide the sum of its parts. Endless combinations are possible, each with its own result, some better than others. Each individual trust the conductor and follows its suggestions, together forming a beautiful composition, but each individual maintains in full control to reciprocate these guides, or not. Through practise the conductor will gain better insights in each individual and learn what signs work best to deliver a good result.

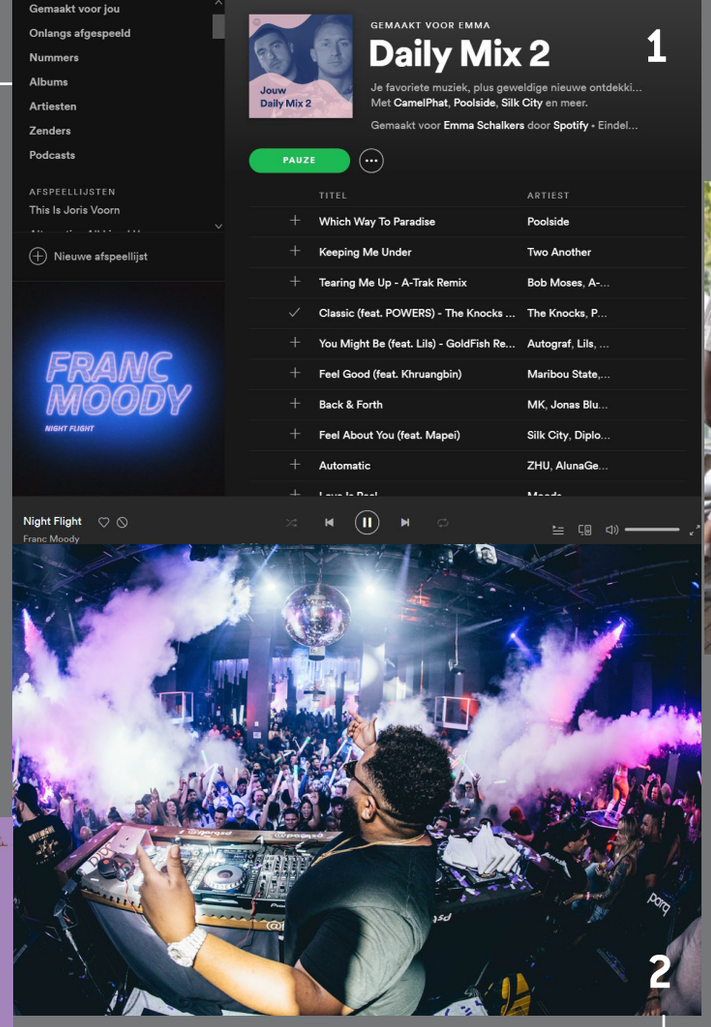
6

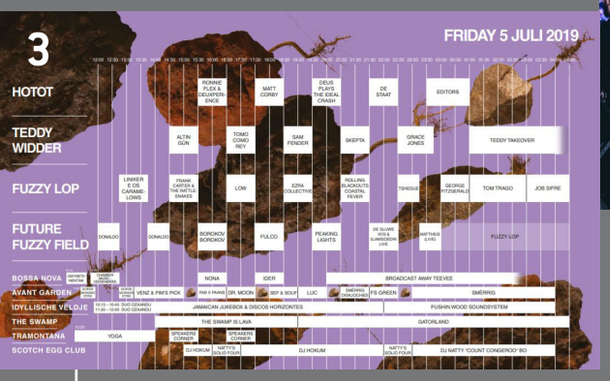
TARS: A robot from the movie Interstellar. He is programmed with the human qualities like humour and honesty, but the crew can adapt these to their desired percentage. Symbolising how an artificial being can deliver human qualities accordingly.

1. Hitchhiker's Guide to the Galaxy
2. Starwars Episode IV: A New Hope
3. Aladdin
4. Dirigent
5. Harry Potter and the Philosopher's Stone
6. Interstellar

Individual experience

The music platform Spotify knows what your listening and makes playlists based on your previously played songs and genres. This all goes effortlessly, but if you do not like a particular song, you can easily indicate this, giving you control over the list and simultaneously improving the algorithm. However, even though these lists are created autonomously (which could give you an unempowered feeling), all the musical content on the platform is very clearly available for you as well, and you still can create your own playlist, you are just not required to do so anymore.





Match the crowds

This common experience of being together with people have the ability to enjoy the same music is dependent on who are in the crowd in the first place. Having the right people in the room is of great importance for the success factor of the party, that is a job for the programmer, who needs to line up the acts accordingly for people to be in the right rooms and do the proper promoting. For which you would have the have the initial individual user understanding.

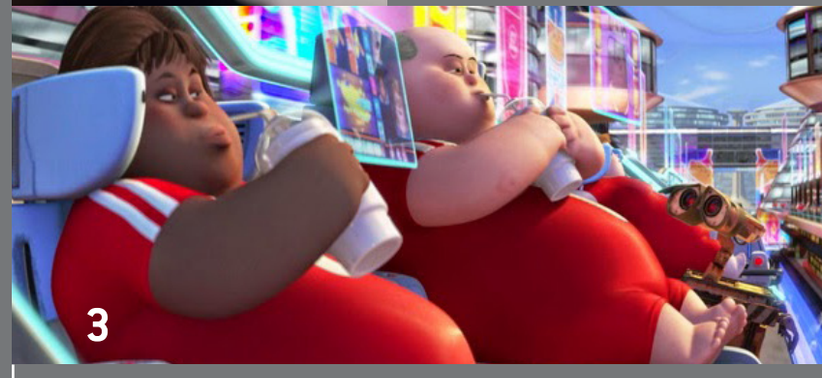
Crowd experience

Where Spotify's MADE FOR YOU function has learned to optimally understand the preferences of one single user, a DJ is a good example of someone that has to feel a room full of people and cater them with music that will properly build a party. Taking in to account the duration of the party and the responses of the crowd an individual's play a setlist that will exceeds people's expectations. And despite the fact that every individual might have had a different favourite song, Spotify daily mix, the common experience of enjoying music with other who enjoy the same type of music will exceed the individual experience of listening to your favourite songs.

ANTI-ANALOGIES

The application Coach is part of a dating service called 'the system' in the episode Hang the DJ from Black Mirror. This services claims to have an 98,9% change of finding your ultimate life partner. But first it sets you up on dates, match made through the system. These matches are out of your control, and 'Coach' also gets to decide how long you will have together with this date. Varying from a couple of hours, to multiple years. If you do not like your partner, you cannot leave the relationship since 'the system' is 'gaining essential information to provide you with your perfect match'. This extreme form on being unempowered is the opposite of how we want people to experience their matches made for a shared-rides. Even though coach facilitates engagement, a common understanding, and gives people have a lot of certainty and clarity over interpersonal interactions, the complete lack of autonomy makes this an example of what is undesirable.

The application used in the Netflix' original Black Mirror. As previously explained, through this application, people have the ability to rate every single interpersonal interaction they encounter in their daily lives. This might sound like it provides empowerment, but the opposite effect takes place, as people become entirely dependent on their ratings. The fear of a bad score makes people act, and their natural self does no longer have the freedom to array in interaction. This application is an example where technology does not embrace the human scale and makes people more dependent on ratings then empowered by rating.



The spaceship in the movie Wall-E is a very illustrative example of a human dystopian where technology has grown over our ability to feel empowered and to be in control. People are continually being transported in vehicles along lines with a screen in front of their face, showing them commercials and giving them products they can no longer choose for themselves. Even though this is a highly technically advanced surrounding and people can use seamless and autonomous forms of transportation, it sketches an example of how not to do it, by depriving people of control, empowerment and real life contact.

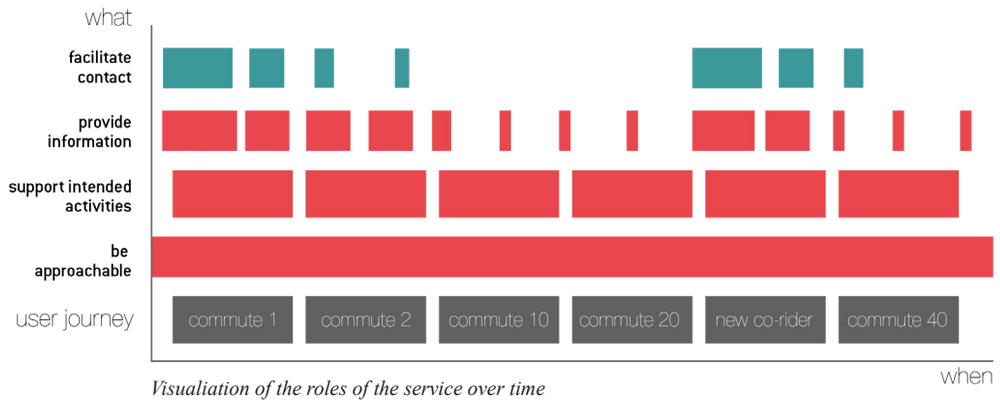
1. Spotify's Daily Mix
2. DJ
3. Line-up Down the Rabit Hole
1. Black mirror: Nosedive
2. Black mirror: Hang the DJ
3. Wall-E

ROLES OF THE SERVICE

To give users the experience of control and common understanding, the service should take on some roles. To be able to take on these roles, the service would need to have a profound understanding of each user. Having much knowledge about the individual user would entitle the service to offer a tailor-made experience, which allows the user to enjoy their desired commute without having to adapt everything accordingly (see the references to user understanding on the analogy pages). The visual below shows the role of the service to provide each experience to the users. Leading to the full vision statement on the right >

Through an individual user understanding, the service should to be able to:	so each user experiences:
facilitate interpersonal contact	engagement & common understading
support intended activities	a sense of autonomy
provide information	certainty & clarity
be appraochable	a sense of empowerment

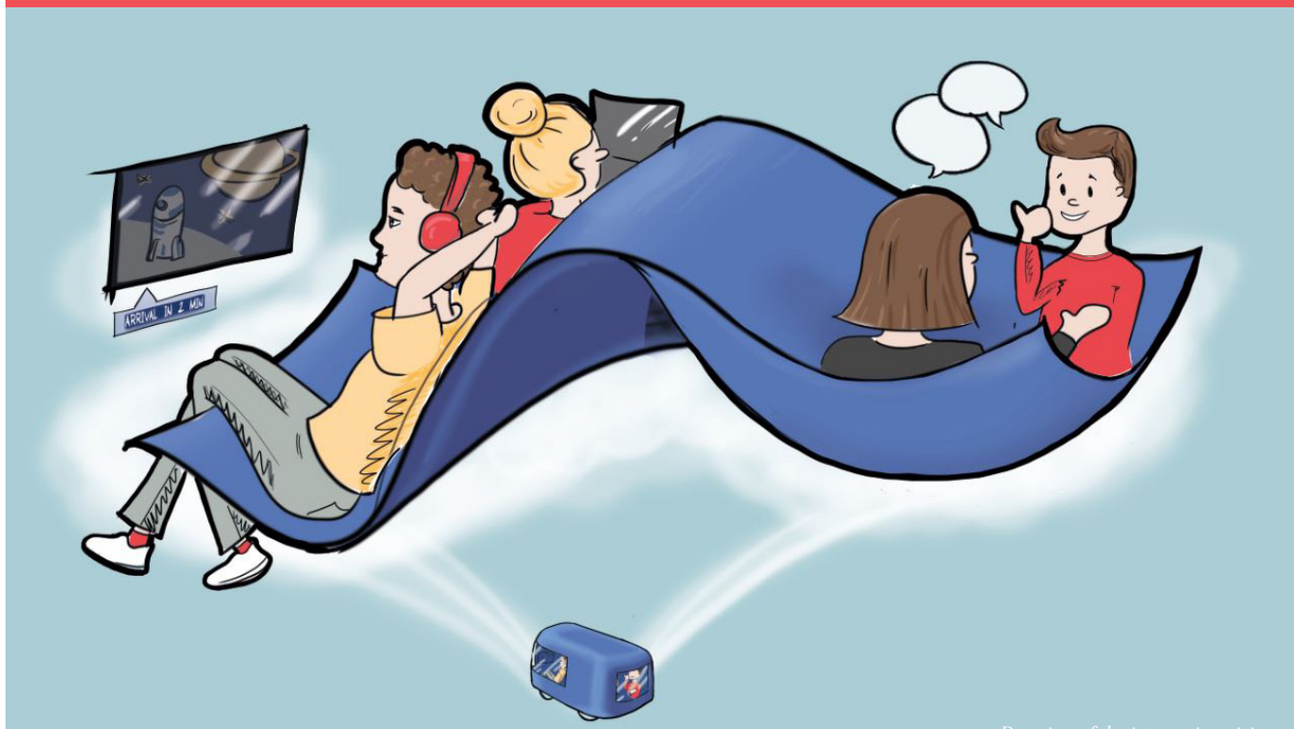
The service should be capable of taking on all these roles simultaneously but does not have to practise each role at all times since this depends on the individual user needs. The scheme below illustrates when which role is required. It shows that the service needs to be approachable at all times. It needs to support the intended activities during the commute but only provide information once so often. Facilitating interpersonal contact only has to happen at the U-U touchpoints and only if an initial relation amongst the passengers has not been established yet. The scheme illustrates that the role of the service in facilitating interpersonal contact would decrease over time if a set of commuters become co-rider for a longer time, and could increase again when a new rider is added.



Visualiation of the roles of the service over time

VISION STATEMENT

Autonomous vehicle rides should be shared in order to maximally utilise the potential AVs have to offer to society. To successfully design shared AV rides for the daily commute, Ford should gain individual insights, to facilitate a common understanding amongst co-rider & provide a sense of control for each user.



Drawing of the interaction vision

The drawing above is symbolisation of the interaction vision: ***Ford should gain individual insights, to facilitate a common understanding amongst co-rider & provide a sense of control for each user.***

It illustrates what users will experience inside the vehicle. The service provides people of a sense of control, without the need to exercise it, since the service fully understands each individual. The carpet flies autonomously but is approachable and responsive like Aladdins flying carpet. The carpet is shaped in a way that it allows both for exclusion as for inclusion, since the carpet is positioned in such a way that the people who enjoy talking are not bothersome to the ones wanting to focus on their own activity.
One of the users is relaxing and watching a movie in the vehicle, while another rider is doing some work on a laptop. They are subtly separated from two other passengers who are enjoying a conversation together.
The carpet is folding inwards symbolising how the vehicle should facilitate the possibility for engagement.
All the users enjoy a common understanding on the other persons desires. On the next page, you see the carpet flying above the desired mobility future. This expresses that, offering a shared servicescape that is tailored to the user in such a way that it is enjoyable for the many, will be vital in realising this desired mobility future.

RIDE-SHARING IN AN AUTONOMOUS FUTURE

BUY NOW!
Super Sale
ARRIVAL IN 2 MIN
AUTONOMOUS

SHARED AUTONOMOUS

VISION STATEMENT

Autonomous Vehicle rides should be shared to maximally utilise the potential AVs have to offer to society.

To successfully design shared AV rides for the daily commute, the service provider should gain individual insights to facilitate a common understanding amongst co-riders & provide a sense of control for each user.

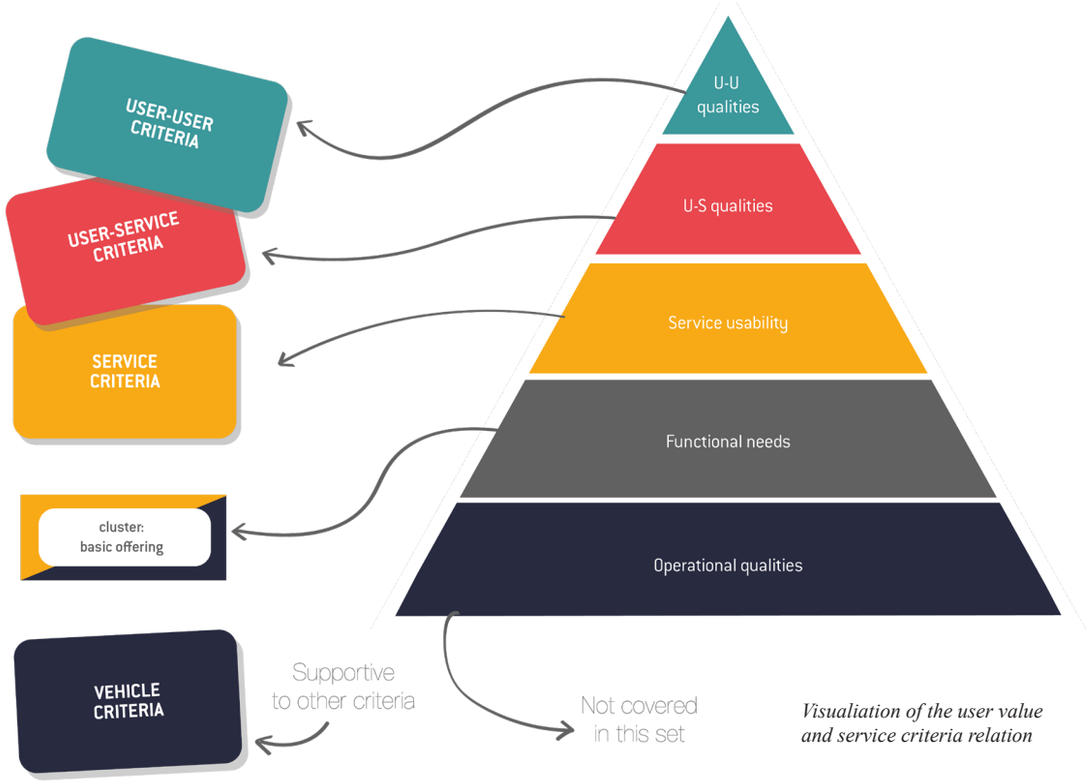
Emma Schalkers

2. CRITERIA

In order to design an autonomous vehicle ride-sharing service for the daily commute in the Netherlands, that would comply with the earlier stated vision, a list of criteria serves to guide a possible design.

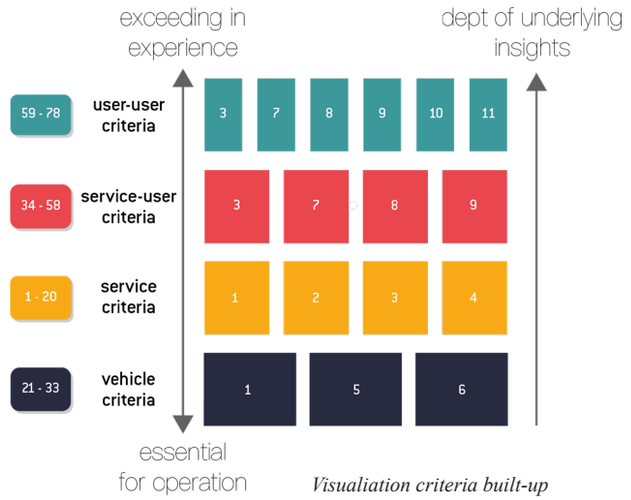
The criteria are categorized per type of criterion. These categories link to the earlier discussed user needs. The criteria created to facilitate interpersonal contact are turqouise, the criteria that focus on creating a proper user-service experience are red and the general service related criteria are yellow. A last category of criteria is focused on requirements that the vehicle should uphold so that all the other criteria can be manifested. These criteria are dark blue.

The criteria are also given clusters, these aim to make it easier to focus on a specific part of the service design (e.g. user autonomy or certainty & clarity). One of the clusters is called basic offering. These requirements regard some of the more fundamental user values that came up during sessions or interviews. However, the set of criteria mostly focusses on the top part of the pyramid; service usability, U-S values and U-U values and add a few vehicle requirements to make the others posible.
In contratry to interaction vision and the user needs, the criteria are formulated from a service perspective. This means that criteria regarding how the infrastructure of the service should operate, in order to be able to manifest a certain user value, are also included in the criteria set.



Visualiation of the user value and service criteria relation

The visualisation: criteria built-up, gives an overview of all the criteria cards. The basic and vehicle criteria have less extensive prior research to their formulation, but are found as additional results in acting out sessions, and should provide the suitable servicescape to facilitate the desired user experience. The numbers on the cards represent the criteria numbers, the squares contain a number representing the different clusters (see next page). These criteria strive to build the foundation for both user-service relationships as user-user relationships, by making specific design choices in, for example, how matches should (not) be made, but do not directly spark a specific interaction.



Visualiation criteria built-up

How to use the card deck

The cards are a manifestation of the results obtained through the different types of user research for this graduation project. They can be used as a checklist to audit concepts for ride-sharing services, or they can be used as a source of inspiration for user insights when a design team is in the creation phase.
The cards cover a large number of possibilities and varieties which all together aim to form a complete overview and conclusion of the insights gained during this graduation project. A criterion on its own might seem obvious or very specific, but combining the qualities of all clusters would lead to a service design where people share their daily commute while enjoying the benefits of AVs and eachother. Since there are quite a lot of cards, the criteria are grouped into four categories which can be used to gain more focus on a specific challenge. The cards also contain clusters which identify a particular theme (e.g. payment) or embody user values (e.g. clarity and certainty) this gives the possibility to select criteria for a more narrow design challenge.
Even though this card set is quite large, there are many more aspects to keep in mind when designing an autonomous vehicle ride-sharing service for the daily commute, which are not included in this deck. This deck was created through user insights and the consequences these insights would have for the service operator, but do not go into technical specifications of the service infrastructure, for example.

Choose of artefact

After obtaining countless user insights I aimed to make a list of criteria that would entail the full spectrum of these insights. This firstly ended in a long list, which was not very attractive nor very useable when presenting it to other designers. They required much focus and were not always self-explanatory.

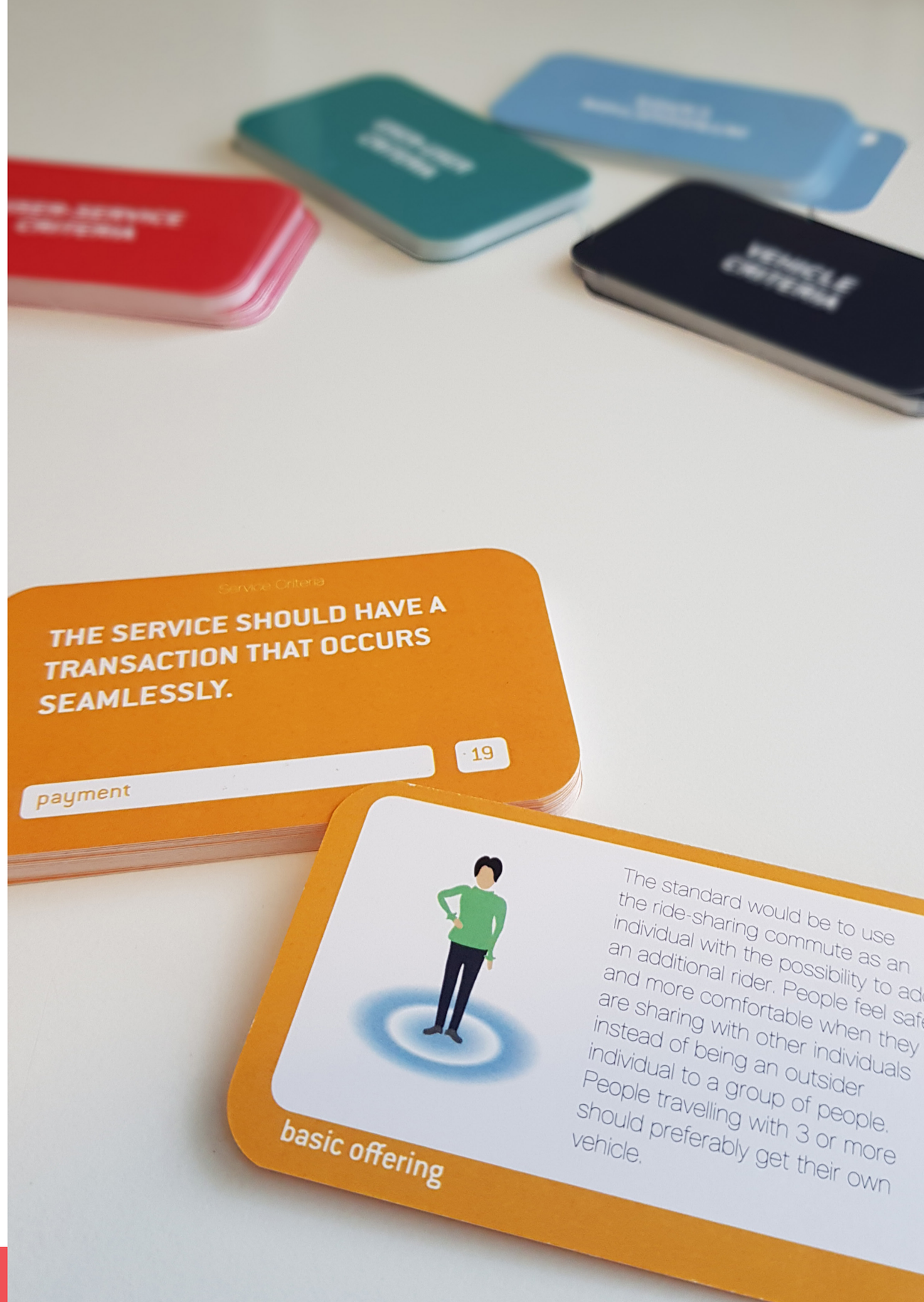
After this feedback, the criteria list was cut up, clustered, re-clustered and put into a card deck. This card deck allows for more dynamic use, for example, making a selection of the criteria you value most or the ones you like to focus on in a specific session. It also allows to easily create hierarchy amongst the criteria, which can be adapted.

Furthermore the format of cards also gave more space to elaborate the motivations behind a criterion, which would make them more self-explanatory. The images were added get a faster understanding of what the card was about and give some suggestions for possible solutions space. The clusters are added to make a specific focus, and the numbers of the criteria are meant to make them easy to communicate and to locate (they do not indicate importance).

Clusters

1. Basic offering
2. Service authority
3. Rewards & consequences
4. Payment
5. Supporting activities
6. Vehicle-service integration
7. Certainty and clarity
8. User understanding
9. User autonomy
10. Facilitating interpersonal contact
11. Matching

The card deck is added as physical deliverable, and all the criteria and descriptions can be found in Appendix 7: Criteria.
Usage of the cards for Ford, and a reflection on the current can be found in: Recommendations, Criteria.



3. USER NARRATIVE

To illustrate a possible future ride-sharing service for Ford, I have created a user narrative with three individuals who are setting out to work. With each character we go through their daily commute. The stories are illustrated from the perspective of each of the personas and cross paths along the way. As the story is explained, the relevant criteria are stated for each moment in the journey and some key moments in delivering user values are highlighted and explaind on the next page. This narrative aims to provide a better understanding of how the service is facilitating engagement and how user understanding and individual control could be manifested.

Please meat Gaby, Puck and Robin, three users of the Ford ride-sharing service. The foldable pages will show today's commute. But first a little background information about the situation.

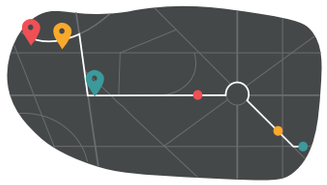
Gaby

Puck

Robin

Gaby and Puck are on a similar route to work and their commutes are matched for almost half a year now. Their houses are quite close to each other, but Puck's commute is a bit longer. They usually have some small talk and watch the morning news together.

Today a new passenger is added to their ride; Robin. Robin lives a little further away but on the route of Gaby and Puck. This is the first time a regular co-rider has been added, the occasional extra passenger joined their commute from time to time, but Robin is going to join their ride every Tuesday from now on.

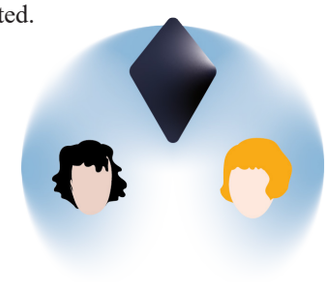


USER NARRATIVE

2. KEY MOMENTS

The narrative sheds light on different moments of the commute of three passengers, the texts below go into a little bit more depth to explain which activity of the service has brought which user value to the servicescape.

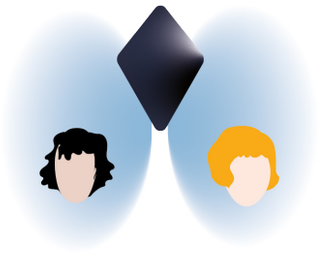
1. Facilitating engagement
In this scenario, the service facilitates the initial contact between the three riders by asking Gaby and Puck if they want to send their new co-rider a welcoming message. By doing so, the service allows them to connect (even before the ride). This makes joining two people, who already know each other, easier. Moreover, without showing a vehicle arrangement, the passengers of the vehicle are faced towards each other, and the same screen is visible for all. They are not back to back or separated.



Visualiation of the service facilitating engaging contact

2. Ice-breakers
A more subtle way of facilitating engagement is through the possibility of checking out each others' profiles, abating the fear of not knowing what to talk about or having nothing in common. Showing on a map of where they are going and where they are from is antoher small intervention that could allow people to engage in contact (e.g. by asking where they are going).

3. Contact ceasing
In this scenario, Puck usually works when Gaby exits, but now we have a new rider. It could feel rude, or disinterested to get out you laptop and get to work. And it might be hard to tell someone you don not have time for a conversation. Through a subtle message, a common understanding between the two riders is created.

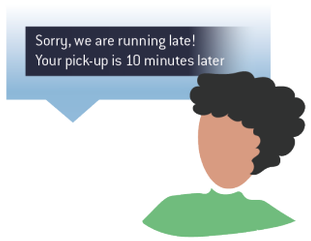


Visualiation of the service facilitating ceasing contact

4. Displays understanding
Such a subtle message as 'do you want to switch to work mode?', shows that the service knows your routines. This kind of message can onle be displayed, because over time, the service has found the routine that when Gaby exits, Puck gets to work. Another subtle message that is a display of user understanding is the pick-up message for Gaby. By saying; 'you can relax a little', it subtly shows that this is something Gaby desires, as not being a morning person. Puck, who has no problems with getting up early, receives a different message. See more at tone-of-voice.

5. Empowerment: Freedom of choice
Over the course of the narrative, there are two moments were the service offers the users a choice.Whether they want to message Robin, and later, whether Puck does want to switch to work mode. This second one is a reaction from the service, as opposed to changing the environments automatically, due to a change in routine (namely that has Robin joined the commute). These moments are a consequence of a newly added rider and were therefor outliers. Usually, it would be better not to present the users with too many choice.

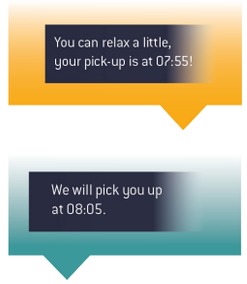
6. Providing information to act upon
Essential information, such as delays, are communicated through notifications. Less pressing information, such as the current location of the vehicle and the number of stops is displayed on a screen in the vehicle. The information about a new passenger is also chosen to be given through a notification. This information might not be essential for the operation, but a new person can have a significant impact on the user experience and requires a form of expectation management.



Visualiation of examplairy messege to user

7. **Common understanding > Pluralistic ignorance**
Creating a common amongst co-rider is key to a successful shared ride. In this scenario, Puck and Robin had a common understanding when they got to work. Puck and Gaby have created a shared understanding of what they both like to do on their commute. Making sure that everybody is on the same page overcomes the pluralistic ignorance, that is one of the causes for lack of engagement amongst commuters today.

8. Tone of voice
Some messages are, like the pick-up time, displayed for each individual user. This is done to subtly show the difference in tone-of-voice. As AI becomes more sophisticated this could allow services to tailor their communication to the individual users, making people feel more welcome and understood.



Visualiation of examplairy changes in tone-of-voice

3. FURTHER EXPLORATION

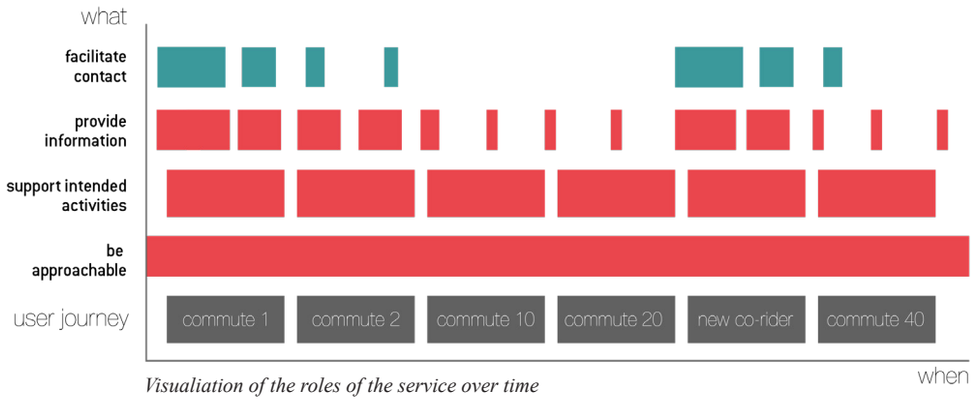
The user narrative included in this thesis is one with little conflict. It is mainly aimed to demonstrate the subtleties of the service in u-u and u-s interactions. It demonstrates both how engaging in contact, as ceasing contact could be facilitated. Scenarios with more friction, and how the service would mitigate this would also be informative to explore. In the following text, I will discuss four more situations that are worth exploring. Some scenarios would require to set some rules regarding the service first but would be great to explore more in-depth regarding u-u contact with acting-out sessions.

Relationship building

Having a user narrative, not of just one commute but a set of user commutes would give a better understanding of how a relationship between people can grow over time and how the service can assist this. Relationship building between the user and the service would also be interesting to zoom in on with an additional narrative. This could display the growing user understanding and the increasingly adaptive service(scape). A set of commutes could also be a display in how the roles of the service change over time as illustrated in figure; visualisation of the roles of the service.

Misbehaving riders

Incorporating different extents of misbehaving users would be very informative to showcase how the service would have users obeying its restrictions. This could start with an action slightly deviating from good behaviour (e.g. throwing a candy wrap in the direction of the trashcan that falls next to it) and designing an appropriate reaction of the service that would not make the user feel offended or sad. Starting very small and building up to the consequences of actual assaults or even crimes would provide a good understanding of how Ford is planning to manage such a service. At this point, no restrictions (apart from illegal activities) have been stated. Things to pay attention to are discussed in the chapter; foreseeable issues.



Visualiation of the roles of the service over time

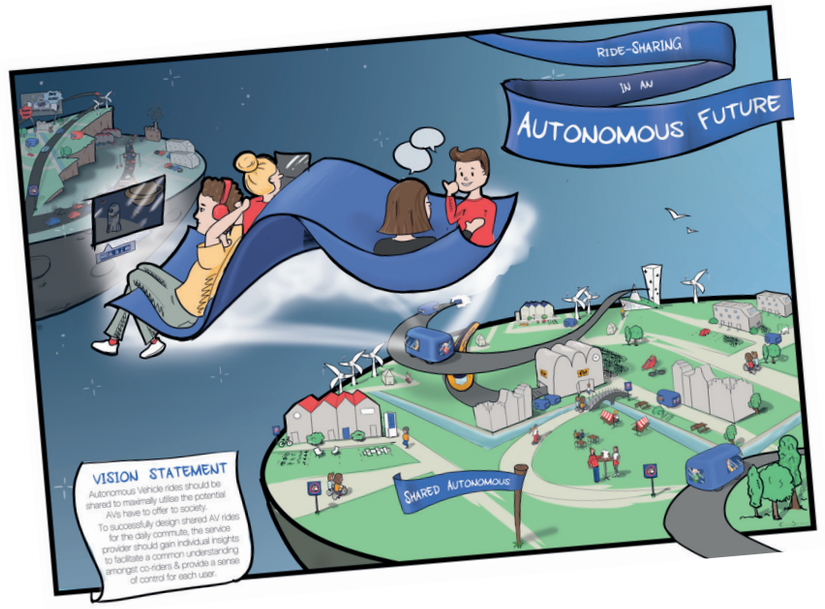
Not getting along with co-rider

Riders who are not satisfied with their co-rider(s) would also be interesting to study. Like having different extents of misuse, there will also occur different extents of disliking, varying from not really getting along to fearing someone. If this service aims to give everybody a pleasant commuting experience it should be able to deal with requests for a new ride, or different co-riders from time to time. Setting boundary conditions to avoid continually switching people, or user trying to bypass the system by constantly declining people to get an individual ride for a shared price, would be harmful for the operation. However, not responding or dealing with user request or complaints about other riders would be very damaging to the user-service relationship of the unsatisfied customer. A first step would be to create guides for the service to adhere to (e.g. you can only switch co-riders two times a month), followed by exploring the desired means of intervention. Also taking into account that it can be a little hurtful for the passenger who is left by its co-rider when he/she did not do anything wrong. Additionally, taking into account that you also do not want to stimulate bad behaviour, to try to get people to leave you, so you will have to ride to yourself.

First use

The first time a person is using this service would be interesting to explore mainly from a U-S perspective, but also to illustrate the role that a user who is using the service for a long time already, can contribute to the first user experience. This could showcase the reciprocal behaviour from a satisfied user as a demonstrator of a good U-S relationship. It can also emphasise the services aim to facilitate engagement amongst riders and the possible positive effects. Next to these relational qualities that can be shown through such a narrative, it could simultaneously function as a friendly way of explaining all the steps operational attributes of the service (e.g. creating an account, making a user profile, choosing a subscription option).

4. RECAP SYNTHESIS



Visualiation: T-profile deliverables

V.
Conclusion

CONTENT

This is the last phase of this graduation thesis. All the findings and results have been discussed and explained. In this phase, we look back at the project as a whole in the conclusion. After concluding what has been done, some recommendations will be discussed. These recommendations serve to guide further research and improvements.
Besides looking back at the content, this phase also reflects on my goals as a designer and a student, set for this project.
Lastly, this part also contains references and appendices.

2. CONCLUSION

Over the course of 100 days, this graduation project has researched the possible opportunities for Ford regarding AV ride-sharing in a changing mobility landscape.

By gaining a better understanding of the possible impact on our mobility ecosystem, I formulated the initial vision statement saying:

>> AV rides should be shared to utilise the benefits AVs have to offer to society maximally.

This created the challenge to make ride-sharing desirable for users without compromising societal impact nor viability for business, since the current motivator to share rides in mainly financial. The theory of relational service design, combined with research finding in the field, showed to importance of interpersonal contact in a shared servicescape. And by eliminating a key actor regarding interpersonal contact, namely the driver, the following research question arose:

>> How can Ford facilitate the desired state of interpersonal contact amongst users in an autonomous vehicle ride-sharing service for the daily commute?

To answer this question, the insights of; field research, literature reseach and several creative and acting-out sessions were combined. This lead to an understanding that individual user understanding needs to be established, in order to provide a sense of control to each user. This individual understanding provides Ford with the ability to facilitate the desired degree of interpersonal contact. Answering the research question by extending the initial statement to:

>> Autonomous Vehicle rides should be shared to maximally utilise the potential AVs have to offer to society. To successfully design shared AV rides for the daily commute, the service provider should gain individual insights to facilitate a common understanding amongst co-riders & provide a sense of control for each user.

If Ford wants to contribute to a better mobility ecosystem and an improvement of public space, they should invest in creating a ride-sharing service. When people share rides in AVs, they will get to enjoy the benefits of door-to-door transportation, being able to enjoy quality time on their commute, while minimizing the negative impact on society and the environment.

To make ride-sharing a success, the importance of interpersonal contact needs to be taken into account. Pluralistic ignorance regarding the shared servicescape should be avoided, and Ford should strive to provide a common understanding by facilitating the engagement amongst riders.

Running such a service requires enough information about all the individual users, to make them feel comfortable and provide a sense of trust, empowerment and control.

To comprehend a large amount of desk research into a tangible artefact, I created a visualized vision of the possible futures that AVs have to offer, including the solution to realize the desired one.

To assist in further designing such a service, a card deck is delivered. This deck contains the user insights from a service perspective and can be used while creating an AV ride-sharing service for the daily commute or as a validation method for a final result.

3. RECOMMENDATIONS & NEXT STEPS

This chapter will discuss a few recommendations based on the outcomes of this thesis and will provide some insight into what I think to be valuable next steps to take. This chapter addresses recommendations and next steps, for further research into Relational Service Design, the envisioned service for Ford and next steps with the outcomes of this thesis for the URP.

3.1 RELATIONAL SERVICE DESIGN

When it comes to relational service design and the toolkit that was provided at the start of this thesis I have a few recommendations for further reserach.

The first recommendation is to make a differentiation between a user-to-user and user-to-service relationships when discussing human-to-human contact.
A relationship amongst users can be purely relational where a relationship with the service provider will always have a transactional base. Furthermore, these relations both can grow over time but do not necessarily increase related to each other. Making a clear differentiation between the U-U and U-S relationships, allows you to explain the effect on each other with more freedom. Seperating the two could lead to a valuable iteration on the 'buckets model' of relationship fostering.

When it comes to the scope of this thesis in relation to the CRX tooling I encountered a few moments of frictions. First of all, the framework is mostly focussed on improving a current service-user experience by adding relational touchpoint. This assignment, however, did not have an existing service to start with, which would not have mattered as much as the context was already more comprehensible. The acting-out session and creative session provided me with great insides on U-U and U-S needs, but also remained to have a significant focus on the more fundamental requirements for the service (as shown in the hierarchy pyramid).This need for an fundament up on with to design for relationships, shows that the tooling for CRX has choosen the right moment of introduction for relationship building.

This graduation thesis delivers an understanding of relational opportunities in an AV ride-sharing service, to start creating a service with. However, in terms of testing the framework, and delivering more measurable relational service designs, I would recommend a further developed scope.

3.2 REOCCURING INTERPERSONAL CONTACT

Unfortunately, the effects of recurring interpersonal contact amongst commuters have not been studied as profound as the effects of initial contact. But since the use case of the daily commute is one where interpersonal contact amongst users is far more likely to occur than having a new co-rider every day it would be recommended to study this.

The implications of sharing a commute regularly has been discussed in the narrative and during acting-out sessions, but it would be interesting to study this relationship forming in an actual commuting context. In the scenario where people get along just fine, it is likely to become comparable to a daily chat with fellow parents at the pre-school square, or talking to a sports buddy a few times a week. The service can spark initial contact and provide ice-breaker to get to know each other when you get to a common understanding or shared commuting ritual this becomes normal. In a positive case, having a buddy for the daily commute could even become a real differentiator for Ford as service proving, since it offers an experience that can not be substituted by any other service.
This is a very positive scenario, but a more pessimistic take on a shared daily commute would be to have a co-rider that annoys you without crossing any measurable boundaries. The effects of a reoccurring encounter with this person might become a dis-satisfier for the service. By building in a way to request a new co-rider, you can ensure some of these issues. Researching, these longterm effects of a shared commute and reoccurring co-riders, would be recommended, to gain a better understanding of the design criteria that have to be established to include the outcomes in the service offering.

3.3 ACTING-OUT & RELATIONAL DESIGN

Exploring U-U interactions en relations with acting-out has given me more insights than I initially expected. However, using this method on a problem set in a very large context without a focus on particular themes also has its drawbacks. One of the final deliverables is a user narrative, accompanied by a set of scenarios that would also be worth exploring, and give more direction in acting out sessions.

Organising acting-out session with a focus on the likely events during these scenario's would be an excellent way to explore possible user interactions (e.g. acting-out initial use, wanting to switch co-riders, or relationship building). The outcomes of acting-out these scenarios would provide further insights into how an AV ride-sharing service should behave in certain scenarios. Starting an acting-out session with a more defined scenario, and interactions to focus on, would give the method more potential. More iterations can be done, and the results can be analysed with a greater focus on specific problems. Doing so would be a good follow up on the initial, more freely oriented, acting-out sessions.
Another recommendation for the acting-out method would be to use both actors and unknowing participants. This was done during the acting-out sessions supporting this thesis and worked well. By doing so, you get to see genuine reactions from people, opposed to staged interactions and actions, but with the use of some acting people, you can still guide the scenarios towards the intended U-U contact.
A last note on the acting-out method would be that it can be used both for interpersonal as for service to users relationships, but that this distinction should be made consciously. This allows observing each type of interaction separately, making it possible to start looking for causes and effects between them.

3.4 SERVICE PROVIDER OR EOM

Over the course of this project, I have always spoken of 'the service provider' or 'the service of Ford'. But in the current situation of the company, their main focus has remained manufacturing cars and developing autonomous technology. Projects like Chariot, or the Ford Pass show their interest and ability to be more service centred, but this does not mean that Ford is ready to compete with companies whose sole focus is providing mobility services. This project has revolved around an AV ride-sharing service, and I think that one of the next steps for Ford should be the consideration to maintain being a vehicle manufacturer and collaborate with a mobility service company to develop and implement such a system. Or offering a service by themselves.

This dilemma also arose in one of the session at Ford, where two teams worked on creating a business model that would be support this service. Without instruction, one of the teams positioned Ford as a manufacturer with a service provider as a key partner and the other team positioned Ford as the service operator. The last option would require large investments in term of resource allocation and a lot of catching up to do in designing both an infrastructure and an interface. Another challenge in starting such an AV ride-sharing service from scratch would be the transition from Ford car owners to Ford service users. Building a user base whilst people might already be committed to current service providers might be difficult, and even cannibalizing as long as they keep selling individually owned cars.

I would recommend Ford to find a suitable service provider to at least manage the infrastructure on which the service could operate an AV ride-sharing service. Or to collaborate with an existing mobility service, where this service partner could manage the users and Ford can manufacture the cars, needed to deliver the envisioned AV ride-sharing service.

3.5 START OF THE SERVICE

How the service should come to existence is in my point of view, an important limitation of this envisioned commuting-service.

First of all, the service would require a significant amount of users to make efficient matches. TNCs who offer shared options today have first gained their users by providing individual use and have started to offer shared options when the density of users had become large enough to makes shared rides viable. If Fords wants to differentiate itself as a brand with the benefits of sharing, they would have to overcome a challenge regarding the roll-out of this service. Secondly, from a user perspective, closing a commuting subscription for a shared fee, would be more affordable than starting at a private ride rate. Starting this service un-shared, could exclude potential users.

The possibility to start the service as a shared ride service with the corresponding fares, should be explored alongside a calculation at what user density this operation would be viable.

Another possibility to overcome a troublesome roll-out of the service would be to explore possible collaborations with existing MaaS services. This would mean a different type of business model. For users, such a subscription could look like an 'all-access gym subscription'. These types of models give people a range of possible mobility modes, for which they an overarching company. Such a construction would provide Ford less control over their pool of users, but also holds great benefits. Firstly, the possibility to have a large user group right from the start and secondly that people will have a much lower threshold to have an initial experience. If Ford can deliver the ride-sharing promise formulated in this thesis, having people experiencing it, would be a great start in acquiring loyal customers.

3.6 URP PROJECTS

Serveral outcomes of this thesis can be used to kickstart new projects of support projects that are already planned.

Operational design

First of all, the hierarchy pyramid shows that the u-u and u-s qualities should be manifested on a solid operational service. This foundation, however, did not get much focus in this thesis. Designing a service from a more functional perspective would be very valuable for Ford, and this thesis provides a lot of insights. Some of these insights can function as a starting point and others can be viewed as a goal. The future vision and the criteria cards would be helpful boundaries to design. Combining the operational part for an AV ride-sharing service with this thesis would form a complete picture of this service design.

Criteria cards and interaction course

A new project in the URP is going to look at the possibilities that AI will facilitate U-S interactions. The criteria cards, interaction vision and user narrative all hold much value for such a project. The most tangible result of this project is the criteria cards, and most of the U-U and U-S criteria are not defined in terms of technology, but in terms of desired interaction from a users' perspective, accompanied with the statement that the service should provide this interaction. Using these criteria as a start to brainstorm on how AI can realise these desired interactions would be a great way to give direction to a broad topic and embody this interaction vision.

3.7 CRITERIA CARDS

A last recommondation is about on of the final deliverables, namely the criteria card deck.

They are initially created to present a complete overview of the user needs for the daily commute in an AV ride-sharing service. The cards standing alone, however, do not form a full design toolkit to start creating a perfect ride-sharing service. Such a design toolkit was never the objective for this graduation project, but I feel as if the criteria alone do not have enough weight create nor validating a ride-sharing service to the fullest since it does not take into account all the needed elements. This relates back to the hierarchy pyramid showing that an operational service and functional elements are hard to neglect. That is why the final card deck possesses more than just the relational criteria, but not enough fundamental criteria to cover all needed elements.
The challenge in usability is also due to changes in the organisation of the client. The extent to which the outcomes of this project would be applicable became uncertain, making the final objective more ambiguous to design or validate.

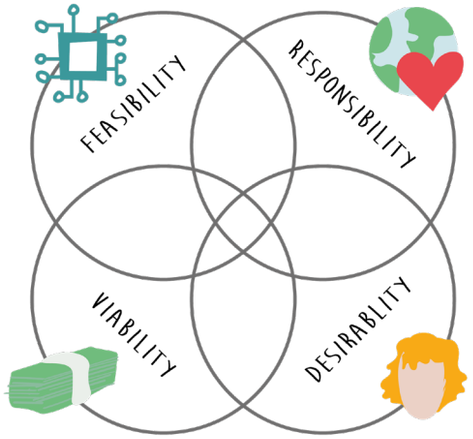
1. Criterion profundity
A critical note is difference in depth of the criteria. Some are relatively obvious, and others go into great depth with many attached consequences. I am aware of the discrepancy between criteria about facilitating the engagement of interpersonal contact, and other criteria to indicate when you are bringing your dog along. Hindsight I would have made a more profound distinction or separation between 'ready to use' criteria that one could easily check off on a list, and criteria that would require a sophisticated design to fulfil them.

2. Completeness vs. quantity
Making the earlier stated distinction between the criteria would have helped to create a more manageable amount of cards to work with. The set now gives a complete overview of user insight criteria and the motivation behind them, making some cards seem obsolete or double, while the underlying motivations for having them might differ. These nuances might have been redundant hindsight.

4. REFLECTION

Here I will shortly look back to my personal learning objectives stated at the start of this thesis, to reflect on my own goals as a student. But first I will reflect on my responsible design statement discussed in 'Designers take on the challenge'.
For every intermediate deliverable, I completed a format to reflect on my own work, process and project management as a person. For the final deliverable, I will do a reflection after completing the graduation presentation and having some time to let everything sink in.

"Thought-out this report, the state of technology will function as building blocks, which will be stacked in such a way that it meets both the requirements for a viable business as a responsible design for society. The shape of the construction will be defined by the way people would wish to use this service to guarantee a desirable design."



I will shortly refelct on the statement above, which I made at the very beginning of this thesis. Trough extensive desk research I became convinced that the technology building blocks of AVs are are solid to start designing with. Calculations with possible ride fares (Appendix 4) and additional desk research, combined with a fruitfull scope showed potential for many viable business models.
However, my personal motivation to design is derived from the possibility to create a positive impact. Looking back at this design challenge I am glad to have taken on this personal goal to design with the aim to create a responsible design, that would not just be technologically feasible, viable for business and desirable for its users, but also responsible for our society and environment.
This ideology helped me find convincing benefits for AV sharing that kept me motivated and convinced to find the key to making this successful. Where this ideology started from a more environmental and rational perspective, the solution space of sharing has opened my eyes to the more intangible and emotional benefits of a responsible design.
Facilitating a common understanding through technology contributes to engagement of people on a societal level, where lately technology has been given us seclusion.
Realising the possible positive impact of an AV ride-sharing service, and that its key to success would lie in its desirability, motivated me to perform extensive user research and gather all these insights to deliver criteria to realise a desirable ride-sharing service.

REFLECTION ON PERSONAL AMBITIONS PROPOSAL

I will look back on the personal objectives stated in my graduation proposal and reflect on the things that stood out to me the most.

Communication; reporting

The first ambition expressed my worries about delivering a written report individually since I am struggling with dyslexia and had never written a decent report on my own (let alone use InDesign). Even though I am sure there are imperfections and some mistakes, I am very proud of overcoming this insecurity and delivering a report on my own.
I also tried to use means of communication that are closer at heart. For example, making a 'praatplaat' is something I really enjoyed and comes relatively easy. Same goes for all the little visuals on the cards or user narrative.

Research & user centricity

Secondly, I said to be enthusiastic to try new types of research and that I wanted to keep a user focus throughout conducting research. As already mentioned in the preface of this report, most of the research methods were new to me, such as observational research or acting-out sessions. Most of my research was very user-focused, hindsight, that sounds quite logical since I obtained a focus on interpersonal contact, but being able to work with so many future users and talk to so many actors in the servicescape, made it a very enjoyable experience. I think that the choice in methodology has been one of the main reason why I enjoyed doing this project so much.

Project management

The third objective set at the very beginning revolved around the challenge of project management as an individual. Doing a project entirely by myself came accompanied with the highest peaks and the lowest moments of this project. From a rational perspective, I really struggled with switching from doing managing tasks (e.g. planning, making decisions, keeping overview) to executive tasks (e.g. writing texts, clustering insights, making visuals). I am comfortable in both positions, but I find it much easier to instruct others what to do than telling myself because I easily disagree with myself a few moments later. The other way around, I can enjoy doing mindless repetitive tasks, but they became far from mindless when I was my own instructor. This has caused a lot of unnecessary overthinking and going round in circles.

Life balance

The last objective was to maintain a healthy balance between studying, working, sporting, doing side activities and a having a social life. Setting this as a goal and putting a graduation project in perspective, contributed to a mostly relaxed project, with enough time to keep living my life the way I like it (apart from a handful of hectic moments of course).

At this point (one day before the deadline) I see so many things that I could have done better, should be imporved, or the deliverables that I would like to iterate further.
But with a little perspective and looking back on the project I am very satisfied with my master thesis and graduation process.

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APPENDICES

APPENDIX 1: AUTONOMOUS TECHNOLOGY TRENDS

1. Sensors

The sensors in AV's could be compared to the human senses. Human senses take in information they witness outside of the car, and are assisted by the sensors of todays' cars that provide the driver with extra input inside the car with information from the outside world. All these stimuli received by the driver are taken in by the eyes, ears, skin and nose. This provides is with a clear enough image of our surroundings to navigate safely. However, when you look at the possibilities and the measurements performed by sensors, these results outperform humans on many levels. First of all, sensors can measure inputs that we as humans are incapable of taking in, this means that AV's (when equipment with such sensors) have additional senses over human beings. Take heath measurements or radar as an example, this would allow a car to 'see' a living creature even when it is out of sight (either for camera's or for human eyes) and if programmed accordingly, the vehicle could respond in an the appropriate way to avoid casualties. An example of a sensor that are used in autonomous vehicles are LiDAR (Light Detection and Ranging) which maps its physical space by bouncing laser beams of objects, creating a 3D model of its surrounding called Simultaneous Localization end Mapping (SLAM) (Giuliano Giacaglia, 2019).

Secondly, sensors have the ability to do a constant measurement and obtain a constant focus on the objects they are programmed to be focused on. This is not the case for human beings at all, since distractions, a wondering mind and a focus on the wrong activities or objects is very common, even when driving a vehicle. To illustrate this, the most common causes of car accidents in de Netherlands are; 1. Calling, 2. Changing the radio station, 3. Eating, 4. Looking back, 5. Drunk driving (AllSecure). All of these activities won't endanger the situation on the road with a constant monitoring of an AV because sensors will not be distracted by a phone call or a car sick toddler in the backseat.
(tesla)

2. Swarm intelligence

This is one of the key factors in the increased safety of AV travel. In the case of AV's it would provide the ability for all the individual cars to work together as a swarm, in the automotive industry also known as a fleet. Fleet intelligence can be defined as the "The emergent collective intelligence of groups of simple agents." (Bonabeau et al, 1999). This quality mainly benefits the communication and learning ability of the vehicles on the road. For humans it is unimaginable that if one person encounter a certain anomalous traffic situation it is simply impossible for all other road users to instantly become aware of this abnormal situation let alone be able to adapt accordingly. With swarm intelligence an AV fleet would have these abilities and can therefor act more efficiently in unexpected traffic situation (Harari, 2018).
An operation AV fleet will have a far more efficient learning curve as a human being, since they share their experiences. This means that every mile travelled by each individual vehicle will be 'travelled' by every other individual as well. The downside of being a human individual is that you can only experience your own experiences, and therefore will not allow you to have the instant knowledge and ability to drive through snow for example if you have never done that before, for an AV as part of a fleet, this is not the case and can there for have an instant amount of experience and VMT that even the most experienced human driver will not be able to gather in a lifetime.

3. IoT & 5G

According to Allied Market Research, the global influx of IoT into the transportation sector was valued at $135.35 billion for 2016 and is estimated to touch $328.76 billion by 2023, a compound annual growth rate (CAGR) growth of 13.7% globally.
The reduction in prices of powerful sensors and controllers, coupled with a demand for faster internet, makes the adoption of IoT for improving the efficiency of the transport sector inevitable (Golomp, 2019). An example of the impact of integrating connectivity in a mobility landscape is shown through a study in Pittsburgh by the Carnie Mellon University. With a smart traffic management system allowed the traffic signals to change based on real-time traffic patterns, resulted in a 40.0% reduction in vehicle wait time, a 26.0% faster commute and a 21.0% per cent decrease in vehicle emissions (Miller, 2018), imagine what the impact could be if all players in the mobility field could be connected through IoT. However, to fully benefit from the potential of IoT, a 5G network is necessary to guarantee the last-minute connectivity between the vehicles, the roads and other elements (Qualcomm, 2018).
5G uses millimetre waves to ensure that each device receives an exclusive data stream, which is uninterrupted and instant. IoT vehicles mainly contain mini "cloud" systems, receiving and transmitting information amongst each other, i.e. vehicles 'talk' to each other and to sensors on every street corner, parking space, bus stop, and traffic signal systems constantly. Furthermore, 5G signals will have such an exact data course location that it allows the use of high-definition maps, as replacement of GPS, which makes it possible to locate an AV to single-digit centimetre accuracy. (Golomp, 2019).

4. Artificial Intelligence & Machine Learning

Kaplan and Haenlein (2018) define AI as "a system's ability to correctly interpret external data, to learn from such data, and to use those learnings to achieve specific goals and tasks through flexible adaptation". Machine learning occurs in AI systems that are able to learn and even self-improve without the need for a rule-based (human made) input.
From 2010 on, AI and machine learning got a rapidly increasing prominent role on the research and strategic business agenda and once became well-funded by governments

as well as organisations (Chui & Francisco, 2017; Ransbotham et al., 2018). Amongst other industries, the transportation industry is one to clearly benefit from these technical developments (Harari, 2018). This because AV would heavily rely on AI and ML to become safer on the road and learning to recognize traffic signs, other cars, people on the street and of course there behaviours. Where the sensors can be seen as the senses of a vehicle machine learning could be compared to human learning. Requiring input and repetition to correctly interpret and act up on the surroundings. But as explain in the section Swarm Intelligence, this would mean that if 1 vehicle in the fleet learns something that all vehicles in the fleet know this too. So if we compare learning to drive with the help of machine learning to a normal 18 year old how to drive, this would mean that when the kid has acquired the skills to drive, all his classmates simultaneously have this skill as well.

5. Virtual training

The technological developments briefly explained above are all indicators of superiority over human drivers. Unfortunately these skills and learning processes have to be acquired in the first place. In order to safely train AVs virtual worlds have been develop where the cars will have to deal with complex traffic situations and weather circumstances, allowing them to experience 'once in a life-time' situations, to prevent cars from crashing or erroring when these rare circumstances would occur in the real world (Giuliano Giacaglia, 2019).
Waymo used this virtual reality to test its software before releasing it to its real-world test cars. In the simulation, Waymo created fully modelled versions of cities like Austin, Mountain View, and Phoenix as well as other test track simulations. It tested different scenarios in many simulated cars—around 25,000 of these at any single time. Collectively, the cars drive about 8 million miles per day in this virtual world. In 2016 alone, the virtual autonomous cars logged approximately 2.5 billion virtual miles, which is a much higher number than the 3 million miles Waymo's cars drove on the public roads. (Giuliano Giacaglia, 2019)

APPENDIX 2: AUTONOMOUS TECHNOLOGY BUSINESS

1. Materials & Construction

A factor in the cost reduction of AV's compared to HDV's is the cost of materials to build cars. Today, the construction of the car, and the selected materials are highly influenced by their ability to perform best in the scenario of a car crash. As explained before, AVs are expected to crash less than HDVs and can therefore be design with less advanced and lighter materials to guarantee the same safety standard (Corwin et al, 2016: Eliaz et al, 2018). This could drive the adoption of polymers, composites, aluminium and lightweight steel alloys. The same goes for the construction of a car, everything in a car is positioned in such a way that the human body will suffer the least possible consequences in case of a car crash, but given the numbers on car crash reduction in AVs, these cars could be design more cost efficient. Also, existing cars have the ability to be rebuilt into AVs as proven by the company Comma,ai (Giacaglia, 2019). The founder of this company is selling software in a dongle of sorts which makes a common car self-driving. These kind of solutions could be an extreme low cost solution to still provide autonomy without the costs of a new model, suitable for e.g. very basic AV ride-sharing options.

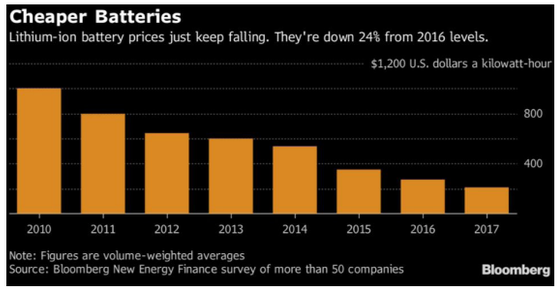
2. Electrification

When talking about AVs it is assumed that we are talking about a vehicle powered by electricity. If we look at the prices of electricity over fossil fuels, we can see a bright future for electric vehicles. First of all because fossil fuels are getting more and more scares since their source is not an infinite one, whereas electricity is. And taking in to account the disposition of political and individuals towards sustainable energy sources, the future starts to look even better for EVs. Recent developments, such as the Paris agreement are only pushing in the direction of renewable energy sources and electrification in mobility would have a great impact. So when it comes to taxes or subsidises electric vehicles will be more cost efficient. This benefit can be enjoyed by al EVs not just AVs.

Battery

As the electrification and the automation of our vehicles go hand in hand the price of a car battery is an important component. And luckily the costs of these Lithium-ion battery packs are dropping drastically. The average price of $209 a kilowatt-hour in 2017 is just a fifth of the costs in 2010 (Chediak, 2017). And according to a Bloomberg New Energy Finance report the costs a kilowatt-hour is expected to drop below $100 by 2025, which is widely seen as 'a tipping point in EV adoption'. This the current 80% price drop and the expected lowering in costs are mostly driven by scaling up the production,

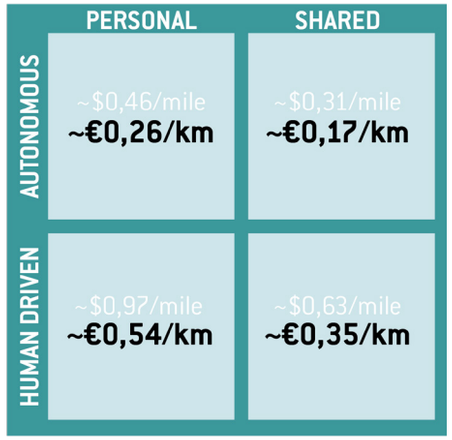
competition, new cooling systems and cathode binder materials such as PVDF & SBR (Smith et al, 2017: Eliaz et al, 2018: Bloomberg, 2018). Therefor also lowering the price of a key component in AVs.

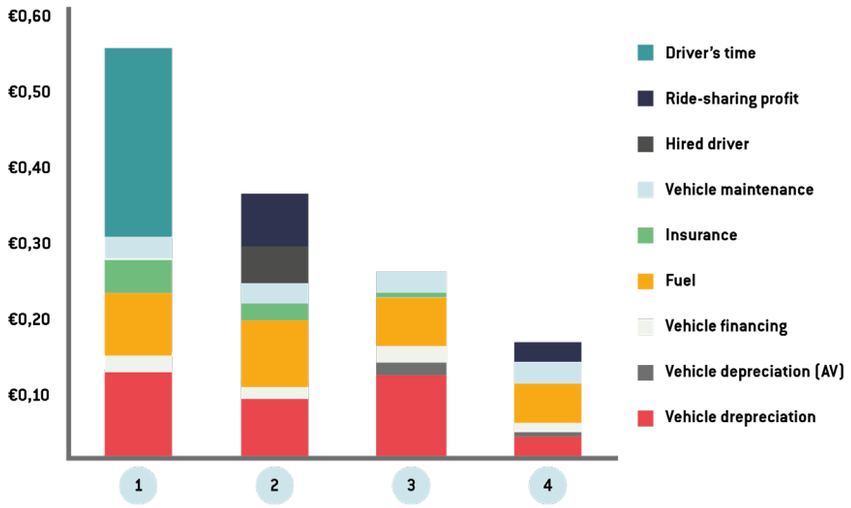


3. Cost decrease for users

The graph below shows Deloitte's calculations for 4 different future scenarios, the forth assuming the optimal possibilities being taken advantage of and therefor representing the largest impact, shows the most relevant scenario for this part of the thesis. It illustrates the future cost per mile to be approximately $0,31/mile equivalent to €0,167/km (Corwin et al, 2016).

The drivers for this decrease in costs are explain in the following subchapters.





4. Sharing

A final factor of price reduction is the ability of sharing both the vehicle and the ride to reduce the costs for de individuals involved. As explain in the section societal impact > parking, it would be easy for multiple individuals to be in de same car on the same day, which allows all of this people to enjoy the freedom of mobility that a car has to offer without suffering from the initial costs that come with the purchase of a car today. These purchasing costs would be made by the mobility service provider and would be split over all the rides the car makes, leaving a very small amount per ride per person.

Adding to the benefit of AV sharing, this project is aiming not only for a shared vehicle but for the ride to be shared as well. This would even further drop the cost of mobility since the cost the miles travelled per ride would be distributed over all its passengers. The concept of shared rides and its impact on the prices for the users have already been proven by TNCs like Lyft and Uber. The image on the right is a screenshot that illustrates the price differences between sharing or going solo.

5. (wo)man hours

Compared to current TNCs: When looking at this screenshot you can see that a trip of roughly 30 minutes (16:17 order time and 16:45 earliest arrival option) is only $7.88 when shared. These costs depend on many things in the current system, but a set percentage of these costs goes to the driver. When comparing today's TNC or taxi services to a future AV TNC or taxi there can be a drastic decrease in the cost of labour.

Compared to HDV: 'Time is money' is a very common expression and very relevant when it comes to AV's. As has been mentioned, a key benefit of AV's over HDV's is the fact that it opens up time when people make the transition from being a driver to a passenger. In many use cases you can see this additional time as an opportunity to either spend as free time or as a workhour. When you would work in an AV the cost of driving and the money earned during the ride would sketch a competitive advantage over the costs of a HDV.

6. Insurance

As explain in the sections AV's superiority and Societal impact, AV's will increase the safety of people on the road. Shifts in safety standards haven proven to impact the insurance landscape in the past, and are most likely to create shift with the rise of AV as well. For example, think about the effect of airbags on car insurances, when airbags where introduced people who purchased cars with airbags were given discounts on the premiums over people who purchased cars without them. The impact of airbags is only visible when an accident has already happened, but with the prediction of a significant decrease (Corwin, 2016; SFCTA, 2019) in the amount of accidents occurring, the differences in insurance between human driven vehicles and AV is most likely to become larger.

APPENDIX 3: THE LIVING STREET PRINCIPELS

The Living Street optimizes for place
Much more than just a path for getting from point A to B, the street is a public living room where daily life unfolds, where a child climbing a tree to collect fruit illustrates that streets are first and foremost places, belonging to the public for common use.

The Living Street forgives
Kids can enjoy playing in the street and don't have to worry about major consequences for chasing a ball since the street accommodates for a range of mistakes and inattention.

The Living Street embraces the human scale
Designed considering both the dimensions of the human body and the fact that people are sensory creatures, the buildings are rich in detail with interesting facades, allow for direct access to the street, and transition gradually from public to private through soft, occupiable, edge zones.

The Living Street invites participation
Members of the community actively participate to improve their street by working together to pave it.

The Living Street supports a range of interactions
Taking a moment to sit down and relax in an inviting public space with comfortable seating, a group of strangers - both young and old - engage in conversation, demonstrating the street as a place for interaction.

The Living Street delivers access and opportunity
A bustling transit node, easily accessed and connected to bus routes and a shared bike system, provides the perfect platform for a mobile vendor to sell goods and provide a service to passing pedestrians.

The Living Street promotes sharing with others
A bicyclist and skateboarder happily share the same space along a high quality bike path.

The Living Street provides a variety of real choices
From walking to taking the bus to biking or hoping on an electric scooter, the options are abundant so people have the freedom to choose how they want to move.

The Living Street allows people to be more human
A stranger keeps the door open of his shared ride to invite someone else in, reflecting people's inherent desire to connect and good mobility's ability to allow people to be more human.

The Living Street improves a sense of place
A well designed bus stop invites people to stop and stay with its playful and comfortable seating, which helps to create a rich, holistic mobility experience.

APPENDIX 4: TNC & CAR COSTS

FIESTA

Vanaf € 17.625
Actieprijs € 16.875

NIEUWE KA+

Vanaf € 15.690
Actieprijs € 14.940

1 Kia Picanto (€12.215)

Een kleine stadsauto

Maandkosten: **private lease €241, kopen (lening) €278, kopen (eigen geld) €257**

We vergeleken de maandkosten voor de populaire Kia Picanto 5-deurs EconomyPlusLine:

	Lease-aanbod	*Lening*	*Eigen geld*
Totaal per maand	**€***241*	**€***278*	**€***257*
Kosten bestaan uit:			
Vaste kosten			
Afschrijving	**incl.**	**€135**	**€135**
Rente	**incl.**	**€23**	**€2**
Verzekering	**incl.**	**€45**	**€45**
Wegenbelasting	**incl.**	**€21**	**€21**
Pechhulp	**incl.**	**€12**	**€12**
Variabele kosten			
Onderhoud en banden	**incl.**	**€42**	**€42**

Auto kosten

Model	Kia Picanto*	Ford Ka+	Berekening
Aanschaf kosten	€ 12.215,00	€ 15.690,00	
Restwaarde**	€ 5.754,00	€ 7.390,93	(15.960*5.754)/12.215
Vaste kosten			
Afschrijving***	€ 135,00	€ 173,00	(15690 - 7391) /48
Rente	€ 2,00	€ 2,56	2 * 100 / 135 = 1,48%
Verzekering	€ 45,00	€ 45,00	
Wegenbelasting	€ 21,00	€ 21,00	
Pechhulp	€ 12,00	€ 12,00	
Variabele kosten			
Onderhoud	€ 42,00	€ 42,00	
Totaal per maand	€ 257,00	€ 300,00	
Totaal per dag	€ 8,29	€ 10,00	
Totaal per km	€ 0,20	€ 0,24	

Table 1. Car ownership costs

De bovenstaande kosten zijn op basis van:
4 jarig gebruik
bij directe aanschaf zonder lening
jaarlijkse rijafstand van 15.000 km = 41 km per day
Excl. Bezine kosten
Excl. Parkeerkosten

*Numbers retrieved from Consumentenbond (2019)
**Restwaarde voor Kia Picanto na 4 jaar gebruik
***Op basis van de restwaarde na 4 jaar (aankoop - rest / 48)

2. Car usage

Personen auto's staan gemiddeld genomen 96% van de dag stil (Barter 2013).
Positively rounded to 5 % in the following calculations.

	time of day	% in use	minutes in use
1 AV	06:00 - 22:59	90%	918
	23:00 - 05:59	45%	189
		77%	1107
1 HDP	nvt	5%	72
Increase		72%	1035

Table 2. Car usage in time

Sharing a car could potentialy increase the percentage it is used with 72%. To play on the safe side we assume 70% (insteade of 77%) usage per day.

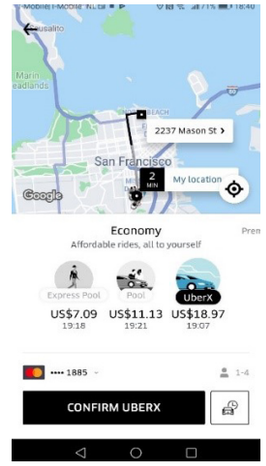
Type of ride	Short	Average	Long
Distance	10 km	50 km	100 km
Travel time	20 min	60 min	90 min
Speed	33 km/h	50 km/h	75 km/h
travel min / AV / day		*1008*	
max. rides/day	50	17	11
Average rides/day*	14		

Table 4. Types & amounts of rides possible per day
*based on the average of 41 km per day.

3. TNC Case San Francisco

During my TNC rides I interviewed drivers to get a better understanding of the infrastructure behind the application you experience as a user. One of the driver elaborately explained their income structure. In San Francisco a driver for Uber earns $0,6825/mile, $0,29/minute, $1,65 for the first passenger and $1 for every additional passenger. These rates are highly circumstantial, depending on the area ranking (Berkeley 2nd rank e.g. and San Francisco 1st rank), demand and time of day. Also Uber is allowed to change these fares on a daily basis. These number however, are based on daytime San Francisco area and had not been changed in 2019.
This use case aims to illustrate what percentage of the costs for the user is being payed to the driver to get a rough estimate of the possible price reductions possible when operation TNCs with AVs.
Location A: 1519 Mission St, San Francisco
Location B: 2237 Masson St, San Francisco

Driver income*	
$0,68	/ mile
$0,29	/ minute
$1,65	/ passenger
$1,00	/ + passenger
Use case info	
Fastest route	2.8 miles
Estimated travel time UberX	27 minutes
Estimated travel time Pool	41 minutes



	UberX	Pool**
User costs	$18,97	$11,13
Earnings per mile	$1,91	$1,91
Earnings per minute	$7,83	$7,83
Boarding	$1,65	$2,65
Total earnings driver	**$11,39**	**$12,39**
Income Uber	$18,97	$22,26
Profit Uber	$7,58	$9,87
Percentage driver costs	**60%**	**111%**

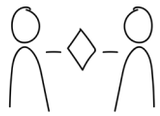
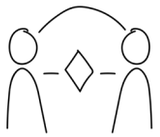
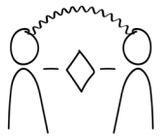
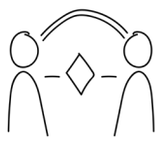
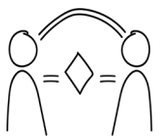
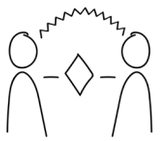
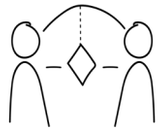
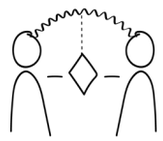
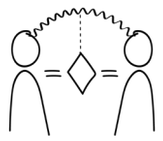
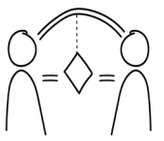
APPENDIX 5: RELATIONAL SERVICE DESIGN

Relationship do not occur out of nowhere, a relationship needs to grow and to be built. The next pages aim to illustrate how I envisioned relationship building from a U-U and U-S perspective in a joined servicescape, what the differences are between interactions and relations, and how the U-S and U-U relationships are interdependent.

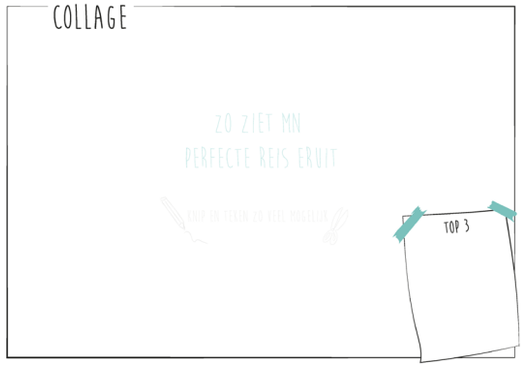
Visualisation	Term	Defenition
	Interaction	Interaction is a kind of action that occur when two or more objects have an effect upon one another.
	Negatively experienced interaction	An interaction that has a negative effect on the user experience of a service. This type of interaction can occur both in U-U and U-S contact.
	Positively experienced interaction	An interaction that has a positive effect on the user experience of a service, can also be described as an encounter when this experience is from a relational nature. This type of interaction can occur both in U-U and U-S contact.
	Relation	The bond that can occur between two actors, or between an actor and a service. This is achieved through proper design and a series of positive interactions or encounters.
	Facilitation	In this context facilitating means the creating a service (scape) where the room over interpersonal relations is actively designed for.

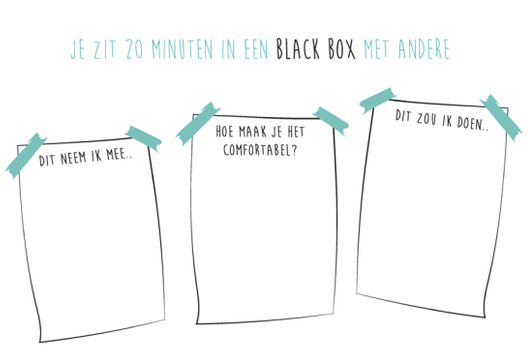
Visualisation	Term	Defenition	Authors
	Service	A system suppling a need through a holistic, multidisciplinary and integrated design. The application of competences by one entity for the benefit of another.	Reason et al. (2016) Sleeswijk Visser (2013) Vargo & Lush (2004, 2006)
	Actor	The people who play a role in the delivery of the service. Different roles can be the end-user, a decion maker, a producer etc.	Reason et al. 2016
	Product	A product is a physical object that helps to deliver the intended service to fulfil user needs. (S-D logic)	Vargo et al. (2006)
	Factor	Factors are elements that influence the user(s) and their experience of a service.	Reason et al. (2016)
	Attributes	Attributes (or objects) are building blocks of the environment, sometimes put to complex or unintended uses, changing their function, meaning and context .	Wasson (2000) Kimbell (2014) Snelders et al. (2014)
	Servicescape	The character and function of the spaces where things take place.	Snelders et al. (2014) Wasson (2000) Kimbell (2014)
	Channel	The means through which the user interacts with the service, creating touchpoint.	Reason et al. 2016

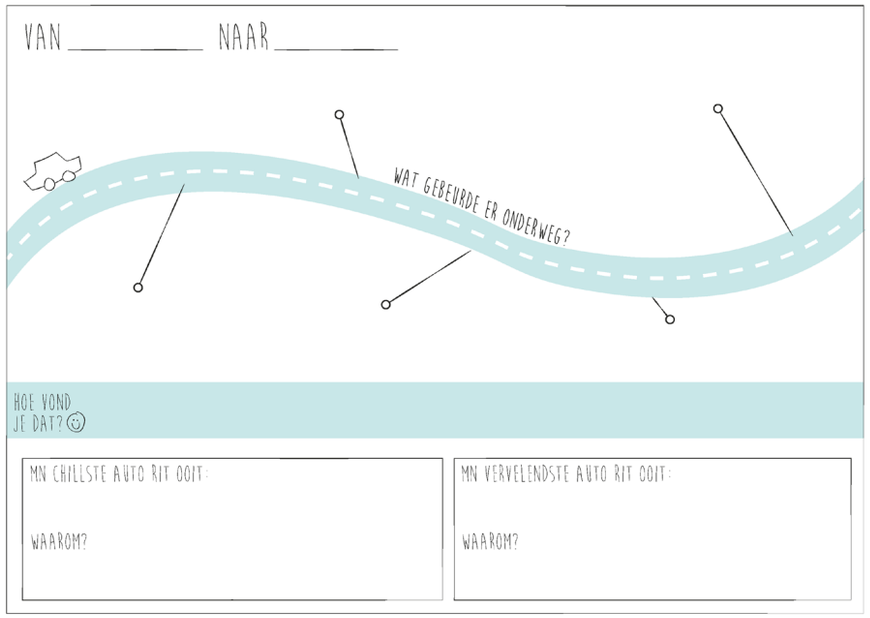
INTERACTION VS RELATION & RELATIONSHIP BUILDING

	Visualization	Explanation	Ride-sharing example
1.		When two people are simultaneous and real life users of the same service,	Two users traveling in the same vehicle ordered through the same service.
2.		They will have an (however small) interpersonal interaction.	An on-boarding moment where people make eye-contact or say ‘Goodmorning’
3.		If interpersonal interactions are positively experienced and reoccurring by both users.	A pleasant conversation amongst riders, or encountering the same people on a daily basis and sharing a newspaper.
4.		These interactions could potentially grow into an interpersonal relationship (but this not assumed to happen spontaneously).	Establishing a certain level of added value of sharing your ride with this certain co-rider. Frequent chats e.g.
5.		If it would occur, the U-S interaction could rise in value and become relational as well. The added value of a co-rider could also increase the value of this particular service for each rider since this is a service-specific feature.	If your ride-share buddies travel with company A then you would mis out on them if you choose to use B. There is a great opportunity to invest in continuity of service usage though interpersonal relations with co-rider(s).
6.		Since we did not assume a positive interpersonal interaction to occur spontaneously, we should also take into account the consequences of negative interaction amongst users in the servicescape. A negative	From distasteful eating and loud phone calls to sexual harassment or violence, the ride-sharing experience will be negatively influenced. Posing harm for the long-term relationship the users can engage in with the service.
7.		experience with a co-user could have the opposite effect on the relationship users hold towards the service provider. And will defiantly influence the experience of that particular ride. However, if the service actively facilitates these interpersonal interactions, stimulating positive ones and attenuating or avoiding negative ones,	Letting current rider(s) know an other passenger is about to enter. Playing music that matches the taste of both passengers, asking someone to stop displaying inappropriate behaviour.
8.		These interactions are for more likely to be positive. Either because a simple interaction could be supported to become more, of by mitigating the negative interactions.	The service could match people who are more likely to have an enjoyable time together either because they share common interests or because to both prefer to work in silence.
9.		Actively facilitating positive interpersonal interactions within the servicescape is a challenge, but one that would improve the user experience on short term basis and would help users to engage in a relation with the service itself on a longer term.	
10.		The desired effect would be to facilitate positive ride-sharing experiences in order to grow a long term user to service relationship. Possible being fostered though a good interpersonal relationship.	If your ride-share buddies travel with company A then you would mis out on them if you choose to use B. There is a great opportunity to invest in continuity of service usage though interpersonal relations with co-rider(s).

APPENDIX 6: SESSION FORMATS







HKJS

SCALES

I WOULD LIKE TO DO

SERIVOUS BUSINESS — FUN STUFF

I WOULD LIKE TO BE

SHHHH — BLA BLA BLAAA

I WOULD WANT TO KNOW .... ABOUT THE OTHER RIDERS

NOTHING — AS MUCH AS POSSIBLE

KNOW AS LITTLE ABOUT ME AS POSSIBLE — I WANT THE SERVICE TO — FULLY PERSONALIZE MY RIDES

I VALUE THIS THE MOST DURING MY RIDE

EFFICIENCY — PERSONAL PREFERENCES

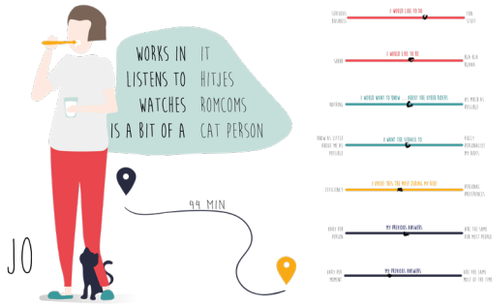
MY PREVIOUS ANSWERS

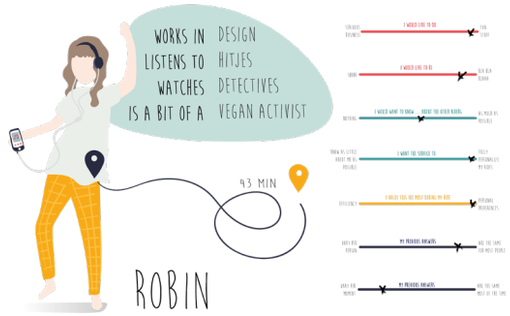
VARY PER PERSON — ARE THE SAME FOR MOST PEOPLE

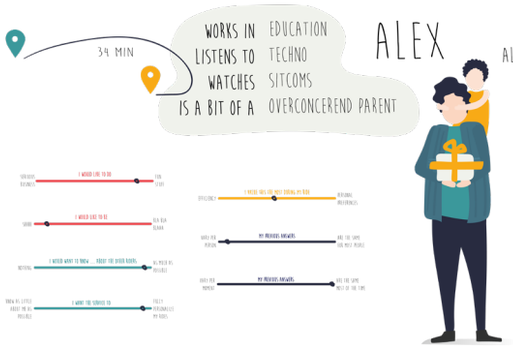
MY PREVIOUS ANSWERS

VARY PER MOMENT — ARE THE SAME MOST OF THE TIME

PERSONAS







APPENDIX 7: FIELD RESEARCH FORMAT

APPENDIX 7: CRITERIA

CLUSTERS

1. Basic offering
This cluster describes criteria that sound fairly basic, but are not to be underestimated when you want to roll out a successful ride-sharing service. They apply to the service and vehicle criteria and function as a basis upon which other criteria can be manifested.

2. Service authority
The criteria in this cluster service to establish the roles and responsibilities between the service and its' users. Which tasks should the service fulfil? And what should the service ask from its' users to guarantee a pleasant commute for everyone?

3. Rewards & consequences
This cluster applies both to the user-service criteria and the service criteria as rewards and consequences can both be used in the plain service offering as be used to create a good user-service relationship. Rewards and consequences contain criteria that will stimulate proper usage of the service.

4. Payment
A very specific cluster that states the preferred form of payment form a user perspective and the considerations from a service provider perspective.

5. Supporting activities
The cluster supporting activities describes how the vehicle in which the service operates should support the activities intended by the user. The most common activities observed or stated during different phases of research as part of this graduation project form the basis of these criteria.

6. Vehicle-service integration
This is an important cluster when considering that the vehicle provider or service provider might not be one party but multiple collaborating companies. The vehicle is the servicescape and the largest manifesting and most essential part of the service and should be properly integrated to guarantee optimal user experience.

7. Certainty and clarity
Feeling empowered is one of the most important user values for an AV ride-sharing service and understanding your surroundings, knowing what to expect, and being certain about your commute, are at the foundation of empowerment. The criteria in this cluster assure the foundation to user empowerment.

8. User understanding
In order to provide every user with a comfortable ride, the service needs to understand each individual user. Today there is only a limited possibility for having a deep user understanding of many individuals, but emerging technologies promise to improve this capability and as a ride-sharing service for everyday use, understanding the user and translating this into the service experience is a great way to make all riders feel comfortable.

9. User autonomy
Just as it is important to understand the user and act accordingly it is just as important that the users keep feeling a sense of control and empowerment. That is why certain choices and possibilities should never disappear from the service offering. These criteria aim to provide users with a feeling of control over their commute.

10. Facilitating interpersonal contact
Since the servicescape is shared, the service should facilitate the desired amount of interpersonal contact amongst the riders. The desired state has a lot of variables such as the involved individuals, their mood and other factors in their lives. Properly facilitating engagement amongst users will improve the ride-sharing experience, so does facilitating ceasing of interpersonal interactions when desired.

11. Matching
In order for a ride-sharing service to actually be shared, multiple users have to be matched to the same ride. This requires parameter on which to match individuals. This cluster elaborates what are, and what are not suitable parameters to match individuals.

CATAGORIES

Service criteria
These criteria are mainly focused on the initial service offering. In this card deck, the desired outcome is a service design for autonomously driven vehicles, which will transport multiple people on their daily commute.

Vehicle criteria
To deliver the service to its users, one will need vehicles to transport people. The vehicles and the services will have a high impact on each other's functioning and therefore it is crucial to take into account some design aspects for the vehicle in designing the service (vice versa). Integrating the service with the vehicle will add to the possibilities and user experiences during the daily commute.

User-Service criteria
This set of criteria is more focused on how the service should manifest toward the users. And how the service should interact with the users to provide an optimal experience. The criteria have mostly originated from the relational touchpoints in the user journey of today's TNC use. They focus on essential user values such as certainty & clarity and making the users feel empowered.

User-User criteria
These criteria are all about the facilitation of interpersonal contact and how to ensure that all individuals can travel comfortably amongst other users. It also includes what patterns matches should (not) be made. The possible solutions that uphold these criteria will provide a servicescape where there is a high amount of designerly input for relationships, but leave the output susceptible for all the factors that the users bring into the service.