

The MaaS design for incentivizing sustainable mobility

Graduation report, Nov 2021
Seamless Personal Mobility Lab

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Faculty of
Industrial Design Engineering



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This report is part of the Seamless Personal Mobility Lab

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Preface

A designer mentioned in her blog, "This is a time of self-expression, self-reflection, and social consciousness. During this era, value-driven design takes the lead in engaging communities and designing for sustainable change."(Xiao, 2018) I couldn't agree more.

As a citizen of the earth, everything that happened in the past 2020 and the first half of 2021 has definitely painted an important stroke in my life and in the long history of mankind. The climate is warming and disasters occur frequently. All the time, I have seen great changes in the lives of animals and the loss of everything for the people in the disaster areas. The anxiety and guilt that I am familiar with appeared, but I did not make any changes as I was engulfed in the high-intensity and high-speed development of social life.

However, the quantitative change of anxiety has indeed caused a qualitative change. Recently, I have begun to rethink what my personal needs for survival mean to the earth and what the gap between environmental awareness and environmental action is.

As a graduating strategy designer, I hope to have the opportunity to use the psychology and sociology knowledge I have learned to create a meaningful service that can interfere and influence people. Therefore, I strive to seek cooperation opportunities from real companies, hoping to make a verifiable design that can be applied in practice.

I got acquainted with the founder of MobiFi service by chance. After talking, I discovered the huge development space of this project for the promotion of green transportation, so I chose this project as my final project, and looked for experts in the field of transportation in universities as mentors, hoping to create meaningful services together.

After successfully starting this project, difficulties and surprises existed at the same time.

This is a relatively broad proposition that allows me to freely explore the industry and explore users to form a more mature design plan.

During the epidemic, there is always great uncertainty in the implementation of user interviews and related propositions. This is not only manifested in the mouth of ordinary users, but also experts believe that this is not a good time to promote such projects. The surprise is that the epidemic has given enough time for research and development to make this unusual idea land.

At the same time, I am very grateful to the three mentors for their help. In the past six months, I have been helping me to solve the puzzles of research and provide assistance with resources..

Executive summary

In the next 10 years, the European Union has formulated a detailed emission reduction plan, and ordinary people living on the earth who face climatic disasters every year have also realized the importance of environmental protection. Among them, the transportation sector, as the most influential sector, also urgently needs a sustainable change.

In this report, the literature and data tell us what is happening in this world full of vehicles, and where the traffic in the Netherlands has created opportunities for development. Through user research, from the action machine and actual travel decision-making, as well as the user's view of sustainability, I explored what users care more about in the proposition of sustainable transportation.

Based on the research, I have clarified that the drivers are my target group. By observing their travel mode, I understand their travel needs, and put forward a design vision and plan.

At the same time, the research on the reward mechanism and the analysis of classic cases have provided this direction with a tool model that can be used for expansion. Motivation, ability, and opportunity are all essential to changing user behavior. In the current service model, sustainability-related data is only a simple display of MaaS companies, without affecting or changing user behavior. Therefore, on this basis, how to tap user motivations and provide user capabilities and opportunities is the key to design.

In this way, MobiFi MaaS was born. Faced with the design of driving users, MobiFi will provide driving-related travel services, starting from parking to promote changes in user choices by providing greener travel methods. And let users first understand the possibility of connecting transportation services to replace private car travel, give users the opportunity to choose, and finally attract customers to make choices through the advantages of price and rewards. This is a plan created based on a long-term social sustainability vision. Different from ordinary MaaS providers, MobiFi not only focuses on empowering users and providing users with more diverse travel options as choices, but also fully grasping users' long-term vision and giving users long-term positive feedback.

And long-term accumulation of green points is bound to bring more development possibilities to enterprises. The user's long-term usage record has transformed these from a certification of a green environmentalist into a replaceable resource, from using the service by oneself to sharing the service with everyone.

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Introduction



1.1 Project introduction

In 2021, there will be deadly extreme weather events around the world, ranging from large-scale wildfires to extreme temperatures, heavy rains and flash floods. Such events will become more common in a warming world.

The Intergovernmental Panel on Climate Change (IPCC) issued a special report on August 9, 2021, stating that “The Intergovernmental Panel on Climate Change (IPCC) issued a special report on August 9, reporting that the concentration of carbon dioxide in the atmosphere in 2019 was higher than at any time since at least 2 million years, and that the temperature of the earth’s surface has been rising since 1970. It has been rising, at least faster than in the past 2000 years than in any 50 years.”

It is urgent to make changes to the climate issue, but there are not many corresponding actions. Therefore, I paid attention to and participated in the construction of the MobiFi project, hoping to use the designer’s insight and design ability to promote the implementation of environmental protection creativity. The MobiFi project is mainly to think about what people’s travel patterns will be in the future, and at the same time, what the future travel patterns should be under the more severe environmental situation.

Although the proposition of sustainability is often preconceived, it limits the possibility of development of things. But the world is the real world, and resources are always limited. Therefore, in this research, I used the opportunity to analyze the progress of the matter and explore the pain points and difficulties of users to design. In the project, I grasp the real demand through the analysis of the market and the analysis of the users. Further Mobility as a service design is based on real opportunities and demand points.

1.2 Cooperation with Things Protocol

Company introduction

Things Protocol BV is a blockchain powered MaaS company and they aim to build a future mobility as a service product with blockchain-based financial technology. As a start-up, they value disruptive innovation and economically feasible service models and marketing methods.

How could we cooperate?

1. Their business goal is in line with my design vision. We all want to create a smart and sustainable green travel system. Therefore, they will join my research as a service provider in the entire service system.

2. They are still looking for ways to apply blockchain technology to consumers’ lives. Its unformed service model is lack of strategy from design and market perspectives. They are taking into account its acceptance and ease of use, but did not think clearly how to integrating control, intrinsic motivation and emotion into their service, so the positioning and design of service providers in my research will also become an effective reference for them to explore service models.

3. Meanwhile they can offer some research resources. They have accumulated some blockchain user groups, and such semi-professionals will become the best early adopters to participate in my research. Some transportation service providers they have contacted in their business development can also provide valuable opinions for my research. The technical experts of their team will also become a powerful pillar of the work based on technological innovation.

1.3 Limitations of this project

1.It's not a good time to discuss travel modes during the epidemic, because everyone's travel opportunities are drastically reduced, and a year's home life may cause users to be insensitive to travel needs. At the same time, it also set limits and difficulties for my on-site investigation.

2.This is a research project based on technological innovation and exploration mode innovation. I don't have a blockchain knowledge background. In order to better complete the design task, I must study the technical literature and highly collaborate with the technical staff to create the most feasible solution.

3.People's travel behavior research is a project with many intervention factors. The entire project is mainly aimed at young European groups. But there are decisive intervention factors. For example, the Dutch university student group is having the government's public transport subsidy.

1.4 Opportunities for this domain

1.At present, the environmental awareness of European people is high, they just need a more practical, more convincing and attractive environmental protection service model.

2.At the same time, long term of working remotely also weakened the inherent thinking and created an opportunity to make people rethink about their true travel requirements and change irrational travel habits.

3.The application of blockchain in transportation is not common in the market. New technology-oriented innovation has broad prospects for academic research and market applications. Meanwhile, users are not familiar with blockchain technology and don't trust decentralized services now. It's a challenge for user testing but also a chance to study about consumers' perceptions of the use of blockchain technology and how to benefit users with new tech.

Project approach



2.1 Design process: Double diamond design model

Creativity is the habit of continually doing things in new ways to make a positive difference to our life (Nessler, 2016).

I choose the 'Double Diamond' process maps which shows the divergent and convergent stages of a design process as the overall research and design model. Created by The British Design Council, it conclude the commonality about how people process information in order to create solutions and modes of thinking that designers use.

1. Discover stage: Multi-dimensionally explore the problem and problem background

- a. Technology research
- b. Competitive analysis and existing research theories of incentive mechanism study
- c. User research: Identify and classify end users

2. Define stage:

Gain insights and define the problem Problem framing and clarify the design problem and the scope of solution.

3. Develop stage: Develop possible mobility as a service solutions through iterations

- a. Service model idea generation by system design and scenario mapping
- b. Summarize the future development direction and design the roadmap.

4. Deliver stage: Improve and optimize final service system

a. Prototyping and testing: Using the prototype as a 'physical hypothesis' to prove the feasibility of a proposition and as a stimulus in the testing of an overarching theory for which it constitutes an instantiation.

b. Critical reflection: I will deepen the analysis of prototype issues and the discussion of system mechanisms by arranging interviews with other stakeholders.

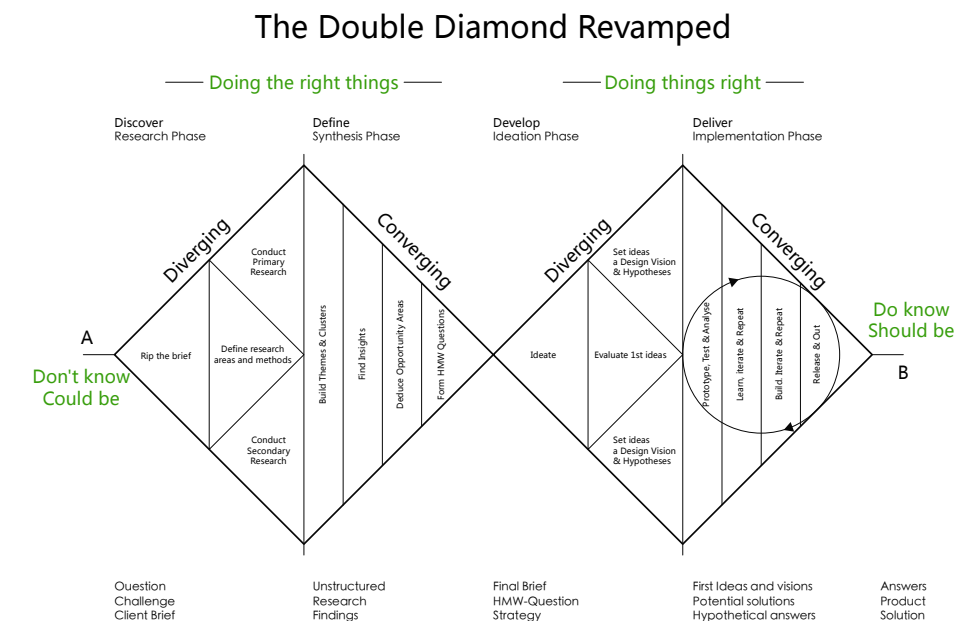


Figure 1: The double diamond revamped (Nessler, 2016)

2.2 User demand verification: Qualitative research

I apply the qualitative research in the study because it can help build the common ground for brand new innovation. Qualitative research involves collecting and analyzing non-numerical data (e.g., text, video, or audio) to understand concepts, opinions, or experiences. It can be used to gather in-depth insights into a problem or generate new ideas for research.

In order to fully understand the travel habits and travel ideas of the Dutch, I use a survey questionnaire as my sensitization material to help the interviewee recall and sort out daily life. I conducted a total of 8 interviews of more than 30min, and two trips with the car.

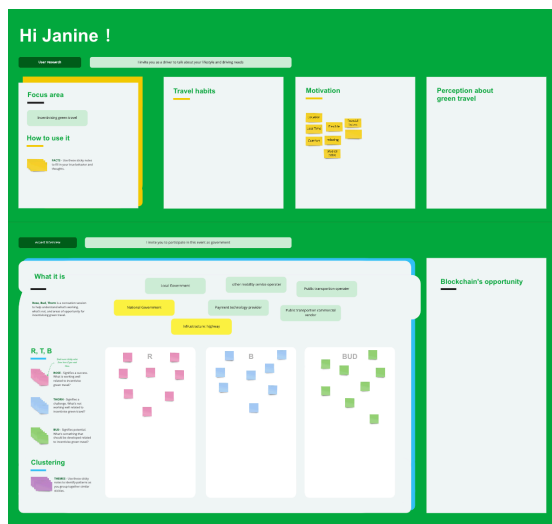


Figure 2: Communication board with interviewee

From sufficient textual materials, I collect data and classify them. According to the interview, I found that users have different travel habits for different purposes. Different users have relatively consistent travel choices and thinking paths. And based on the results of the interviews, the participants' understanding of green travel was summarized and why they expected to be more environmentally friendly but did not take action. Through classification and analysis, I completed the user portrait and user flow chart of young dutch drivers.

2.3 Outcome model guidance: Roadmapping

This is a transportation service design project for ordinary users. The company is still exploring the project. The service background, service goals, and service targets are not clear, so trend research, user research, technology research, etc. are needed to assist decision-making and provide strategic solutions for enterprises. The strategic design roadmap is the most high-quality presentation method among them.

Design roadmaps, which are intended to capture core customer and user needs, identify the design elements required to meet those needs and then connect those design elements with appropriate product features and technology choices. (Kim et al., 2018) The essentials of design roadmapping includes uncovering new trends, scouting for new technologies, and mapping long term values. Therefore, with the aid of the design roadmap, companies can plan their future development paths and directions more clearly. Based on the ultimate goal of the design roadmap, I restructured the research process to be more tailored to the needs.

Inspiration



3.1 Context Analysis

- What's happening?

3.1.1 Mobility consumption & consequences

Increasing Consumption

Travel has been part of the human experience since the migrations out of Africa millions of years ago. People's motivation for travelling has varied, though for the most part, people have travelled to improve their lives. Whatever their motivation, travel in early times was uncomfortable, dangerous and enormously time-consuming—today, some might argue that little has changed; travel is still uncomfortable, dangerous and enormously time-consuming. There are, however, two indisputable differences between travel then and now: in modern times there has been an extraordinary growth in mobility (in terms of trips made and distance travelled by motorized passenger kilometres) and a great increase in its environmental and social consequences.

During the twentieth century, growth-rates in population were remarkable—with the world's population growing by a factor of about four. The growth in mobility was remarkable too—with motorized passenger kilometres and tonne-kilometres by all modes growing on average by a factor of about 100.(International Energy Agency, 2009) However, whereas population growth shows signs of levelling-off, the growth in mobility does not. In particular, the growth in mobility has been extensive during the last half century.

From a macro perspective, with transport contributing around 5% to EU GDP and employing more than 10 million people in Europe, the transport system is critical to European businesses and global supply chains.(mentioned in Transport and the Green Deal) People need a seemingly infinite network of vehicles and transportation systems to uphold societies and economies. The energy consumption of personal travel every year is huge, and it is still showing an increasing trend before the epidemic.

Consequences

The high population density and high urbanization in the Europe has given birth to a developed transportation system, which brings urban prosperity and also costs to a lot of consequences, for instance, our environment: greenhouse gas, pollutant emissions, noise and so on.

Transport is a major consumer of energy. Around 31.6% (2016) of the world's final energy consumption is used for transport, mostly from non-renewable energy resources.(International Energy Agency, 2016)

The production of motor vehicles requires large amounts of materials, e.g., ferrous and non-ferrous metals. 2017 motor vehicle production consumes 7% and 3% of ferrous metals (similar for non-ferrous) in OECD and non-OECD countries respectively. Demand for metals in these regions is expected to grow by a factor of 2.2 and 3.5, respectively, between 2017 and 2060 (OECD,2018).

Transport is a major contributor to local, regional and global pollution of the air, soil and water. European Commission points out that transport emissions represent around one quarter of the EU's total GHG emissions. As we can see in this chart, during the epidemic, transportation carbon emissions have been reduced but still a lot. According to the EU's target of 90% reduction in mobility emissions by 2050, there is still a long way to go.

Mobility	Total greenhouse gases	2019 1st quarter	8.6
		2019 2nd quarter	9.0
		2019 3rd quarter	8.7
		2019 4th quarter	9.0
		2019	35.3
		2020 1st quarter*	8.0
		2020 2nd quarter*	7.2
		2020 3rd quarter*	7.9
		2020 4th quarter*	7.6
		2020*	30.7
		2021 1st quarter*	7.0
		2021 2nd quarter*	7.9
		2021 3rd quarter*	7.8
	Carbon dioxide (CO2)	2019 1st quarter	8.5
		2019 2nd quarter	8.8
		2019 3rd quarter	8.5
		2019 4th quarter	8.8
		2019	34.6
		2020 1st quarter*	7.8
		2020 2nd quarter*	7.0
		2020 3rd quarter*	7.7
		2020 4th quarter*	7.5
		2020*	30.0
		2021 1st quarter*	6.9
		2021 2nd quarter*	7.7
		2021 3rd quarter*	7.7

Figure 3: Emissions of greenhouse gases in mobility sector according to IPCC guide-lines, quarter (Changed on: 15/12/2021 02:00)(Source: CBS)

While transport networks and infrastructures cover only 3% of artificial land in Europe (European Environmental Agency, 2017), the associated impacts can have dire consequences, e.g., land fragmentation which in turn effects biodiversity.

3.1.2 Car ownership and usage in NL

Car ownership

Since the advent of the car, the number of cars around the world has always been on the rise, and the Netherlands is no exception. The Netherlands is a great country to live in if you're car-free, but it's a very long way from being a car-free country. Dutch car ownership and use are at an all time high.

The most popular vehicle by far is the private car. In January 2020, there were over 7.6 million privately owned passenger cars in the Netherlands. This is equivalent to 543 cars per thousand inhabitants aged 18 years and over. This was still 528 per thousand at the start of 2015. (Statistics Netherlands, 2020)

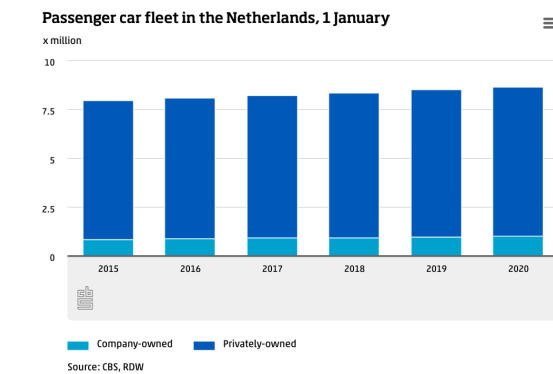


Figure 4: Passenger car fleet in the netherlands, 2020 (Source: CBS,RDW)

Evidence shows purchases increased and average car usage decreased. In 2019, the Netherlands had more than 9.5 million passenger cars, almost 180 thousand more than the year before. (Statistics Netherlands, 2020)

Present age distribution

The car ownership rate is highest in the group aged 50 to 64 years: 679 cars per thousand inhabitants. Car ownership is lowest among 18 to 24-year-olds at 172 cars per thousand inhabitants. In comparison, car ownership is over twice as high among the over-80s. As for the group aged 30 to 64 years, they own 65 percent.

According to the age stratification of car ownership, we can observe the aging of car owners. But the direct assertion that young people will use private cars less often is worthy of vigilance, because the key factor affecting car ownership is the degree of affluence.

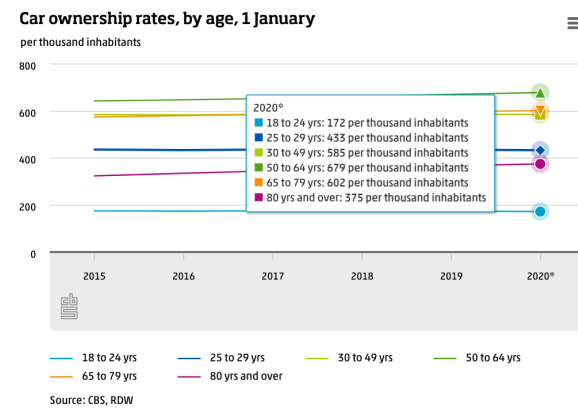


Figure 5: Car ownership rates, by age, Jan 2020 (Source: CBS,RDW)

Car ownership rates, by age, 1 January 2020*

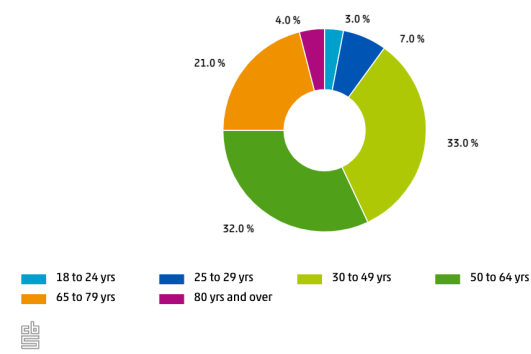


Figure 6: Car ownership rates, by age, Jan 2020 (Source: CBS,RDW)

Present income distribution

On average they're fairly wealthy so can afford cars. They are just as influenced by advertising and the appeal of shiny new things as anyone anywhere else. What's more, there are tax breaks and subsidies for buyers of new cars. Almost anyone who can easily afford a car has one and there aren't many people at all who choose to go without if they can afford one: Amongst people of average income, just 12% of households don't have a car and that drops further to just 6% for high income households.

One part of the picture is that the influence of younger people on the growth in driving in the Netherlands is less than the influence of older people who on average account for more of the growth.

Passenger cars by vehicle age category, 1 January 2017

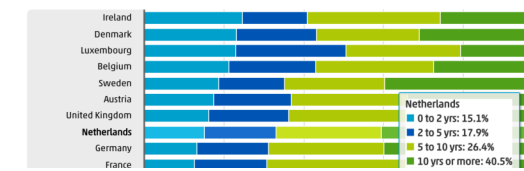


Figure 7: Passenger cars by vehicle age category, 2017 (Source: CBS)

Naturally, there have been some attempts to make a generational issue out of this, to make out that the young are behaving differently because they think differently. This is still to be explored. In fact, these differences are very small and there is another better explanation: It's not about age, it's about wealth. Wealthier people drive more than less wealthy people.

Car usage

Overall increase

The stats shows 2019 is another record year of car driving here in the Netherlands. Dutch drivers drove 122.5 billion kilometres last year. While the 1.2% rise in driving last year prompted my concern, this year we've seen an even bigger 1.9% rise. (Statistics Netherlands, 2020)

Private individuals (natural persons) drove more than three quarters of all kilometers on petrol (72.7 billion kilometers) in 2019, 0.9 percent more than one year previously. Diesel cars were driven 2.8 percent less. Private individuals owned more than 7.1 million cars with a petrol engine and more than 1 million diesels last year.

Distance traveled by Dutch passenger cars

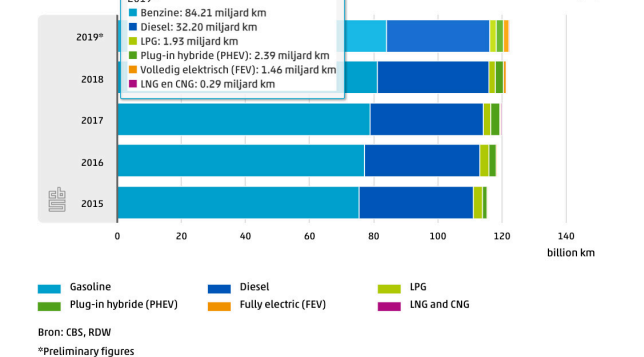


Figure 8: Distance traveled by dutch passenger cars, 2019 (Source: CBS,RDW)

High willingness to use cars

54% of respondents answered the question "And which modes of transportation do you use for your daily commute to work/school/university?" with "Own / household car" in the Netherlands in 2021. (Kunst A., 2021)

The continuous growth of mobility consumption demand is undermining environmental sustainability.

3.1.3 Mobility trends

Ever since the Model T (Ford) took to the road in 1908, the car-centric model has been the dominant transportation system. Now that our society is striving to become more sustainable, digital and innovative, it is time to reshape the mobility system. Based on the literature research of five professional research reports, I have summarized the following trends.

Travel demand growth has slowed after the epidemic

It comes as no surprise to learn that the number of people working from home has increased exponentially. Today, 62% of people work from home, compared to only 37% before the pandemic.(ALD Automotive, 2021)That does not seem to have had a negative effect on our productivity, however; 80% of the respondents say that they are at least as productive as they were at the office. But it has resulted in us driving 25% fewer kilometres for business.

The respondents expect that many of the things we've done differently over the past year will become permanent elements of life in the future. The insights do differ from group to group, however, depending on the mode of transportation they used before the pandemic. For example, 46% of car drivers felt that the new 'normal' will be different from what we had been accustomed to. In contrast, 56% of travellers on public transport (tram, metro, bus) and no less than 78% of train passengers said the same. People also plan on avoiding rush hour to some degree, according to 26% of car drivers, 35% of public transport users and 60% of train passengers.(Manen, W., Wit, W., & Middelkoop, L., 2021)

Journey safety affects public transportation usage

Research in China has already indicated that people are a bit hesitant to use public transport to return to work, even if there is no immediate danger of infection. The high percentage in the NZMO survey (60%)(ALD Automotive, 2021) who expect to avoid rush hour may also indicate that people are not eager to face crowded trains again.

As demand is expected to shift towards more individual transportation, it results in an increase in demand for pre-owned cars. Last year was the first in which more than 2 million cars were sold. 1.3 million of them were pre-owned vehicles sold by dealerships, which represented a growth of 1.3%.(ALD Automotive, 2021) They have also observed a shift in demand from the traditionally popular models to smaller cars on the one hand and SUVs on the other, which has an effect on the average sale price. Dutch prices increased by an average of only 94 euros (0.57%) (ALD Automotive, 2021).

These trends are based on the expectation that the Netherlands won't 'return to usual' after the COVID-19 pandemic. The development towards a greater focus on working independently of a specific time and place is unlikely to be reversed now that we've all experienced a different way of working, and that means we will make different choices in how we organise our mobility.

Use technology to improve efficiency

- Digital identity (e.g. biometric and facial recognition), driving an increased throughput and security.
- Customer experience design involves e.g. easier digital transportation tools and better infrastructure for pedestrians
- AI-augmented mobility (the fifth trend) can harness the power of data, analytics, and cloud to help reduce travel time and manage congestion.(Verstoep, S., Pasman, J., & de Groen, S., 2021)

Focus on the development of intensive urban transportation

The environment we live in becomes more and more urbanized. We're forced to share less space with more people. Due to urbanization, the 'last mile' is becoming shorter and will mostly be covered by foot.(Smit, I., 2020)

And urban land resources are becoming more and more tense. Transportation development needs to consider more efficient use of land.

The integrated, frictionless travel, with minimal stoppages or checkpoints is the future need.

This trend consists of e.g. better infrastructure for pedestrians, mobility hubs for multimodal transportation and last-mile connections.

Focus more on the travel experiences themselves

The epidemic has caused people to reconsider the meaning of going out. People are inspired by new environments and the people they meet on their travels.

In an era where everything is online, the choice of travel has risen to the choice of lifestyle. Some people may want to do a little meditation session on their commute or plan for the amount of calories they want to burn and the transportation will be adjusted accordingly.

More convenient and comfortable journeys are more popular. While we expect that more and more people will choose to take their e-bikes for shorter distances, the mobility budget won't entirely eliminate the convenience of having a car. Some percentage of them will choose to for a private lease, so that there's always a car when you need one. And since the monthly mobility budget will cover part of the expenses, the fixed monthly Private Lease payment will be an obvious choice. Studies show that even public transport users expect to shift to driving a car in the future, and they will naturally look for a care-free, reliable alternative like a private lease. (Audenhove, F.-J., & Eagar, R., 2020.)

From ownership to use and from single use to sharing

The sharing economy has been discussed for a long time. However, the comfort of shared bicycles and the convenience of renting a car have obviously not met the needs of citizens.

According to the market situation after the epidemic, 2020 was the year that e-bikes finally became mainstream. (Benjamin, E., 2020) The version with a maximum speed of 25 km/h, which is ideal for short distances, was constantly sold out. For longer distances, cyclists could choose for the speed pedelec, as its a maximum speed of 45 km/h makes it a serious alternative to travelling by car or public transport. The main shift was among public transport passengers, but employers are also increasingly reaping the e-bike's benefits.

Climate change requires a more environmentally friendly system

Global warming and the melting of polar ice are accelerating. Rethinking energy and mobility systems is part of the solution. Think of solar energy, electric vehicles and above all making more efficient use of the system.

Meanwhile, lack of space and sustainability ask for public-private coalitions to drive innovations in e.g. sharing services and multimodal transportation.

Key Insights

Reduced travel demand after pandemic

Work from home

Driving less

Journey safety affects public transportation usage

Anxiety of infection

Avoid rush hour

Individual transportation

Use technology to improve efficiency

Digital identity

Digital mobility service

AI-augmented mobility

Focus on the development of intensive urban transportation

Less space

Shorter last mile

Focus more on the travel experiences themselves

Diverse Lifestyle

Comfortable Travel

Mental and physical health

From ownership to use and from single use to sharing

Usage

Sharing Economy

3.2 Problem definition

- Where is the opportunity?

3.2.1 Sustainable mobility definition

Everyone has a different perspective on the understanding of sustainable mobility. The core purpose of sustainable mobility is to realize an environmentally friendly and sustainable transportation mode. How can we achieve a sustainable travel model that meets the needs of the future society? Academics, governments, and ordinary civilians have all given similar interpretations.

Government's perspective

The government's understanding of sustainable transportation is more in line with the government's goal of carbon neutrality.

The European Commission presented its 'Sustainable and Smart Mobility Strategy' together with an Action Plan of 82 initiatives that will guide our work for the next four years. This strategy lays the foundation for how the EU transport system can achieve its green and digital transformation and become more resilient to future crises. As outlined in the European Green Deal, the result will be a 90% cut in emissions by 2050, delivered by a smart, competitive, safe, accessible and affordable transport system.

- Boosting the uptake of zero-emission vehicles, vessels and aeroplanes, renewable & low-carbon fuels and related infrastructure, for instance by installing 3 million public charging points by 2030.
- Creating zero-emission airports and ports, for instance through new initiatives to promote sustainable aviation and maritime fuels.

- Making interurban and urban mobility healthy and sustainable, for instance by doubling high-speed rail traffic and developing extra cycling infrastructure over the next 10 years.
- Greening freight transport, for instance by doubling rail freight traffic by 2050.
- Pricing carbon and providing better incentives for users, for instance by pursuing a comprehensive set of measures to deliver fair and efficient pricing across all transport.

Specific transportation departments have more specific operational goals. The urban transportation system defines green transportation as follows: reduce traffic congestion, reduce environmental pollution, save construction and maintenance costs, and promote social equity. And sustainable transportation involves all aspects of transportation, making it help to promote the sustainable development of mankind.

Based on EU's climate action 'A European Strategy for low-emission mobility' (Itkonen A., et al., 2016), the transportation industry proposal issued by EU can be summarized as the following:

- Increasing the efficiency of the transport system by making the most of digital technologies, smart pricing and further encouraging the shift to lower emission transport modes,
- Speeding up the deployment of low-emission alternative energy for transport, such as advanced biofuels, renewable electricity and renewable synthetic fuels and removing obstacles to the electrification of transport
- Moving towards zero-emission vehicles. While further improvements to the internal combustion engine will be needed, Europe needs to accelerate the transition towards low- and zero-emission vehicles.

Academics' perspectives

Researchers in academia view sustainable mobility from different perspectives based on their different professional backgrounds.

Among them, sociologists led by Høyer (2005) believe that sustainability includes not only the impact of the transportation system on nature but also human needs.

Høyer transferred the concept of sustainable development into the idea of sustainable mobility in the transport sector. According to him, sustainable mobility has the following conditions:

- Transport activities do not threaten long-term ecological sustainability.
- Basic mobility needs are satisfied.
- Inter- and intra-generational mobility equity are promoted.

In the eyes of social economists, sustainability has more realistic economic requirements. Sustainability aims for environmental resilience, which starts with reducing climate risk but also includes much broader preservation of natural capital as well as intergenerational fairness, all considered in terms of economic and societal costs and benefits. (Sternfels, B., Francis, T., Madgavkar, A., & Smit, S., 2021) The transportation industry is no exception, and it must also take into account the economic and social needs of sustainable growth.

Actual traffic researchers have obtained more accurate sustainability evaluations of transportation modes based on operating data.

In general, mobility with a private car had the highest environmental impacts for mobility, whenever used in short-haul travels. This was similar to Kalbar et al. (2018), who found this transportation habit as strongly related to high environmental burdens.

Conversely, the use of a bus, bicycle, and walking were the alternatives with the lowest environmental impacts, as also identified by Barros et al. (2019) and Cuéllar et al. (2016). Similarly to found by Ornetzeder et al. (2008), taking flights for long-distance travels resulted in higher environmental impacts than the other alternatives available.

Car-sharing (also carpooling) contributed for lowering individual environmental impacts. Uber's "Climate Assessment and Performance Report" report released in 2019 analyzed the real data of Uber's operations in the United States and Canada from 2017 to 2019, with nearly 4 billion pieces of data. The analysis results show that as the number of travel services used increases, Uber generates less carbon emissions and is more efficient than traditional taxis. From 2017 to 2019, the report estimates that the Uber platform will reduce carbon dioxide emissions by at least 500,000 tons and use up to 56 million gallons of gasoline compared to traditional taxis. The report also found that using the Uber platform to travel has significantly lower carbon emissions than single-drivers in the same situation.

Nijland and Van Meerkerk (2017) found a 13–18% reduction in CO₂eq emission due to car-sharing and variations in car ownership. Given that impacts from emissions were equally shared among all passengers, thereby offsetting impacts related to an individual consumer.

Changing the travel environment and travel mode is the foothold of sustainable transportation.

Conclusion

The government's perspective is more practical and operable about reducing the carbon emission. The academic perspective is either a macro-thinking based on social needs or a more detailed and detailed carbon emission, which is a good supplement to the long-term sustainable transportation planning in the future.

Based on the analysis from different perspectives and the former conclusion made by Banister, D.(2007) and Holden, E., et al(2019), the following three strategies for sustainable mobility can be summarized.

Volume reduction

The most essential way to achieve environmental sustainability of mobility is to reduce transportation energy consumption and thereby reduce carbon emissions, so we must fundamentally change behavior and consumption patterns; people must travel less, and freight volumes must decrease.

Technology improvement

This strategy is based on the idea that environmental problems caused by transport can be improved by developing new and more efficient technologies to replace old, inefficient, and polluting materials and methods.

Model's substitution

The last strategy is substitution which argues for a change to less polluting means of transport. Using a combination of travel to replace private car travel is a proven way to be more environmentally friendly.

Both the scale of travel and the improvement of travel efficiency are limited by demand and actual technology. Changes in travel patterns are more due to human factors, and the difficulty lies in guidance.

3.2.2 Mobility as a service

What's MaaS?

If you simply understand it from its functional analysis and technical composition, Mobility as a service (MaaS) is a range of digital solutions designed to make transportation more efficient and simple. MaaS aims to integrate all aspects of customer journeys into a single, user-friendly service or application. This includes trip planning, booking, ticketing, payment, and updates. (Segal et al., 2020)

From the analysis of the personal travel paradigm, it is a revolutionary change. Mobility-as-a-Service (MaaS) refers to the concept of urban residents abandoning personal transport in favor of access to a range of tailored transport services via a unified platform. (Audenhove, F., & Eagar, R., 2021)

MaaS has huge potential to move towards the goals of sustainability, resilience and human-centricity. For example, if properly framed, it can: offer users more flexibility to choose multiple mobility options, reducing congestion; enable carfree cities; allow for system-level optimization of mobility investments and assets; and enable better integration between goods logistics and passenger transport. #

Why is it necessary?

MaaS is a future-proof alternative to private vehicle ownership

MaaS is on the rise as on-demand transportation options have exponentially increased in the last decade. Consumers' preference to own a personal vehicle is declining worldwide as people can rely on an ecosystem of mobility services that meet different needs.

Create a better urban life experience

Currently, citizens lack a complete and seamless transportation experience. Therefore, the possibility of the construction of the MaaS system has been proposed, providing alternative solutions through associated travel services, giving users more travel choices and choice dimensions.

At the same time, the apps that users use are limited. The highly integrated MaaS service is more in line with user needs. Research from App developer SimForm among customers shows they only use a fraction of installed apps on a frequent basis: on average around 15, with 25 for young adults down to 10 for seniors. (Shah, H., 2020) This underpins the difficulty of achieving continuous engagement and retention.

Opportunities to recover asset costs

City officials' perspective: Cities acknowledge that new mobility services can generate tremendous socioeconomic value at a lower cost than investments in traditional infrastructure, but they are struggling mightily to understand how to unlock this potential.

Individual perspective: MaaS, in the form of ride-sharing or vehicle lending, can help vehicle owners offset some of the costs associated with ownership.

Effectively promote the development of public transportation

By supporting a decrease in the demand for private vehicles, MaaS can help redirect funding to public transportation programs and other community efforts. When public transportation is better supported and funded it is more likely to be used by travellers and can be efficient than private transport.

As an additional benefit, when public transportation is more widely adopted, the overall cost per passenger goes down. This enables travellers to save significant amounts of money without sacrificing time or convenience.

MaaS Development History

Based on BCG's benchmarking of MaaS initiatives (Hazen, J. et al., 2021), they have successfully divided all the MaaS in market by the functionalities. I combine it with the familiar MaaS services in the European countries to form a MaaS hierarchy model (Figure 9)

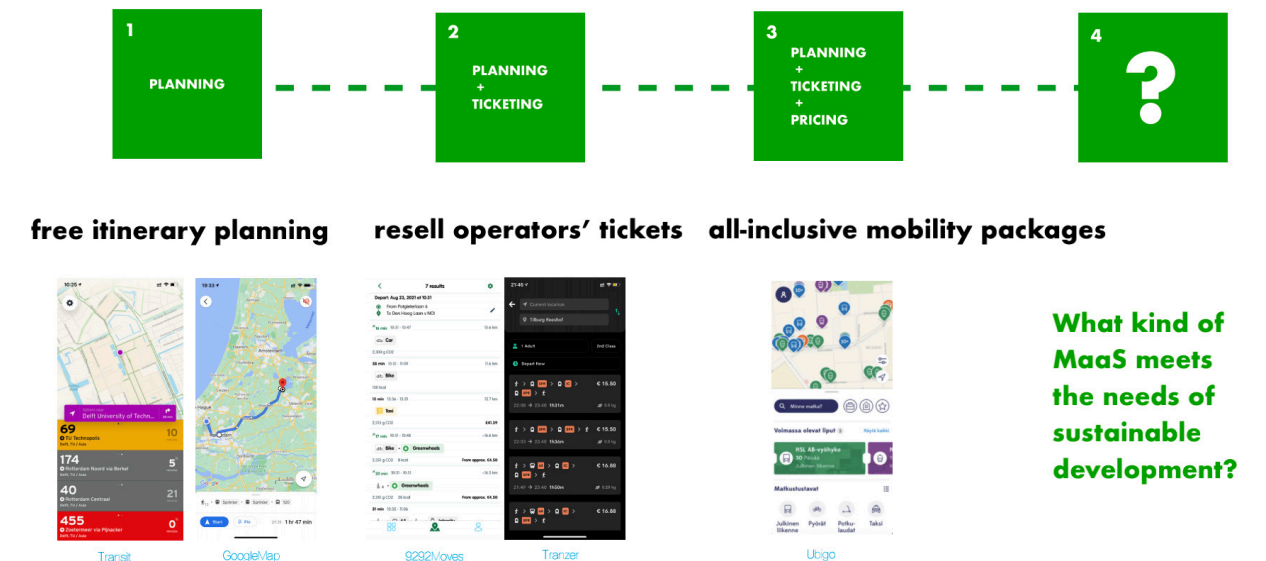


Figure 9: MaaS hierarchy model

Level 1

Initiatives at this level coordinate various modes of transportation and personalize routes. Level-one platforms like Google map offer free itinerary planning for users and provide stable and paid technical support for small upper-layer service providers because it's a monopolistic player with high penetration rates and a strong technical foundation. Other MaaS all acknowledged their strong dependence on Google Maps in map services and route retrieval but they would integrate more mobility service options to create a better planning platform.

Level 2

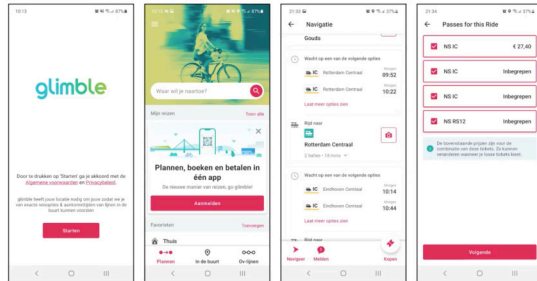
At this level, platforms are able to aggregate mobility offerings from different operators, resell operators' tickets to individual commuters, and charge commissions to operators. BCG mentioned in this level third-party mobility distributors unlike trip recommendation APP are left with limited bargaining power. This model poses particular challenges for the mobility industry, because transport providers already operate in a low-margin context and cannot afford the distribution of funds to third parties. (Hazen et al., 2019) Therefore, they are often endorsed by the government or large transportation companies or have their own service products as a profit method.

This years dutch MaaS pilots are released. Based on the functions and interfaces, we can easily identify most of them are in the level 2. They provide the single trip tickets for all the user.

Level 2- Actual MaaS usage in NL

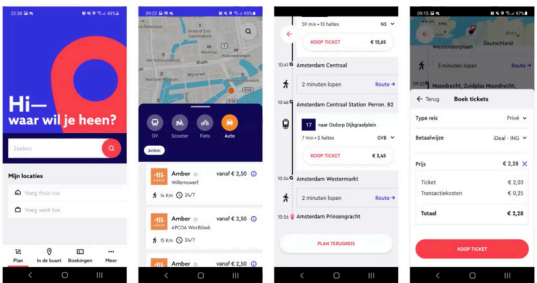
Glimble

Pilot Limburg & Pilot Groningen/Drenthe



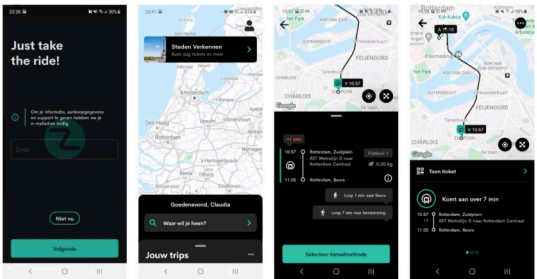
Amaze

Pilot Amsterdam



Tranzer

Pilot Rotterdam/Den Haag



Moves by 9292

Pilot Rotterdam/Den Haag

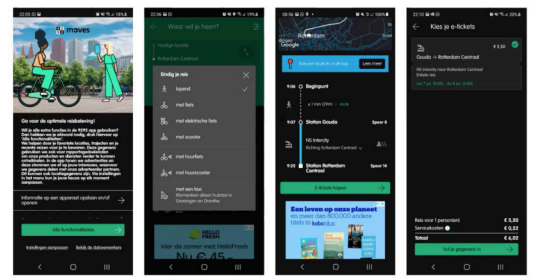


Figure 10: Dutch MaaS pilots

Based on the sharing meeting with MaaS research experts Claudia, I identified the following MaaS usage status.

- MaaS platform is more attractive for leisure trips than for commutes. This could be due to the fact that leisure trips are less often based on a routine, as opposed to strong habits regarding commute journeys.
- The user mostly use the app as a planner, they do not recognize the extra functionalities. And almost no one purchase the ticket.
- They are positively surprised by the shared mobility in the apps.
- The user don't really want to share much information and create account. Nobody uploaded their driver license.
- The user are positive about the combination of PT and shared mobility and see the added value in multiple service providers per modality.
- The users are not familiar with new shared service and the brands may give threshold for the first use and makes it complex to use.

Level 3

Level-three platforms bundle single transportation tickets into all-inclusive mobility packages. They use various customer acquisition techniques to expand their user base. For example, the Helsinki-based Whim app is one of the rare level-three platforms. It is considered to be the international reference for MaaS. With Whim, users can subscribe to a monthly unlimited mobility plan that gives them access to all transportation modes in Helsinki and the surrounding region. According to a research report on the value of Whim users from Aalto University, MaaS's development space is creating user value by allowing customers to express their personal values and personality, and by providing services that are customized to personal preferences and situational factor. The key sources of customer value in MaaS are the products, yet the usability and features of the platform itself also contribute to value creation. (Luukkainen, 2020)

3.2.3 The next generation MaaS

Next generation MaaS - Level 4

Bundling mobility solutions with very different unit costs is not an easy equation. All-inclusive pricing will motivate users to choose modes of transportation that are more convenient for them but also more expensive to operate, like ride-hailing and taxi services. The level-three model is unsustainable because it lacks incentives to encourage users to choose less expensive transportation options (for example, mass transit and free-floating bikes as well as travel at off-peak hours). This brings us to level-four platforms, which will provide incentives for users.

Possible MaaS user

MaaS service as a service market for new products is not yet mature, so it is very important to insight into potential users based on research. Based on scholars' practical research (Sochor and Sarasini, 2017 and María Alonso Gonzalez, 2019), I listed the potential and impossible early adopters of MaaS.

Possible users

- Adults younger than 35
 - People with high digital maturity
- At least people have a smartphone and mobile internet and feel comfortable using it.
- Frequent public transport/combination of mode users
- They are public transport/multimodal transport supportiveness. People with this quality are also more inclined to be interested in a MaaS solution.
- Low income households
- Public transportation and sharing services are more economical options than private car travel.

Potential laggards

- Older adults
 - People with low digital maturity
 - Frequent car users
- People that are very fond of their car are less likely to be interested in MaaS, yet people that do not really care for cars are much more likely to be into MaaS.

Possible Development Direction

- Flexibilization and adaptation of offers to better align with changing customer needs
- Providing new mobility solutions and services, for example, more on-demand services and mobility-as-a service to replace fixed routes
- Using pricing to incentivize multimodal trips to benefit the overall system, and promotions and incentives to rebuild patronage
- Acceleration of digitalization, including new prebooking processes, better data analytics and predictive capabilities to enhance quality and timeliness of services
- Improvement of passenger information, analytics and customer relations management

3.2.4 New technology application

Since the partner company has the technical capabilities of the blockchain, in the research phase, I also considered the possibility of combining the MaaS design in combination with the technical characteristics and advantages of the blockchain.

What's blockchain?

Blockchain is a shared, immutable ledger that facilitates the process of recording transactions and tracking assets in a business network. An asset can be tangible (a house, car, cash, land) or intangible (intellectual property, patents, copyrights, branding). (Yaga et al, 2018)
Virtually anything of value can be tracked and traded on a blockchain network, reducing risk and cutting costs for all involved.

Key characteristics of blockchain technology

- **Digital**

All the information on Blockchain is digitized, eliminating the need for manual documentation

- **Chronological and time-stamped:Updated near real-time**

Blockchain, as the name suggests a chain of blocks-each being a repository that stores information pertaining to a transaction and also links to the previous block in the same transaction.These connected blocks form a chronological chain providing a trail of the underlying transaction.(Yaga et al., 2018)

- **Distributed ledger**

Indistinguishable copies of all information are shared on the blockchain. Participants independently validate information without a centralized authority. Even if one node fails, the remaining nodes continue to operate, ensuring no disruption

- **Consensus-based**

A transaction on Blockchain can be executed only if a the parties on the network unanimously approve it However, consensus based rules can be altered to suit various circumstances.

- **Cryptographically sealed**

Blocks created are cryptographically sealed in the chain.This means that it become impossible to delete, edit or copy already created blocks and put it on network, thereby creating true digital assets and ensuring a high level of robustness and trust Furthermore, the decentralized storage in a Blockchain is known to be very failure-resistant. Even in the event of the failure of a large number of network participants, the Blockchain remains available, eliminating the single point of failure. Data stored in a Blockchain is immutable.

Why it's useful for MaaS

MaaS business runs on information. The faster it's received and the more accurate it is, the better. Blockchain is ideal for delivering that information because it provides immediate, shared, and completely transparent information stored on an immutable ledger that can be accessed only by permissioned network members. A blockchain network can track orders, payments, accounts, production, and much more. And because members share a single view of the truth, you can see all details of a transaction end-to-end, giving stakeholders greater confidence, as well as new efficiencies and opportunities.

How could blockchain be incorporated as a stimulus for exploring new MaaS models

From a technical point of view, blockchain which brings decentralized trust have the potential to disrupt digital ecosystems by providing alternatives to centralized storage and management of data. This also has the potential to radically transform mobility industries and services through new models of data storage, transparency, tracking, payment systems.

Its breakthrough technical features will also give birth to radical new forms of decentralized participative governance models that could lead to the evolution of new generation of MaaS digital platforms and multi stakeholder business interactions.

Blockchain technology also could provide other value propositions beyond decentralized storage, such as innovative crypto economic and investment models that have the potentials to reconstruct the world's financial and credit system. These kinds of the value propositions are easier to integrate with MaaS digital platforms as an incentive.

While , more disruptive value propositions such as business automation, economic and governance models present greater challenges but could lead to not just innovation at the technological level, but also metamorphosis of the existing social, economic and governance models.(Zutshi et al., 2021) Considering Juan Corro's view that MaaS have undiscovered opportunity to present the concept of "Governance by design", which states that real user-centric systems are governance centered, blockchain technology brings a more open imagination space..

3.3 User research

- What does the user desire?

3.3.1 Travel motivations and behavior

Preliminary research

In the early research, my research goal was data from all over Europe, so I interviewed people from 5 different countries to collect and understand their travel habits.

The traffic conditions in different countries are completely different, so that users' travel behaviors are also completely different.

During the communication process, it was discovered that the differences in national conditions led to completely different travel habits and decision-making.

Interviewees from southern European countries such as Spain and the Czech Republic mentioned that public transportation may be shorter and more convenient than actual driving because of the heavy traffic congestion in the city center.

Respondents in Ireland mentioned that the country's public transportation is not well developed, and many mountainous areas do not have a public transportation system, so choosing a private car is the only option.

Participants from Spain even pointed out that in large cities with higher population density, public transportation is the best choice. Its price is very low and there are many choices and shifts, which saves more time than driving by yourself. Participants in the Netherlands believe that the roads in the Netherlands are in good condition. Public transportation is not so economical and affordable, but it is not always on time and reliable. In most cases, it is not as convenient as driving.

Formal interviews

Since this project is an innovative project and will start in the Netherlands, I will narrow the scope and follow up with invited Dutch drivers and intended car buyers.

In the follow-up, I conducted 8 interviews and two trips with the car to understand and experience the daily life of driving users.

First of all, due to the limitation of online communication, when I invited users to participate in the test, I first invited them to fill out a questionnaire as a sensitized material to evoke their relevant memories.

Travel purposes have a great influence on travel decisions

Based on the survey results of 8 formal interviews, I realized that travel purpose have a great influence on travel decisions.

The travel purpose of all interviewees can be divided into four categories, work and study commuting, daily purchases, business trips, leisure and entertainment. Respondents mentioned that before the epidemic, the car was purchased mainly for commuting to work. After the epidemic, vehicles are mainly used for daily purchases.

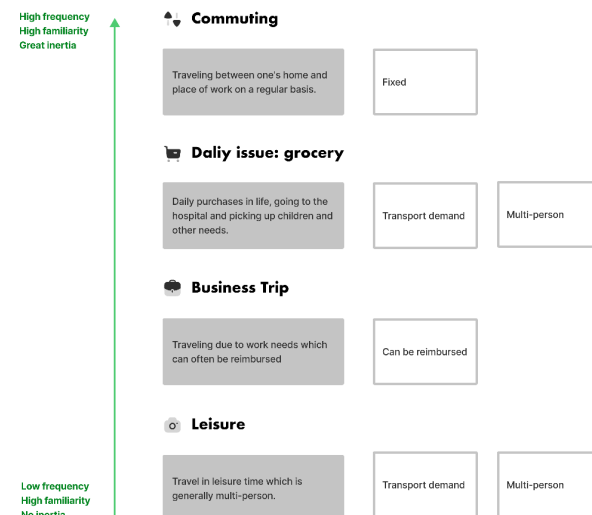


Figure 11: Different travel goals

Respondents' thinking about travel decisions is characteristic. Among them, objective factors are more than subjective ones.

The vast majority of interviewees mentioned the daily travel mode by first mentioning the travel destination and then the travel mode. This indirectly proves the thinking path that most people take when traveling.

At the same time, when inviting participants to plan a trip, the influencing factors they consider can also be summarized into the following categories.

Accessibility

Most interviewees mentioned the distance of their family from the bus station. And use this as the reason for choosing a private car to travel. At the same time, two interviewees mentioned the private car rental service around their homes, but they did not use this service again due to the inconvenience of handing over the keys.

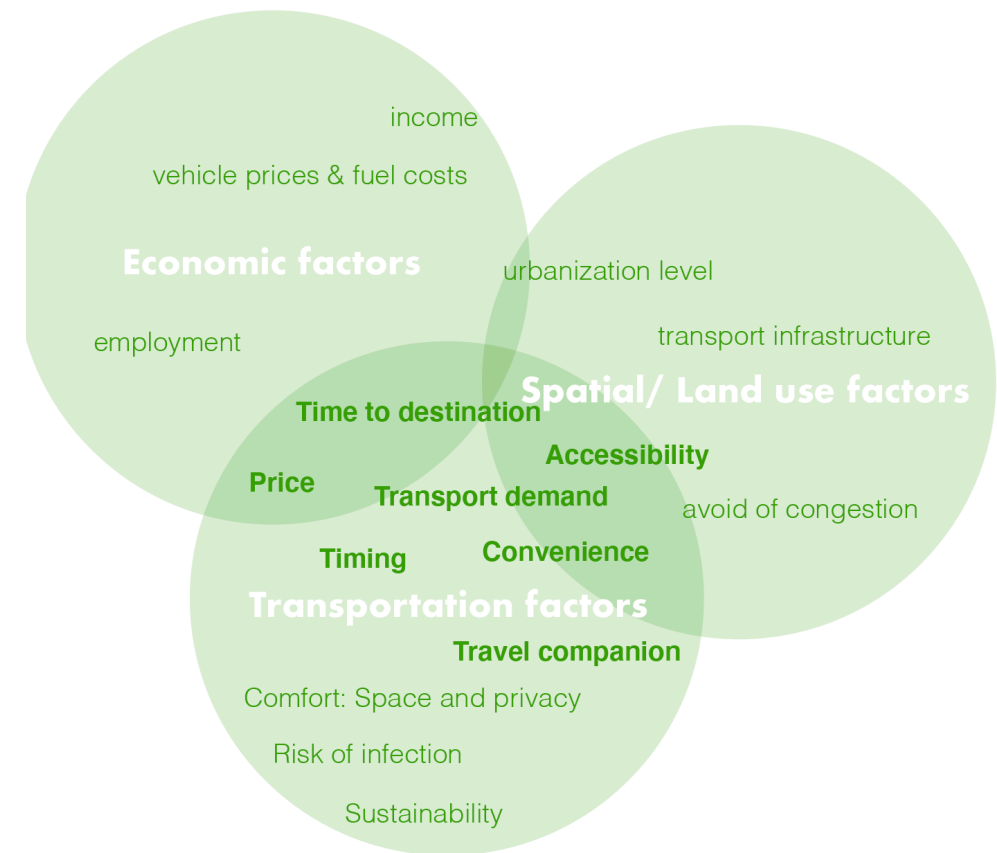


Figure 12: Travel Mode Decision Making Factors

Time-saving/ Time to destination

Respondents generally consider the urgency of time, and the timing of public transportation is the key to affecting it not being selected.

One of the interviewees even mentioned that the husband and wife had a conflict of working hours and bought two cars.

Travel companion

Three interviewees mentioned the necessity of private cars for family trips on weekends. The price of public transportation for four people is not cost-effective, and it is also difficult to take care of young children.

One interviewee considered renting a bicycle that can bring children, but gave up due to the price and rarity of the service.

Driver travel decision making pipe line

Based on the key influencing factors mentioned in the user research and the sequence of the interviewee's explanation of the decision-making matters, I have drawn this driver travel decision making pipe line. It clearly depicts all the factors that a driver needs to consider when switching modes of travel. Each factor may become a key obstacle to his decision to change. At the same time, the picture also shows the fixedness that the rider is used to, and only when the driving conditions are not met will they start to consider other travel modes.

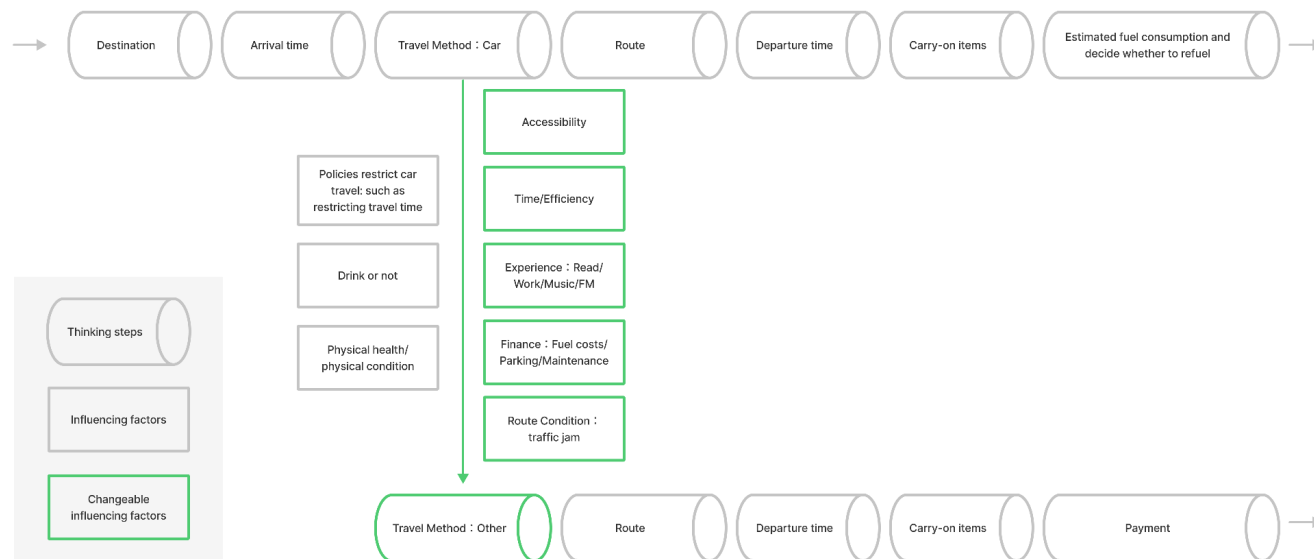


Figure 13: Driver travel decision making pipe line

3.3.2 Green travel perception

During the interview, I collected everyone's perceptions of green travel.

The vast majority of friends reported that green travel is to reduce carbon emissions.

A small number of feedbacks mentioned carbon emissions in the manufacturing process of vehicles, and two others mentioned that the way of travel that is good for physical and mental health is green.

The diversity of perception have provided more options for developers to think about before they actually start to design.

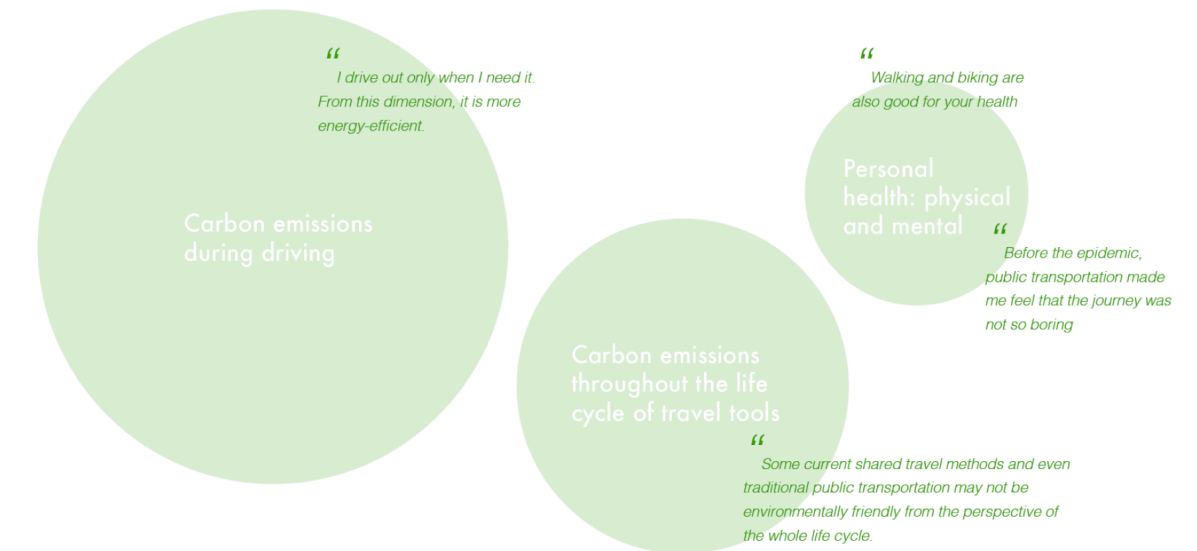


Figure 14: Green travel perception

3.3.3 Attitude-Action Gap

This qualitative research explores the gap between consumers' sustainability attitudes and behaviors. To inform my design, I conducted a deep ethnographic study with 6 car users from Netherlands.

There's an obvious Attitude-Action Gap in daily mobility decision making.

**5 participants mentioned they want to be more sustainable
2 of them did**

When asking about the question "Why don't you use greener traffic mode?"

The user's answers are real and varied.

Accessibility

Three interviewees mentioned where they live is not convenient to take public transportation.

At the same time, many emerging services have not covered some residential areas, so they are more explored and used in prosperous urban areas and unfamiliar travel situations.

Time-saving

Some user mentioned the efficiency of public transportation is not high, and it takes time to transfer, especially the punctuality of the train will affect the efficiency of work.

"There is no chance to handle the daily work-/family tasks, because the timings for the public transportations don't fit or there are no public services available."

Even more, participants think that connecting transportation is more time-consuming.

The sense of time is totally different from always in action and stop-and-go. Compared with private car, even the travel time within one public transport journey is not experienced the same.

There's also research shows time within a multimodal journey is not experienced the same: a minute spent waiting on e.g. a bus is perceived to be longer than a minute spent in-vehicle. This leads to an even larger imbalance between the subjective travel time of motorized vehicles and public transport. (Kennisinstituut voor Mobiliteitsbeleid, 2017b)

Convenience of multi-person travel

What users mention most is the demand for family travel and transportation of goods.

Family travel demand: In interviews, I found that most car buyers described starting a family as the reason for buying a car. It is also very relevant to family travel when describing recent usage scenarios.

This includes managing multiple family members (especially infants).

Financial

Some users mentioned that the cost of green travel is not necessarily low.

"Green travel methods are often way more expensive (for example a normal car to an e-car). In many regions outside the metropolis."

Two participants mentioned a single person could travel quite much with public transport for the sum. When travelling with multiple people car costs are shared, while public transport does not offer the same cost share opportunities.

Car ownership itself

For instance, I so observed if a person is used to commuting between work and home by car irrespective of how short the distances are, car-use become habitual for the person when thinking of ways to commute to work. As a result, changing behaviour to alternative and more sustainable ways of commuting modes might be difficult.

When asking about the question "How do you hope to change?"

Users place more hopes on changes in the external environment.

Some relatively radical interviewees believe that the government should take actions to strictly manage road traffic in urban areas.

"in the city they should slowly ban private owned cars. There is simply no space. I like how they already do it in Utrecht. You can travel to Utrecht, park on the edge of the city for cheaper and travel with bus or bike from there to the centre."

One of the staff of the Dutch transport department mentioned that the land in the urban area is already very tight. Government planning needs to consider the vicinity of existing transportation facilities, rather than new transportation facilities to meet the needs of the public.

Some respondents said that the government and corporate green subsidies should be more invested in public transportation, and the price of green travel modes should be lower.

Many people mentioned that there are plans to replace petrol cars with electric cars

Asked about the personal changes that will be made in the short term, more users mentioned replacing gasoline vehicles with electric vehicles.

"Now I would choose electric over older cars bc there is the option now. But that's for when I start a family or get a dog or something, that would make me reconsider getting a private owned car. Not only for me."

3.3.4 Opportunities in MaaS design

Highlight the low prices and rewards of green transportation modes

Relatively low prices are an important attraction of public transportation and shared transportation. Most interviewees believe that choosing a greener mode of transportation requires rewards, but there is no penalty for not choosing.

The convenience of interline services needs to be guaranteed

Although there are various modes of travel, at the same time, there are practical difficulties in the integration and planning of service fragmentation. The new MaaS service should focus more on expanding the scope of services, providing more service options, and optimizing the efficiency of switching between services.

Incorporate environmental travel promotion from car-related experience

Car users have a lot of inertia, so it will not be good to directly promote MaaS services to them. According to the organization of their travel needs, it is possible to promote more environmentally friendly and sustainable travel methods to car users through services like parking services and other services that are just needed by car users.

Pay more attention to the guidance and experience of new users

Most Dutch car users are not familiar with the new shared travel mode, and the integration design in the MaaS requires detailed guidance rather than simple LOGO promotion.

Ideation

4

4.1 Future Vision

In the future, people who choose green travel methods should be rewarded.

Green travel is constantly being mentioned in our lives, whether it is media promotion or school education, we are working hard to explain the meaning and value of green travel to more people. The change of attitude is very obvious to everyone, but in actual life, everyone has their own travel requirements and the actual desire to create a better life.

Therefore, changing travel behavior requires a clearer value system. I hope to use the common aspirations of a green future as the starting point to create new values that best meet the needs of future social development.

This value system is future-oriented. Reaping rewards for environmentally friendly choices is incentivized to make people more supportive of sustainable transportation modes. In this way, the sustainable transportation experience industry will flourish, and finally the sustainable transportation development of the entire society will be constructed.

In order to achieve this goal, I disassembled the requirements:

- Provide users with economical and convenient low-carbon products
- Help drivers find alternative modes of travel and encourage car-free travel
- Improve connectivity and convenience between multiple modes
- Fully demonstrate the impact of each trip service to users and stakeholders

The idealistic long-term conception requires a solid foundation of service functions and a reasonable propaganda strategy.

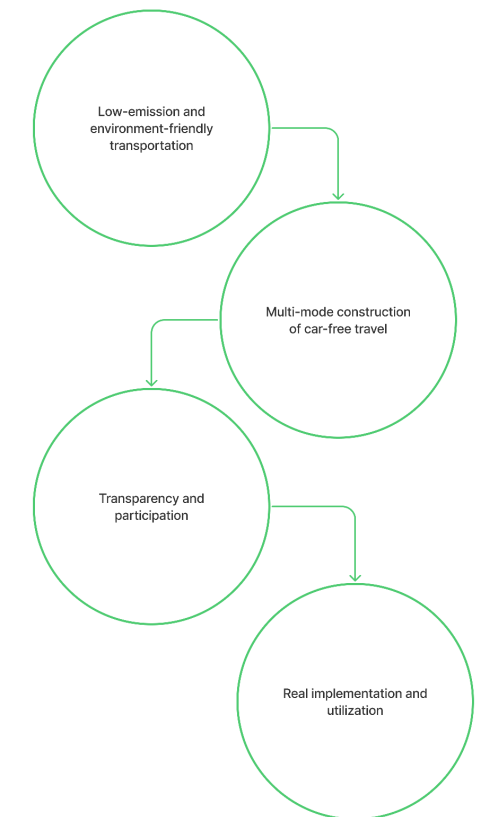
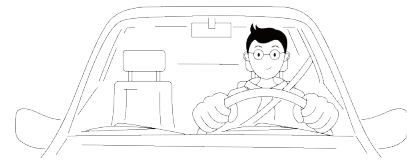


Figure 15: Propaganda strategy

As you can see in the picture, they are the main functions which meet users' demand. The next step is to brainstorm the whole service story to build the theme of the project and design the tone of publicity.

4.2 Results inspiration phase

4.2.1 Typical personas



Driver Persona John

AGE	LOCATION	OCCUPATION	LANGUAGE	STATUS
28 years	Rotterdam	Engineer	Dutch, English	Married

MAIN PURPOSE OF TRAVEL	HIS LIFE WITH CAR	TRAVEL HABIT
50% Daily commute and picking up children 30% Daily grocery and transport items 10% Doing sports or other hobbies 10% Traveling	His family needs a car, and he lives in a relatively suburban location, so buses are not very convenient. The need for transport is even greater after having children. And the car give him a sense of freedom. He has a sky diving hobby and uses the trunk to carry his equipment.	If he is familiar with the address, he do not do planning and go directly. If it is not familiar with the location, he uses navigation software.

GOAL	PERSONALITY	FAVORITE MOBILITY SOFTWARE
Travel efficiency and safety are very important. While maintaining a certain level of travel comfort and convenience, he wants to save travel expenses as much as possible.	introverted, thinking, creative	GoogleMap, Yellowbrick, NS

COMMUNICATION	SOCIAL NETWORKS
He mainly uses the phone and Whatsapp to communicate with his family and friends.	f, y, t

4.2.2 Car related activities

I observed and interviewed the lives of roommates with cars. They are fresh graduates and also my target users. One of them mentioned that cars are also a standard of independence and maturity for young people. "After graduation, I started to work and leave the family. The car is a tool for my free access and a symbol of my free status." In the process of traveling with them, I summarized some common characteristics of car users and the perceived necessity of the car. I summarized the life matters of people with cars in the picture.

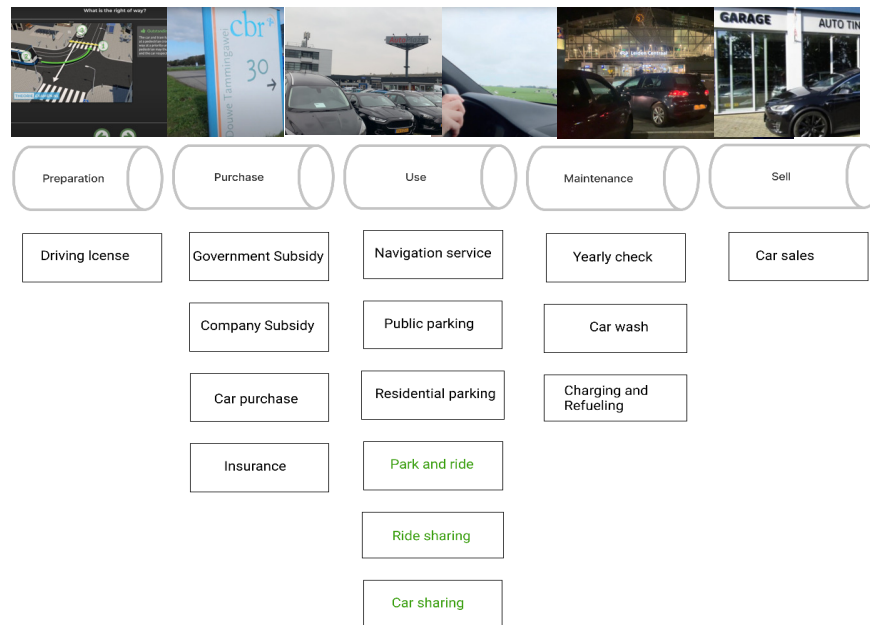


Figure 16: Car related services

4.3 Existing incentive mechanism

- How can we change?

4.3.1 Behavior change theory

Everyone has a different perspective on the understanding of sustainable mobility. The core purpose of sustainable mobility is to realize an environmentally friendly and sustainable transportation mode. How can we achieve a sustainable travel model that meets the needs of the future society? Academics, governments, and ordinary civilians have all given similar interpretations.

Habit generation

Habits are those behaviours that we carry out frequently and without thinking (Verplanken & Orbell, 2003).

All habits that represent historically learned routines are developed through both personal and social spaces of interaction, which results in a self-sustaining paradigm. They are consistently treated as something that is shaped by factors, sometimes including social situation, history, or infrastructure. (Shove, 2010)

But fortunately, the cause is the long-term interaction of the environment, and the entrance to change can also be the interaction with the environment.

There has been evidence suggesting that habits can be countered, especially for those individuals who are in a transition in their lives, such as moving to a new neighbourhood or changing offices (Verplanken & Wood, 2006; Walker et al., 2014). Such natural changes in one's life seem to provide the best opportunity to inform people about alternative ways of commuting, and getting them acquainted with more sustainable modes of transport.

Behavior Change

COM-B Model is well-known and widely used in behavior change field. Incentivizing green travel is essentially a behavior change issue, so I choose to analyze based on this model. As explained in the figure, the given intervention might change one or more components in the behaviour system. The causal links within the system can work to reduce or amplify the effect of particular interventions by leading to changes elsewhere. Such dynamic changes and interrelationships are exactly what needs to be considered in the issue of travel choices.

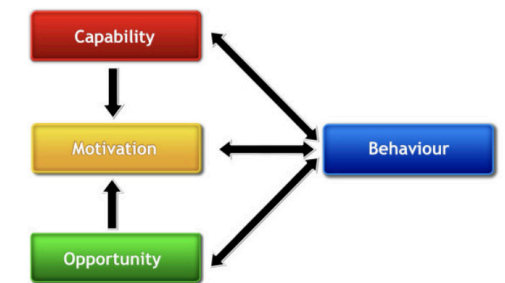


Figure 17: COM-B model

In order to make the concept more comprehensive and avoid the omission of thinking, I introduce the theory of behavior change wheel (BCW) to assist in the analysis of the mechanism of change behavior.

The BCW is being developed into a theory- and evidence-based tool allowing a range of users to design and select interventions and policies according to an analysis of the nature of the behaviour, the mechanisms that need to be changed in order to bring about behaviour change, and the interventions and policies required to change those mechanisms. (Michie et al., 2011)

4.3.2 Analysis of existing mechanism

The current various initiatives in the transportation field can be sorted via using this model.

Interventions and policies proved in mobility or environment protection domain

Interventions	Definition	Examples
Education	Increasing knowledge or understanding	Ant Forest (There is analysis below), Propaganda for high carbon emissions from airplanes
Persuasion	Using communication to induce positive or negative feelings or stimulate action	-
Incentivisation	Creating expectation of reward	Researches indicate offering credits and monetary rewards may be effective in altering travellers' behavior, while the provision of other non-financial passenger services does not influence individuals' travel choice. (Polydoropoulou et al., 2018)
Coercion	Creating expectation of punishment or cost	-
Training	Imparting skills	Ant Forest (There is analysis below)
Restriction	Using rules to reduce the opportunity to engage in the target behaviour (or to increase the target behaviour by reducing the opportunity to engage in competing behaviours)	-
Environmental restructuring	Changing the physical or social context	-
Modelling	Providing an example for people to aspire to or imitate	ForestMan-Payeng, Greta Thunberg
Enablement	Increasing means/reducing barriers to increase capability or opportunity	Possible MaaS Future
Policies		
Communication/marketing	Using print, electronic, telephonic or broadcast media	Disaster news even cause mental health issues.
Guidelines	Creating documents that recommend or mandate practice. This includes all changes to service provision	The European Union sets a goal of reducing traffic carbon emissions by 90% by 2050
Fiscal	Using the tax system to reduce or increase the financial cost	Corporate Carbon Emissions Trading Market is thinking about including mobility domain
Regulation	Establishing rules or principles of behaviour or practice	-
Legislation	Making or changing laws	"European Climate Law"
Environmental/social planning	Designing and/or controlling the physical or social environment	IPCC
Service provision	Delivering a service	Possible MaaS Future

Mature case study-Ant Forest

Ant Forest is the world's largest platform for individual participation in environmental governance. In 2019, due to driving 500 million people to participate in low-carbon life and converting carbon emission reductions into 122 million real trees planted in desertified areas, Alipay Ant Forest was awarded the highest

environmental protection honor of the United Nations. In recent years, they also expand the construction of protected areas to more counties and fields, and begin to tap the cultural value of ecological agricultural products and build IP. It's not a typical MaaS solution that why i put all the content in the Appendix C.

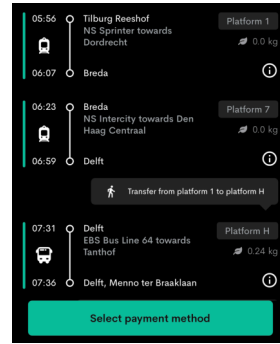


Figure 18: Tranzier

MaaS practise1: Tranzier

The APP's low-carbon recommendations only include public transport. At the preliminary stage, there is not much attention. It provides users with the carbon emissions saved in the bus route during journey planning.



Figure 19: Citymapper

MaaS practise2: Citymapper

Citymapper provide three dimensions of green travel mode factors.

Firstly, they provide calories user burned to add up all their efforts. They insist public transit is healthier since you walk more.

Secondly ,they mention as trees saved, which actually represent CO2 saved by public transit. The number also account for user's individual contributions.

They also count the money saved by public transit. They take into account both standing costs (purchase, insurance, depreciation) and running costs (fuel, repairs, city parking) to help user understand all the expense they've been saving.

4.3.3 Conclusion

Individual Level behavior change

Give as much attention to habit formation and endogenous renewal as to habit breaking. Behaviour change is about working with rather than against existing habits.

Public influence and guidance

Also target the stakeholders beyond 'users' of transport systems—transport industry, retailers and advertising companies, the media, lobby groups, employers and non-transport government agencies and departments – whose practices contribute to the collective sense-making and (Schwanen T., et al.,2012) normative coding of different forms of mobility.The informational, financial, symbolic or affective signals regarding which travel practices are desirable from across government agencies to citizens and other stakeholders should be made more coherent for extended periods of time.

Capability

The service should provide seamless and user friendly mobility service which allow user to do what they want.

Motivation

The final design could have some special data which may make user recognize the importance of sustainable transportation.

Opportunity

The service should provide info and guidance and make user fully understand the green options and its possibility of choices

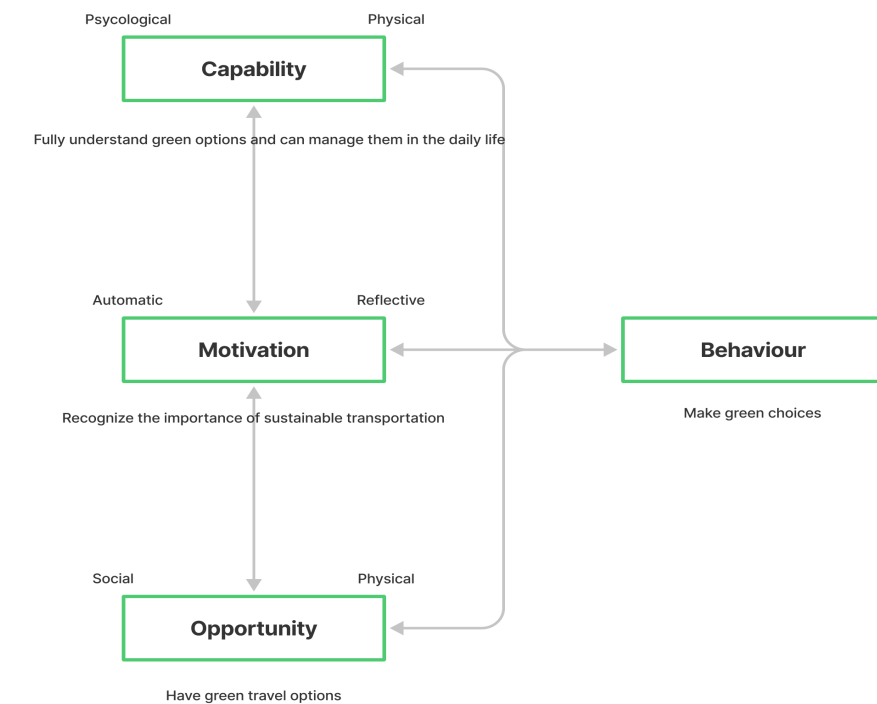


Figure 20: Opportunities in behavior change model

4.4 Brainstorm

Within the project team, we organized two marketing personnel and two product designers to conduct experience planning. In the end, four feasible directions were summed up, and then the final plan is reached after voting.

the routine is no more a routine, it is my life path
the road is my discovery of the life
the dependency is no more passive, it is my active choice of a path
we make the city greener "The Sims"?

- Now our life is boring, three points and one line, this routine is very boring
- Create your own world and life trajectory
Have your own tower, build your own world
- Life Experience Recorder
The path to the unknown, the future
- That road is getting more and more sustainable, and this road is getting greener and greener

Participate in a competition to save carbon emissions

- Going out is the game
- Use the initial fund to participate in this competition
- Transportation has less carbon emissions, earn points

Ordinary citizens become city heroes through continuous green travel.

- Ordinary travel users have travel needs
A more affordable way to travel
- Willing to share and communicate with friends
- Get accumulated rewards and reputation

Turn the journey into a carbon-emission card/survival game

- Realistic journey = virtual game
- Survival requires lower carbon emissions

UX Design Storyboard

Scenario: *My life*

UX Design Storyboard

Scenario: *When I go outside, I start a game about green travel. The world is my playground.*

- Everyone has an initial fund to start the game. Say 100 coins
- The app can help track city fund and my traveling path
- Each day, the app will display a leaderboard according to every player's accumulation points
- James discovered that he can use multiple mobility services, pay them with crypto and he can even earn money from using the APP that's sick!
- He discovered that he can use multiple mobility services, pay them with crypto and he can even earn money from using the APP that's sick!
- Now he travels in the city with multiple options and pay with his cryptocurrencies. So cool, he tells his friend to join him
- James, his friends and many other people join different events while travel around the city to earn rewards, NFT, and create their own digital landmarks on the map. Some of them even trade the NFT on marketplace and become a millionaire!
- They didn't realize that they are building their reputation score to become the future hero of the city. Banking in the app, make it more sustainable game to move the leader in Metaverse community who is organizing a lot cool event every month to encourage sustainable travel!

The game lord will reward most active players

UX Design Storyboard

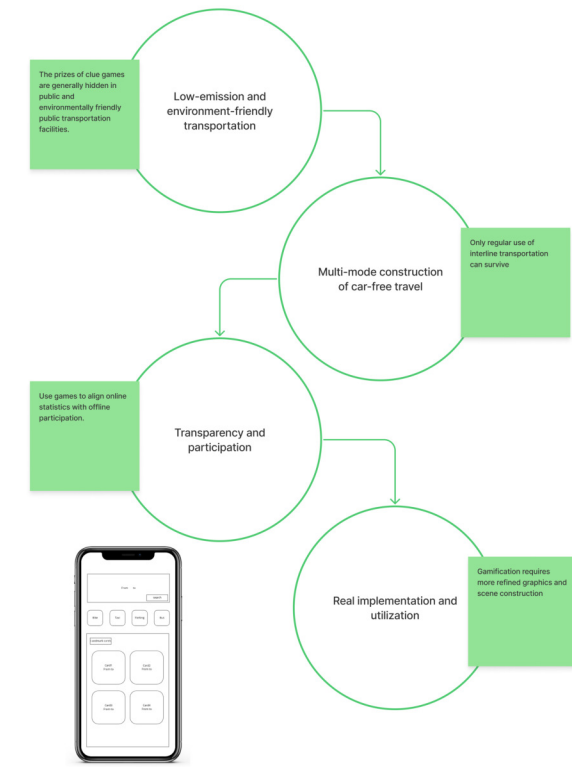
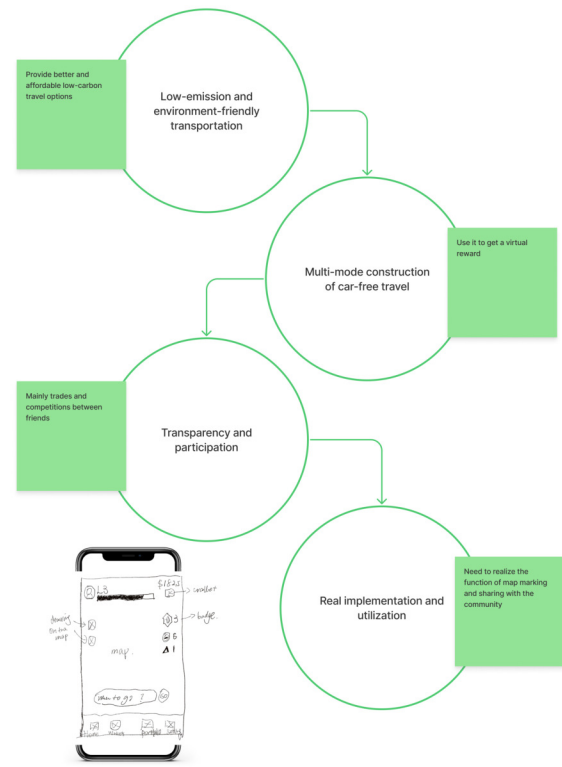
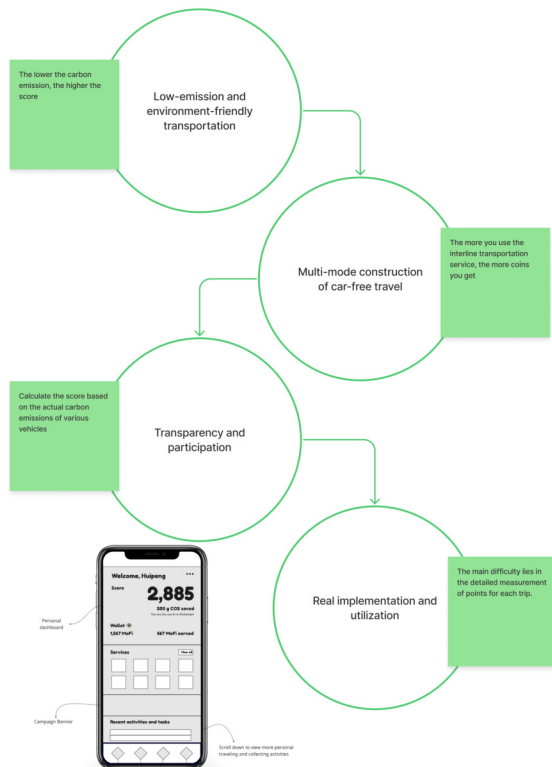
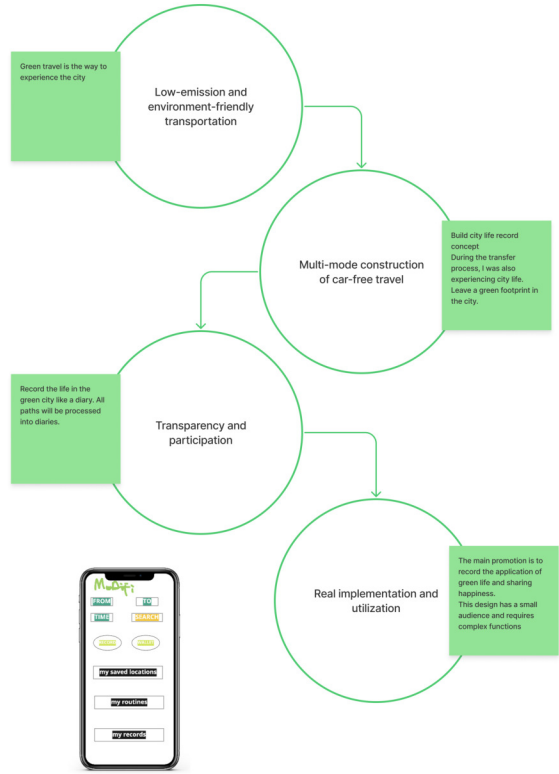
Scenario: *James discovered that he can use multiple mobility services, pay them with crypto and he can even earn money from using the APP that's sick!*

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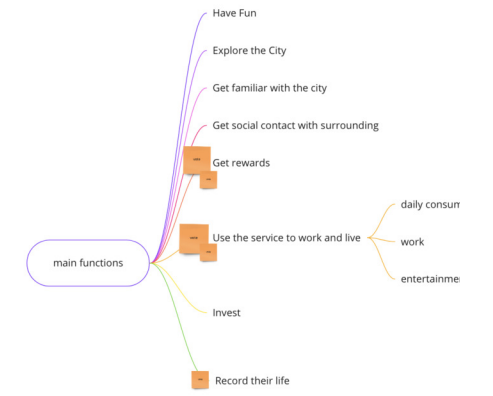
UX Design Storyboard

Scenario: *James discovered that he can use multiple mobility services, pay them with crypto and he can even earn money from using the APP that's sick!*

- Idea1: Clue game: Guide users to search cards in the city
- Map label: NFT: A game that captures some urban landscapes
- Collect city cards or landscape cards
- Idea2: Survival: The city has energy calculation/ Has a mission
- Use with limited carbon capacity
- Finally get the survival achievement



According to everyone's thoughts, I listed all the main function points mentioned, and finally voted and screened. Everyone agrees that the provision of bus services is still the most important function, and the second is to earn rewards. Therefore, these two functions are mainly considered in the final design.



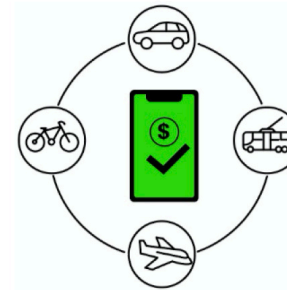
Conceptualization



5.1 Service design introduction

5.1.1 MaaS Features

In the first phase, MobiFi mainly provides Parking+ services around parking. The main purpose is to attract private car users to use MobiFi and increase the exposure of alternative travel modes. At the same time, MobiFi uses its own financial attributes to build a green credit reward mechanism to encourage users to choose more environmentally friendly travel methods, such as parking in indoor parking garages, parking in the suburbs, and so on.



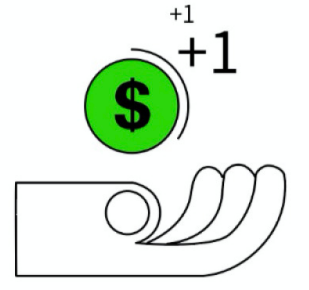
Multimodal Transport

- Enjoy a seamless way to move around with different transport and mobility services.
- All-in-one app that brings simplicity in life.



Mobility Wallet

- Streamlined experience in payment for wherever you go
- Managing all your digital assets and rewards in one place



Sustainable Incentives

- Earn eco rewards by using sustainable transport modes.
- Exchange rewards credit to services or just cash out.

5.1.2 MaaS Rewards system

MaaS features provide users with real travel services and meet their functional needs. This is the satisfaction of ability and opportunity. In the process of user selection and order placement, we hope to provide more innovative services to give users the motivation to choose a green travel mode. One of the innovations is the provision of green services that are different from ordinary services.

Users can get specific green credit rewards after choosing green services. The key to determining green credit lies in scoring the low-carbon and environmentally friendly degree of travel behavior. The initial reward standard is based on research results.

Credit Green Choice

- 1 Use EV charging
- 2 Indoor/Offstreet parking
- 3 Parking close to the destination but in the suburb
- 4 Use car sharing service (as lender)
- 5 Use car sharing service (as borrower)
- 6 Use car pooling service (as driver)
- 7 Use car pooling service (as passenger)
- 8 Use public transport
- 9 Use car sharing scooter/e-bike
- 10 Use car sharing bike

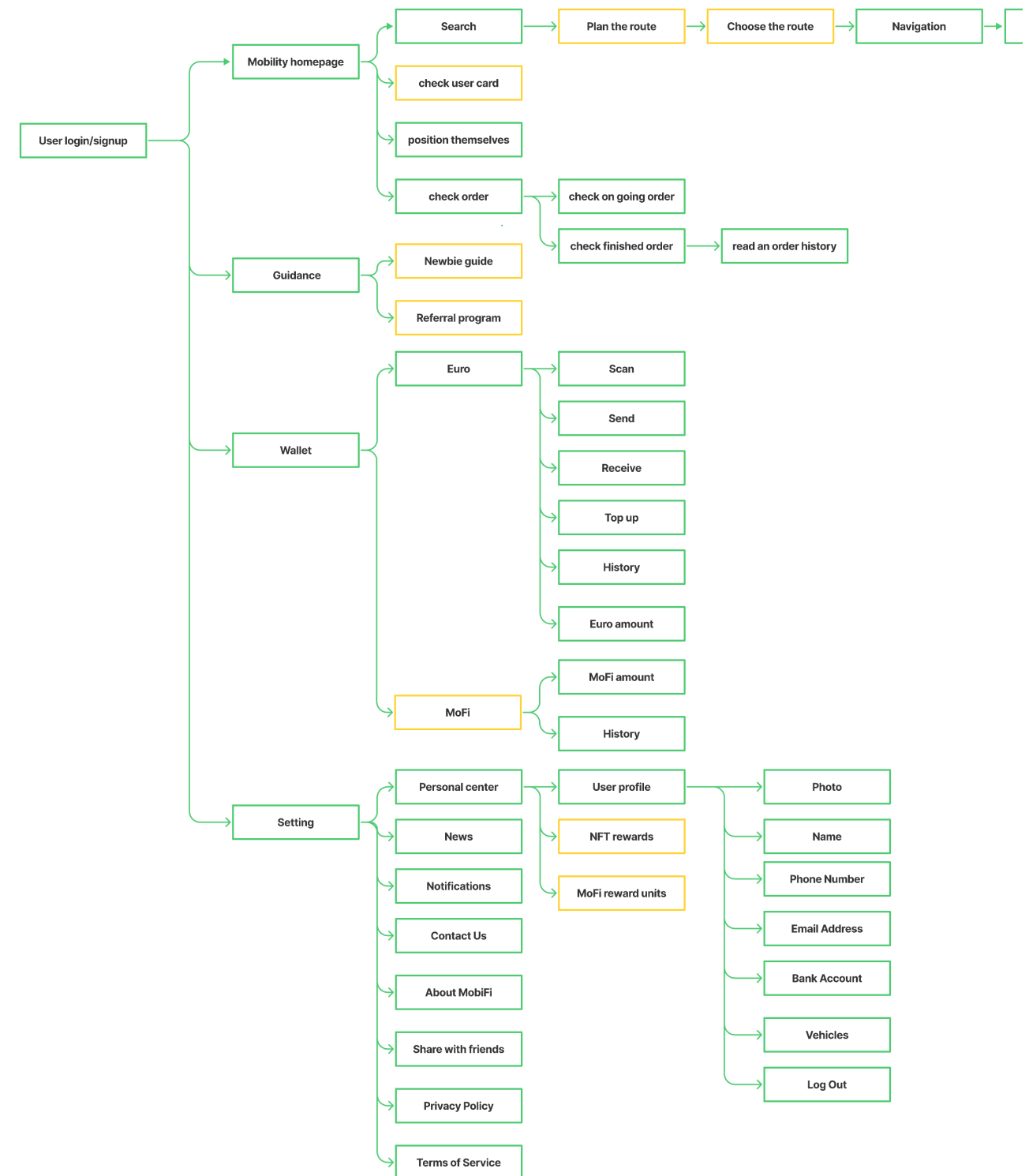
5.1.3 MaaS App Introduction

MobiFi is a mobility as a service provider which offer drivers driving related services, especially recommend green choices (indoor parking, car sharing, car pooling etc.) and offer better travel discounts for green travel practitioners.



MaaS App Framework

Based on the demand for basic service functions and innovative thinking about the reward mechanism, I built the APP framework system as shown in the figure below. The green part is the basic function, and the yellow part is the reward mechanism.



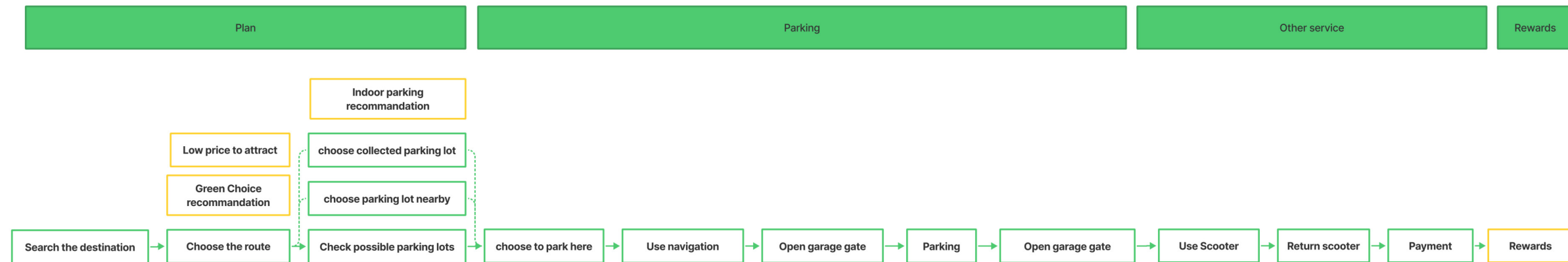
Use flow Design

MaaS itself is a grand cooperative proposition, and its usage scenarios are very rich. Based on the common service touchpoints of private car users from user research, I chose a combined travel mode of parking and electric vehicles for simulation. Use one of the small scenarios to explain the use process of MobiFi and the incentive model for green travel.

Design Goal : 1. make users choose a more environmentally friendly way of travel.

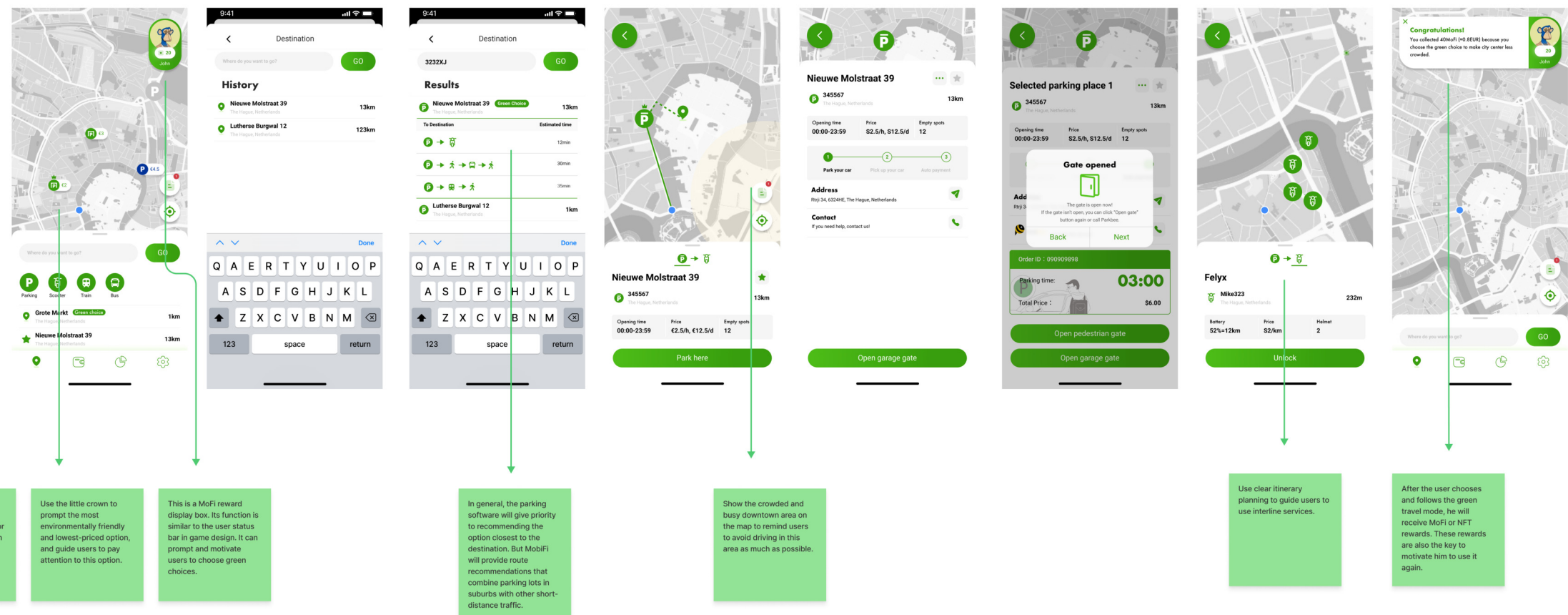
Design Goal : 2. Design practical travel planning functions

Design Goal : 3. make users willing to use the service again



Travel Green

Welcome to MobiFi — An all-in-one crypto-wallet that solves all your mobility problems



Indoor parking is more friendly to the urban environment than outdoor parking, so this is a green choice.

Use the little crown to prompt the most environmentally friendly and lowest-priced option, and guide users to pay attention to this option.

This is a MoFi reward display box. Its function is similar to the user status bar in game design. It can prompt and motivate users to choose green choices.

In general, the parking software will give priority to recommending the option closest to the destination. But MobiFi will provide route recommendations that combine parking lots in suburbs with other short-distance traffic.

Show the crowded and busy downtown area on the map to remind users to avoid driving in this area as much as possible.

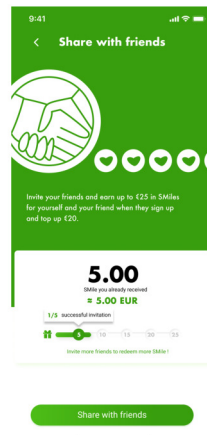
Use clear itinerary planning to guide users to use interline services.

After the user chooses and follows the green travel mode, he will receive MoFi or NFT rewards. These rewards are also the key to motivate him to use it again.

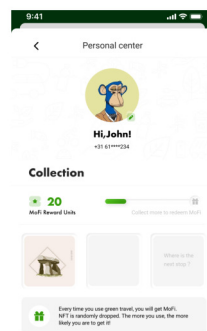
Incentive system



Use clear navigation with attractive rewards to guide users to use the service.



The influence of personal use is small, and the incentive mechanism is used to encourage users to invite more friends to use it together in order to expand the scope of services and realize the promotion of green travel.



This design makes full use of the technical expertise of the blockchain to create a personal green credit profile. It truly records users' green travel behavior and rewards users with green credit points MoFi and NFT green travel badges.

5.1.4 The significance of MobiFi

To raise public's awareness of carbon neutrality and encourage them to take actions

MobiFi establishes an incentive mechanism to encourage users to achieve low-carbon activities in daily life. The APP can also raise users' carbon reduction awareness and encourage them to work and travel in a green way. MobiFi also further optimize the incentive mechanism for employees to participate in carbon emissions reduction activities.

To affect the travel industry and build a green travel ecological chain

The green travel mechanism will naturally give priority to suppliers with lower-carbon and high-efficiency production/service models. Such a model will help truly low-carbon services to be promoted and attract the attention of investors and users.

After long-term development and expansion, it will subtly affect the transportation industry, so that participants in the ecological chain will pay more attention to the environmental protection of their own production and service models, thus truly helping to build a sustainable business society.

Strengthen the process management of mobility emissions and improve the transparency of carbon neutrality

The scientific process management of mobility services serves as the basis for the realization of "net-zero emissions" as well as the implementation of actions to reduce carbon emissions for mobility. In accordance with relevant international standards, the project refers to a professional third-party organization to account for greenhouse gas emissions in a scientific and prudent way. Also, the APP establish a greenhouse gas emissions tracking and monitoring mechanism to take the lead to apply blockchain to trace the carbon neutrality process. Taking advantage of blockchain technology's anticounterfeiting and anti-tampering features, the APP will move all of users' carbon emissions and emissions reduction data onto the blockchain so records are traceable and tamper-proof. In addition, MobiFi can further improve its information disclosure mechanism to disclose carbon neutrality progress on a regular basis and gradually improve the transparency of carbon neutrality information.

5.1.8 MaaS Ecosystem

One of the great challenges of mobility systems is that they are complex, typically comprising many different players and components with strong interrelations and interdependencies; hence, a high degree of collaboration is required between the key players to make progress.

Due to the higher level of technological integration between all parties, which has increased mobile options for customers, industry barriers are becoming blurred. Therefore, a new way of thinking is needed: pay less attention to simple product sales, and pay more attention to creating value through the ecosystem. Therefore, the first challenge many companies face is to form a complete view of the ecosystem to which they belong. As mentioned earlier, traditional sector boundaries are blurring, and mobile-related sectors are transforming into interconnected ecosystems.

As shown in the figure below, based on my design, MaaS is a fluid overall system that has the sustainability to promote the success of all parties as a whole. Integrating various transportation services that replace private car travel can provide users with ease of use, thereby intervene in user decisions. And the large amount of green travel data generated in it can feed back transportation research, green transportation investment and policy guidance, so it is an important part of sustainable transportation planning.

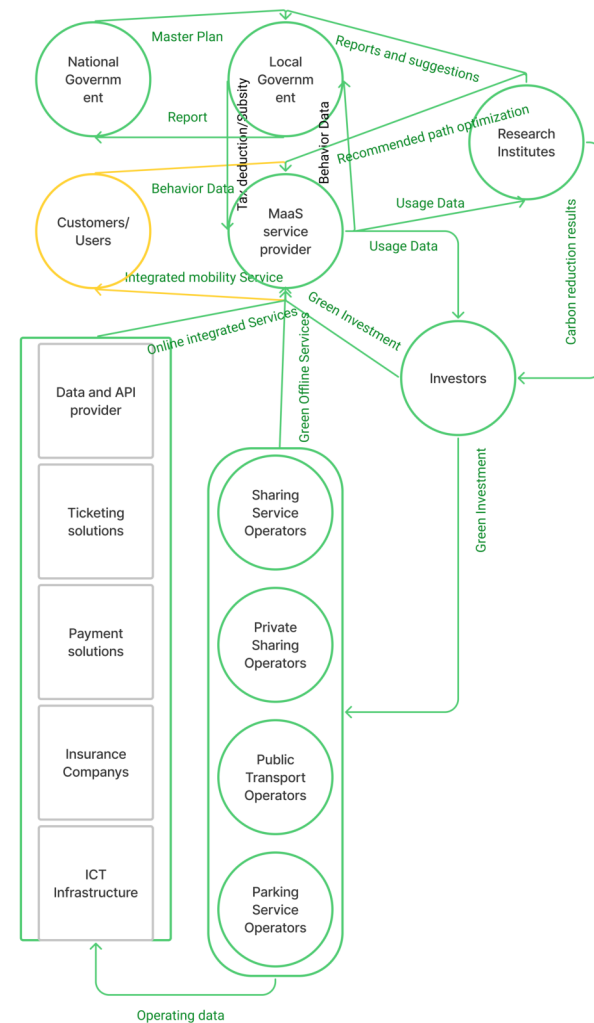


Figure 21: Ecosystem map for future

The MaaS provider who own the consumer relationship can play a key role as the MaaS ecosystem matures.

Integrated apps sit at the center of future MaaS ecosystems, shifting the consumer relationship from the vehicle they own to the mobility service they use. Driven by the all-too-familiar “data is the new oil” adagio, there is an increasing competition to control customer relationships and the associated data in a dynamic context of emerging value chains, the breakdown of sector boundaries and the rise of aggregator business models. In a fully digitized mobility universe, where having far-reaching customer insights based on real-time data and being top-of-mind of customers is essential, it seems a logical reaction to survive.

As a result, many companies are seeking to unlock new ways of (highly frequent) customer contact in order to retain maximum control over customer journeys and touchpoints. They often try to do this by building their own digital channel or customer-facing platforms. These direct relationships enable MaaS organizations to continually gather data and make more informed innovation decisions based on a deep understanding of consumers’ needs and behaviors.

5.2 Stage assumptions

Sustainable goals can never be achieved overnight. According to Mobifi’s company size and foundation, previous trend background research, and user research conclusions, I designed a strategic design roadmap, which is divided into three stages.

The first is the initial exploration and market intervention strategy design stage. The second is to clarify the cooperation model and the business development stage of continuous access, and the third is to fully roll out the scale development stage to increase the utilization rate.

The first stage: learning green

The goal is to guide and change the travel behavior of drivers and reduce the use of private cars.

Enter the life of car users from car-related services. The program guides users to use maas to arrange and plan trips by providing parking services. In the parking behavior, add the thinking about whether to park indoors or outdoors, whether to park in the city center or the suburbs, provide supporting public transportation and shared tram services, and guide users to try greener joint travel methods. The reward mechanism is used to educate users on the impact of different travel behaviors on the urban environment, thereby changing their perceptions.

The second stage: doing green

The goal is to maximize the proportion of non-private car travel.

When there is a certain amount of user accumulation and user data, advanced algorithms such as machine learning can be used to calculate capacity and demand, and provide more reasonable green travel recommendations.

The implementation of the green incentive mechanism helps Mobifi analyze users’ low-carbon travel needs, and then help operators evaluate how to help promote the improvement of relevant urban policies in low-emission/zero-emission areas.

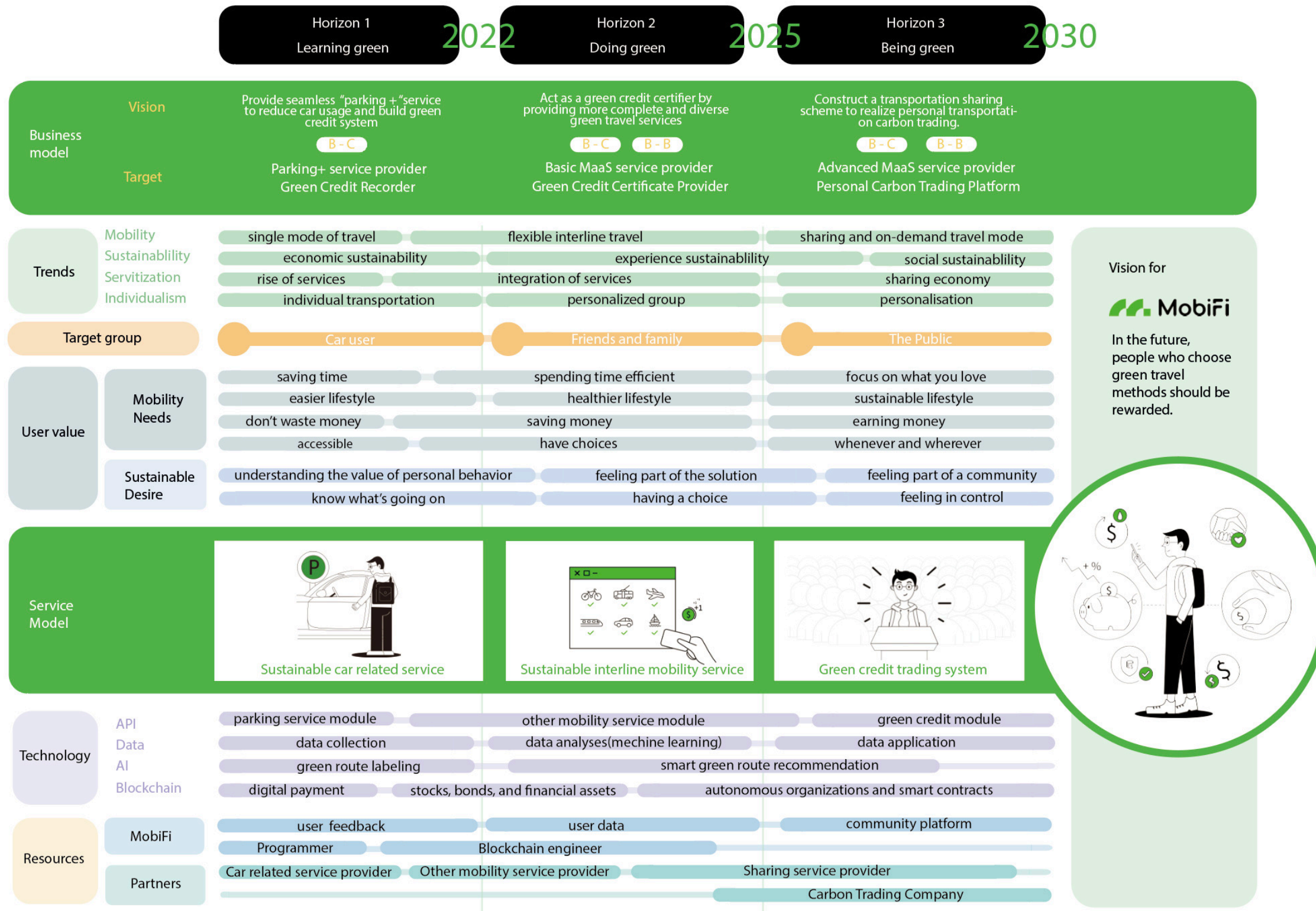
After users develop the habit of connecting travel, Mobifi will provide richer travel options, more environmentally friendly travel methods and higher rewards to encourage users to use more. Those who choose green travel more often can get more rewards.

The third stage: being green

The goal is to build the concept of “Carbon Equality, Carbon Power and Carbon Responsibility” which emphasizes that the earth belongs to all mankind, and everyone should face climate, environmental and sustainable survival crises together.

The accumulated green travel rewards are also proof of personal green credit. Such a credit certificate is also an important business card for individuals in future social life. Low-carbon people will not only be recognized by various environmental protection organizations and foundations in the future society, but also an important guarantee for the reliability and guidance of individuals to carry out shared services or green services. The accumulation of real carbon credits can then be used as the basis for a wide range of personal carbon trading.

5.3 Strategic Roadmap



Vision for



In the future, people who choose green travel methods should be rewarded.



Figure 22: Roadmap design for MobiFi

Validation

6.1 User validation

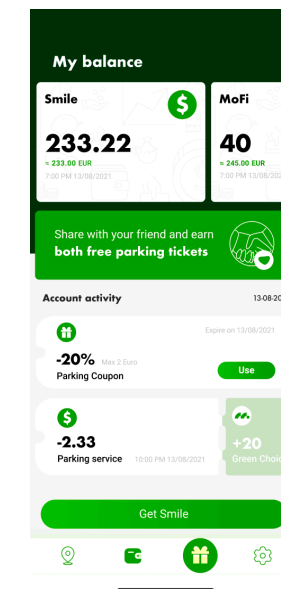
- Which type of incentive user may choose?

6.1.1 Experiment setting

According to the research on changing behavior, the reward mechanism is diverse. How to make consumers have the ability to have the opportunity to go green consumption, and at the same time to make consumers have the motivation to go green consumption. The main solution is to make them perceive the power of choice.

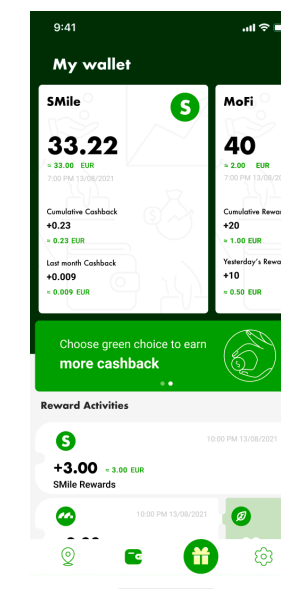
Plan A

I set one of the schemes as a reward after each specific behavior, and use coupons as a common way to promote consumers' consumption again.



Plan B

The other reason is a long-term reward can give consumers who insist on using green behaviors a higher reward share.



6.1.2 User feedback

According to the survey results (Appendix D), long-term rewards are indeed more attractive. The general view is that the attractive part of long-term feedback is simple use. You don't need to worry about complicated discount calculations, and you can always get some feedback. It used to be useless to store money in a transportation card, but now you can at least reap some rewards. At the same time, many times the time-effective discounts in Plan A make people nervous, and are relatively old-fashioned, and do not give users the feeling of new services. Someone mentioned that this is the core spirit of blockchain-driven services. Real data calculates the rewards that can be obtained, and the cumulative way to obtain long-term continuous motivation.

There are still a small number of people who think that Plan A is equally attractive. They mentioned that from a business perspective, long-term practice has proved that discounts can enable users to come back and continue to consume, which is very important for the sustainability of corporate business. At the same time, some people also mentioned that Plan B is boring, which is very similar to the savings profit of a bank card. The amount is small and more suitable for conservative elderly people.

In addition to the test results of the bias of the incentive method, one of the participants also put forward very constructive suggestions to us. "And what if the user is given the opportunity to choose the reward system himself when registering in the application? for example, for 3 months with the possibility to change it" Of course this suggestion is very difficult for software development. But in a small sample size research, I can simulate this function through the design page in the next experiment to provide a more immersive testing experience.

6.2 Expert validation

- Do you agree with this strategy?

6.2.1 Interview setting

From November to December I engaged with 2 executives from dutch MaaS mobility related companies, covering transport service operators to exchange views on the impact of the crisis, actual and planned responses, and insights on the longer-term future.

In order to make full use of the opportunity of expert interviews, I listed several main research questions in the research process on the Kanban in advance, and discussed each question in detail with them.

The topic setting is guiding them to explore this topic. First, I asked them questions about the industry service form-MaaS, which they are familiar with, and ask them to understand the status quo of the industry and the current development direction. Then, based on their long-term customer experience in the industry, i want to learn from them the true needs of customers. Finally, i show the plan and ask them for suggestions.

MaaS Research

Question 1: Have you identify any types of mobility trend after Covid-19?

Question2: What's your opinion about MaaS actual usage nowadays? High or low? What's the reason?

User research

Question 3: Based your experience with users, have you identify any other decision making impact factor?

Concept Evaluation

Question 4: Do you think this machnism design may affect user's behavior?

Question 5: Do you know about carbon trading system?

Will you willing to trade your green credit to earn more money?

Question 6: Do you agree with the ecosystem map for future?

The final process is not exactly as originally set. After clarifying the interviewee, I will ask more specific questions based on the professional field of the interviewed expert. At the same time, when he answers the main line question, I will further ask the details. The result is very rich, each expert has his own unique perspective, helping the entire design to cover all aspects of the user's life. At the same time, experts also gave me some unexpected development directions.

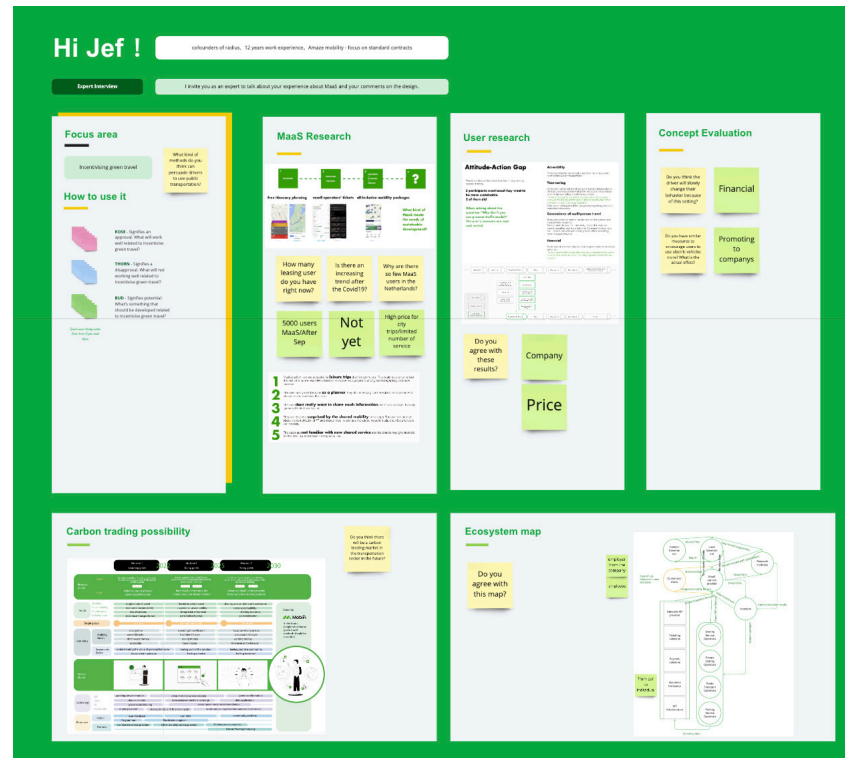


Figure 23: Expert Interview setting

6.2.2 Feedbacks

Expert from Gaiyo

The theme of sustainability is not a good promotion strategy.

He mentioned sustainability wont change the choices yet. So the user say they are influenced by sustainability. But it doesn't mean they choose a different mode just yet, because it's not. It's mainly focusing on price. He knows from previous projects with changing travel behavior that people mentioned, they like to change before because of sustainability.

Work with operators: We need cooperations

We need those third parties all working together to make it work for a consumer. So again, it's a matter of time we need to have a number of customers they need to be able to to get the money in for providing a guarantee on availability of an E bike. So it's a sort of chicken and egg problems.

Subscription package is meaningless now.

He mentioned a lot of people don't even understand, don't even know the costs of their own vehicle, let alone the costs of using public transport the shared mobility as an as a complete alternative. So without experience without knowledge of your own cost of your own travel behavior, especially in this lockdown situation, you're not able to do any calculation, any optimization of your own budget with a mass package.

He mentioned at this moment, it's probably only going to be single use tickets. And in some cases, hopefully a multimodal trip and hopefully increasing multimodal trip, but making a package work. For a consumer means people need to provide a lot of information on pricing on costs, compared to what they know. And people don't know anything about costs. So people can't make any rational decision on changing from their own vehicle to mobility package, that's not gonna work, they're able to sell it

Expert from Amaze

Company car will be a burden

He also mentioned the car lease, and the company car lease, users, there is no incentive to try something else, they will stick to their their company car, rather than trying to try other mechanisms.

Because if I have given as an employer, I have given a car to an employee, then I don't expect him to come with costs, like a taxi, or a train, or things like that. Because I have already provided them with a car.

Operator Competitors

He also mentioned the operators are competitors to the mass pilots. They want to develop their own mass solution. In Amsterdam, Rotterdam and The Hague, they only provide the hourly tickets or two hourly tickets. So that's definitely a big burden for the acceptance of users to use the apps, the mass apps in those cities, ah, for public transport.

Subscription package should be government guaranteed

He mentioned in Sweden, or in other countries where they have this all inclusive mobility package, it's the government that takes the risk, if there is a change of shift. And if the package is not 100%, balanced, you know, the risk is with the government. In the Netherlands, the risk would be with the mass providers. So if somebody would, would buy too much taxi, compared to public transport, the risk would be the mass provider, that bundles the packages, and that is simply not acceptable in a market, which is so young, with this with players, which are so small.

if the government owns the public transport, or owns the bikes, for example, in some way they, they are much more flexible in creating packages, were allowing packages to be created.

Conclusion



7 Discussion and conclusion

Interpretations:

The whole report is divided into two phases: research and design. Taking research as the starting point for design also stipulates the scope of design.

The survey results show that the growth of mobility is an inevitable trend in social development, and this corresponds to the ever-increasing number of car ownership, use times, and willingness to use. At the same time, the sudden change in the epidemic stage is a great change in travel behavior. The growth of travel demand has slowed, and the mode of travel has changed from public travel to private travel. In the outlook after the epidemic, we will use technology to improve efficiency more, and with the progress of urbanization, society and companies will focus on the development of intensive urban transportation.

That's why MaaS becomes the first option to fit the trend meanwhile providing a more sustainable future. Based on the actual usage study we find MaaS is not well promoted to the citizens and the main obstacles drivers facing now when their want to make the choice.

Finally, by seizing the needs of users, the design goal is to enable customers to obtain genuine feedback when they truly choose green travel. At the same time, by analyzing the main activities of driving customers, finding high-frequency parking behaviors as important customer touch points, so as to give users the ability to choose. And in this way, let users recognize this special product, and let customers familiarize themselves with the use process of MaaS.

Based on the design of the roadmap, this service will provide customers with more dimensional value compensation at different stages in the future. The virtual currency brought by the blockchain serves as a game reward, and the actual coupons and cash feedback encourage users to use this product more.

Implications:

Extensive literature research and user and expert results will contribute to the further development of MaaS, providing users with services more in line with their needs, both at the technical level and at the user level. At the same time, the design of the ecological structure and the design of the future development roadmap will help developers to more clearly define their work goals and real-time resource allocation.

Limitations:

Based on sustainable goals, this may not be the best solution. This report is just a further exploration based on this feasible idea. Because this is a brand-new concept, the entire design is based on the content supply of the basic page. During the test, it is also a completely online experience. The user feedback collected may not be detailed and the results are inaccurate.

The landing experiment of this kind of complex process design requires simple development and the most effective feedback can be obtained when the product goes online. At the same time, expert feedback also mentioned the widespread impact of the epidemic on such projects. Therefore, it is very likely that users can only start the experience from a relatively small service point (such as parking), and can have a complete experience after the epidemic.

Recommendations:

The scope of this survey is limited, whether it is the coverage of the interviewees or the authenticity of the services experienced by the interviewees. Therefore, how to continue to provide users with a more sustainable travel mode requires more researchers to join. On the one hand, it is to advance existing solutions through rapid implementation and continuously improve solutions through user feedback. On the other hand, with the development of MaaS, more research is needed on what changes will happen to user needs. At the same time, what kind of traffic behavior is a more environmentally friendly choice also requires further calculation and exploration. The resulting strategy can truly begin to affect society in this complex and changeable transportation system.

References

A

- ALD Automotive. (2021). Business mobility in 2021 - 5 trends for this year. <https://www.aldautomotive.nl/en/about-us/news-and-press/ArticleID/4417/Business-mobility-in-2021-5-trends-for-this-year>

- Aneesh Z., Antonio G., Tahereh N., (2021)The value proposition of blockchain technologies and its impact on Digital Platforms, Computers & Industrial Engineering, Volume 155,107187,ISSN 0360-8352,<https://doi.org/10.1016/j.cie.2021.107187>.

B

- Barr, S., & Prillwitz, J. (2014). A Smarter Choice? Exploring the Behaviour Change Agenda for Environmentally Sustainable Mobility. *Environment and Planning C: Government and Policy*, 32(1), 1–19. <https://doi.org/10.1068/c1201>

- Benjamin, E. (2020, May 4). Micro-mobility Market Report 2019 – 2020 Winter / Spring. Light Electric Vehicle Association. <https://levassociation.com/micro-mobility-market-report-2019-2020-winter-spring/>

- Barros, M., Silva, B., Piekarski, C., Luz, L., Yoshino, R., Tesser, D. (2019)Carbon footprint of transportation habits in a Brazilian university *Environ. Qual. Manag.*, 28, pp. 139-148, [10.1002/tqem.21578](https://doi.org/10.1002/tqem.21578)

C

- CBS. (2019). Car ownership - The Netherlands on the European scale. The Netherlands on the European scale | 2019. <https://longreads.cbs.nl/european-scale-2019/car-ownership/>

- Cuéllar, Y., Buitrago-Tello, R., Belalcazar-Ceron, L. (2016) Life cycle emissions from a bus rapid transit system and comparison with other modes of passenger transportation *CT&F - Cienc. Tecn. Fut.*, 6 (3), pp. 123-134 ISSN (press): 0122-5383

D

- David Banister (2008), The sustainable mobility paradigm, *Transport Policy*, Volume 15, Issue 2, Pages 73-80, ISSN 0967-070X, <https://doi.org/10.1016/j.tranpol.2007.10.005>.

E

-EUROPEAN COMMISSION. (2021). Sustainable and Smart Mobility Strategy – putting European transport on

track for the future. *Mobility and Transport*. https://transport.ec.europa.eu/transport-themes/mobility-strategy_en

- European Environmental Agency.(2017) *Landscapes in Transition—An Account of 25 Years of Land Cover Change in Europe*.

H

- Hazan, J., Reeves, M., Marteau, P. (2018, November 9). Solving the Cooperation Paradox in Urban Mobility. Boston Consulting Group website. <https://www.bcg.com/publications/2018/solving-cooperation-paradox-urban-mobility>

- Hazan, J., Lang, N., & Chraïbi, H. E. A. (2021, January 8). Seeking Perpetual Motion with Mobility as a Service. BCG Global. <https://www.bcg.com/publications/2019/seeking-perpetual-motion-mobility-as-service>

- Høyer, K. & Aall, C. (2005). Chapter 18. Sustainable Mobility and Sustainable Tourism. In C. Hall & J. Higham (Ed.), *Tourism, Recreation and Climate Change* (pp. 260-272). Bristol, Blue Ridge Summit: Channel View Publications. <https://doi.org/10.21832/9781845410056-020>

- Holden E, Gilpin G, Banister D. (2019) Sustainable Mobility at Thirty. *Sustainability*. 2019; 11(7):1965. <https://doi.org/10.3390/su11071965>

- Holden, E. *Achieving Sustainable Mobility: Everyday and Leisure-Time Travel in the EU*; Ashgate Publishing: Farnham, UK, 2012.

- Hembrow, D. (2019). The car-free myth. *Aviewfromthecyclepath*. <http://www.aviewfromthecyclepath.com/2019/08/the-car-free-myth-netherlands-is-great.html>

I

- International Energy Agency. (2009) *Transport, Energy and CO2: Moving towards Sustainability*; International Energy Agency: Paris, France

- International Energy Agency. (2016) *Share of Total Final Consumption (TFC) by Sector—World 2016*

- Itkonen, A., Bockstaller, N., & Perier, A. (2016). A European Strategy for low-emission mobility. European Commission. https://ec.europa.eu/commission/presscorner/detail/en/MEMO_16_2497

K

- Kim, E., Beckman, S. L., & Agogino, A. (2018). Design Roadmapping in an Uncertain World: Implementing a Customer-Experience-Focused Strategy. *California Management Review*, 61(1), 43–70. <https://doi.org/10.1177/0008125618796489>

- Kamargianni, Maria & Matyas, Melinda. (2017). The Business Ecosystem of Mobility-as-a-Service.

- Kunst, A. (2021, August 26). Modes of transportation for commuting in the Netherlands 2021. Statista. <https://www.statista.com/forecasts/1226760/modes-of-transportation-for-commuting-in-the-netherlands>

- Kalbar, P., Birkved, M., Hauschild, M., Kabins, S., Nygaard S. (2018) Environmental impact of urban consumption patterns: drivers and focus points *Resour. Conserv. Recycl.*, 137, pp. 260-269, 10.1016/j.resconrec.2018.06.019

L

- Luukkainen, P. (spring, 2020). Moving on a Whim: Customer Value Creation in MaaS. Aalto University School of Business Information and Service Management, <https://core.ac.uk/download/pdf/333887911.pdf>

M

- Mario Fruianu, M., Leeuwen, F., Blanker, F., Stelling, C. (2010). Public transport in the Netherlands. Minister of Transport, Public Works and Water Management. 6

- Maher, R., Maher, M., Mann, S., & McAlpine, C. A. (2018). Integrating design thinking with sustainability science: a Research through Design approach. *Sustainability science*, 13(6), 1565–1587. <https://doi.org/10.1007/s11625-018-0618-6>

- Michie, S., van Stralen, M. M., & West, R. (2011). The behaviour change wheel: a new method for characterising and designing behaviour change interventions. *Implementation science* : IS, 6, 42. <https://doi.org/10.1186/1748-5908-6-42>

- Manen, W., Wit, W., & Middelkoop, L. (2021, August 9). Five trends that are reshaping the mobility agenda. Deloitte Netherlands. <https://www2.deloitte.com/nl/nl/pages/consumer/articles/five-trends-that-are-reshaping-the-mobility-agenda.html>

N

-Nessler, D. (2016, May 4). Design Thinking & Creativity at hyper island. Medium. Retrieved December 20, 2021, from <https://medium.com/digital-experience-design/design-thinking-creativity-at-hyper-island-53d41fc359cc>

- Nijland, N., Van Meerkerk, J. (2017), Mobility and environmental impacts of car sharing in The Netherlands *Environ. Innov. Societ. Transit.*, 23 pp. 84-91, 10.1016/j.eist.2017.02.001

O

- OECD (2018), Global Material Resources Outlook to 2060: Economic Drivers and Environmental Consequences, OECD Publishing, Paris. <https://doi.org/10.1787/9789264307452-en>

P

- Polydoropoulou A., Pagoni I., Tsimpa A., Tsouros I. (2019) Modelling Travelers' Behavior in the Presence of Reward Schemes Offered for Green Multimodal Choices. In: Nathanail E., Karakikes I. (eds) *Data Analytics: Paving the Way to Sustainable Urban Mobility*. CSUM 2018. *Advances in Intelligent Systems and Computing*, vol 879. Springer, Cham. https://doi.org/10.1007/978-3-030-02305-8_43

R

- Roni M. Severis, Flávio J. Simioni, José Mauro M.A.P. Moreira, Rodrigo A.F. Alvarenga. (2019) Sustainable consumption in mobility from a life cycle assessment perspective, *Journal of Cleaner Production*, Volume 234, Pages 579-587, ISSN 0959-6526

S

- Statistics Netherlands. (2020, March 12). Car fleet growing faster than population. <https://www.cbs.nl/en-gb/news/2020/10/car-fleet-growing-faster-than-population>

- Statistics Netherlands. (2020, Sep 9). Opnieuw record personenautokilometers in 2019. <https://www.cbs.nl/nl-nl/nieuws/2020/40/opnieuw-record-personenautokilometers-in-2019>

- Sochor, Jana. (2021). Piecing Together the Puzzle: Mobility as a Service from the User and Service Design Perspectives.

- Sarasini, Steven & Sochor, Jana & Arby, Hans. (2017). What characterises a sustainable MaaS business model?.

- Sternfels, B., Francis, T., Madgavkar, A., & Smit, S. (2021, November 17). Our future lives and livelihoods: Sustainable and inclusive and growing. McKinsey & Company. <https://www.mckinsey.com/featured-insights/sustainable-inclusive-growth/our-future-lives-and-livelihoods-sustainable-and-inclusive-and-growing>

- Shah, H. (2020). App Usage Statistics 2020 that'll Surprise You. Retrieved from <https://www.simform.com/the-state-of-mobile-app-usage/>

- Schwanen T., Banister D., Anable J. (2012), Rethinking habits and their role in behaviour change: the case of low-carbon mobility, *Journal of Transport Geography*, Volume 24, Pages 522-532

- Sternfels, B., Francis, T., Madgavkar, A., & Smit, S. (2021b, November 17). Our future lives and livelihoods: Sustainable and inclusive and growing. McKinsey & Company. <https://www.mckinsey.com/featured-insights/sustainable-inclusive-growth/our-future-lives-and-livelihoods-sustainable-and-inclusive-and-growing>

- Smit, I. (2020, December 8). 8 trends that drive the future of mobility. INFO. <https://info.nl/en/conversation/8-trends-that-drive-the-future-of-mobility/>

T

- Tsouros, Ioannis & Tsimpa, Athena & Pagoni, Ioanna & Polydoropoulou, Amalia. (2021). MaaS users: Who they are and how much they are willing-to-pay. *Transportation Research Part A: Policy and Practice*. 148. 470-480. 10.1016/j.tra.2021.04.016.

V

- van Audenhove, F.-J., & Eagar, R. (2020, July 16). The Future of Mobility post-COVID | Arthur D Little. Arthur D Little. <https://www.adlittle.com/en/future-mobility-post-covid>

-van Audenhove, F., & Eagar, R. (2021, November). The Future of Mobility postCOVID-19 – Turning a crisis into an opportunity. Arthur D Little. <https://www.adlittle.com/en/insights/prism/future-mobility-postcovid-19-turning-crisis-opportunity>

- Verstoep, S., Pasman, J., & de Groen, S. (2021, January 7). A successful digital agenda for the future of mobility. Compact. <https://www.compact.nl/en/articles/a-successful-digital-agenda-for-the-future-of-mobility/>

W

- Walnum HJ, Aall C, Løkke S. Can Rebound Effects Explain Why Sustainable Mobility Has Not Been Achieved? *Sustainability*. 2014; 6(12):9510-9537. <https://doi.org/10.3390/su6129510>

X

- Xiao, L. (2018, September 5). A brief history of human-computer interaction (HCI). Medium. Retrieved December 20, 2021, from <https://blog.prototypr.io/the-rise-of-human-computer-interaction-hci-823dd6286e1d>

Y

- Yaga, D., Mell, P., Roby, N. and Scarfone, K. (2018), *Blockchain Technology Overview*, NIST Interagency/Internal Report (NISTIR), National Institute of Standards and Technology, Gaithersburg, MD, [online], <https://doi.org/10.6028/NIST.IR.8202> (Accessed December 19, 2021)

Z

- Zutshi, A., Grilo, A., Nodehi, T. (2021). The value proposition of blockchain technologies and its impact on Digital Platforms, *Computers & Industrial Engineering*, Volume 155, ISSN 0360-8352, <https://doi.org/10.1016/j.cie.2021.107187>.

Appendix

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A. Graduation brief

DESIGN
FOR OUR
future

5152

TU Delft

IDE Master Graduation

Project team, Procedural checks and personal Project brief

This document contains the agreements made between student and supervisory team about the student's IDE Master Graduation Project. This document can also include the involvement of an external organisation, however, it does not cover any legal employment relationship that the student and the client (might) agree upon. Next to that, this document facilitates the required procedural checks. In this document:

- The student defines the team, what he/she is going to do/deliver and how that will come about.
- SSC E&SA (Shared Service Center, Education & Student Affairs) reports on the student's registration and study progress.
- IDE's Board of Examiners confirms if the student is allowed to start the Graduation Project.

! USE ADOBE ACROBAT READER TO OPEN, EDIT AND SAVE THIS DOCUMENT
Download again and reopen in case you tried other software, such as Preview (Mac) or a webbrowser.

STUDENT DATA & MASTER PROGRAMME

Save this form according the format "IDE Master Graduation Project Brief_familyname_firstname_studentnumber_dd-mm-yyyy". Complete all blue parts of the form and include the approved Project Brief in your Graduation Report as Appendix 1 !

<p>family name: <u>Chen</u></p> <p>initials: <u>C</u> given name: <u>Qiuyi</u></p> <p>student number: <u>5162750</u></p> <p>street & no. _____</p> <p>zipcode & city _____</p> <p>country _____</p> <p>phone _____</p> <p>email _____</p>	<p>Your master programme (only select the options that apply to you):</p> <p>IDE master(s): <input type="radio"/> IPD <input type="radio"/> Dfi <input checked="" type="radio"/> SPD</p> <p>2nd non-IDE master: _____</p> <p>individual programme: _____ (give date of approval)</p> <p>honours programme: <input type="radio"/> Honours Programme Master</p> <p>specialisation / annotation: <input type="radio"/> Medisign</p> <p><input type="radio"/> Tech. in Sustainable Design</p> <p><input type="radio"/> Entrepreneurship</p>
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SUPERVISORY TEAM **

Fill in the required data for the supervisory team members. Please check the instructions on the right !

<p>** chair: <u>Suzanne Hiemstra-van Mastrigt</u></p> <p>** mentor: <u>Eui Young Kim</u></p> <p>2nd mentor: <u>Yudi Xu</u></p> <p>organisation: <u>Things Protocol BV</u></p> <p>city: <u>The Hague</u> country: <u>Netherlands</u></p>	<p>dept. / section: <u>SDE / MD</u></p> <p>dept. / section: <u>DOS / M&C</u></p>
--	--

Chair should request the IDE Board of Examiners for approval of a non-IDE mentor, including a motivation letter and c.v.

! Second mentor only applies in case the assignment is hosted by an external organisation.

comments (optional)
:
:
:

! Ensure a heterogeneous team. In case you wish to include two team members from the same section, please explain why.



Personal Project Brief - IDE Master Graduation

A blockchain based mobility service system for incentivizing green travel project title

Please state the title of your graduation project (above) and the start date and end date (below). Keep the title compact and simple. Do not use abbreviations. The remainder of this document allows you to define and clarify your graduation project.

start date 01 - 07 - 2021 18 - 11 - 2021 end date

INTRODUCTION **

Please describe, the context of your project, and address the main stakeholders (interests) within this context in a concise yet complete manner. Who are involved, what do they value and how do they currently operate within the given context? What are the main opportunities and limitations you are currently aware of (cultural- and social norms, resources (time, money,...), technology, ...).

-The context of your project: The high population density and high urbanization in the Europe has given birth to a developed transportation system, which brings urban prosperity and also costs to our environment: greenhouse gas and pollutant emissions, noise. European Commission points out that transport emissions represent around one quarter of the EU's total GHG emissions. As outlined in the European Green Deal, our goal is a 90% cut in emissions by 2050. Therefore, it is imperative to innovate the green mobility service model. I reached a connection with the startup company Things Protocol BV, and I will work with them to design a green travel service based on blockchain.

-Who are involved: Things Protocol BV: a blockchain powered MaaS company and they aim to build a future mobility as a service product with blockchain-based financial technology.

-What do they value: As a start-up, they value disruptive innovation and economically feasible service models and marketing methods.

-How do they currently operate within the given context:

1. Their business goal is in line with my design vision. We all want to create a smart and sustainable green travel system. Therefore, they will join my research as a service provider in the entire service system.
2. They are still looking for ways to apply blockchain technology to consumers' lives. Its unformed service model is lack of strategy from design and market perspectives. They are taking into account its acceptance and ease of use, but did not think clearly how to integrating control, intrinsic motivation and emotion into their service, so the positioning and design of service providers in my research will also become an effective reference for them to explore service models.
3. Meanwhile they can offer some research resources. They have accumulated some blockchain user groups, and such semi-professionals will become the best early adopters to participate in my research. Some transportation service providers they have contacted in their business development can also provide valuable opinions for my research. The technical experts of their team will also become a powerful pillar of the work based on technological innovation.

- Limitations:

1. It is not a good time to discuss travel modes during the epidemic, because everyone's travel opportunities are drastically reduced, and a year's home life may cause users to be insensitive to travel needs. At the same time, it also set limits and difficulties for my on-site investigation.
2. This is a research project based on technological innovation and exploration mode innovation. I don't have a blockchain knowledge background. In order to better complete the design task, I must study the technical literature and highly collaborate with the technical staff to create the most feasible solution.
3. Users are not familiar with blockchain technology and don't trust decentralized services now. It's a challenge for user testing but also a chance to study about consumers' perceptions of the use of blockchain technology and how to benefit users with new tech.
4. People's travel behavior research is a project with many intervention factors. The entire project is mainly aimed at young European groups. But there are decisive intervention factors. For example, the Dutch university student group is having the government's public transport subsidy.

- Opportunities

1. At present, the environmental awareness of European people is high, they just need a more practical, more convincing and attractive environmental protection service model.
2. At the same time, long term of working remotely also weakened the inherent thinking and created an opportunity to make people rethink about their true travel requirements and change irrational travel habits.
3. The application of blockchain in transportation is not common in the market. New technology-oriented innovation has broad prospects for academic research and market applications.

space available for images / figures on next page

Personal Project Brief - IDE Master Graduation



PROBLEM DEFINITION **

Limit and define the scope and solution space of your project to one that is manageable within one Master Graduation Project of 30 EC (= 20 full time weeks or 100 working days) and clearly indicate what issue(s) should be addressed in this project.

1. The energy consumption of personal travel every year is huge, and it is still showing an increasing trend before the epidemic. A report from Minister of Transport, Public Works and Water Management mentions the Dutch are increasingly turning to the car to meet their mobility needs. The slogan of low-carbon travel did not affect citizens' irrational travel behavior in the Netherlands.
2. The development of new technology has given birth to a large number of new travel services, but it has not yet changed people's main travel habits. BCG & the French digital agency My Little Paris found that even though 75% of Parisians aged 25 to 45 have tried new mobility services, less than 6% rely on them for their daily commute. (Hazan et al., 2018) To realize the true potential of the green market, companies must help consumers change their behavior. This requires surmounting the barriers between the desire to become green consumers and their actions.
3. Researches indicate offering credits and monetary rewards may be effective in altering travellers' behavior, while the provision of other non-financial passenger services does not influence individuals' travel choice. (Polydoropoulou et al., 2018) As a new technology that is reconstructing the world's financial and credit system, blockchain has the potential to change user travel behavior through incentive mechanisms. How blockchain could be incorporated as a stimulus for exploring new models is the problem.

ASSIGNMENT **

State in 2 or 3 sentences what you are going to research, design, create and / or generate, that will solve (part of) the issues) pointed out in "problem definition". Then illustrate this assignment by indicating what kind of solution you expect and / or aim to deliver, for instance: a product, a product-service combination, a strategy illustrated through product or product-service combination ideas, ... In case of a Specialisation and/or Annotation, make sure the assignment reflects this/these.

Creating a blockchain powered mobility as a service ecosystem to incentivize green travel.
The service model aims to provide meaningful experience to enhance citizens' willingness to use public transportation, shared travel services and other environmentally friendly travel modes.

In the end, I expect to deliver a Mobility as a Service (MaaS) strategy based on blockchain illustrated through product-service combination ideas. I would present my strategy through the user experience design based on the research and concept creation of the business ecosystem of green mobility.
The product-service design would be presented in the way of service system which is a whole composed of relationships among its members. And to make the service system more feasible and sustainable, I will analyze the needs of stakeholders such as public transport operators and explore forms of cooperation and value chain among them.
The system is structured to explain how end-users could get incentivised to choose green travel. In the end, the design initiatives would help transport service providers, end-users, blockchain developers and platform company itself to understand the context of sustainability challenges more holistically.
To be concrete, I plan to complete three deliverables:
A. A service system map which identifies the main actors as supplier, intermediary, or complementor and possible end users and their characteristics and shows the relation between them.
B. A prototype of the service that can be used in the test with the end-users to confirm system's effectiveness.
C. A roadmap which demonstrates how technology development, customer adoption stages and other factors could reshape and develop the system in a long term.

IDE TU Delft - E&SA Department /// Graduation project brief & study overview /// 2018-01 v30 Page 5 of 7
Initials & Name C. Chen Student number 5162750
Title of Project A blockchain based mobility service system for incentivizing green travel

Personal Project Brief - IDE Master Graduation

PLANNING AND APPROACH **

Include a Gantt Chart (replace the example below - more examples can be found in Manual 2) that shows the different phases of your project, deliverables you have in mind, meetings, and how you plan to spend your time. Please note that all activities should fit within the given net time of 30 EC = 20 full time weeks or 100 working days, and your planning should include a kick-off meeting, mid-term meeting, green light meeting and graduation ceremony. Illustrate your Gantt Chart by, for instance, explaining your approach, and please indicate periods of part-time activities and/or periods of not spending time on your graduation project, if any, for instance because of holidays or parallel activities.

start date 1 - 7 - 2021 end date 18 - 11 - 2021



1. Discover stage: Multi-dimensionally explore the problem and problem background
 - a. Technology research, competitive analysis and existing research theories of incentive mechanism study
 - b. User research: Identify and classify end users
2. Define stage: Gain insights and define the problem
Problem framing: Clarify the design problem and the scope of solution.
3. Develop stage: Develop possible block chain based mobility as a service solutions through iterations
 - a. Service model idea generation by structure design and scenario mapping
 - b. Prototyping and testing: Using the prototype as a 'physical hypothesis' to prove the feasibility of a proposition and as a stimulus in the testing of an overarching theory for which it constitutes an instantiation.
4. Deliver stage: Improve and optimize final service system
 - a. Critical reflection: I will deepen the analysis of prototype issues and the discussion of system mechanisms by arranging interviews with other stakeholders.
 - b. Design iteration: Combine conclusions from user testing and critical to modify the service system
5. Evolve stage: Consider the feasibility of actual promotion and use
Implementation: Summarize the future development direction and design the roadmap.

IDE TU Delft - E&SA Department /// Graduation project brief & study overview /// 2018-01 v30 Page 6 of 7
Initials & Name C. Chen Student number 5162750
Title of Project A blockchain based mobility service system for incentivizing green travel

MOTIVATION AND PERSONAL AMBITIONS

Explain why you set up this project, what competences you want to prove and learn. For example: acquired competences from your MSc programme, the elective semester, extra-curricular activities (etc.) and point out the competences you have yet developed. Optionally, describe which personal learning ambitions you explicitly want to address in this project, on top of the learning objectives of the Graduation Project, such as: in depth knowledge a on specific subject, broadening your competences or experimenting with a specific tool and/or methodology, Stick to no more than five ambitions.

Motivation:

The original intention of choosing strategic product design is to be dissatisfied with the level of industrial product design. I hope to participate in the discussion of complex social issues as a designer, and finally realize the social influence of my own design. This project with a startup company background just met my design goals of combining new technologies, creating new service models, and delivering new social values. Reducing mobile pollution has long been a social proposition. All stakeholders are innovating for this: the government has long listed it as a work goal, innovative companies have launched shared travel services, and traditional public transportation companies have tried to attract more users through discounts. However, the results have been minimal. Therefore, as a designer educated in user research, stakeholder analysis, product commercialization, roadmapping and system thinking, I hope to use my strengths to study effective user incentive mechanisms and explore the sustainability of the service system.

Learning objectives:

1. I want to apply context mapping and gain complete experience in planning user research projects by myself. In the previous courses, I mostly participated in part of the contextmapping process, and I have not been able to apply the results to the final design practice.
2. Getting deep understanding of Research through Design (RtD) I learnt in the research project course will be the second goal. Studying how to incentivize green travel is a challenge which is complex, uncertain and contested by multiple stakeholders. RtD takes a holistic perspective and is a process of producing simple and effective responses to complex and vague problems that span across disciplines and stakeholder groups. (Maher et al., 2018) Developing a proposal through multiple iterations can help a single initiative to achieve multiple goals in the end which could help the final design usable and fit for the real world.

[1] Mario Fruianu, M., Leeuwen, F., Blanker, F., Stelling, C. (2010). Public transport in the Netherlands. Minister of Transport, Public Works and Water Management. 6
 [2] Hazan, J., Reeves, M., Marteau, P. (2018, November 9). Solving the Cooperation Paradox in Urban Mobility. Boston Consulting Group website. <https://www.bcg.com/publications/2018/solving-cooperation-paradox-urban-mobility>
 [3] Polydoropoulou A., Pagoni I., Tsirimpa A., Tsouros I. (2019) Modelling Travelers' Behavior in the Presence of Reward Schemes Offered for Green Multimodal Choices. In: Nathanail E., Karakikes I. (eds) Data Analytics: Paving the Way to Sustainable Urban Mobility. CSUM 2018. Advances in Intelligent Systems and Computing, vol 879. Springer, Cham. https://doi.org/10.1007/978-3-030-02305-8_43
 [4] Maher, R., Maher, M., Mann, S., & McAlpine, C. A. (2018). Integrating design thinking with sustainability science: a Research through Design approach. Sustainability science, 13(6), 1565 – 1587. <https://doi.org/10.1007/s11625-018-0618-6>

FINAL COMMENTS

In case your project brief needs final comments, please add any information you think is relevant.

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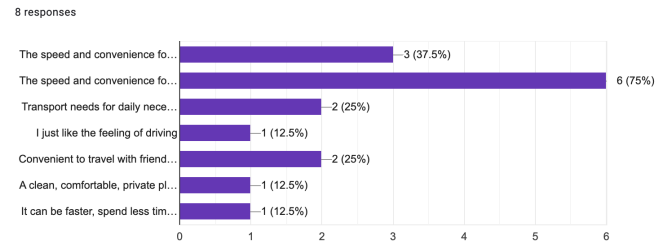
Initials & Name C Chen Student number 5162750

Title of Project A blockchain based mobility service system for incentivizing green travel

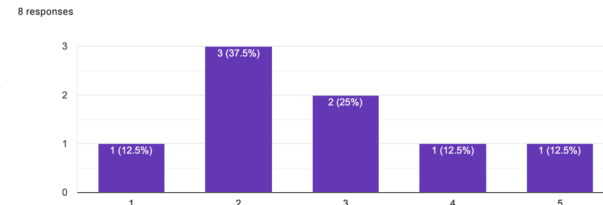
B. Qualitative Research materials

Sensitizing Questionnaire and results

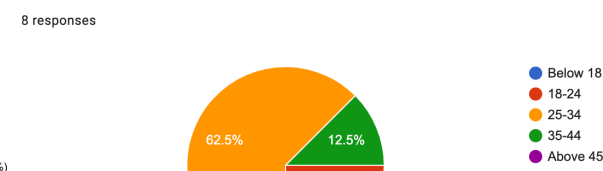
What are the most attractive advantages of traveling in a private car?



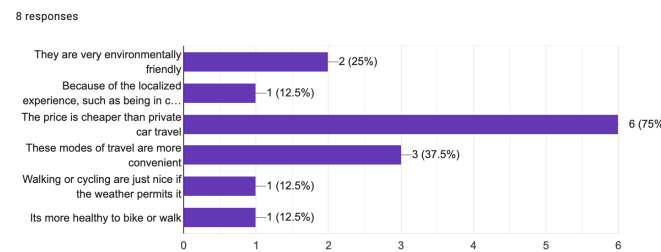
Do you consider the impact of your travel mode on the environment when you travel daily?



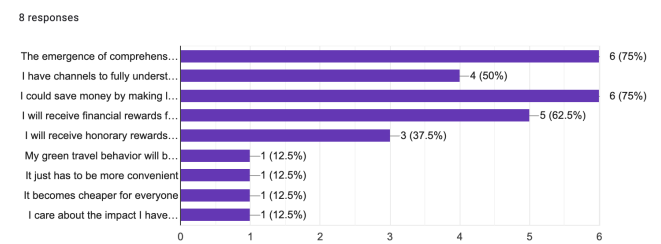
What's your age?



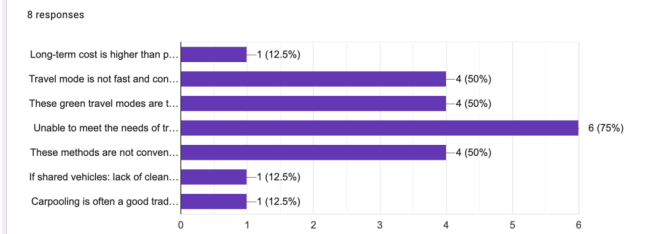
Why do you usually choose these green travel methods?



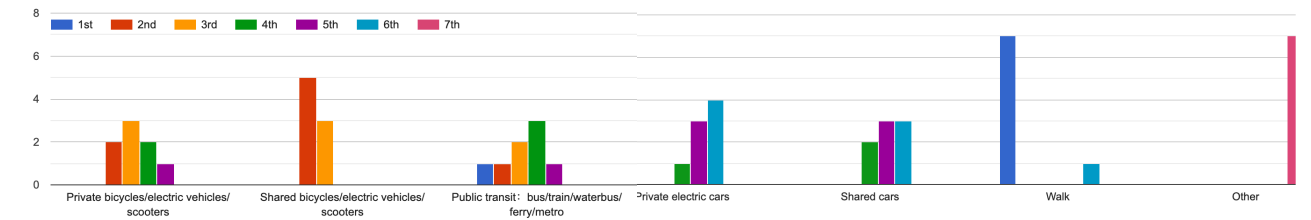
In the future, for what reasons do you think you will choose to use more green travel methods?



What are the usual reasons why you don't choose green travel modes?



What's the most eco-friendly choices for daily travel in your mind?



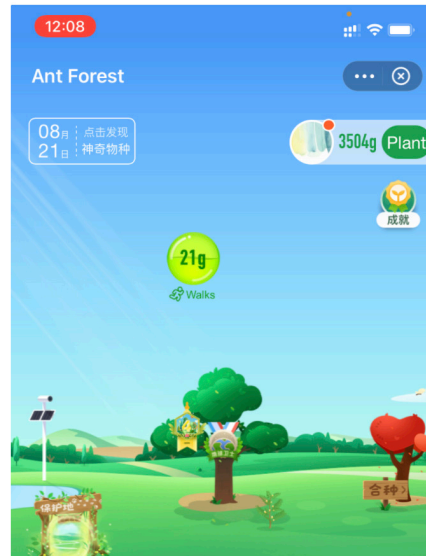
In addition to the examples above, do you have other green travel practices?	How often do you choose the green mode of travel in a week?	What is your view on those who frequently use green travel methods and appreciated, and those who have been using private cars for travel need to be criticized?	Have you ever been inspired by any other form of environmental protection promotion to truly change your travel behavior?
		Yes, green traveller should be rewarded. there is no need to criticize people of not using green travel transport.	
I saw many electric steps on my holiday	5	I agree, especially in the city they should slowly ban private owned cars. There is simply no space. I like how they already do it in Utrecht. You can travel to Utrecht, park on the edge of the city for cheaper and travel with bus or bike from there to the centre.	Yes, indirectly I was targeted and now I would choose electric over older cars bc there is the option now. But that's for when I start a family or get a dog or something, that would make me reconsider getting a private owned car. Not only for me.
Avoid flying	2	Don't think to will work. Also, it usually gets pretty hypocritical. Walking, cycling and public transport are still better.	Yes by avoiding flying as much as possible
no	4	not necessary to criticize anyone. the choice sometimes depends your economic level and personal need	no
I avoid far vacations	5	I think green travel options should be subsidised more and more widely available. Make pt tickets cheaper and international train travel more convenient	The government giving me a week ov (free public transport in the netherlands during weekdays) was HUGE. It allows me to get almost anywhere without.
stay at home	5	Yes. In this way, maybe better influence people's behavior	if i can know the exact impact of my behavior
I don't.	4	I think the use of green travel should be rewarded, but it's not good to shame people who use private cars because we don't know their life circumstances, and daily life is stressful enough already, I don't support adding more things to worry about.	No.
Some airlines offer the option to pay to offset the CO2 emission caused by the flight	3	I am all for rewarding and appreciating people who use green travel methods. I am opposed to criticising people who use private cars especially during a pandemic where using green methods can be dangerous to your health. Also why criticise the individual who doesn't want to spend hours every day on public transport when big corporations are doing significantly more damage haha	As greener options emerge (electric powered transports) I want to take those more. Provided the electricity is also made in a sustainable way.

C. Incentive mechanism case study

Case study: Ant forest

What it is?

Ant Forest is the world's largest platform for individual participation in environmental governance. In 2019, due to driving 500 million people to participate in low-carbon life and converting carbon emission reductions into 122 million real trees planted in desertified areas, Alipay Ant Forest was awarded the highest environmental protection honor of the United Nations. In recent years, they also expand the construction of protected areas to more counties and fields, and begin to tap the cultural value of ecological agricultural products and build IP.



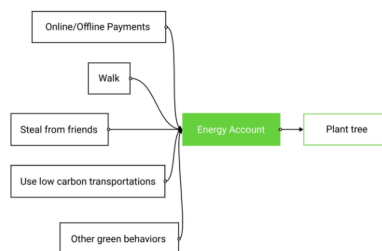
Why i study it?

Although Ant Forest is currently only a social product design that mobilizes everyone to use a green lifestyle, in the eyes of financial analysts, it has become the prototype of a personal carbon trading account, which has great development and creation space. Since it's a great success and it has been online for 5 years and has a massive user base, I chose to summarize the value chain behind it and it's user experience.

How it works?

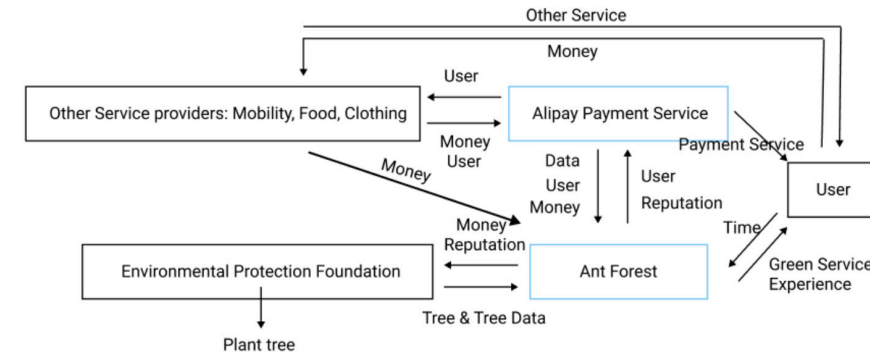
- Function-wise

Ant forest was originally designed to be a personal carbon account to let users know the relationship between their daily behavior and low-carbon emission reduction. However, because the concept of carbon account is too far away from users' cognition, Alipay made products in some fun ways that can interact with users, so as to make the concept of carbon account more grounded: planting real trees.



- System-wise

Its success is also inseparable from the integrity of the systematic value chain behind it. I was inspired by studying its collaboration model.



- Strategy-wise

Why Ant Forest is a great product is largely due to its user retention rate. It is a savvy player in terms of user strategy. I analyzed its method based on the popular Hook model.

The Hook



1. Trigger

Internal factors:

- Self-realization (public welfare)
Public welfare that does not cost money, every finger is to protect the earth, which satisfies most people's desire for public welfare and realize their own value.
- Satisfaction
Ant Forest is a habit-forming game, similar to the happy farm in the past, grabbing parking spaces.

2. Action

Good experience, simple functions and processes
The function and process of the ant forest are very simple: collecting energy from various channels, and then planting trees to consume energy.

Social

It satisfies the social needs of users through co-planting trees (family, love, friendship), friends invited energy, and friends sharing.

External factors

- Regular delivery
Marketing activities, homepage recommendation, push, friend sharing, official account, video, etc.
- Interpersonal trigger (social)
Ant Forest sets up a lot of social triggering scenarios, such as stealing energy, friends inviting me to plant trees, and ranking lists. Energy competition this week and so on.

Entertainment

A habit-forming game meets the needs for leisure and entertainment, and adds protective covers and rankings.

3. Rewards

Considering the Maslow's demand model. Rewards mainly meet the user's self-realization needs, respect (satisfaction) and social needs.

Self-realization (public welfare)

As mentioned earlier, planting trees for public welfare meets the self-realization needs of users.

Steal energy from each other

The interaction between friends and the stealing of energy make this process a huge uncertainty. This enhance the interaction between friends through this form also greatly increases the use time of Alipay users.

Respect (sense of accomplishment)

The PK with friends and the ranking of the list have activated the user's comparative psychology, hoping to be able to get on the list by collecting more energy. The medals and rankings on the list give users a sense of self-identity and great satisfaction.

Medal collection (Desire to collect)

Ant Forest has opened up more and more advanced tree species, constantly attracting users' attention.

4. Investment

Time

Grabbing energy, collecting energy, watering, rewarding, etc. are all routines...Alipay created a routine for every 24 hours.

People will also spend time researching game mechanics to better achieve their goals.

Emotion

Users will have a kind of emotional sustenance when they see high-definition videos of trees growing up and down, and high-definition pictures of trees growing into forests.

User feedback

I not only summarized the system background and related experience they implemented, but also collected some real user feedback. I issued an online questionnaire to users who have used this product. The current sample size is 30, and I have invited 2 low-frequency users and two high-frequency users to conduct one-on-one interviews.

According to the results of the initial 30 questionnaires and interviews with more detailed views, 70% of users believe that Ant Forest has not changed their transportation mode.

According to the theory of COMB model, I analyzed why Ant Forest failed to change user mobility behavior.

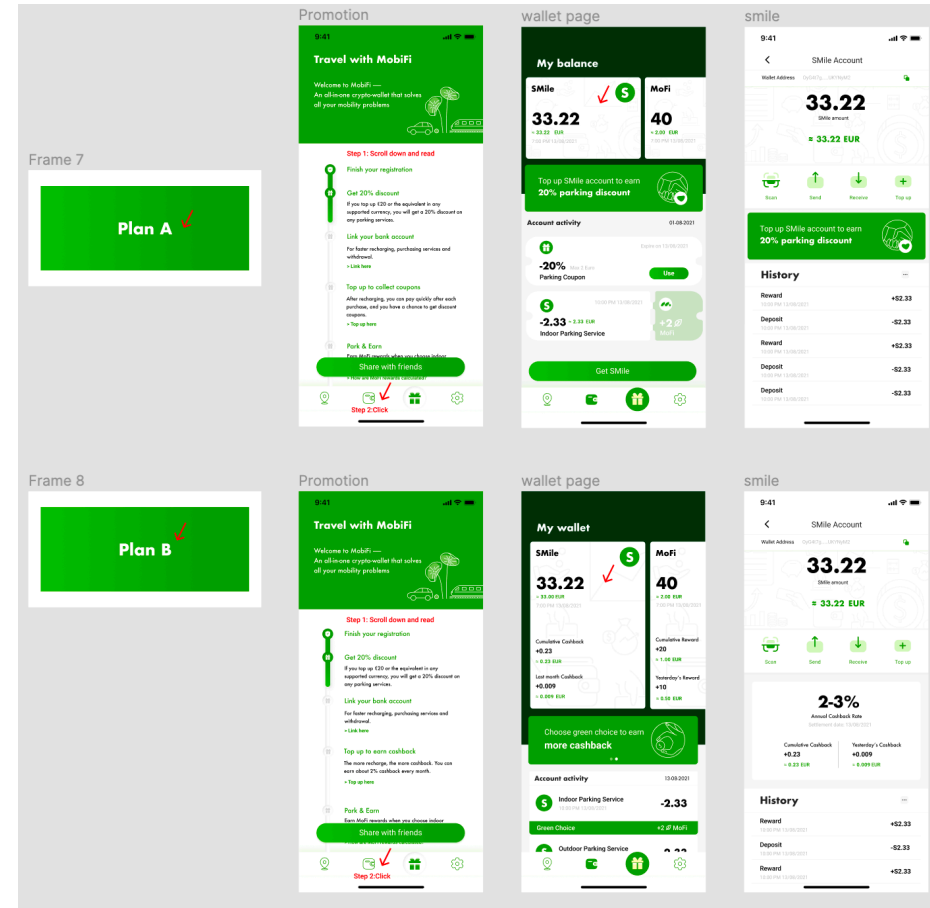
- Motivation (belief that guides and encourages individual behavior change)

As reflected in the HOOK model analysis, the product of Ant Forest is more about enhancing user motivation to make users choose low-carbon behaviors. However, actual user surveys found that this motivation-enhancing model has some shortcomings.

1. The ant forest lacks an inherent incentive mechanism. Most users only start energy harvesting on a whim, just because they happen to choose green travel to generate energy, and then collect it. Instead of collecting energy, choose green travel. Lack of a sustainable positive incentive mechanism.
 2. The tree planting process is very abstract for the user. After the user exchanges energy for the sapling, he will only get a certificate.
 3. There will also be some voices of doubt. For example, sharing bicycles. When a person is going to drive or ride a non-motorized vehicle but chooses to ride a shared bicycle when he is out for business, this is a real alternative and belongs to carbon emission reduction. However, shared bicycles mostly solve the problem of the last mile, and those who should ride a bicycle or walk but choose to share a bicycle at the end. Strictly speaking, this does not belong to energy saving and emission reduction, because it exists in the first place.
- Ability (mental and physical ability, necessary knowledge, skills and behavioral supervision ability)
1. Alipay itself provides payment services, so payment itself gives users the ability to choose low-carbon travel by making transportation convenient. But because it also provides payment capabilities in scenarios such as airplanes, car rentals, and taxis, it fails to provide specificity for low-carbon options.
 2. The number of saplings is in short supply. In many cases, users have enough energy, but there will be a shortage of saplings, which will also undermine the enthusiasm of users.
 3. The results of the questionnaire survey showed that 23.3% of the people recognized Ant Forest's low-carbon environmental protection knowledge propaganda results.
- Opportunities (environment, external factors, physical and social opportunities, environmental background and resources, social influence)
1. At the level of creating social opportunities, Ant Forest allows users to indirectly compensate for unenvironmental behaviors by planting trees to improve the environment. However, due to indirectness, users cannot perceive the changes brought about by planting trees in their daily lives, so the opportunities are not fully utilized.

D. Rewards Method Questionnaire and Results

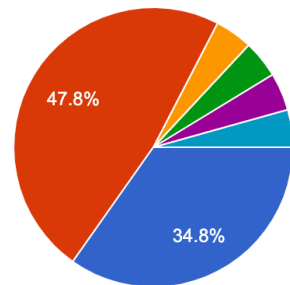
Questionnaire setting



Questionnaire feedback

Which one would you choose?

23 responses



- Plan A
- Plan B
- Are the coupons generic, percentage based coupons used for all services, or is it a flat discount for a specific service...
- I don't see plan B 😞
- and what if the user is given the opportunity to choose the reward system himself when registering in the app...
- Both. Depends on my needs.

What's your opinion about plan A? Would that attract you to use?	What's your opinion about plan B? Would that attract you to use?	Which one would you choose?
Unexpected surprises are more attractive to continuous use than long-term accumulation. Rewards are not very attractive. But good to go.	As a new user, I would be very worried about the large amount of money in it. Good rewards.	Plan A
The structure is good, however, I wouldn't say that the rewards would attract me to use.	I like B better as it does attract me more to use than A.	Plan B
I would go for plan A. I think the word coupon currently has the most meaning for a user in this context, since it currently makes more sense for a user to get a discount rather than "gaining money by parking" - I think this last part is more the focus of plan B, and might B a bit too abstract for users.	- This design is more clear to me since it contains more labels to explain what each section is for - Still, same as for A, this misses the explanation of the "Smile" and "Mofi" currency - why are they together? - Would personally still go for A since I think the concept of interest like explained above is still a bit too new in the mobility sector.	Plan B
A few side notes: - I noted on page 3 the currency "smile" is used - this is not introduced on the page before. It might be useful to introduce the user to the different concepts in the app. Since it is not directly clear for me what "smile" is compared to a mofi and a euro. - I believe the part on the bottom that has two list items with "parking transactions" is the most recent transactions - maybe this need some labels to make it more clear - Does receive mean sending a payment request or something? In that case it might be better to put a label like "Send payment request"	As written in plan A - not really a fan of small cashbacks - you don't get the feeling that you earned something right from the moment which did impact your purse ;)	Plan A
I like it more - you get bigger rewards - my bank also has a cashback and if I see I got 3c back for a certain inquiry that doesn't really incentivise me to use the service where I get 2% back - is linking your account something that is done in the NL? I think not many people in Austria would do this (especially not when the app is new and well not proven to be trusted) - only via PayPal (but that's just my opinion).	Plan B has shorter history, I like that. This allows to have more space for other important things.	Plan B
Page nr 3 seems good, informative.	Despite plan B looking more convoluted, it doesn't feel as attractive as plan A.	Plan A
Plan A has a more established and familiar interface, thus being more intuitive.	Plan B's display for the balance/wallet has more information. I always prefer to have more info displayed on 1 screen (cumulative and last month gains are always good to know)	Plan B
Looks pretty good, I prefer plan B though	I would use Plan B before A. It looks slimmer and has all information easily available. Good overview!	Plan B
Good and easy to understand. I would definitely use it. Rewarding system unclear with the Mobifi token.	Cashback is a little boring, it doesn't seem much different from credit card rewards. It all depends on the % of discounts offered by Plan A to decide between the two. Also, because Mobifi is transport-service based, it's likely the total amount spent on services won't be more than 1000 a month, unlike huge expenses that can be incurred on credit cards. The 2-3% reflected in numbers wouldn't seem like a lot, but it might be beneficial for the older population that like things simple. But chances are the consumers using your app would be largely made up of the tech-savvy that would be interested by novelty. As mentioned above, perhaps scratch-cards for cashback?	Are the coupons generic, percentage based coupons used for all services, or is it a flat discount for a specific service? Will you get coupons based on the services you used? Would be good to give an example like (percentage of discount / expiry period / chances of getting) coupons, to make a more informed decision deciding between the two plans. If it's just like 4% or less, I'd rather get the 2% cashback which is less of a hassle, but then again that doesn't seem very different from credit card rewards. If I can get a 10%-20% or like a 0.5 discount coupon then I'm likely leaning towards Plan A. Love the idea of introducing 'lucky chance/gambling' into the app, would complement other gamification concepts you might have. Also would be great if these were automatically applied when applicable. Personally, I'd like there to be a 100% chance of getting discount coupons, only variation being the discount offered. That would definitely hook me in.
Gambling/gamification, chances for obtaining a bigger discount. Make it a 100% chance of getting discounts but with varying percentage/flat value, it will keep users coming back for sure.	I use this service once, I get another coupon, I'd likely want to utilize it than let it go to waste. Or perhaps a scratch-card for cashback instead?	
It's not very applicable to me. I hate keeping track of coupons	Prefer having the a better use case for Mofi ERC20 governance token The annual cashback feels more rewarding and I like the idea to reward holding. It's the spirit of blockchain driven services. What about an option to choose between MoFi or SMile as the reward. SMile for the safe way (stablecoin) and MoFi for the riskier one (volatility)	Plan B
A classic discount is nothing that I would like to see on such a new financial product that is linked to a blockchain and digital currency. So that would not attract me to use it.	yes because u always get something back	Plan B
yes looks easy to use	ok	Plan A
ok	Yes.	Both. Depends on my needs.
It seems very attractive. I like it.	for me, the main advantage is the opportunity to receive income from unused funds on the transport card. any incentive system will be attractive	and what if the user is given the opportunity to choose the reward system himself when registering in the application? for example, for 3 months with the possibility to change it
for me, the main advantage is the opportunity to receive income from unused funds on the transport card. any incentive system will be attractive	dont like	Plan A
like. good	I guess Plan B is better than A. Coupons make it too complicated.	Plan B
no	I don't see plan B	I don't see plan B
I don't drive a car, so parking is not that important to me. Public transportation and/or city bikes etc. Green transportation should be rewarded imho.	Cashback	Plan B
Apart from the Step 2:Click on page 2/4 which is better centered below the icon, I don't like the idea of collecting coupons of Plan A. "(...) and you have a chance to get discount coupons." is not attractive.	Less attractive	Plan A
I think its more attractive	No	Plan A
Yes	Plan a better	Plan A
Yeah it is really attractive.		Plan A

E. Expert interview raw material

Hi Thijs

Business development manager - work with Galjo- responsible for the commercial side of all the integrations we do with all the transport operators, and all the mobility services in the Netherlands

Expert Interview: I invite you as an expert to talk about your experience about MaaS and your comments on the design.

Focus area

Incentivising green travel

How to use it

ROSE - Signifies an approval. What will work well related to incentivise green travel?
 THORN - Signifies a disagreement. What will not work well related to incentivise green travel?
 BUD - Signifies potential. What's something that should be developed related to incentivise green travel?

MaaS Research

do decide on our own pricing

Scale: we have over 50,000 installs in the Netherlands, basically in the last eight months

Package won't work

User research

Attitude-Action Gap

What kind of feedback do you think can persuade drivers to use public transportation?

THORN - Signifies a disagreement. What will not work well related to incentivise green travel?
 BUD - Signifies potential. What's something that should be developed related to incentivise green travel?

Concept Evaluation

We need governments to change the rules for accessing mobility, making it difficult to get to your destination with your car: raising parking prices, environmental zones in cities, reducing parking spots in residential areas

And the most important thing we need to provide or in this case they would need to provide any operator is a guarantee of availability for the parking spots, and a guarantee that there's a bike available. Otherwise a guard driver won't change the destination or the routes.

because the car is the most efficient way to get from A to B. So that means you need to provide with multi for a service that's focusing on car drivers to help them change their behavior support. I mean, using your own car, which basically means you need to provide for parking surfaces. So I guess we're providers, that fully integrated street parking, and we are working on adding all kinds of carriage parking as well.

We need those third parties all working together to make it work for a consumer. So again, it's a matter of time we need to have a number of customers they need to be able to get the money in for providing a guarantee on availability of an E bike. So it's a sort of chicken and egg problems.

Carbon trading possibility

Hopefully, the new government will introduce the the taxes for car drivers on usage instead of owning a car. That will make a big difference.

customers are also have a direct relation with all the service operators, all the transport operators themselves

In the future, I hope it would have been, at this moment, CO2 emissions don't influence pricing. Not for parking, not for shared mobility, not for public transport.

So in that sense, we're not that different from a service operator, or a sharing service operator, we're putting transport operators, we just we just put a layer on top, integrating them all.

Hi Jef !

cofounders of radius, 12 years work experience, Amaze mobility - focus on standard contracts

Expert Interview: I invite you as an expert to talk about your experience about MaaS and your comments on the design.

Focus area

Incentivising green travel

How to use it

ROSE - Signifies an approval. What will work well related to incentivise green travel?
 THORN - Signifies a disagreement. What will not work well related to incentivise green travel?
 BUD - Signifies potential. What's something that should be developed related to incentivise green travel?

MaaS Research

How many leasing user do you have right now?
 Is there an increasing trend after the Covid19?
 Why are there so few MaaS users in the Netherlands?
 5000 users MaaS/After
 Not yet
 High price for city trip/limited number of service

User research

Attitude-Action Gap

What kind of feedback do you think can persuade drivers to use public transportation?

THORN - Signifies a disagreement. What will not work well related to incentivise green travel?
 BUD - Signifies potential. What's something that should be developed related to incentivise green travel?

Concept Evaluation

Do you think the driver will easily change their behavior because of this setting?
 Financial factor make change
 Promoting to company
 If taxes change and things like that financial changes, that will have the biggest effect on the on the user behavior, that's in my opinion.

Do you have similar measures to encourage users to use electric vehicles more? What's the effect?
 In the past, we did some CO2 compensation options and some CO2 calculations, you know, ultimately, customers in those days, they were not really interested in, to say for last compensation.

It's important to show the brand because once you are at the hub you need to find the exact location and you need to find the bike or the car, so it must be recognizable. Yeah, if you have three options, how do you find so it's a challenge. But this will come through time.

Because if I have given as an employee, I have given a car to an employee, then I don't expect him to come with costs, like a taxi, or a train, or things like that. Because I have already provided them with a car.

It becomes much more attractive to use your car rather than buy five tickets for one adult and four children

Company change

Price

And that is why that is the reason why electric vehicles were so popular in the Netherlands. Yeah, because electric vehicles, they didn't have to pay anything at all, before using it privately.

what is important as well is trying to find parking spaces where you have other modalities available

Carbon trading possibility

Do you think there will be a carbon trading market in the transportation sector in the future?

you can use credits in such a way that it becomes much more cheaper, both for yourselves as a car owner, or as a car user. I think that's that's a great idea. But it's not in the culture of the Dutch to have to do this.

Ecosystem map

Do you agree with this map?

a new government and their plans, they will introduce what is called a special on depending on the time of the day when you enter your car, so that's something new.

the employer also as an important player in the in the ecosystem. Yeah, the employee is a customer user and the employer may have from the top we saw your

in the Netherlands at this moment, insurance companies are not really involved.

Colophon

Student

Qiuyi Chen did her Master of Science in Strategic Product Design at the Delft University of Technology. This report is her graduation project for the Strategic Product Design master degree.

Academic Supervisors

Suzanne Hiemstra-van Mastrigt studied Industrial Design Engineering (BSc and MSc) at Delft University of Technology, with a specialisation in automotive design. She has performed her PhD research project at TU Delft, faculty of Industrial Design Engineering, on the topic of 'Comfortable passenger seats'. Currently she is the director of the Seamless Personal Mobility Lab.

Dr. Euiyoung Kim is Assistant Professor of Design for Dynamic Stability in the Design, Organisation, and Strategy (DOS) department and Chief Research of People in Transit (PiT) / Mobility at the Faculty of Industrial Design Engineering.

Project

This project was launched in cooperation with Things Protocols.

<https://delftdesignlabs.org/seamless-personal-mobility/>

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