The road towards a new urban mobility system

A strategic view on the future of Tiler

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TUDelft TILER

Colophon

Preface

A little more than six months ago, coincidence brought me to the company Tiler. After being approached by Tiler and discussing the assignment, I was excited to do my final master's project at an innovative start up and dive into the future of a complex topic like mobility. I have learned much about the mobility context, my skills as a strategic designer and got an impression of entrepreneurship.

Looking back on these past months I would like to thank the company and in particular my company mentor Joris for believing in me and supporting me along the way.
To my supervisors Jasper and Jeroen from the University, I am grateful to you for the many meetings in which you let me pick your brains, exchange ideas, and ask me critical questions. You provided the guidance that helped me go in the right direction, ask different questions, and think deeper for myself. It was a pleasure having you as a supervisory committee.
I also want to thank my friends and family for their support and kind words. Sharing struggles, design tips, and reminding each other that we can do this has been support I deeply appreciate. Special thanks to my boyfriend for always being there for me to listen to my progress and setbacks, chat about ideas and celebrate my achievements with me. To all the experts from various companies that I had the opportunity to talk to, thank you for sharing your perspectives with me.

A final word to all the employees of Tiler for making me feel welcome. I have witnessed your passion for micromobility and enjoyed the energising pingpong and pool breaks.

In this project I have pushed my own boundaries and learned much about my curiosity, resilience and attraction to tough challenges.

Happy reading!

Dmidejongh

Executive summary

The purpose of this graduation thesis is to design for Tiler's long-term strategy, based on research into mobility. As a hardware startup that produces a wireless charging solution for light electric vehicles, Tiler sought guidance on its next steps to grow into a thriving business in the future. The company finds itself in the tumultuous mobility industry, which changes fast as the world tries to decarbonise transport. The mobility transition requires collaboration between different stakeholders such as municipalities, mobility providers and other parties that help to enable the changes society wants to see. Forging a future of sustainable transport in cities results in boosts of innovation and regulatory responses as we try to define what we want urban mobility to be like.

After conducting in-depth research into the mobility context during the exploration phase, this project describes the design process of creating a dynamic roadmap for Tiler as a strategic tool for the future. This concept was crafted based on trend research, knowledge of the stakeholder system and technologies that could drive the product evolution. The designed roadmap distinguishes itself from the common format as it integrates the uncertainties of the mobility context through use of scenarios. To evaluate the content, the concept was tested with experts. To discover the value for Tiler, the concept was evaluated with the team in the form of a workshop. In this session, I facilitated a walk-through of the concept which triggered discussions about the impact of alternative future scenarios.

Based on this evaluation, the team has gained insights on which markets to approach, which stakeholders to manage closely and the importance of continuing the conversation about the company's future strategy on a weekly basis. The dynamic roadmap concept shows the potential to be adopted by the company. Furthermore, to extends its application, additional research and design activities could focus on making it suitable for other target groups and adding additional visual elements to bring the future to life even more.

(Midjourney,n.d)

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1 Introduction

In this first chapter, the topic of the graduation thesis will be introduced, who is involved, and how this project was approached. It also provides a brief description of the design process and how to navigate through this document. This master thesis is the result of a collaboration between me as the graduate, the Delft University of Technology, and hardware start-up Tiler, which develops a wireless charging solution for light electric vehicles. The second chapter will provide an internal analysis of the company and its position in the external environment.

1.1 Topic background: mobility in transition

Mobility is evolving continuously. Since the beginning of its time, the car has become a core part of our mobility system, giving people the feeling of freedom and independence (Steg, L., 2003). The impact of this vehicle has shaped our infrastructure, creating cities designed with cars in mind. It does not take a trained eye to observe that cars take up most of the space on our roads, are given priority to ensure traffic flow through cities, and will always have a parking place nearby (E. de Jong, personal communication, November 16, 2022). However, in the grand push towards a more sustainable planet, decarbonizing our transport system is considered a huge opportunity to bring down emissions (Ronan, 2018). This transition towards sustainable mobility is at the intersection of major topics and challenges. For example, the energy transition and the electrification of transport or continued urbanisation and how to keep cities liveable (Department of Economic and Social Affairs, UN, n.d.). For the latter, changing the urban mobility system and stepping away from petrol-puffing cars is seen as a potential solution for a diverse set of problems. Instead of using polluting and space-inefficient vehicles, there is a growing movement towards *"micromobility"*, which entails smaller, human-powered, or electric vehicles such as (cargo) bikes, scooters, and mopeds. Doing so combats air pollution, congestion and frees up public space for other purposes such as housing and other facilities (EYGM, 2020). As with any major societal shift, transitioning to a new urban mobility system will certainly bring unforeseen consequences and new challenges. Tiler wants to be part of this transition, acting as an enabler of electric micromobility such as e-bikes and other small vehicles by contributing to the charging infrastructure. Tiler foresees a world in which these vehicles can be charged using their wireless charging solution.

However, the plunge into this mobility transition means many developments are happening, with major uncertainties constantly pulling the system in different directions. As a young company wanting to conquer the world of micromobility, it is important to stay on top of this dynamic environment and identify the risks and opportunities. In this way, the company can make informed strategic decisions, adapting its strategy when necessary to solidify the future of Tiler.

1.2 Project context

This project was carried out at Tiler, which was founded in 2019 as Fesla Charge. Tiler now operates from within the YES!Delft Tech start-up incubator in Delft. With a core team consisting of business and technology expertise, the company has patented a wireless power transfer concept that was originated within the Delft University of Technology (TILER, n.d.). The hardware start-up was born out of the idea that charging electric vehicles with a wire is an outdated and vulnerable process, a realisation the co-founder had during his previous work on charging infrastructure

for electric cars (TILER, n.d). Roughly four years after its founding, Tiler has reached the stage at which they have a working product, the Tiler Uno, which can charge every e-bike wirelessly through the kickstand when parked on top of the matching tile. During the pilot projects the product has been put at different company locations and recently in a public setting in collaboration with shared mobility provider Bondi (Meerman, 2022).

With these first moves towards a growing and thriving business, Tiler is searching for its next steps. Up until now, they have operated in a narrow market to validate their product, lacking a holistic overview of their business environment, and not always being aligned on what information to promote. Among other topics, they wonder how their product will continue to add value in the future, what their business model should be in new markets, and what activities should be part of their value chain. Around Tiler are different stakeholders that could be important to monitor or stay close to as Tiler starts entering new territories. The locations where Tiler places its product determine who is involved. Placing it in public ground means new stakeholders enter the picture such as governing parties or shared mobility providers. These parties have different interests that Tiler needs to work with, such as safety or affordability. Expanding to the consumer market exposes the company to new user needs and wants, which also add complexity.

As the company has no dedicated research & development or strategy department yet, I used my skills gathered during the Strategic Product Design master's program to help Tiler with these challenges. I had the opportunity to speak to a few connections within the Tiler network and reached out to different organisations myself to further strengthen my outside-in perspective.

1.3 Project scope and purpose

This master thesis departed from the assignment to investigate the future of micromobility in urban environments, providing Tiler with insights that help them learn about potential opportunities, risks, and how they could respond. To narrow down the scope, I decided to start with the Dutch context, looking at a timeframe towards the year 2030. Choosing a period of roughly ten years leaves enough room to include a broad range of developments without being overly speculative for the company to act on (B.Govers, J.Langhout personal communication, October 2022). As Tiler develops products for light electric vehicles, from now on referred to as LEVs, the focus will be on this product category within micromobility. Although the Dutch context was the starting point, I considered the global context where relevant. The purpose of this project is:

"To design for the long-term strategic position of Tiler based on research into the future of urban mobility"

1.4 Project Approach

As a guiding framework for the design process, I was inspired by the systemic design framework (Design Council, 2021), which builds on the double diamond process (Design Council, 2004). Besides that, I used a scenario-based approach that I combined with road mapping. In a complex domain like mobility, my goal was to understand the interrelatedness of the elements in the system, learn about which factors are pushing and pulling the system to change, and what the results mean for how this system develops into the future. The purpose of using this combined approach was to achieve a design that would fit better with the dynamic nature of a shift like the mobility transition.

1.5 Process & Reading guide

1.5.1 The design process
As a guiding framework for the design process of this project, I chose to work with the systemic design framework. I started with an exploration phase, which I used to get to know the company, research the mobility domain, and speak to external stakeholders. The findings that arose from this were narrowed down and synthesised to reframe the problem and produce the design brief. This design brief marked the transition to the creation phase in which I designed a concept and evaluated it externally and internally. This evaluation process was the first step in catalysing change for the company's long-term strategy. Figure 1 displays an overview of the design process and its main activities. Doing interviews with different external stakeholders demanded me to be flexible and manage different parties and processes simultaneously. During the exploration phase, I formed a context view using parts of the vision in product design method, SWOT analysis framework, and 4C analysis (van Boeijen et al., 2020). For concept creation, I used Figma and Miro to develop the digital prototype and an offline cardboard version.
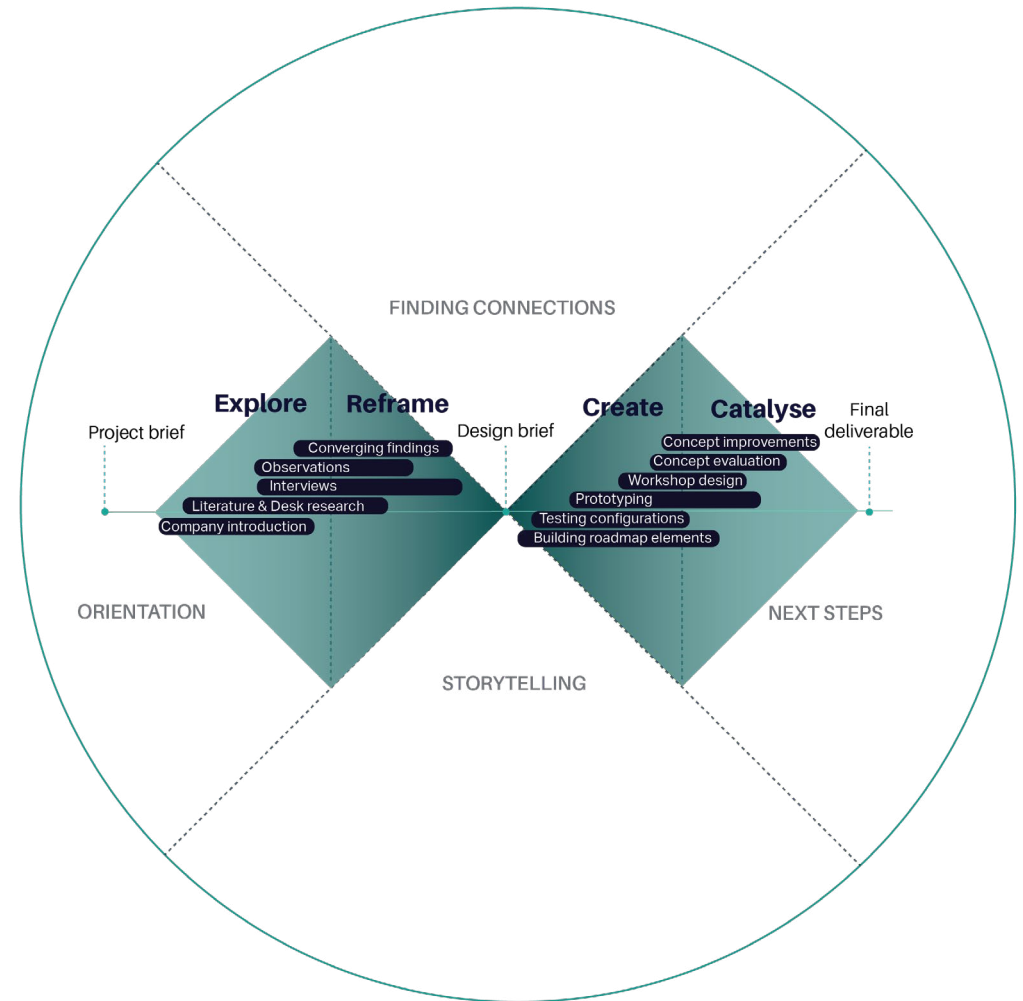
Figure 1: Approach

1.5.2 Reading guide

This report brings together all the activities and findings of my design process in four parts. As certain topics may interest different stakeholders, this reading guide shows which chapters I expect are most interesting to start ups, municipalities or other regulatory parties, designers, and other mobility related companies.

Please see Figure 2 for an overview of the content of each chapter and recommendation per stakeholder type.

Start ups

Municipalities

Designers

Companies in mobility

Chapter 2: Internal analysis
Strategic position company & product analysis

Chapter 4: Design brief
Problem reframing into design goal

Chapter 6: Concept
Future visualisations & Design additions

Chapter 8: Concept improvement
Future visualisations & Design additions

Chapter 3: External analysis
Mobility trend research

Chapter 5: Developing the roadmap
Designing a dynamic roadmap

Chapter 7: Concept evaluation
External expert interviews & internal workshop evaluation

Chapter 9: Conclusion
Implications & Recommendations

Figure 2: Chapter overview with reading guide (Flaticon,n.d)

Part I *Explore*

2 Internal analysis: Tiler

In the previous chapter, the project, topic background and structure of this thesis was introduced. At the centre of this project is the company Tiler, which will be discussed in this internal analysis chapter. I will go into how it started, what Tiler does and who they want to sell their product to. I performed a SWOT analysis to address the strengths, weaknesses, opportunities, and threats of Tiler and provide an overview of the company's strategic position and partial 4C analysis, supported by insights retrieved during weekly meetings. This information contributed to how I conducted my research into mobility as it guided me in determining which parts of the mobility topic were most relevant.

2.1 The Company

With their wireless charging solution, Tiler wants to contribute to the greater good, encouraging people to choose more space-efficient, clean transport over the private car in cites. Today, the company's mission (Tiler,n.d) is:

"To create liveable cities, where cars are no longer the centre, people and nature are. And micromobility is so easy it's irresistible."

Figure 3 shows the core team composition and their titles. The first three are placed next to each other as the business developer works closely with the CEO on client management. The CEO and COO have the most professional experience. The CTO seems to form the bridge with the engineering part of the team as he brings together knowledge from a technical background and previous employment at a successful mobility start-up that was acquired by a bigger company.

The team has recently expanded with a firmware engineer and multiple interns who are working on the prototypes for cargo bikes and mopeds. Two new software interns have also joined the team. Additionally, there is a group of students working on the business model for product placement in hubs. The company is eager to make its product compatible with new vehicles, especially since they already communicate this to stakeholders around them.

These additions display the company's focus on the product, searching to expand to other vehicles and add digital features.
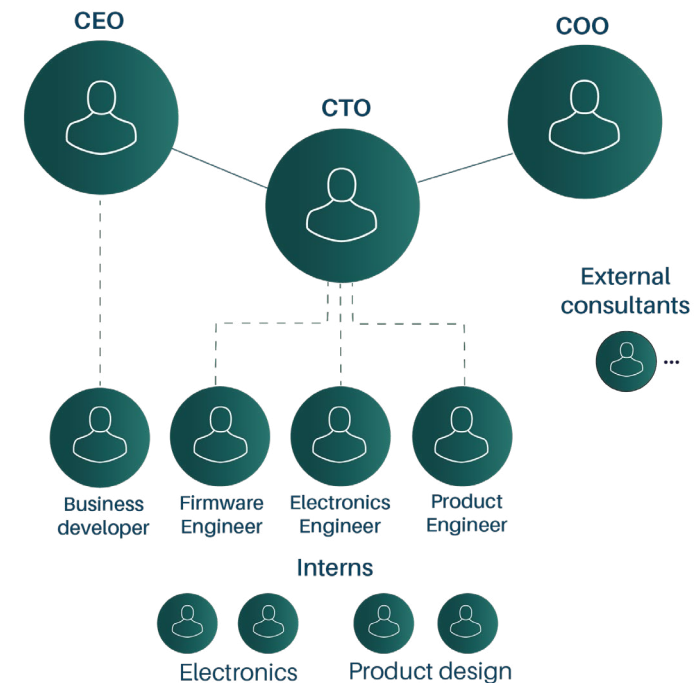
Figure 3: Company composition

2.2 The Tiler Uno

2.2.1 The product: How it works

The current Tiler product combines parking and charging, aiming to simplify and smoothen the charging procedure. The product consists of a special tile and kickstand (top and middle Figure 4). Parking the kickstand on the tile activates the magnetic field necessary to start the charging process (bottom Figure 4).

Unlike wireless smartphone chargers that work using two flat coils that need to be placed precisely on top of each other (Shenoy, A., 2020) this technology contains a U-shaped coil that creates a different magnetic field. This means the battery will start charging even if the coils are not exactly aligned.

Since the beginning, the team has been optimizing the design of the Tiler Uno system resulting in a relatively compact kickstand and minimalistic looking grey tile. The first version of the product was designed for a double kickstand and much bulkier due to the size of the product components. The tile can be embedded in-ground and connected to the power grid or placed in a plug-and-play platform. The special kickstand replaces the regular kickstand of the e-bike and must be connected to its battery using a connector wire for which the battery compartment needs to be opened. To be compatible with all types of e-bikes and their batteries the engineers have worked with different bikes to ensure the product works properly. Through programming, the system can regulate the speed at which the battery is charged and shut down if needed. This smart charging feature benefits both the battery life and reduces the risk of overheating the battery. Compared to the conventional method to charge e-bikes, for which users can simply detach their battery and carry it inside to charge, using the Tiler solution means the battery can stay in place. This decreases the opportunities at which people could drop and damage it, which is detrimental to such batteries. However, it is important to note that batteries are still valuable components that get stolen a lot, which means
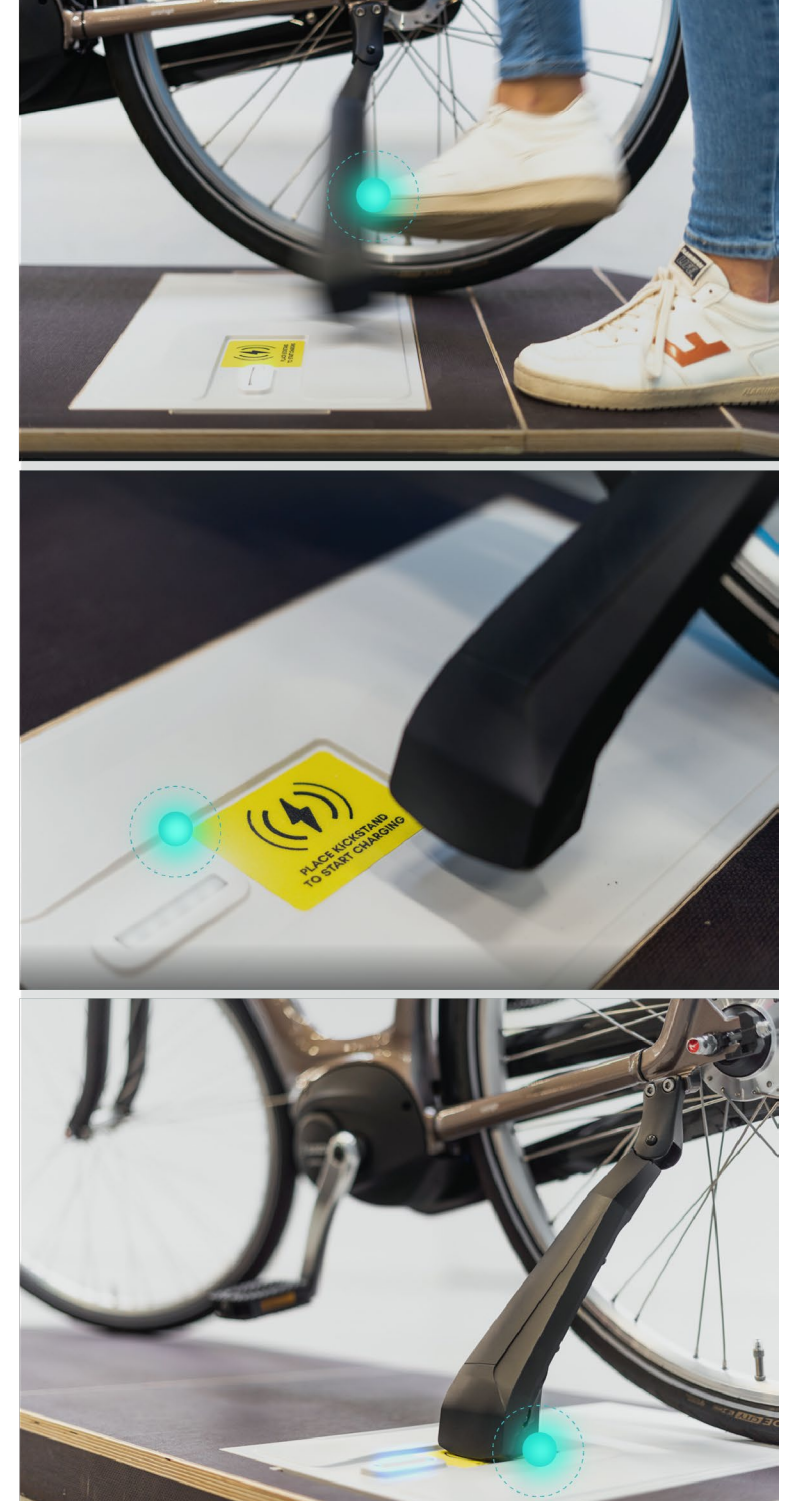
Figure 4: The Tiler Uno system

users tend to detach the battery to charge it elsewhere anyway. In terms of efficiency, Tiler's method of inductive charging is just as efficient as plugged charging according to the company (Tiler,n.d).

2.2.2 The interaction: how is it used

When the bike is equipped with the special kickstand connected to its battery and the tile is placed in-ground or on a platform, the product is ready to be used. Figure 5 shows the interaction with the product starting from the moment a user approaches it. Once a user gets off the bike, they can approach the tile and position it to be able to place the kickstand on the conductive part of the tile. This area is marked with an eye-catching yellow sticker, indicator light next to it, and visual guidance to it due to the visible lines on the embodiment design (Figure 4 middle picture). At this point, Tiler's role is mainly to offer the right use cues for the product, so they can offer an experience that can become just as easy and automatic as plugging in the regular charger. As a bike is usually not heavy, the user can move it around to line it out correctly. If the kickstand is placed successfully, the indicator light will change colour to show the charging process has started. This will also appear on the indicator screen of the bike itself on the steering wheel. In this moment, the Tiler system must offer sufficient feedback to users to ensure users will perform the action correctly and knows what to do when it does not function right away. This supporting role is extra important in case the system does not give any response, in which the user will look to Tiler for troubleshooting help.
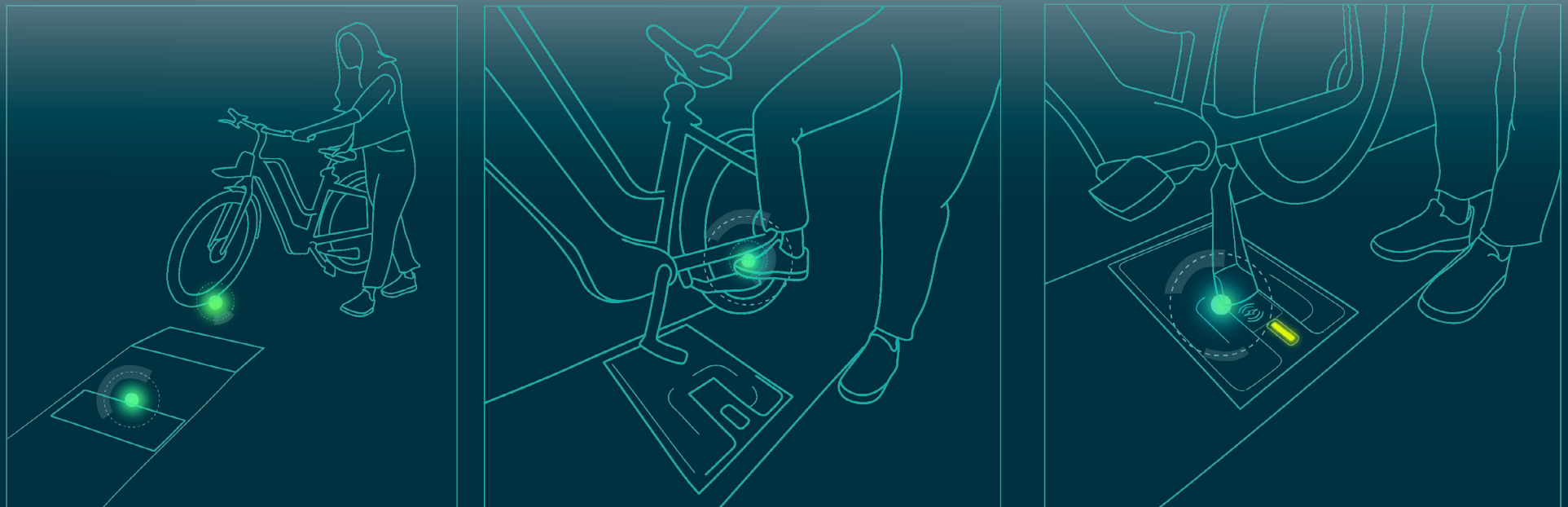
Figure 5: User interaction

2.3 SWOT Analysis of the organisation and product

2.3.1 The organisation
The small size of the core team puts more pressure on each member, which could weaken the ability to do the work the employee is expected to perform. For example, the product engineer is also concerned with developing comprehensive meeting report templates or assessing the visual style of important documents. The business developer is not only managing clients but also marketing and communication, and she will also be called if clients experience trouble with their system. Moreover, the degree of collaboration with external consultants and occasional delays that occurred could also pose a risk if relied on too much.

On the other hand, a company strength seems to be building strong relationships with clients and being there for them. During the weekly meetings, I observed that the organization displays little hierarchy, resulting in open communication among the members, allowing for everyone to voice their opinion. Next to that they are clearly passionate about the product and its superiority compared to other charging solutions.

An opportunity for the company lies in the expansion to other light electric vehicles. With the growing popularity of shared mobility, this could be a big market for them, especially because keeping batteries charged is an operational challenge. A threat that comes with publicly shared vehicles available is seasonality. While Dutch people are known to be all-weather cyclists, ridership changes with the seasons, showing lower usage during winter months as Figure 6 displays (Zoba, 2019). This could be due to consumer preferences which impact the earnings of the provide (Joyride, 2022). In addition to that, batteries are sensitive to changing weather circumstances, risking irreversible damage and fire hazards (Stibat, 2021).
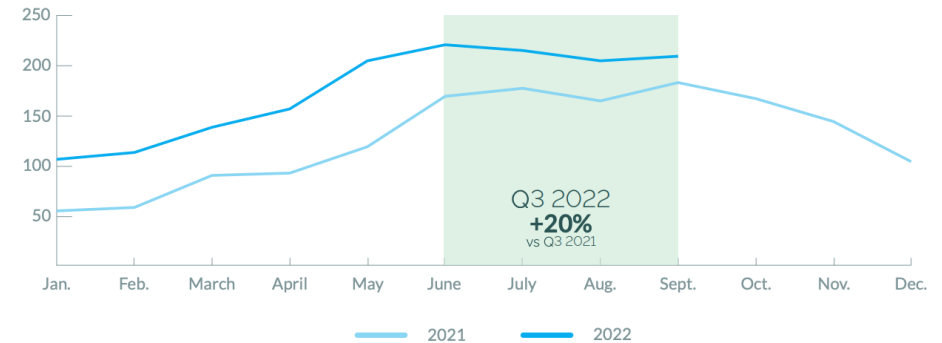
Figure 6: Ridership throughout the year

This issue with batteries is tied to Tiler's product, for which batteries do not have to be removed from the vehicles, exposing them to these weather conditions. Therefore, a threat to Tiler is the development of batteries and whether these will be more weather resistant in the future or better protected inside the vehicle itself. Batteries are literally a hot topic, as they have caused devastating fires, even pushing the New York fire department to ask the American government to investigate banning universal chargers and strengthening regulations for these devices (FDNY [@FDNY], 2023). Regulations in general could be a large threat, as the government's decisions impact Tiler's business. This will be discussed in more detail in the next chapter.

2.3.2 The product
When looking at threats from the competitive landscape it is important to define which market Tiler is in. Broadly speaking, Tiler produces a charging solution for light electric vehicles, placing it in the same category as a wide range of existing options that include wires or physically bigger designs. These include special parking stations such as the station by Bikeep that has a compartment to plug in one's own charger or Duckt
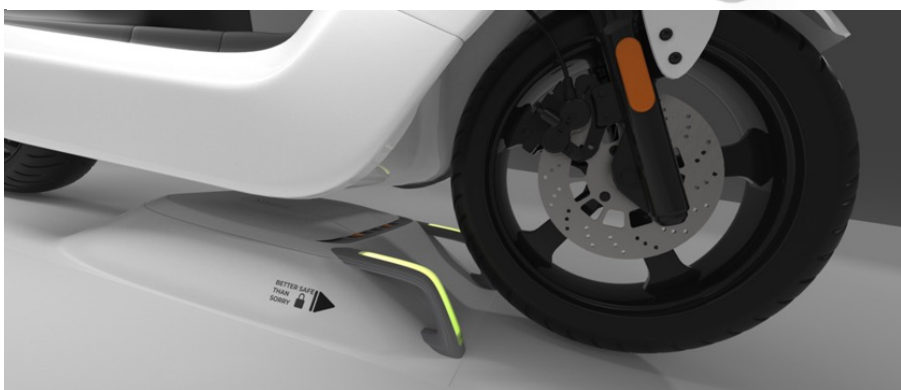
Figure 7: Examples of other charging solutions (Acton, 2023; Bikeep, 2023, Swell Electrics, n.d)

station for shared mobility visible in Figure 7 (Top two pictures). Defining the market as a wireless charging solution for LEVs, brings in one competitor that has a very similar product, Swell Electric. This company has worked together with moped manufacturer NIU to develop a charging tile for the mopeds and is looking to expand to cargo bikes and presumably a car-like vehicle as listed on their website (Swell Electric, n.d.). Unlike Tiler, their solution does include a component that allows the user to attach a lock to (Bottom Figure 7) .

The option to lock the vehicle currently clashes with Tiler's product quality of blending in with its surroundings but appears to be important to consumers. E-bikes and other electric micromobility vehicles are still interesting for theft (RTL Nieuws, 2022). Besides the fact that vehicle owners bring their batteries inside to attach them to their charger, it seems like most e-bikes will continue to have a detachable battery in the future (12goBiking, personal communication, October 25, 2022) making it likely people will continue to take it along to charge it elsewhere, for which the Tiler solution is not designed. The lack of a physical locking element can also be an opportunity for Tiler to further develop the design of their system and create an add-on to the space where the product is placed. Next to that, the benefit of prolonging the battery life and decreasing the risk of overheating is an important concern Tiler's product removes. It could be one of the most important strengths of the product to promote. Other strong points of the product concern its interaction. The action of parking the e-bike is familiar and easy to perform as users can move the bike forward and backward and observe how the kickstand aligns. This parking action is more complicated for other LEVs, such as mopeds. The steering wheel of a moped has limited movement and the vehicle itself is quite heavy and wide. This makes it harder to reposition the vehicle for correct kickstand placement.

For mobility providers, the Tiler product could simplify their charging operation, eliminating the need to drive around

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with spare batteries to exchange empty ones. However, the moving part of the Tiler system still presents a vulnerability as well as the water tightness of the product. Also, if installed in the public space, the product might blend so well that people place regular bikes or other items on it, blocking the charger for its actual users. Moreover, if it does not stand out enough, users might overlook it altogether. Lastly, as underlined by the NY fire department example, the universal character could be a potential weakness, also because the vehicle needs to have the special Tiler kickstand.

2.4 Corporate sharing: Tiler's entry market

With a working product for e-bikes, the company started targeting a market in which they identified a clear need. In the market they defined as "corporate sharing", Tiler has observed the struggle of fleet providers to keep their vehicles charged and available for use. In contrast to charging one's own bike vehicles shared among employees do not have one owner, meaning there is no inherent feeling of responsibility that encourages people to keep the bike charged. If one employee uses and parks it, there is no natural incentive for them to ensure it is available for the next user. Thus, installing the Tiler system that makes charging part of the parking process, means these clients no longer had to worry about this. Since the early days of the company, the product has been piloted at several locations. The first pilot tests were done at the event location Ahoy Rotterdam (Mobility Lab, 2022) and an NH Hotel (Tilercharge, n.d.) that provided e-bikes for their guests which were owned by Rent-a-bike van Dam. At this hotel, guests could indicate they wanted to rent a bike, after which the rental company had to come to the hotel to drop off the bikes the next morning and pick them up after use. Using Tiler systems meant the bikes could be parked and charged at

the hotel without necessary back-and-forth trips by the rental company, saving time and costs. Tiler's current fleet provider clients can be divided into two groups for which mobility is the core of their business or an additional service. The following sections discuss which clients exist within each segment.

2.4.1 Mobility as core: Rental & Shared mobility
Examples of this client type include a bike rental company or shared mobility provider which are businesses that have mobility as their core offering. Only vehicles that are used bring in money, making this an important priority for them. A self-sufficient charging operation can appeal to them as it makes them less dependent on employees to do the job, which could save costs. However, because mobility is their core, this client needs a solution they can rely on. Tiler can help to reduce operational hurdles and maximise use-time.

2.4.2 Mobility as an additional service: Hotel, Company X
This client type offers mobility as an extra to internal or external end users. In the case of the NH hotel, a bike service adds to their image as they can provide extra value to their customers. However, as mobility is not their core business, they are not necessarily equipped to deal with the operational conditions of providing e-bikes. Charging batteries behind the reception counter with intertwined wires is an example of a risky and improvised solution that makes it difficult for such companies to supply this service without too much trouble. Another client type in this group is any company that provides vehicles for its employees to share. Using a charging solution such as Tiler takes this effort out of the hands of the employees without asking too much from the customers. In this case, the vehicles can present an alternative to using other transport to go to meetings or as a last-mile solution for commuting. The company providing the vehicles can encourage this behaviour by making sure the vehicles are visible, ready, and easy to use.

2.5 Future target markets

2.5.1 Shared mobility
After starting out in a narrow market, Tiler is already moving towards the public sharing market. This is where clients such as Mobian and Bondi come in. The Park & Ride hub and shared e-bike company are the first clients through which the product becomes available to a larger audience. In October 2022, the first set of four tiles was put into public ground next to Arnhem station at an e-hub where Bondi bikes are available (BNR Nieuwsradio, 2022) Bondi is one of the many mobility providers who have put fleets of e-bikes across different cities.

This popular and growing market is a large territory that Tiler can enter with its product for e-bikes and for other vehicles in the future. Shared mobility providers currently use different solutions to keep their vehicles charged, including battery-swapping operations which will be discussed in the next chapter. The vehicles are owned by the providers and not the end users, taking care of everything so users always have a vehicle ready to go. In this situation, sufficient battery levels and a proper parking location do not interest users as they are usually not the next driver.

Selling the Tiler system to the shared mobility market provides the opportunity to scale up into a large business-to-business-to-consumer market and gather usage data from versatile end users. This input can then be used to develop or improve the product to be made suitable for the consumer market.

2.5.2 Consumer market
Equipped with learning from the shared mobility market, Tiler can set foot in business-to-consumer territory. As of now, the Tiler Uno system does not seem suitable for consumers yet as it is relatively expensive and not solving an urgent need. Private e-bike owners have an incentive to keep their vehicle charged

and take care of the battery. In its current form, the consumer would need quite some space to install the product as well. An interesting option could be to sell the kickstand separately and provide the possibility to access public charging tiles.

2.6 Tiler's stakeholder environment

2.6.1 Closed system
For its first target market, Tiler has had a relatively simple stakeholder situation that enabled them to sell and install their product fast. This "closed system" meant they had to make agreements with the fleet provider and install the product on private property. To start up the business, this stakeholder system was easy and quick to manage, ensuring a quick acquisition process.

2.6.2 Semi-open system
In the shared mobility market, the stakeholder environment opens up, becoming more complex as governing parties such as the municipality or province control the public space. On a bigger level, nationwide rules by the Dutch government could apply, or even the European Union.

Furthermore, there are parties such as the RDW (Dutch Vehicle Authority) or the cyclists' association who share an interest in the vehicles themselves and the conditions of use. The RDW can decide on which vehicles are permitted on Dutch roads and cyclists' association can influence the design of the infrastructure that goes with them. These parties can impact the success of shared mobility which is illustrated by the fact that the RDW is still not permitting the use of e-scooters (RDW, n.d.) a small vehicle that is popular in other countries. This results in less favourable conditions for companies who provide e-scooters and underlines the importance of being aware of such developments as it impacts who Tiler can sell their product to. Another stakeholder

that enters the system is insurance companies. As observed during a visit to a Check location (January 17, 2023) the insurance can set strict requirements for the charging operation. In this specific case, this included the decision to charge batteries outside the office building, stored in shipping containers that had to be placed at a fixed distance. This shows how a seemingly distant stakeholder can have a direct impact on how a mobility provider uses its company space for their charging operations. Though Tiler is selling its product from business to business, the shared mobility vehicles that fill our cities are used by many different consumers who would be the ones interacting with the Tiler system as well. Because shared micromobility is still in its early years, this group is expanding. Today, shared mobility is mostly used by young singles or couples who do not have children (AM, n.d.).

Installing Tiler's product in the public space presents the company with a more complex stakeholder environment. The most important stakeholders for Tiler that can be identified are governments, end users, and mobility providers (M. Isbouts, personal communication, November 16, 2022).

2.6.3 Open system

Once Tiler has entered the shared mobility market, the product will get more exposure as everyone could encounter the product in the public space. Around this time as a Tiler network has started forming, the company can consider appealing to the most open and diverse group, the consumer market. For business-to-consumer sales, Tiler can investigate what user needs it wants to focus on such as affordability, ease of use, or aesthetics. Then, the company can target different consumer segments and expand this group gradually if there is sufficient demand.

2.7 Ecosystem

Looking closer, the different stakeholders and entities involved in the current and future markets form an interconnected ecosystem. Figure 8 shows the elements in this system and the relations between them.

This Figure shows that there are many parties involved in the public space that form different relationships with each other. I connected them to each other in a way that reflects how I perceive the current situation. The missing connections could be places where Tiler can seek partnerships or build relationships to get more direct access of that serves the company. For example, it seems that municipalities and shared mobility providers have a natural way of finding each other as providers must apply to tenders to earn the right to place their vehicles in a city. For Tiler, as LEV charging infrastructure is a new phenomenon, this link is not there yet. Also, if Tiler manages to enter the chain early on by working with bike or battery manufacturer's, their solution could potentially become part of the entire system from the start.

Figure 8: Ecosystem map

Conclusion

This chapter has provided a summary of what the company does, its current position, and the stakeholder system they are part of. Different aspects were visited through the use of different tools such as SWOT and 4C. In short, this analysis shows that the company can serve different markets creating an increasingly complex stakeholder situation. This system will require Tiler to closely manage multiple relationships. The team is focused on expanding the application and features of the product. Besides that, a lot is happening in the context around Tiler.

The next chapter explores the mobility domain to create a broad overview of the important trends and developments happening now and in the future.

3 External analysis: Researching mobility

Tiler is a new player in mobility. This multi-billion industry knows many developments and dynamics that can be impactful to Tiler's current activities and long-term future. To find out what is happening around the company, I conducted research into the mobility topic. This analysis was exploratory at first to create a broad understanding of the topic after which I started to become more selective by distinguishing between nice-to-know and need-to-know information. As it is a complex topic, I find it valuable to develop knowledge on different levels, to understand the situation up close, and know how different developments are connected to each other and what their consequences are. This chapter aims to capture today's and tomorrow's mobility situation by presenting findings from desk research, stakeholder interviews, and observations relevant to the problem space. These findings will be used as input to create the design brief that will be detailed next.
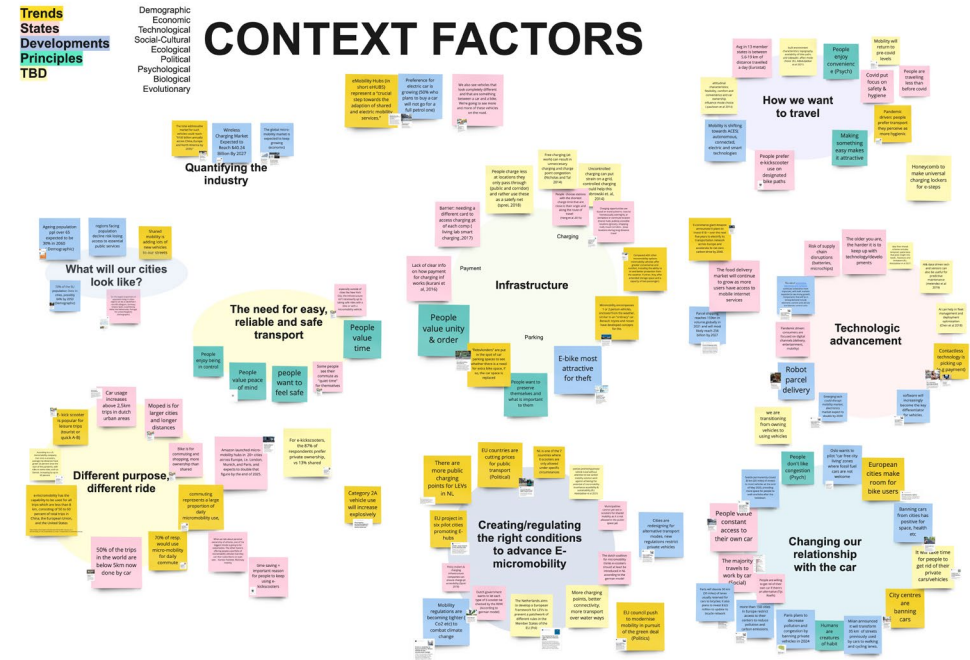
3.1 Research approach

3.1.1 Desk research

At the start of the discovery phase, I explored existing literature and media through desk research. Collecting information from versatile sources such as scientific literature, consultancy reports, news articles, mobility podcasts and newsletters helped to stay up to date on the latest mobility news. Search terms I used included sustainable urban shared micromobility, mobility trends, sustainable & smart cities, electric vehicle charging infrastructure, travel behaviour, and many more. As supporting tools, I used part of the Vision in Product Design method to classify the information I found into trends developments, states and principles. Besides this method I also clustered and connect findings to make sense of the information. Figure 9 gives an impression of how I documented my research.
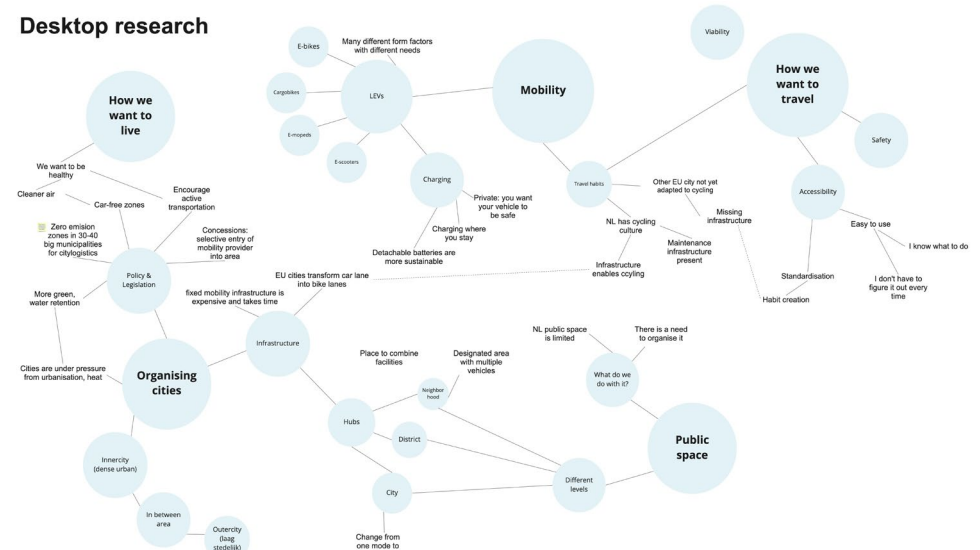
Figure 9: Desk research impression using different methods

3.1.2 Stakeholder interviews & observations

Another way to collect qualitative information was from the stakeholders around Tiler. I conducted multiple semi-structured interviews with different members of the Municipality of Amsterdam, independent consultancy firms Goudappel and Mobycon, the Seamless Personal Mobility Lab of the Delft University of Technology, PostNL, GreenMo and mobility providers Felyx and Bolt. In these conversations I deepened my understanding of each stakeholder's perspective, asking them about what challenges they face, how they respond, what their thoughts are about developments. I had basic questions prepared which I adjusted for each interview based on short background research I did on the person before the interview. This background research consisted of looking people up online and finding details about them that could be relevant during the interview. Several interview guides can be viewed in Appendix A. Besides that, I consciously paid attention to everyday micromobility, observing the use of shared transport and people interacting with these services. A field visit to the company terrain of Check mobility also provided the opportunity to observe charging operations from up close and ask their employees about it.

3.2 What is micromobility?

The term micromobility is relatively new with no agreed upon definition yet. Horace Dediu, who is a prominent advocate for micromobility, reportedly first used the term during the first micromobility summit in 2017. Since then, the term has evolved from *"roofless short distance urban transport"* to *"personal transportation using any vehicles whose gross weight is less than 500 kg"* (Reid, n.d.).

Other definitions define it according to the distance it is used for, vehicle speed, most efficient way to transport a person, or whether it is electric (Arval,n.d; ITDP, n.d.) Next to that, the Mckinsey mobility centre has added another term, mini mobility which they use to describe three or four-wheeled vehicles that offer more convenience in the form of weather protection and storage space (A. Grausam et al., n.d.).

For this project, "micromobility" **entails all electric and human-powered vehicles with a maximum of three wheels.**

Figure 10: Micromobility vehicles

This definition is used because the vehicle mix that excludes cars fits better with the likely future urban situation where the car has a different purpose and space is used differently. It purposely includes human-powered bicycles as this form of transport is both non-polluting, space efficient, and healthy for its users making it a desirable option in a human-centred mobility system. Because the term micromobility is still developing and innovation continues to produce new types of vehicles (See Figure 10), this definition will likely continue to change. Throughout this thesis, different terms are used to refer to subcategories within micromobility. The most used and important one is the category of light electric vehicles (LEVs).

3.3 The present mobility context

3.3.1 Cities need to change
Over the coming years, the population in cities will grow, putting pressure on urban areas to remain or become pleasant places to live in (Urbanization Causes and Impacts | National Geographic, n.d.) (Urbanization: Expanding Opportunities, but Deeper Divides | UN DESA | United Nations Department of Economic and Social Affairs, n.d.). Though the pace and level of urbanization differ between high- and low-income countries, all regions show the continuing shift of people to urban areas. (DESA, UN, 2020). The impact of this development results in the need to rethink how public space is used. More citizens increase the need for more housing and adequate access to facilities. Aside from that, cities need green spaces for recreation, and water storage, to help cool down (Stuiver, 2014). Green spaces also help to combat air pollution, a health concern that impacts everyone and increases the chance of developing respiratory or cardiovascular illnesses. One of the contributors to this ambient air pollution is transport through the gasses released by burning fuel (WHO, 2022). Congested roads during rush hours provide an additional reason why resistance against cars in cities is growing on multiple levels. This is underlined by the fact that global car occupancy is estimated at 1.5 passengers per car (Wolfram et al.,

2021), making it a space-inefficient vehicle compared to public transport or micromobility vehicles.

3.3.2 The rise of alternative and shared transport
Regardless of their size or power source, cars offer a comfortable and private space. These characteristics make it hard to imagine urban environments without cars in the near future, because cars appeal to important travel needs such as safety, reliability, and convenience (Mobiliteit En Gedrag - CROW, n.d.).
However, the trend of the sharing economy that entails granting others access to under-utilised assets to improve efficiency and sustainability (Frenken & Schor, 2017) (What Exactly Is the Sharing Economy? | World Economic Forum, n.d.) creates a promising opportunity with the growing popularity of micromobility vehicles. Over the past years shared micromobility services have grown rapidly, ranging from vehicles that can be taken from and returned to docking stations, to free-floating vehicles that can be found scattered across a particular area. Nowadays, people can choose from a variety of vehicles such as e-scooters, (e)-bikes, e-mopeds, and others depending on the purpose and length of their trip. Which demand exists for which vehicles involves other factors such as user socio-demographics, built environment, geography, and weather (Reck et al., 2021).
No matter the purpose or motivation, innovation in this new vehicle category remains in full swing. Figure 10 displays how vehicle types are mixing. Companies search for ways to provide a comfortable vehicle that looks good and preferably does not need to adhere to vehicle-specific rules such as helmets (Kraniotis, 2021). Car makers have also joined the micromobility market with new vehicles (Polestar, n.d; Dow, 2023).

3.3.3 Vehicle regulations
Another factor that influences the micromobility mix is regulations. For example, in the Netherlands, e-scooters are still not permitted as the Dutch government wants to develop clear regulations on this new category of light electric vehicles

first (RDW, n.d.). In other European countries and across the globe, brands like Bird, Tier, Bolt, and even Dutch-founded Dott provide e-scooters rides to thousands of users (Heath, 2022). The European Mobility Index shows the popularity of this compact and light transport mode as it accounts for 43% of the 100 million shared trips across the 33 cities between June and September last year. (Fluctuo, 2022).

Furthermore, this year, a new Dutch law for e-mopeds went into effect, requiring all users and their passengers to wear a helmet (Ministerie van Infrastructuur en Waterstaat, 2022). The impact on the use of shared mopeds is still hard to determine, but it does affect the choices consumers make. It appears that since people must wear a helmet for a speed of 25 km/h, they would rather use a faster vehicle or one that does not require them to wear a helmet, such as an e-bike or fat bike. "Fat bikes" are vehicles (Figure 10, third in the bottom row) that resemble both a motorbike and regular bike without the legal obligation of a helmet or driver's license as the top speed is 25 km/h. A problem with these bikes is that it only takes a quick online tutorial to modify the vehicle, illegally increasing the speed to 45 km/h (VVN, 2023). This is an easy way in which people try to omit the helmet requirement and travel faster. The Dutch cyclists' association and Veilig Verkeer Nederland want to stop this, highlighting how vehicle manufacturers are taking advantage of lacking legislation by making it easy to tweak the vehicles (Kraniotis, 2021).

3.3.4 The pains and gains of free-floating

Now that shared mobility has been around for several years, its first effects start to show. The free-floating model ensures flexibility and convenience where users can find vehicles close to them and end their ride everywhere within the service area. This also impacts the accessibility of outer urban areas as people can bring the vehicles back and forth themselves, making them less dependent on the available public transport, if they can afford it. The downsides of the free-floating model include mopeds being left anywhere, blocking sidewalks, being thrown

in ditches, or being left on parking spots for the disabled (Radar, 2022). The Dutch government wants new rules to improve control of the shared mopeds, limiting the service area or number of vehicles that are allowed (Nieuwenhuis, 2022). Another missed opportunity and disadvantage is the fact that these services have been designed without including the needs of disabled people, overlooking a group for whom accessibility is already a big challenge (Goralzik et al., 2022).

3.3.5 Charging operation challenges

An operational challenge of shared LEVs lies in keeping the vehicles charged and ready to go. Today, mobility providers use battery swappers and battery stations to provide a full battery fast. An example of the latter is provided by the company Swobbee, which has set up a network of battery stations where new batteries can be taken from a locker (See figure 11). This "charging-as-a-service" solution is available for logistics, delivery, and sharing purposes and puts the action of swapping in the hands of the vehicle user (Swobbee, n.d.).

Figure 11: Swobbee battery locker (Swobbee, n.d)

Battery swappers are employees dedicated to swapping batteries for the user. Mobility providers such as Check and Felyx have employees driving around in small vans to swap partially depleted batteries for new ones. With a legally permitted amount of 30 batteries per car (K, personal communication, January 17, 2023), the employees must locate the free-floating vehicles, drive to each one of them and perform the battery swap. The batteries are stacked on top of each other in the trunk where a 3D-printed component keeps them from touching each other. In addition to this, not every vehicle is easy to reach by car as they are parked everywhere. On the company terrain of Check itself, the battery swap operation extended to the shipping containers placed on the property. In these containers, there were shelves filled with batteries, accompanied by an air conditioning unit to regulate the temperature. These containers were placed a specific number of meters apart from each other and equipped with special gaps to use for extinguishing battery fires. Check did this due to the demands of the insurance company they worked with. The safety precautions taken in these containers for storing and charging appear to be much stricter than the swapping operation, which seems more improvised, potentially less safe, and therefore not ideal.

For large fleets ,battery swapping is the option that does the job, but this is different for smaller fleets. For a takeaway restaurant with electric delivery bikes, the charging happens inside, putting the batteries in a firebox attached to the cable charger. Unlike mobility providers, these bikes must be parked on the street like privately owned bikes. This means the only option is to park the bikes inside after opening hours to protect them against vandalism and theft (D. Dalfsen, personal communication, January 12, 2023).

3.4 The fickle future: tomorrow's urban mobility system

3.4.1 The X-curve: Symptoms of transition

As mentioned before, mobility is in transition. More usage of public transport and micromobility can help to bring down emissions and free up space in cities previously reserved for private cars. A transition is a non-linear shift often used to describe large changes, including societal shifts such as the mobility transition. In general, a transition contains a movement where an established system is deconstructed, and a new system emerges. Disruptive changes coincide in the middle, creating a chaotic situation. As Loorbach et. al describes it (2017, p. 7): "a transition is the result of an interplay of a variety of changes at different levels and in different domains that somehow interact and reinforce each other to produce a fundamental qualitative change in a societal system". Figure 12 displays a representation of the two general transition movements, called an X-curve. It is difficult to pinpoint where we are in the mobility transition, but the speed of developments, new innovations, and lack of a steady way forward gives the impression of chaos. Transitions can take decades, reaching a new stable state through a series of disruptive changes. After analysing the present mobility context, this section will discuss the fickle future, going along multiple changes that are happening now.
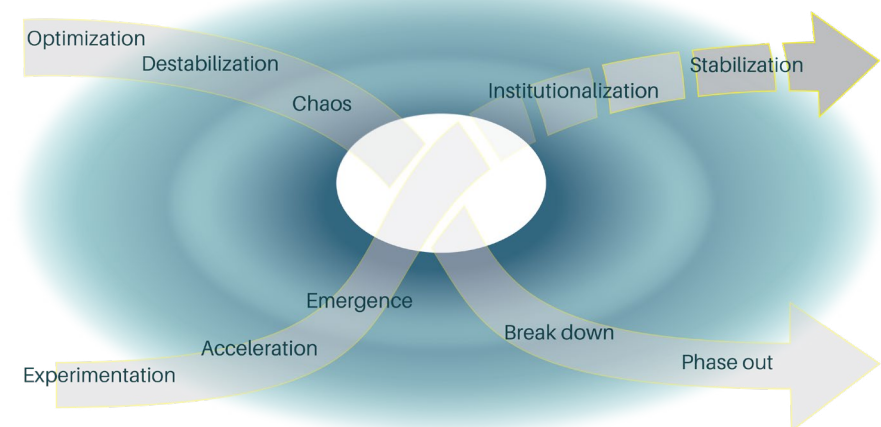
Figure 12: X-curve (based on Loorbach et. al, 2017)

3.4.2 Change happening now

In this transition, we witness the deconstruction of the old system as elements of possible futures emerge. Change is taking place at different levels, pulling the future of sustainable transport a little closer. Looking at the business, technology, society, and human level, multiple changes can be observed.

Society: Governance

"We need to figure out what we want our mobility system to look like and then start to fund it"

- G. Klein at Micromobility World 2023 (Former DC & Chicago commisioner of Transport)

As an authority, municipalities and other governing parties have the power to provide guidance to its citizens in times of change. On an individual level, the idea of transport within walking distance sounds attractive. Nevertheless, the collective resistance society has against e-mopeds blocking sidewalks or being treated badly shows the tension between individual and collective needs. Governing parties have started taking responsibility in urban mobility. An example of this is the shift away from free-floating vehicles, toward designated parking spots. Felyx, a Dutch e-moped provider recently announced try-outs with "parking hubs" in collaboration with the municipality of Amsterdam (felyx (@ridefelyx) / Twitter, 2023). The idea of such "hubs", or mobility hubs as they are often referred to is gaining popularity. This too is a term that is defined in different ways. Combining the recurring elements of these definitions,

this thesis defines a hub as a publicly accessible location that brings together different travel options (walking, biking, public transit, and shared mobility), catering to a user's individual needs.

Organizing vehicles in hubs is viewed as a potential solution to combat free-floating chaos. These locations could be placed strategically throughout cities, providing transfer points to car users at the edge of cities and creating a network to serve different travel needs towards city centres. Furthermore, hubs could also serve as locations where facilities come together, making room for parcel points or food and beverage services for example. Hubs are therefore seen as promising concepts, which are still in their trial phase. Across cities, different hub concepts pop-up; e-hubs, "buurthubs", and larger hubs (Amsterdam, n.d.). What this hub looks like depends on the characteristics of the surrounding area and existing travel needs of its users.

Another change in society where governance is involved relates to influencing people's mobility behaviour. The acronym "STOMP" developed by the CROW and the mobility pyramid (Figure 13) created in the Share-North project by Interreg Europe both summarize mode priority for sustainable transport (CROW, n.d.; Interreg North Sea Region Program, 2021).

Figure 13: Mobility pyramid

These frameworks give priority to pedestrians, after which cyclists and micromobility users are next, followed by public transport. After that, the next group in line is ride-sharing and shared cars, leaving private cars and planes in the last place. These frameworks can guide policymaking and urban planning to influence individual mobility behaviour.

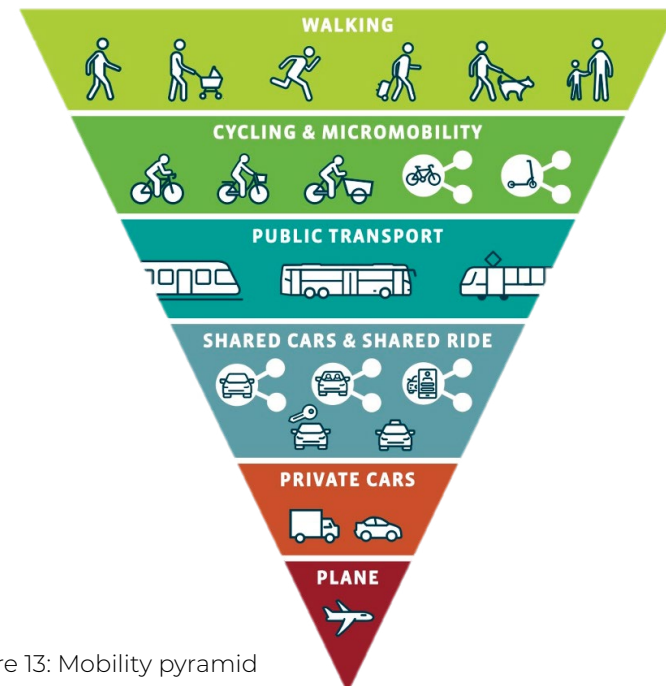Recently, after research showed that the distance travelled on shared e-mopeds and shared bikes was almost equal, the city of Utrecht refused to extend the Tier mobility's permit sending a signal about which mode choice it wants to encourage (Amaze mobility, 2022).

A third example by the municipality of Amsterdam is the ambition to deny access to all combustion engine motorbikes and mopeds (J. Veger, personal communication, October 21, 2022). This is in line with the announcement by the European Council, which reached an agreement to prohibit the sale of combustion engine cars from 2035 onwards (NOS, 2022).

Technology & Business: Market changes

"If using the car becomes too difficult, you might eventually choose to take a moped instead"

- (E. de Jong (Mobycon), personal communication, november 16, 2022)

The transport sector has started responding to expected legislation concerning mobility. For example, PostNL is starting to use smaller trucks and cargo bikes for city logistics. This is no easy switch as the vehicle cannot always withstand the weight of the cargo and not all delivery drivers are happy with the idea of using LEVs.

However, with the prospect of increasing e-commerce demand and its role in contributing to liveable cities, PostNL has started to change their operations. In the company's effort to decarbonise its delivery network, Amazon also expanded its E-cargo bike

fleet in the United Kingdom (Amazon, 2022). These changes show early signals that switching to sustainable urban mobility is feasible. In technology, the use of data and the Internet of Things enables cities to become more efficient and connected by acting on real-time data. Deploying technology in this way can improve traffic flow and waste management, and make better use of resources such as light and heat for buildings and other applications (Thales Group, 2023) (European Commission, n.d.). These changes are happening already offering a glimpse into the future of smart cities.

Human: End users

"20 years ago, we did not want to live in apartment buildings, now we do. Society is changing and the mobility system needs to adapt"

- (B. Govers (Goudappel), personal communication, October 31, 2022)

With the emergence of mobility hubs and expanding shared mobility offer, the system starts to become complicated for users. Having to navigate a growing number of separate mobile applications to access vehicles from different brands is impractical. With new transport modes and transport patterns, human needs can change too. For example, the modern "work-from-home young parents" can benefit from a system that incorporates the entire trip chain typical of someone with these characteristics. For this, mobility-as-a-service, or "MaaS" might be a solution as it provides access to a range of mobility options through one system. This all-in-one solution integrates the planning, booking, and paying process, offering multimodal convenience in a few clicks. As an example, this would enable such a parent to bring the children to school with a cargo bike, commute to work by train, and easily go to a specific location on a moped for an important meeting. MaaS has the potential to connect modalities so it can satisfy many different use cases. The Dutch government launched a pilot program several years

ago, testing out several promising MaaS concepts (Ministerie van Infrastructuur en Waterstaat, 2019). The popular travel app 9292, is also experimenting with MaaS features and adding them to its existing application where possible (S. Hiemstra-van Mastrigt, personal communication, October 31, 2022).

The aim is to optimise the mobility offer and create a desirable system to foster the adoption of shared mobility. Today, there are different systems that resemble the idea of MaaS. For example, in the Dutch NS app, a user can view nearby shared vehicles.

A development that connects to this is one mentioned by an employee of the municipality of Amsterdam. He spoke about how the municipality is searching for ways to convince people not to purchase a private car. By presenting the option of shared mobility during a key life event such as attaining a driver's license, people can have a conscious moment to decide instead of blindly buying a car. This seeks to break patterns of routine behaviour, showing that having a driver's license and using a shared vehicle has benefits too (M. van der Linden, personal communication, 31 October 2022).

A barrier to the development of MaaS systems is the question of how integrating parties can earn money from a MaaS system. Requiring a small service fee could be a relatively big request if the user only wants to take a short moped trip (S. Hiemstra-van Mastrigt, personal communication, October 31, 2022).

3.4.2 Uncertainties
Apart from the described changes occurring now, developments in urban mobility also raise questions.

Push it to the limit: strain on the electric grid
As the push for cleaner mobility coincides with the energy transition, the pressure on the electric grid continues to escalate. The demand for electricity will keep growing as companies and civilians try to make sustainable changes. The phasing out of natural gas is an example of this. While this may be a positive development, it is driving the grid to maximum capacity (RTL Z, 2021) (Kleinnijenhuis & van Hest, 2022) (Netbeheer Nederland,

n.d.). The consequence of this is that companies and institutions have to wait to be connected. This demands net operators and the government to assess their priorities regarding who to connect first. It also strengthens the need to consider better distribution of energy use, encouraging people to not only put strain on the grid during peak times.

Yay or nay: government attitude toward shared mobility
Another uncertainty is the stance of the government regarding shared mobility. As of now, shared micromobility is seen as a potential solution to urban problems, encouraging the government to create regulations, and think along with the sector to make it work. However, there is no guarantee this will continue to develop like this. Will the government fund shared mobility or rather improve public transport? Will they fund charging infrastructure for micromobility? There are no answers to these questions yet.

Thrive to survive: creating a profitable business
The funding raises the question of profitability too. Unlike the electric car market which has been invested in by multiple market parties, the shared mobility market is not profitable yet. Recently, provider GoSharing went bankrupt, as its growth did not turn out as expected (Berbers, 2023). A charging infrastructure expert of the Municipality of Amsterdam also underlined the uncertainty of creating a profitable business case. Creating dedicated charging infrastructure for light electric vehicles is difficult as there are no on-the-shelf solutions like in the electric car market (J. Veger, personal communication, October 21, 2022).

This is how we do it: developing standardisation
Such on-the-shelf solutions touch upon another question, which is the creation of charging standardisation. This agreement to produce certain technology in a particular way is beneficial for buyers and end users. The interoperability ensures buyers do not have to depend on the product of one manufacturer and the consumer can enjoy consistent quality across products

that adhere to the standard. Another important benefit is the reduction of costs, which is especially important when Tiler wants to sell to consumers. (ISO - ISO and Small & Medium Enterprises, n.d.). But standardisation for LEV charging is not guaranteed. Will it be a legal standard, or will big companies collaborate on an industry standard?

This or that: shifting consumer preferences

Looking at consumer preferences, there is an ongoing trend to share vehicles, but these preferences could shift and be impactful. If people do not want shared mobility services, it is not a sustainable business. An example that supports this will take place in Paris. Soon, Parisians will get to express their opinion on free-floating e-scooters in the form of a vote. The permits of several providers will expire in March, which the mayor saw as an opportunity to ask Parisians what they want (Dillet, 2023). Despite measures being taken to reduce the negative effects shared scooters have had, Parisians are still being plagued by reckless riders on sidewalks and vehicles cluttering the streets. The referendum will take place on April 2 this year and will be watched closely (LEVA EU, 2023) (Frost, 2023). These uncertainties are not in Tiler's direct influence and will need to be monitored so the company can see where they want to get involved or how they consider adapting when circumstances change.

3.4.3 Evaluating the impact of uncertainties

In the interviews I conducted, the role of the government was repeatedly emphasised. Also, several interviewees mentioned the quest for a viable business model. Additionally, at the Micromobility World 2023 conference, I asked the global leader of McKinsey's Future Mobility Centre Kersten Heineke about which uncertainties he thinks will make a real difference to the future of urban mobility (such as regulations or user preferences), to which he replied that how much cities will keep allowing shared mobility will certainly matter, mentioning a possible domino effect depending on the mobility vote in Paris. Another possible extreme could be further restriction of personal vehicles to push

micromobility adoption more. Additionally, he mentioned the uncertainty about the buying behaviour of consumers, putting forward the possibility that people might build a portfolio of micromobility vehicles to use for various use cases or people might find one vehicle that fulfills all their needs. This last option could bring down the total amount of vehicles people own. Concluding his answer, Heineke highlights he has no doubt about adoption but does question the portfolio choices degree to which micromobility will replace the private vehicle or become a complementary option. The full reply can be reviewed on the online recording from 11:25-13:30. (Micromobility Industries, 2023) (K. Heineke, personal communication, January 19, 2023).

Conclusion

The findings from the research phase show the potential of shared micromobility to solve urban problems. This new and young market is full of innovation, trying to push urban mobility toward a system that revolves around the use of smaller electric vehicles. Regulations are starting to define the rules of the game, companies respond to adapt and users familiarise themselves with new mobility services. The findings also underline the degree of uncertainty in the developments that can be impactful to Tiler. The path forward is uncertain which makes it extra important to consider the impact of possible changes and the alternative scenarios they give shape to. From a design perspective, the information I gathered has given me enough food for thought to help me frame the problem to be solved. These findings need to be narrowed down to determine the focus in the design phase. The end of the research phase defines the moment to consider what the internal and external information means for the specific design challenge that should be solved. In the next chapter, I will bring this information together in the design brief.

Part II *Reframe*

4 Design brief

After analysing the mobility industry broadly and selecting the main findings relevant to this project, I formulated my design brief. The purpose of this brief is to define the key challenges that the design phase will revolve around. It offers a conclusion of the research phase, converging to a focus within the initial brief the project started with. The chapter starts by formulating the vision and mission, followed by a summary of the main challenges Tiler faces. The design goal and criteria conclude the chapter by explaining the design direction I have taken into my concept phase.

4.1 Vision & mission

The vision articulates the desirable future mobility situation for Tiler, followed by the mission that describes how they can contribute to achieving it. The most important insights that I made part of these statements are about the need to design a system that is not car-centric, but about the needs of people and planet. In addition to this, I wanted to acknowledge the facilitating role of Tiler in the transition towards sustainable mobility.

Vision
An urban mobility system that prioritises the needs of people and the environment.

Mission
Facilitate (shared) electric mobility to support liveable and accessible cities.

4.2 Main challenges

The biggest external challenge Tiler is facing are the **uncertainties** regarding the future of shared micromobility in cities. In this dynamic and **young market**, change can occur fast on different levels. The **complex stakeholder environment** makes this harder as there are diverse interests involved. On the organisational side, Tiler has mostly been focusing on the short-term survival of their business. Doing so the company could miss out on insights important for their **long-term strategy**.

Uncertainties: Municipalities have shown changing attitudes regarding shared micromobility. What collaboration between private and public parties will mean in the future is uncertain. Which vehicles will be allowed, or whether consumers will continue to enjoy sharing vehicles is not set in stone either. Standardisation for LEV charging and profitability of shared mobility are also long-term unknowns.

Young market: Micromobility is relatively new, meaning that society is still figuring out what it wants this new system to be like. Guidelines for pedestrian and cyclist design are still being created, market parties are not investing heavily in infrastructure as has been done for electric cars and governance has not developed a coherent approach yet.

Complex stakeholder environment: The growth of the shared mobility market presents opportunities for various parties. Not only does it bring together mobility providers, municipalities, and end users. It creates opportunities for new charging solutions such as Tiler, construction companies for infrastructure, digital solutions for MaaS purposes, and associations who want to act in the best interest of the consumers. All these companies could be valuable parties for Tiler to collaborate with and thus be aware of.

Long-term strategy: Tiler is currently preparing to scale up, making it an exciting but busy time. From what I have been able to observe, the team is focused on managing their current clients and potential investors, developing the perfect product, and dealing with business matters that require their attention now. To them, showing traction is part of proving they are a business with potential for the future. However, thinking about the strategy for years to come therefore seems to happen on a minimal level. The risk of this is that Tiler could miss out on future opportunities that require their attention and resources now. For this reason, I think Tiler could benefit from a roadmap to help make the abstract future more concrete and part of their organisational discourse. However, since it is the first dedicated strategic document in a business context sensitive to outside changes, I did not want to present their path to the future as linear and straightforward. Instead, I aimed to incorporate these uncertainties, designing for different scenarios.

4.3 Design goal & criteria

4.3.1 Design goal
In the conceptualisation phase the design goal will be:

"To design a roadmap that gives Tiler an overview of evolving urban mobility scenarios, enabling them to identify strategic pivot points and find balance between short and long-term thinking"

4.3.2 Why a roadmap
The definition of a roadmap as defined by Simonse et. al (2018) is *"a visual portray of design innovation elements plotted on a timeline"*. A roadmap presents a tool to explore the strategic future of the company through its own style with different elements plotted on. By exploring ideas about the future and converging internal and external information, a roadmap enables a company to articulate new directions, innovations, and the time to make those plans happen. Though it may seem early to narrow down the scope to a roadmap in the design process, I chose to do so as think the company can benefit from a visual portrayal of strategic decisions placed in time. From everything I heard and observed at the company, I judged the concept of a roadmap could provide a useful answer to the question the company wants to answer. To me, the questions asked and challenges the team appeared to experience expressed the need for something to bring it all together and consider the bigger picture instead of seeing challenges in isolation.

4.3.3 Criteria
I have defined three criteria for my concept I think my concept should meet as I believe it increases the change the company can implement it.

Dynamic
To include the major uncertainties, I wanted to explore the possibility of creating a dynamic roadmap. With this, I aim to show the outcomes of different scenarios. For example, changing the placement of elements provides a way to visually see priorities shift. to reflect the unsteady environment.

Organisational compass
The concept should serve as a conversation starter the Tiler team can check in with during the year to see how their current

strategy is playing out, how the external situation has evolved, and whether they have the necessary capabilities to deal with these changes. In a growing team in which members carry many different responsibilities, keeping this conversation alive can strengthen the mutual understanding of where the company should go. This can also help to ensure the team members make the same promises to external parties, telling a consistent story.

Stakeholder sensitive
To accelerate the mobility transition and increase the chance of success, collaboration within sectors and between private and public parties is crucial. Therefore, it can be useful to design the concept in a way that is sensitive to the needs and language used of the stakeholders involved. This can enable Tiler to conduct conversations with potential clients with empathy and understanding, fostering productive communication.

Part III *Create*

5 Developing the roadmap

In the previous chapter, converging the main findings in the design brief helped to get a clear vision of how I can bring value to the company as a strategic designer. In a rapidly evolving environment, Tiler could benefit from a tool that enables them to navigate external circumstances and reflect on how to best align their strategy in a new situation. Having finished the discovery and define phase of my design process brought me to the second diamond. In this part, I developed the first roadmap concept. The chapter goes into the design of the ingredients that form this document. In the next chapter, the complete concept that I built from this foundation will be explained, after which its evaluation is discussed.

5.1 Design method and activities

5.1.1 Method
Creating a roadmap for Tiler meant starting from scratch, moulding the information I had gathered thus far into the building blocks for the concept. To do this, I took inspiration from the design road mapping process (Simonse et al., 2018) and went along the steps of future visioning, technology scouting, time pacing, and linking the activities. Figure 14 shows how I performed these steps and what I used them for.

One of the most challenging parts of making a comprehensible roadmap is organising it in a way that is useful to those using it and to manage to serve the purpose it was created for. There are endless ways in which it can be configured as *"no standard design exists for roadmaps"* (Simonse et al., 2018, p. 12). I aimed to create a document that could be used by the Tiler team and used as a conversation tool with different external clients. This is also why I evaluated the content with external parties to gather their feedback, which is discussed in the next chapter.
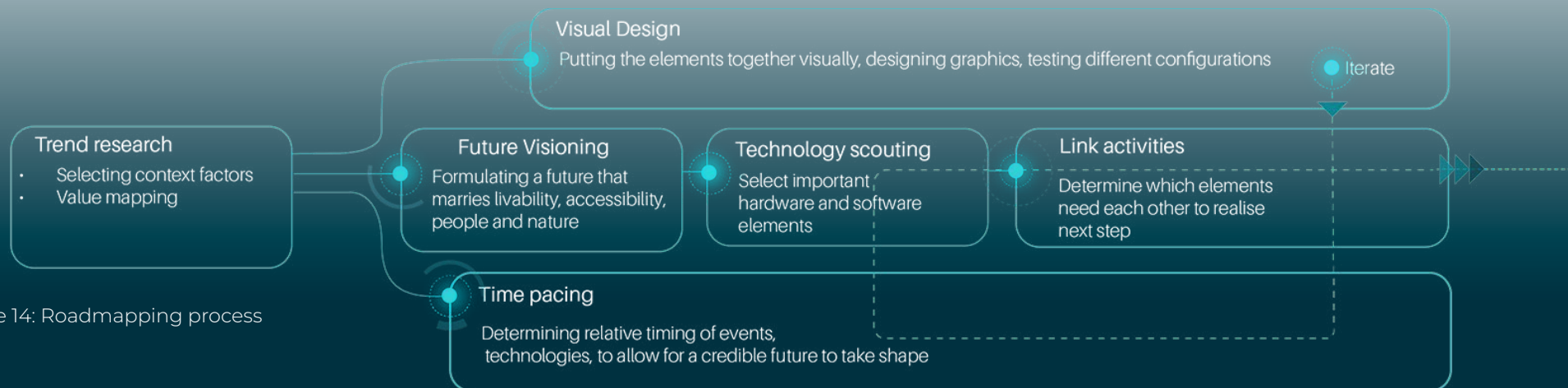
Figure 14: Roadmapping process

5.1.2 Design activities

I brainstormed about the different layers that would form the roadmap, their content, and visual style. For this, I used the digital tool Miro, and offline sketching to try out ideas quickly. Once elements started coming together, I tried different configurations of the roadmap using paper prototypes. Laying out the trends and developments allowed me to make clusters and condense the information into larger themes. Once I found a suitable configuration I made a digital prototype using Figma (Figma, n.d.). In Figma, I created multiple iterations, which I adjusted based on new ideas to visualise data or additional insights from my research or company meetings. Figure 15 gives an impressions of my prototyping activities.

5.2 Conceptualisation

5.2.1 Selecting roadmap elements

Because there is no standard design, it is important to consider which parts the roadmap should consist of. For Tiler, I wanted to connect the internal environment to their external business context. Also, I saw value in connecting this context to the target markets could reveal information about the best timing to enter each market. As Tiler is proud of its product, visualisation of the product evolution could speak to the imagination of the team, helping to imagine the possibilities of the future. Furthermore, I also considered including promising technologies to be relevant as the company shows interest in expanding the digital features of the Tiler Uno. Finally, to consider the internal implications for the company, a resources layer allowed me to think about potential partnerships or suggestions for new employees.
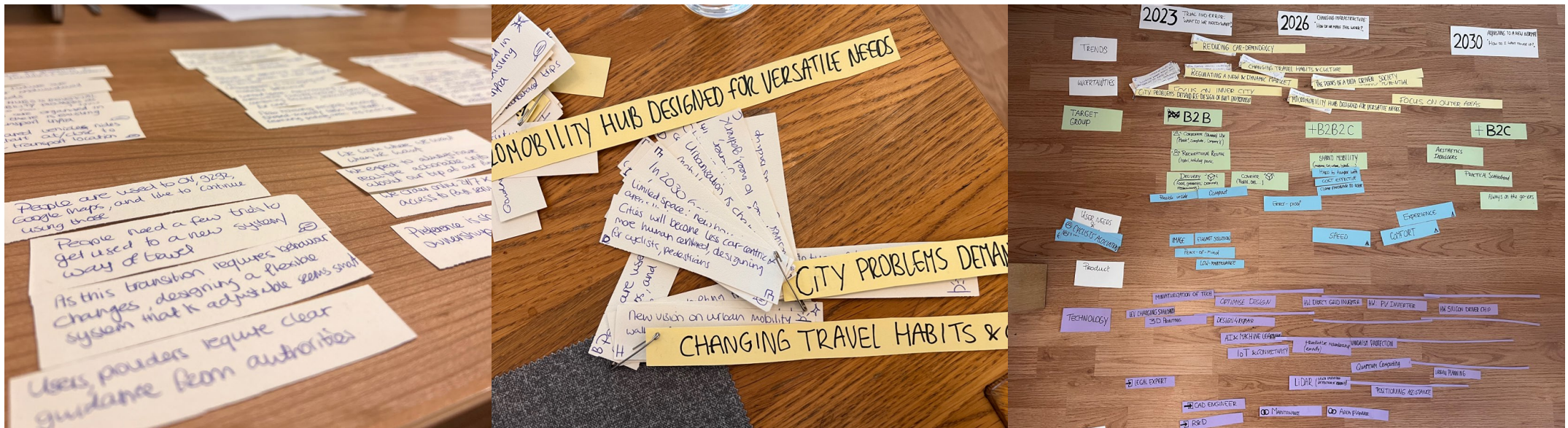
Figure 15: Prototyping activities

5.2.2 Future visioning

Since a roadmap is a strategic tool, it never really comes to an end. A strategy must be adjusted, revisited, and thought about critically to see whether it still provides the guidance needed. The practical "endpoint" of a roadmap is the future vision, a desirable future that the company works towards. Based on my research and the company's mission I wanted to include the elements: people, environment, and micromobility in relation to the creation of liveable and accessible cities. I experimented with multiple formulations of this statement and tested the following three with the team.

A	B	C
An urban mobility system built around shared electric micromobility to support healthy, livable, and accessible cities	An urban mobility system adopting shared electric micromobility to satisfy all travel needs in a way that supports the creation of liveable and accessible cities	A human-centred urban mobility system that facilitates active and (shared) electric micromobility, by shaping cities that people consider safe and pleasant to live in

By asking them what they understood from the statement, and which one appeals to them most, I wanted to find out whether the statement conveyed what I intended. I also asked the opinion of a mobility manager of the Dutch cycling embassy (C. Bruntlett, personal communication, January 26, 2023) to get an external view too. The feedback (see Appendix B) led me to adjust the statement to create the final version:

"An urban mobility system that prioritises the needs of people and environment by facilitating (shared) micromobility to support liveable and accessible cities"

5.2.3 Articulating horizons

For the scope of my project, I chose to consider the mobility domain until the year 2030. In a roadmap, horizons are used to divide the document into phases which detail how to progress more into one direction or multiple. I wanted to create three horizons, taking the current year, 2030, and a moment in between. Instead of simply numbering the horizon's I decided to give them short titles that describe our position as society in the mobility transition. This is how I came up with: Trial and error for 2023, realising infrastructure for 2026 and adjusting to a new system for 2030 and onwards. The subtitles "What do we want?", "How do we make this work?" and "What do we think of this?" aim to reflect the question we seek to answer as society during each phase.

Horizons

Layers

Future vision
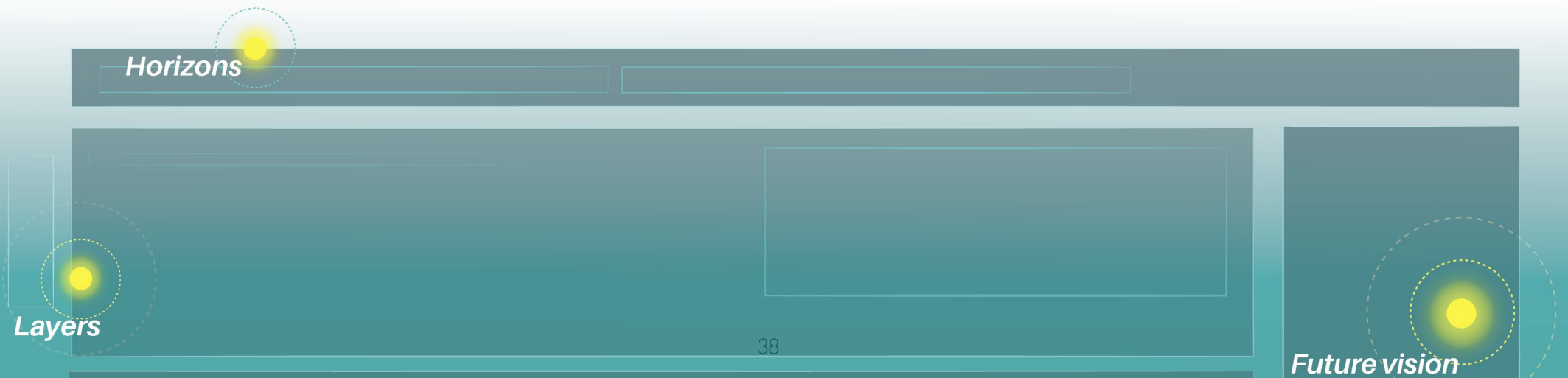
Product visualisations

5.2.4 Condensing the context & time pacing

To decide what to include in the trend layer, I clustered trends multiple times. Being so deeply involved in this context made it difficult to see which information was essential and which were details. This is where writing trends on pieces of paper and clustering them helped to create a categorized overview. I used this to allow for overarching themes to emerge, which can be used to create fitting names. Developments that formed small clusters or did not seem to belong anywhere at all could be left out for now.

The information in the trend layer had to be placed in time too. I did this by taking a theme and its trends and considering how this could likely develop in the future, also taking into consideration the horizons. Placing all this information in time meant making a forecast based on my assumptions about how developments would follow each other up. Some of these assumptions included that the car would get a different purpose, a new urban mobility system would form with micromobility at the centre and cities would be built according to the needs of a growing urban population.

5.2.5 Vertical categories

Below the trend layer, I organised the target markets, stakeholders, product & service, technology, and resource layers. I chose this order as the contextual information would impact the markets Tiler could consider selling to. These markets had specific stakeholders involved which could therefore be put below that layer. Next, the small product visualisations would bring together the bottom and top parts of the roadmap displaying possible new system combinations. Lastly different technology features and corresponding new partnerships or employees were put in the bottom layers. Appendix C shows different iterations of how I tried to organise and build up the roadmap.

5.2.6 Choosing the most important tipping points

From trend and literature research it was evident that there are major uncertainties that could be of great impact on what kind of urban mobility system will evolve over the coming years. Some uncertainties can be influenced by Tiler whilst others are more in the hands of governing parties or big companies with budget and power. Over the course of my project, I collected several uncertainties that seemed most impactful to Tiler's future if

they would turn out differently compared to the scenarios that seemed to be forming now. These uncertainties were about regulations, consumer preferences, standardisation, and the business model of shared mobility. battery development and vehicle design.

Incorporating these uncertainties in the roadmap would create alternative scenarios that could make priorities shift for Tiler. chose to incorporate the following uncertainties:

- Regulation attitude towards shared mobility
- Consumer preference to share vehicles
- Creation of standardisation
- Profitability of shared mobility

Conclusion

The different steps of the road mapping process have resulted in the first concept of the tool, comprising of trends, target markets, product details and resource implications. The design activities presented me with a big puzzle, trying to fit the pieces together to achieve the future vision. There is no single way to do this but going over the content multiple times helps to create a plausible complete story. To provide insight into why I designed the first concept as it is, the next chapter will explain each layer in detail.

6 Concept: The first roadmap

After ideation and performing roadmap design activities, the first concept was ready. The aim of this chapter is to describe the roadmap in detail by going over the content of the layers. The chapter starts with a description of the trends and developments layer for each of the three horizons. After this, I will explain the target market and stakeholder section, followed by the product and service layer. The last part goes into the technology and resource layer after which I explain how I introduced the alternative scenarios and how I designed the first interactions for the prototype. This explanation is in line with the descriptions I used to evaluate the concept, which is the topic of the next chapter.

6.1 Context: Trends and developments

The trend layer contains a collection of developments that aims to give an overall view of the current mobility context. This section explains the content of each horizon. In Figure 16 which displays the concept, the transition X-curve is also visible behind the open content boxes to give a rough idea of where we seem to be in the mobility transition.

6.1.1 The year 2023: Trial and Error
As society, we are figuring out what we want the future mobility system to be like. Tackling urban problems and banning cars are measures being taken right now. This meta-trend is fuelled by urbanisation, the need for more housing, combatting congestion and air pollution. To do so, we see zero-emission zones being implemented as we decarbonise transport. Meanwhile, the attitude about public space utilisation is changing, with reduced and repurposed parking spaces as an example. This coincides with the effort to harness the promise of alternative transport.

Free-floating schemes have caused chaos in the streets calling for organisation in hubs and bundling mobility offerings in MaaS systems. Innovation produces new vehicles, further electrifying our future as we transition away from polluting energy sources. Car makers also jump into the market showing interest in its future and features like smart charging shows the need to make e-mobility efficient.

In navigating this new market, municipalities have started to regulate parking spots, but these policies differ across cities. It remains a challenge to foster consumer adoption, but companies are already responding to expected urban mobility laws. Collaboration between companies is still low, even though this could bring forth standardisation which is profitable in multiple ways. Profitability however is still a question mark, just like the attitude of the government concerning shared mobility. The passive attitude of governing parties has led to an experimental attitude of providers, seeking how far the government will let them go.

6.1.2 The year 2026: Realising infrastructure
Making progress in combatting urban problems will lead to more resilient city design. Urban planners will look at climate resistance, more green, and better water management. Petrol vehicles will be denied access to city centres and data will be used to better manage the city. Solutions like superblocks ,that pushes cars to the edge of multiple blocks, and cycling highways will help to get citizens around on micromobility vehicles safely and fast without being bothered by cars. To reduce this car presence, improving public transport connections, and building car-free districts are measures to reduce car dependency. Shared mobility is being included in new housing projects and hubs become attractive places to get transport and access other facilities. These locations offer smooth experiences through improved MaaS systems that

Horizon

Closed trend layer box, with summarising trend title

Opened trend layer box

Monitor

2023 **Trial and error:** "What do we want?"

2026 **Realising infrastructure:** "How do we make this work?"

2030+ **Adjusting to a new system** "What do we think of this?"

Trends
People, business, society, technology

Tackling urban problems & banning cars
- Urbanisation Housing Congestion Air pollution
- Zero-emission zones Decarbonising transport
- Reduce and repurpose parking space Attitude shift public space

Harnessing the promise of alternative transport
- Free-float chaos Testing hubs Setting up MaaS systems
- New small vehicles Energy transition: electrifying our future
- Car manufacturers expand into micromobility Smart charging

Navigating a new dynamic market
- Regulate parking Divergent policymaking Fostering adoption
- Companies respond to expected laws Collaboration needed
- Developing standardisation Creating a profitable business
- **Regulation enables shared mobility** Mobility providers experiment

Resilient city design

Minimize car dependency

Standardising a new way of travelling

Human centered urban planning

Micromobility as the new normal

Improving a flexible system

Future Vision

An urban mobility system that prioritises the needs of people and environment by facilitating (shared) micromobility to support liveable and accessible cities

Target market for Tiler

- Leisure rental (Hotel, Holiday park)
- Corporate sharing (company X)
- Operational fleets (PostNL, DHL, Amazon)
- Shared mobility
- Low-effort commuter Occasional freestyler Risk averse rookie
- Aesthetics indulgers
- Tech enthusiasts
- Always on the go-er
- Convenience seekers
- Practical scatterhead

B2B +B2B2C +B2C

Influence

Stakeholders & Needs

- Fleet provider
- Tiler
- Shared mobility providers
- Insurance Municipality Shared mobility users
- Tiler
- Consumers
- Tiler

Product & Service

- Uno system - e-bikes Only
- Locking feature & kickstand design for other LEVs
- Design for hub use & mobility dashboard
- Adapt design, expand application
- Design for b2c use

Technology

Hardware
- Cloud module
- Sensor, lock Design optimisation
- PV inverter Direct grid inverter Silicon driver chip
- Eliminate redundant parts

Software
- Vehicle data
- AI & ML:Vandalism & Theft protection AI: Predictive maintenance
- Usage data

Resources

Tiler
- Legal expert
- AI/ML Developer
- R&D Support
- User research

Partner
- Vehicle maintenance Hub owner

Examples of possible partnerships based on new tech & features

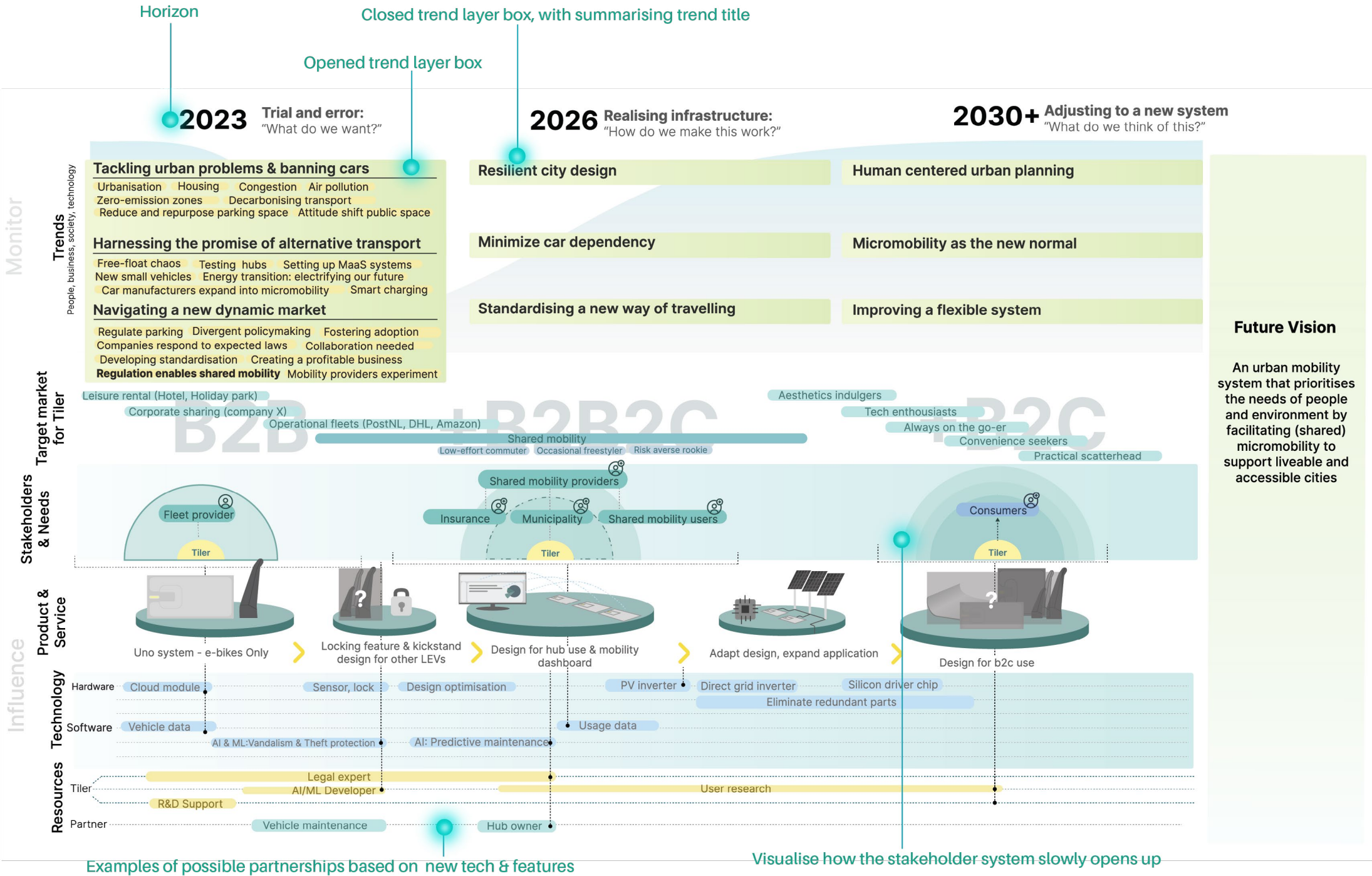**Visualise how the stakeholder system slowly opens up**

Figure 16: Roadmap concept

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contribute to the continued preference to share. Altogether society starts standardising this new way of travelling, finding the appropriate purpose for each vehicle, and investing in the necessary infrastructure. Standardisation for LEV charging will be developed opening up the market. Guidelines for pedestrian and cyclist-centred urban planning foster adoption and new sharing concepts arise.

6.1.3 The year 2030: Adjusting to a new system

Building resilient cities also created room to further implement a human-centred mindset in urban planning. This will express itself through more investment in pedestrian infrastructure and climate-adaptive smart cities to create a pleasant place to live. By this time, the fruits of consistent investment in city design using new priorities can be harvested enabling shared mobility to be the new normal, offering accessible alternatives to all citizens. Charging infrastructure will have expanded and the merging of public transport and micromobility creates a uniform system that is easy to use. This system is designed to be flexible to allow for smooth integration of new modalities. It has also become a profitable business case with the help of private and public parties working together.

6.2 Target market & Stakeholder situation

The second and third layer show Tiler's target markets and stakeholder situation. The target markets have been placed in the order that seems most sensible in the company's current situation. After their first business-to-business sales, Tiler can move into shared mobility further and add the business-to-consumer market after. The consumer market contains the names of several persona names I created to give an idea of the diversity in this market. For example, as visible in Figure 17 too, the "Aesthetic Indulger" persona describes people who are

willing to treat themselves to a product that has aesthetic value to them, making them less price sensitive. "Tech Enthusiasts" are always looking to get their hands on new innovations and the "Practical Scatterhead" could be convinced if the product will guarantee a charged vehicle for them. The corresponding stakeholder environment displays how this system opens up, adding new parties which could make managing clients more difficult.

Aesthetic Indulger
Wants to have pretty things
Design more important than price

Tech enthusiast
Wants the latest gadgets
Impressed by function and looks

Practical scatterhead
Wants something to rely on
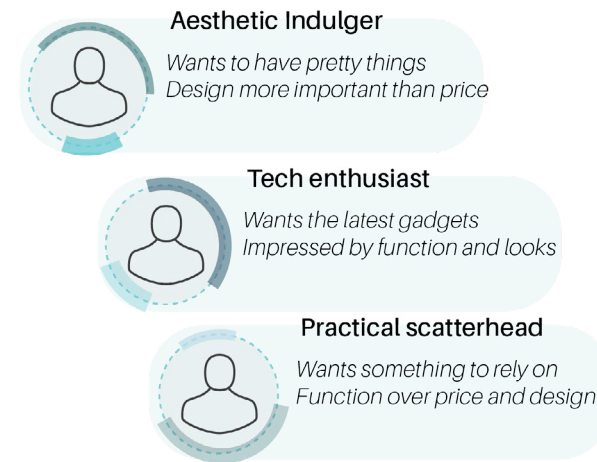*Function over price and design*

Figure 17: Expanding to different consumers

6.3 Product and service

Showing graphical representations of the product, the fourth layer is meant to introduce the thought that the product might evolve in terms of shape, function, material, or application. It helps to show which stepping stones are necessary to move from the Tiler Uno to the 2.0 or even 3.0 system. Moreover, visually showing additional features and designs for other vehicles could also emphasize that a lot needs to be done to achieve that.

6.4 Technology & Resources

At the bottom of the roadmap are the technology and resource layers. During the conceptualisation I performed the technology scouting step which consists of identifying impactful technologies for Tiler's business. In connection with the trend of smart cities, artificial intelligence, and machine learning are technologies that would make sense to investigate. Furthermore, I added hardware components such as a photovoltaic, direct grid inverter, and silicon driver chip. These are examples that the CTO had included in a list of possible future components to improve the product.

6.5 Introducing the alternative scenarios

In the trend layer, a few of the developments are displayed in bold. In the digital Figma prototype, hovering over this item would make a pop-up appear as an overlay, showing the opposite. For example, "regulation enables shared mobility" becomes "regulation restricts shared mobility". This worked the same way for each of the scenario parameters. Though not included in this version of the concept, these elements could also move around based on which pop-up is selected to show the impact of this alternative scenario.

6.6 Interacting with the concept

The first Figma prototype enabled me to put a lot of information together in a coherent visual. Clicking on various elements opened up containers where more information was stored or pop-ups would appear. The offline paper version consists of the same elements without the digital interactions, making it a messier version of the concept. The online version may appear more dynamic but can allow for less interaction as it is up to me as

the designer to decide where the elements move to. The offline version allows for customisation from everyone interacting with the document as they can all move around papers themselves. The Figma prototype can be accessed through the link below.

Conclusion

This chapter has explained the roadmap layers, describing the content in detail step by step. Together, this first version has provided a coherent document that lays out a credible course of events to achieve the future vision of this roadmap. Next, I assessed this content and whether the roadmap is a useful strategic tool for the company. For this, I evaluated the concept with a few external stakeholders and internally with the Tiler team.

Part IV *Catalyse*

7 Concept evaluation

In the previous chapter, the first concept was explained in detail. The next step in the design process is about evaluating the concept to see how it is received and to what degree it achieves the intended purpose. To gather multiple perspectives, I performed a round of external evaluations and one collective internal evaluation. The external sessions were held with three experts in which I went through the content of the roadmap to find out whether the document sufficiently summarises the mobility context. The internal evaluation was meant to investigate the value of the concept as a strategic discussion tool. This chapter also goes into the results of these evaluation sessions after which the next chapter will go into the concepts improvements that have been explored.

7.1 External evaluation

7.1.1 Method
To get input from experts on my first concept I conducted three semi-structured interviews evaluation interviews of one hour each. In these conversations, I walked the expert through the roadmap, asking for feedback on the content of each horizon, and whether they could reflect on it based on their expertise. During their replies, I probed for ways to find out whether they considered the content to provide a well-rounded picture of the context or whether they missed information. These conversations were also a way to do multiple test runs of the internal evaluation that I was developing, so I could see how much information could be discussed in the time available and how to maintain conversations of sufficient depth. In addition to this, I asked the experts about what they thought would happen in the alternative scenarios, also testing whether these plot twists provided enough stimulation material to think about. The

evaluations were digital meetings of approximately one hour in which I screen-shared the digital prototype. I opened and closed the content boxes as I went through the roadmap.
I interviewed three experts, one from the TU Delft Seamless Personal Mobility Lab, TNO and Shell recharge. I approached these experts as I wanted to include an academic research perspective, an applied research perspective, and the perspective of a potentially big party in the future micromobility charging market.

7.1.2 Goal
The purpose of evaluating the concept with external parties was to get feedback on the complete story and how the different elements connected to each other. I wanted to find out whether there were any important pieces of information missing and whether the story made sense to different experts, both visually and content-wise. Lastly, it allowed me to test parts of the roadmap workshop I had planned to execute within the company and see how people respond to it when viewing it the first time.

7.2 Results

The interviews revealed that the content was of sufficient breadth and depth to have detailed conversations about. Besides that, there were a few topics the experts emphasised that were not included in the concept yet or not in detail. The expert from Shell Recharge stressed the challenges of the energy transition, and the TU Delft and TNO experts highlighted how shared mobility could turn out to be even more important in the outer areas of cities for overall accessibility. This comment was made in the context of investments in urban public transport. If governments

decide to improve train bus and metro connections in cities, citizens may have all they need to get around. This approach would then make shared mobility a more sensible addition outside the city centres to make or keep those areas accessible too. As a practical, students travelling to school could make use of micromobility options instead of having to depend on a bus that passes only once every hour. In addition to that, focusing on offering good chain mobility where consumers can seamlessly transfer from one vehicle to another was crucial as well, according to the TNO expert.

7.3 Internal evaluation

To gather internal feedback from the Tiler team, I created an evaluation workshop. In this session, I presented the roadmap and stimulated team discussions about the content and the impact on the company's strategy.

7.3.1 Method

The purpose of the workshop was to evaluate the roadmap concept by facilitating discussions among the team based on different scenarios. I set up the structure of the workshop using generative session theory from the Convivial Toolbox (Sanders & Stappers, 2012, pp. 156–162) to structure the activities and create a script for myself as the facilitator. For the stimulation material, I created offline paper cut-outs of the digital roadmap prototype I made in Figma. In this way, I could map the content out on the table, gradually adding new content as I explained the roadmap. During the workshop, I engaged the participants with the content through a storytelling format, after which we performed multiple rounds of discussions about the consequences of alternative external circumstances for the company. Using storytelling for strategic business purposes was a suitable tool

for me to convey the risks and opportunities I identified in my roadmap (Denning, 2006). For this narrative approach, I took inspiration from several narrative patterns: "springboard" and "leading people into the future ". The springboard pattern is meant to spark action, helping listeners imagine how a change might work in their situation. Leading people into the future is a pattern that can be used to evoke thoughts about a desirable future, without adding too much detail. I introduced multiple alternative scenarios to the participants as this helps them to realise the uncertainty of the future.

Throughout the workshop, I switched between actively leading the activity and stepping back to allow the conversation to start. Before the workshop, I created a document with short exercises to sensitise the team for the upcoming workshop day and piloted the materials with fellow students. This sensitiser, pilot, and workshop will be discussed next.

7.3.2 Sensitiser

To make it easier for myself and the team to engage in deep thinking during the workshop, I created a set of short activities for them to fill in three days before the workshop. The purpose of this sensitiser was to introduce the participants to the content they had to think about in the workshop, reducing the number of new concepts that would need to be introduced during the actual workshop, benefitting both the participants and me as the facilitator.

The sensitiser consisted of three exercises to be filed in by each Tiler employee individually. The first exercise introduced the concept of the mobility transition and Tiler's role in it. Based on a graphic displaying an X-curve (Loorbach et al., 2017), they were asked to consider Tiler's current and future role in transitioning to a new urban mobility system. This question was meant to trigger deeper thought about the company's future goals using a relatively broad question. I wanted them to consider "Who are

we and who do we want to become as an organisation?"

Next, the team members were asked about the evolution of the Tiler Uno, which provided the opportunity for me to get insight into which added features and product changes each member foresees and what they think the timing of those changes towards 2030 should be. The items they had to place on a timeline ranged from specific features such as a "photovoltaic inverter" as a new hardware element but also a term such as "expand to other vehicles". To me, this could also bring forward any big opinion differences amongst the members that I could use in the workshop to spark a discussion if needed. Furthermore, this also allowed me to observe knowledge differences too as they were also allowed to mark items with a question mark if they did not know what it was or leave it out if they considered it irrelevant. Lastly, I asked them to consider four uncertainties that would produce different future scenarios. They had to choose which three they deemed most impactful to Tiler and its activities. These uncertainties would come back in the workshop, which is why I asked them to select three out of four to encourage them to consider the differences in impact between them. This question was asked last on purpose to give their minds a moment to warm up during the first two activities. The complete sensitiser can be found in Appendix D.

7.3.3 Workshop pilot

To test my workshop facilitation plan, I conducted a pilot workshop with two IDE peers. I did this to see to what degree they could follow along with my story and material on the table. Also, I asked what went through their mind after hearing the alternative scenarios to get insight into whether it triggers questions that can be used to start a conversation. When discussing the content, the students picked up some papers and moved them around briefly before putting them back in the same spot (Figure 18). They did this while speaking about the combination of the target market and product features.
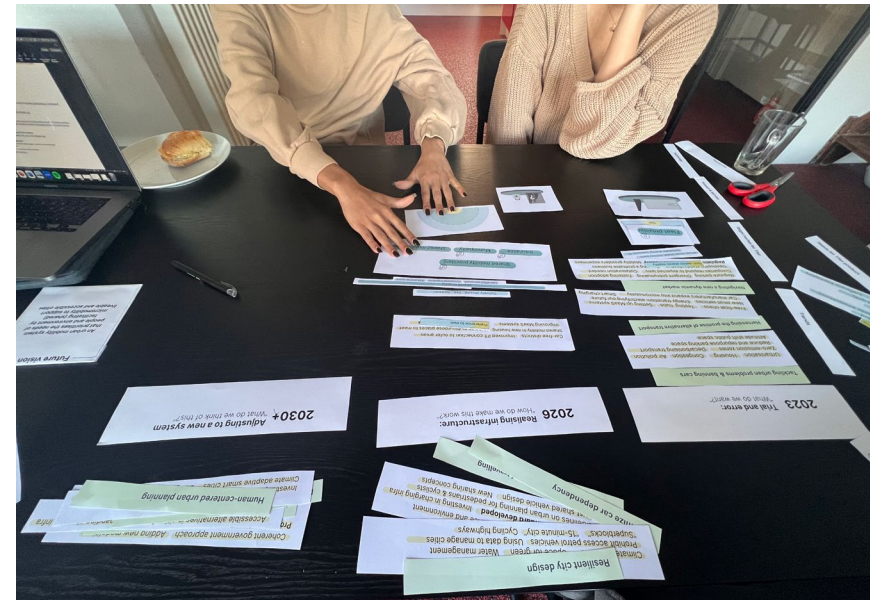

Figure 18: Pilot test

7.3.4 The evaluation workshop

This section elaborates on each part of the workshop and explains the content and questions at the centre of it. To view the complete script I used to guide this session, please view Appendix E.

Introduction

To start the workshop, I gathered everyone around the table in the office, where I had put the materials for the first activity on the table facing down and ready to be used. Using a compact set of slides (See appendix F), I introduced the general concept of a roadmap, what we would be doing together and the practical rules. I wanted to emphasize from the start that there were no right or wrong answers, and that each perspective was equally important. Next to that, I made sure they knew the best way to help me was to explain their thoughts and have open discussions.

Part 1 - Warm up: Foundation of the workshop

After introducing the workshop, general concept of a roadmap, and purpose of the day, the first part was about the foundation of the roadmap. Because a roadmap can be complex, especially when viewing it for the first time, I had practised slowly building up the story, going through it step by step. The future vision was the first familiar piece of information that was to be kept in mind as the goal for 2030. Next, I introduced the horizons as timeline chunks of several years that can be used to structure information in time. I paid attention to using conversational language to avoid unnecessarily complicating the content as I explained it. Thirdly, the horizontal categories were added and linked to the horizons, so the participants understood the function of those roadmap layers in the bigger picture. After explaining this, I checked to see if everything was clear.

Part 2 - Filling in the roadmap

Six out of seven members of the core team were present, creating a mix of different professional backgrounds, level of experience, and skills. I built up the content of the roadmap starting with familiar information such as the current product and target market. I summarised the business context of Tiler in story form. By blending all the relevant trends and developments together in a short narrative I wanted to transport the team to this future, helping them to see the different dynamics happening. I wanted them to take on these perspectives which were sometimes conflicting or strengthening each other, which in turn emphasizes the chaotic character of where we are in the mobility transition. In these stories, I concentrated on illustrating the whole picture. The figure below shows the setting of the workshop at the start, during my explanations, and during the discussions.

Figure 19: Evaluation workshop impression

Once I had given them a moment to let the information sink in, I introduced the first alternative scenario that they could recognize from the sensitiser exercises. After introducing this "What if.." I asked the team what this change would mean for Tiler. To get the discussion started in case the silence would last too long, I had several backup questions prepared, such as:

· How would you respond to this?
· What would you change in the company to deal with this?
· What do you think your competitors would do?
· What would you change about the company strategy?
· What does this mean for the direction the company is going in?
· What will investors want to know from you?
· What would you discuss in your next meeting?

If the team still needed encouragement after this, I had more specific questions prepared to ask about what it would mean for clients, partnerships, or how they could potentially influence the alternative scenario. This process was repeated four times, giving the opportunity to build up the roadmap completely and discuss all four impactful uncertainties. At the end of the last discussion, there was room to talk about the complete roadmap, and exchanging final thoughts before moving on to the reflection part.

Workshop: Part 3 - Reflection
The discussions about the scenarios were followed by approximately twenty minutes of collective reflection. This part was important to discover how they experienced talking about strategy within the team guided by a roadmap. I wanted to find out what they thought worked for them, what did not, and how theory overall experience was. Therefore, I asked questions such as:

· How did it go?
· What did you think of this?
· What was easy?
· What was hard?
· What would you do differently?

7.4 Results

7.4.1 What worked
Discussing long-term strategy with a roadmap as their tool, proved to be valuable. All participants followed along with the content and were able to have detailed conversations about the possible impact of changing circumstances. Overall, there were minor differences in knowledge between team members, for which they also provided each other with explanations if it was necessary. Below are several quotes that illustrate what worked and what the team thought of the workshop. The full transcript of the workshop can be viewed in Appendix G.

"It (roadmap) structured the conversation by having alternatives to specific entries and really focusing on the conversation around those I think that was really powerful"

Management

This (points to roadmap) will be different across cities and countries so nobody can say "oh we already know"... nobody knows!"

Management

"It might also be good to get a few stakeholders from different areas get somebody from rent-a-bike somebody from the municipality of Amsterdam someone from us altogether and then do a session like this"

Engineering

> *"..Lets them (other stakeholders) talk about the big picture and not just their circle of influence"*
> **Management**

> *"These cards kind of show that it is up to debate anyway"*
> **Management**

> *" This was quite a clear discussion and still going into depth instead of moving too much around because then people might get confused"*
> **Management**

> *"I think it would be nice to invite people to move around stuff to make it more dynamic that way"*
> **Engineering**

> *"I feel this (points to resource & technology layers) is a bit more separated because this is more very much related to Tiler.. it's a theme on its own and I don't think it's necessarily contributing to the bigger picture"*
> **Management**

> *"Some of the questions or some of the content might be can be phrased better for some things at least maybe it's my English.. for example standardisation was a bit broad for me"*
> **Engineering**

7.4.2 What did not work

Some points of improvement included the need for more context when introducing the alternative scenarios. Even though these scenarios provided interesting situations to consider, the team needed some more clues to begin imagining the new reality. Furthermore, it was clear from the flow of activities that the lower layers of the roadmap, specifically the technology and resources sections, was too much extra information to discuss. During the activity, I searched for the appropriate moment to add this information to the discussion but noticed it was only picked up briefly by one team member. However, this team member did start to move around the items in these layers by himself. Therefore, it could be useful to use the top layers of the roadmap in the existing roadmap format for internal and external use and create a separate smaller roadmap session for the bottom layers to facilitate recurring internal discussions about the product features and the resources necessary to realise these.

7.4.3 Early impact

An organisational change that the workshop led to is an adjustment to the weekly market fit meeting. A few days after the workshop, the team split up their former market fit meeting into a sales-to-delivery meeting and a smaller market fit meeting with a selection of the team. The old version of the market fit meeting was very operation oriented and always aiming for actionable outcomes. This content is now discussed in the sales-to-delivery meeting which creates space to discuss the actual market fit of the product in a separate meeting with fewer members, where the focus is not just on extracting short-term actions. Another signal that the workshop created value was the immediate request for a set of slides that reflects the content of the workshop. The team also wanted to use this in conversation with external parties and came to me with a concrete proposal to facilitate the workshop with specific stakeholders.

7.5 Data analysis

7.5.1 Method
To analyse the workshop data, I created statement cards (Sanders & Stappers, 2012, p. 224,225) to help me structure the messy data by categorising it. This context mapping method entails transcribing the interview including details that stood out to me such as gestures and emotions. Next, I went through the transcript to extract quotes. I selected the information that I considered important expressions about Tiler's strategy or opinions about the workshop format. First, I copied these to separate cards and added a description of the quote in my own words. A title could be added to the card as well, which could be used if the quote already had a clear theme. A statement card looked like this:
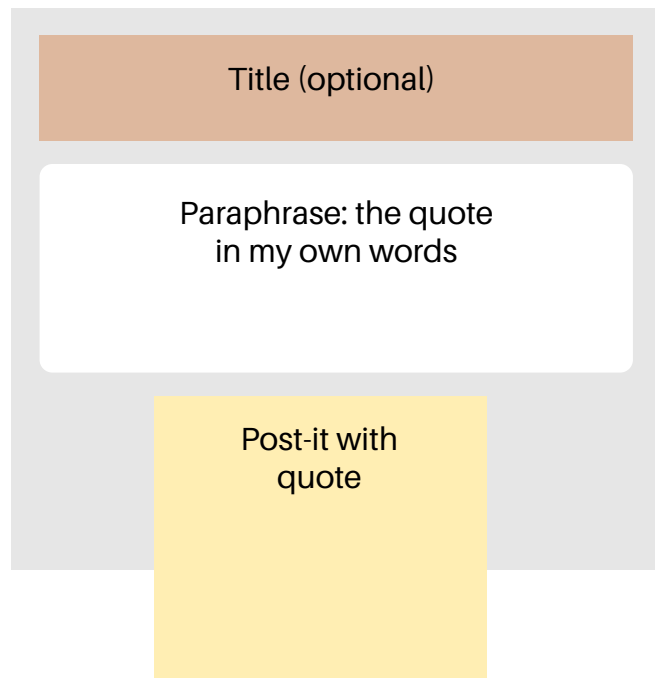
After this process, I clustered the statements cards to see which patterns existed among the quotes in each cluster. Please see Appendix H for an overview of all the statement cards.

7.5.2 Analysis results
On the next page, Figure 20 displays the cluster results of the statement cards. Based on this, I can form initial conclusions for each cluster.
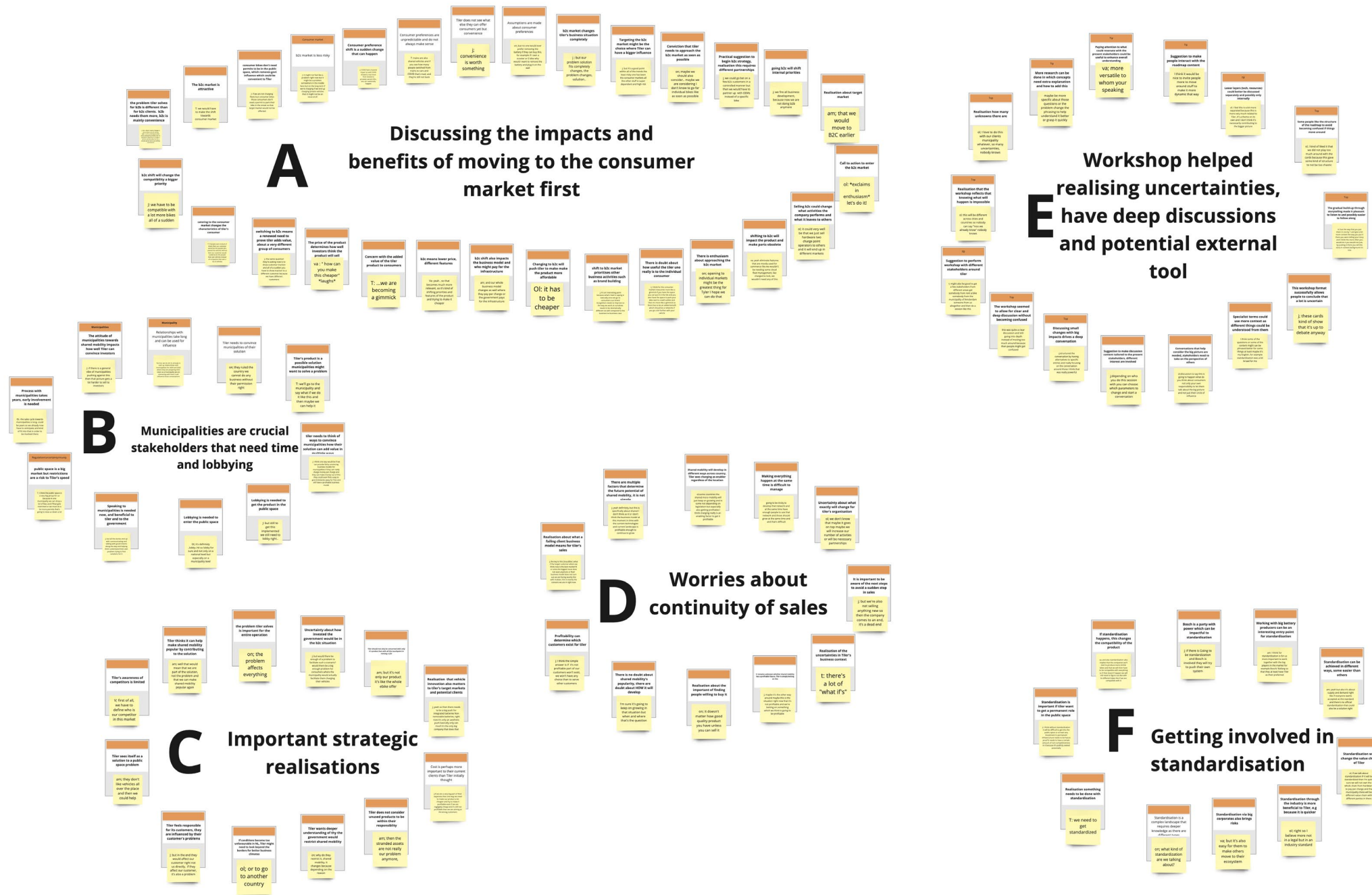
Title (optional)

Paraphrase: the quote
in my own words

Post-it with
quote

Figure 20: Workshop data analysis

Cluster A: Moving to the consumer market

Throughout the workshop, different members of the team concluded that moving to the consumer market first could potentially be a good decision to make. They concluded this based on the risks of the shared mobility market due to uncertainties outside their circle of influence. Therefore, this sounded like an option that I think the team should investigate further.

Cluster B: Municipalities are key stakeholders

To enter the public space, Tiler needs to ensure municipalities are convinced of their solution. However, such processes can take years, which means Tiler needs to start investing time and resources into collaborating with municipalities now if it wants to harvest the benefits in the future.

Cluster C: Realisations about strategy

This cluster is a collection of expressions that reflect thoughts about potentially very important strategic decisions. For example, who does Tiler consider as its competitor or how will they decide that it is time to expand internationally? Also, there was mention of the responsibility of the company as some members discussed how it is not just about Tiler's product, but the entire e-bike offer. For a company that is focused on creating the perfect product, this reveals that they are aware that all the conditions and processes around the product might impact their business too. Thus, Tiler might need to expand their scope of what they consider their responsibility.

Cluster D: Continuity of sales worries

Worries about how to keep selling their product were also expressed multiple times. The most noticeable quote to me was "It doesn't matter how good quality product you have unless you can sell it". This was a quick example of the growing realisation that Tiler needs to be aware of their next steps to ensure they will become and stay profitable in the future.

Cluster E: Workshop value

This cluster contains tips and tops about how the team experienced the workshop. From the quotes, I derived that they consider it to be a valuable way to have in-depth discussions about the uncertainties assisted by the context I helped bring to life. They also expressed that the session could be valuable to perform with stakeholders around the company, indicating interest in broader application of this content.

Cluster F: Approaching standardisation

Lastly, the team spoke about the standardisation, updating each other about what types exist and how they think it should be set up. These conversations showed how they are aware of the power of big companies such as Bosch in this. Such a company can influence the conditions of charging standardisation as they have the resources and people to do it. This fact brought up the dilemma of integrating with Bosch or trying to get a seat at the table themselves to influence this standardisation. It also revealed that the team is a proponent of an industry standard instead of a legal one. Since Tiler pays a fee of 50.000 euros per year to be part of the Wireless Power Consortium, which organises meetings to advance standardisation, I think it could be fruitful to discuss whether this is the right way to invest resources for achieving standardisation.

Conclusion

The roadmap session showed that discussing Tiler's strategy using a roadmap as a discussion tool has value. It enabled the team to consider the complete picture, zoom in on specific details and step back to see the impact on the complete story. It helped to reveal assumptions and consider alternative choices and their consequences. The document reflected the volatility of the market and put different developments into perspective. The roadmap could also be used in sessions with external stakeholders where different topics can be emphasised depending on the involved interests. Improvements can be made in the area of grasping the information quickly and having more empathy with the current knowledge of the participant. From the initial analysis, it can be concluded that Tiler can consider shifting to the consumer market soon, start having conversations with municipalities now and think about how they want to approach standardisation. Additionally, there are more topics that the team can discuss deeply in future sessions such as competition, what should be part of their business activities, and what problem the product solves for their current and future clients. These are all topics that contribute to effective strategy formation.

8 Improving the concept

After evaluation of the first concept, the analysis indicated possible areas of improvement. This chapter will go into a selection of these improvements, explaining why specific adjustments would add value. Because the concept was designed for and tested with the Tiler team, the improvements concentrate on this target audience.
The final chapter will recommend further suggestions for improvement and go over the implications, conclusion and reflection of this project.

8.1 Improvement selection method

To determine which adjustments to make, I compiled list of improvements based on the workshop analysis. As my evaluation provided insights in both the visual design and facilitation method, I categorised each improvement. For example, adding additional verbal explanation is more about the facilitation side of the session. See figure 21 for the overview of improvements.

Design	Facilitation & Design	Facilitation
1: Add image to each horizon > To help imagine new reality/future.	**4: Modify workshop format for different target group** > Consider which layers to add or remove and how to adjust the facilitation accordingly	**5: Provide more details with specialist items from trend layer** > Some terms such as "standardisation" were not clear to all participants
2: Move Technology & Resource layer elsewhere > Was too much info to discuss during workshop		**6:Investigate making the workshop more interactive** > See how to stimulate participants to engage with the dynamic roadmap and move items around themselves
3: "Key takeaways" collection spot > Provide participants with a place to collect their main insights from the session, to reflect on and revisit in the future		

Improvements based on evaluation
- -
Additional ideas for improvement

A: Design: "Hot topic" collection
> If participants hear something they would like to speak about more in the future, they can write it down on a card and save it for later.
> This idea was based on the quote included in the Strategic Realisations Cluster C

B: Design: Modify design to specify which parts are interesting to which stakeholder type
> E.g add icons for mobility providers, municipalities etc.

C: Investigate new workshop/session formats to discuss strategy with
> Different ways to explain content, create new activities to engage with the content etc.

Figure 21: Workshop improvement list

Next, I rated these according to how I estimated the necessary effort and effect of each item. This resulted in the following matrix:
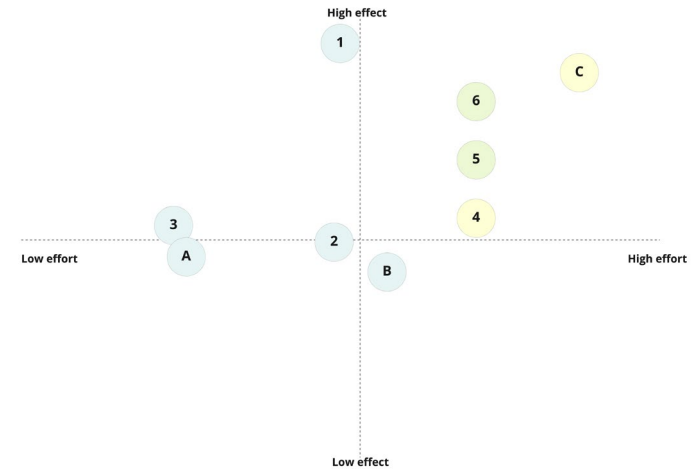
Based on this, I experimented with items 1-3 on the list, which were:
1: Add image to each horizon
2: Move the technology & resource layer elsewhere
3: Provide a place to collect key takeaways from the workshop

The next section will discuss ideas for how I explored these improvements.

8.2 Exploring improvements

8.2.1 Visualising the horizons
During the evaluation, it became clear that it was challenging to create a mental image of all the trends within one horizon, despite the separate trends being familiar easy to understand. To aid this process, a design addition could be to create a visual that

serves as a collective image of the developments within each horizon. To investigate the possible application of this, I used the platform Midjourney (Midjourney, n.d.) to generate compositions of these future situations using artificial intelligence. This discord-operated platform allows users to enter a collection of terms after which the AI model will imagine what this "prompt" looks like. The Midjourney bot will produce four unique images that blend the words entered by the user.

Figure 22 shows a collage of the images generated using prompts that included words such as, "future mobility, resilient cities, greenery, hyper realistic, mopeds, bicycles, hubs, micromobility, sustainability, hubs, roads, infrastructure.

The images produced based on these prompts reflect the knowledge the AI has of the present world. Even after adding keywords as mopeds, bicycles, and other micromobility vehicles, Midjourney still included car-like vehicles, next to futuristic designs for future buildings.

This showed that creating a visualisation of a new urban mobility future using Midjourney needs more effort and research to find the right prompts or visualise this future in a different way.

Figure 22: Future visualisations

8.2.2 Moving the Technology & Resource layer

The information stored in the trend layer offered enough input to enable rich discussions during the evaluation. Therefore, the information in the bottom about technologies and potential partnerships or new employees was not discussed in detail. There were occasional mentions of product features and partnerships but nothing specific was spoken about. In the reflection, it was mentioned that this information was perhaps too much to discuss in addition to the other topics. Therefore, in a new version the technology and resource layers could be removed and put elsewhere. This would also make more room for the other content to be structured further apart, reducing the amount of visual elements, which could make it easier to understand it quickly. As visible on the right in Figure 23, removing these layers results in less elements being linked to each other. For example, "AI for theft protection" from the technology layer was linked to "the addition of a lock feature" in the product layer. Because the links between such information can be important for conversations about the complete picture, it could be useful to investigate in what other ways the technology and resource elements could be integrated.

8.2.3 Takeaway collection spot

As a facilitator looking to evaluate and investigate concept improvements, I transcribed the entire workshop for analysis. Considering the interesting statements made and insights gathered by the participants, it could be valuable to create a place where these main takeaways could be collected for further discussion. For example, there could be empty "Takeaway cards" such as displayed in Figure 24 that could be included in the reflection part of the workshop, providing a space to write down important thoughts.
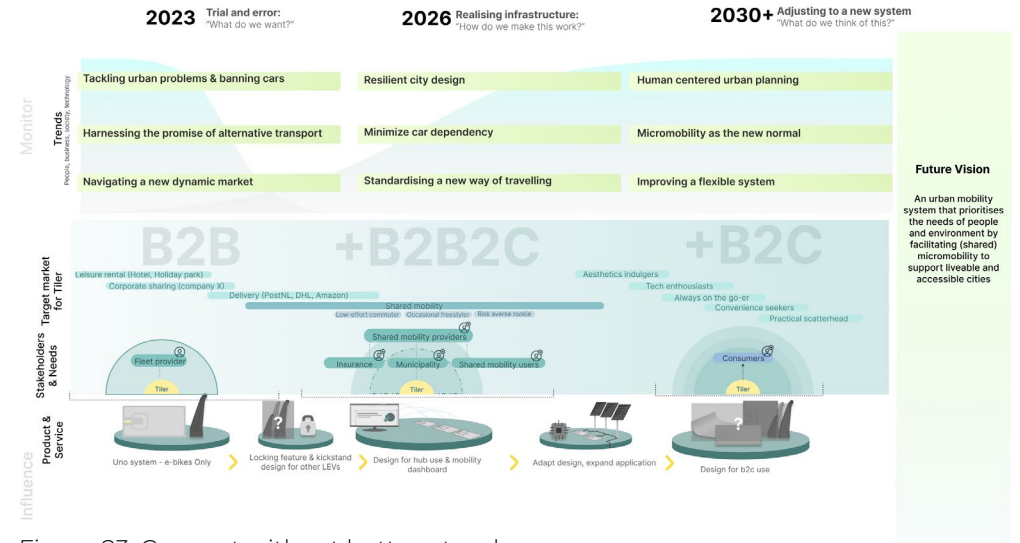

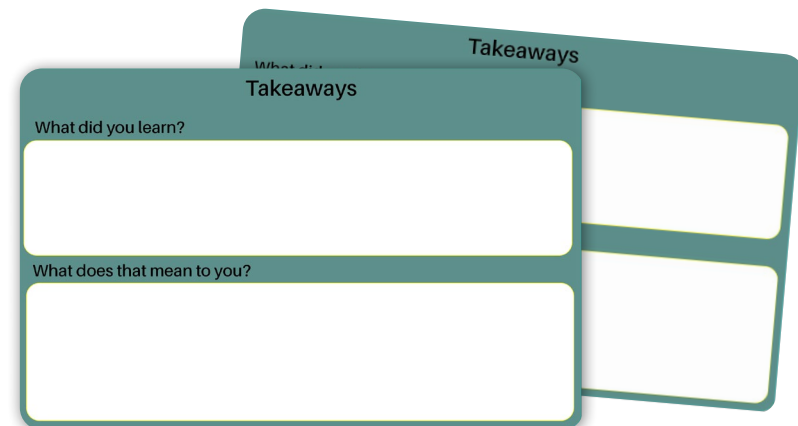Figure 23: Concept without bottom two layers

Figure 24: Example of Takeaway card

9 Conclusion

After touching upon several improvements I tested out, this chapter presents the final conclusions of this project. In the implication sections, the chapter describes the significance of my findings for Tiler and strategic product design peers. Moreover, it explains how the method and content of the concept could be of value to other startups or stakeholders within and outside mobility. Finally, the conclusion highlights the most important findings after which the reflection section looks back on the entire project in the last chapter.

9.1 Implications for Tiler and Strategic Design

9.2.1 For Tiler
The results from this thesis suggest that a dynamic roadmap presents a valuable tool to consider strategic decisions about the future of Tiler. As a hardware start up in a fast-changing domain, gaining awareness of uncertainties that lie ahead has proven to be useful in different ways. Discussing strategy in a team setting with the roadmap as guidance has allowed for detailed conversations in which all team members managed to consider the mobility context beyond their own specialist knowledge. The results have led to a practical change in the content of the weekly meetings and will potentially be integrated as an external communication tool with other stakeholders such as a municipality. The company is investigating the possibility to conduct a similar session using the roadmap with a municipality and project developer. These parties showed interest because they lack overview of the complete context and its developments, yet they are aware of the need to act.
Furthermore, the company has expressed the desire to include a condensed version of the roadmap content in their pitchdeck.

Overall, the initial impact shows that the results have a significant impact as Tiler is seeking to integrate the roadmap in their company activities.

9.2.2 For strategic product design
During the master's program, the roadmapping course presented students with a new framework to converge trends, time and resources into a coherent whole to guide innovation into the future. Combining insights and placing them into time can help companies to rethink priorities and envision what is needed to achieve certain goals. Because of the tumultuous nature of the mobility context and status of company, this project required a different approach to road mapping that did not present the path to the future as a linear one.
This project shows that it is possible to include different scenarios in a roadmap and make it dynamic to reflect different possible futures. Showing the result of a changing context can be achieved through digital or paper prototyping in which the separate elements can be moved around or discussed to see what the impact of a particular change would be. This dynamic roadmapping method can be valuable in situations that involve impactful uncertainties in a complex stakeholder environment. For the designers themselves, it provides a way to transform abstract futures into a coherent overview conveying detailed research in a structured and accessible way.

9.2 Implications for (mobility) start-ups seeking product market fit

Besides Tiler, the results from this project could also be meaningful to other start-ups operating in the mobility domain. The method and content can inform young companies on which

developments to pay attention to now and in the future, and investigate their product fit with different target markets. It could help to consider multiple strategic decisions at once and align on priorities with the employees or external stakeholders. For start-ups outside the mobility context, the method of dynamic road mapping could be useful for building a long-term strategy and determine threats and opportunities. The roadmap can provide a place to collect strategic information and continue to have conversations about it as the company grows and develops.

9.3 Implications for larger private or public organisations working on complex issues

As I have seen during my research, thinking about possible futures with the help of scenarios is already done by governments and consultancies. I have come across multiple detailed reports that outline possible futures based on data and research. Applying the method of dynamic roadmapping could be an addition to make detailed research more accessible and easy to grasp. Perhaps ot could also help to consider new possibilities about the future as it invites to speculate about the future. For organisations interested in mobility such as municipalities and providers, the content of this projects' roadmap offers a holistic view of developments in urban mobility that could help companies look beyond their own circle of influence or interests.

9.4 Recommendations

Next to the improvements explored in chapter eight, the evaluation sessions brought other ideas to light. These will be discussed in this section, as suggestions for next steps to take to improve the concept.

9.4.1 Stakeholder awareness workshop
The workshop held with the Tiler team aimed to test the value of discussing strategy using a dynamic roadmap. However, since the underlying research includes trends and developments that apply to different types of stakeholders, the roadmap could also be adjusted to use in a stakeholder awareness workshop. Depending on who is involved, the trend layer could include or exclude specific topics to stimulate participants to talk about these elements the most.

9.4.2 On-boarding tool for Tiler
For now, the roadmap presents the first step towards the formation of a long-term strategy for Tiler. Besides being a document that can be revisited over time to track developments and goals, the roadmap could also be modified to serve as an on-boarding tool for Tiler. This could be valuable as it helps new employees to get a general understanding of Tiler's business context and provides an opportunity for new talent to consider how they could best add value in their role if they want to contribute to Tiler's mission. Also, using the roadmap content for on-boarding also offers repeated opportunity for the Tiler team to consider what information they think is important to carry out.

9.5 Conclusion

I started this project with the purpose of designing for the long-term strategy of Tiler based on research into the future of mobility. After deep research into the domain and identification of different future scenarios, I reframed the challenge to what I think Tiler could profit from. To provide an answer that Tiler can use to make an abstract future more tangible, I designed a dynamic roadmap.

This concept has helped the team to get a bird's eye view of the mobility context and determine bottlenecks and opportunities. To succeed in the public space, Tiler needs to manage municipalities close and invest in strong relationships. Also, preparing the product for the consumer market could be the best next step to investigate further regardless of shared mobility's success in the coming years. Communicating about the future of the company inspired the team to do this weekly in a renewed version of the market fit meeting.

Including scenarios and making the roadmap dynamic shows a new way in which roadmaps can be used. The workshop in which it was evaluated indicates that a roadmap was a valuable tool to bring Tiler together to discuss what is happening around the company, what that means to them and how they think about the future. The method of dynamic roadmapping could be applied to other challenges that involves high degrees of uncertainty and divergent interests.

10 Reflection

10.1 Reflection on the project

Overall, my graduation project has been a major learning event. I went from working in teams during master courses to being my own project leader, designer, and planning manager. I developed my interview skills and enjoyed interviewing people from different companies. I facilitated a workshop I developed myself for the first time and improved graphic design and prototyping skills.

In my design process, I naturally gravitated towards the idea of a roadmapping concept. My decision to set this scope early on was motivated by the fact that I saw struggles concerning the timing of innovation, why to target future markets and where to try and exert influence. This instinctively led me to a roadmap, which I think still allowed for lots of design freedom.

A possible downside of early scoping is that I missed opportunities to produce better or additional results that cannot be captured in a roadmap. However, I did explore the ways in which a roadmap could be tailored to fit the uncertainties in this situation. By including scenarios in the roadmap and not presenting the future as a linear path to success, I feel that I created a concept that aligns better with Tiler's context and provides an extension to the roadmapping method I was familiar with.

10.2 Reflection on personal learning ambitions

At the start of this project, I defined several learning ambitions I hoped to get more experience with. In short these came down to discovering how I can apply strategic design to a complex societal challenge, learn more about operating in a start-up environment, explore storytelling and argumentation, and lastly, finding balance in knowing when to act fast and when to be patient.

10.2.1 Applying strategic design in a complex societal challenge

In hindsight, I am more aware of how Tiler is only a small piece of the bigger mobility puzzle toward a different future. Through my research, I developed a broad understanding of the mobility system, its stakeholders and how it is changing. Being part of a start up in this big domain was very interesting as I could see the difference between what seemed important on a zoomed in and zoomed out level.

Thanks to this project, conceptual thinking about a complex challenge, researching the details and bringing it together visually appeals to me even more.

10.2.2 Operating in a start-up environment

Setting foot in the world of entrepreneurship and start ups has always interested me. My experience in education so far had primarily been with larger companies, proposing small changes in semester courses. At a start-up I expected a fast-paced environment where the small number of employees allow for quick adjustments, super-efficient communication, and lots of conversations about how to achieve the next milestone. Looking at what I experienced in my time at Tiler, I learned more about day-to-day start-up business, language about "beachhead markets", investors and showing traction to clients. In comparison to graduation assignments regarding new product design, my project existed more on its own, explaining my search for purpose in the beginning. Being a one-woman strategy department was quite challenging but also really interesting to experience. I can imagine that this project will have contributed to understanding the value of strategic design in the company.

Also, I learned that communication and conversations about the future are different than what I expected. Besides the fact that it is possible I simply was not present during these conversations I did observe that not everyone was up to date on all the latest info all the time.

10.2.3 Storytelling and argumentation

To me, one of the joys of design exists in combining the right elements in a story to convey information in a credible and thought-provoking way. Empathising with my audience and speaking to their imagination is a skill I hope to keep developing. In this project, I feel like I managed to incorporate storytelling in how I communicated my roadmap. If I would do this again, I would spend more time forming visual support for my story to bring it to life even more.

10.2.4 Finding balance on when to act

As I wrote in the project brief, I often operate in the extremes when it comes to knowing when to act. This means I find it challenging to distinguish between when to let go of control and when to take it. During this project, I generally feel I managed this better by being pro-active about meetings and asking to be connected to Tiler's stakeholders. This last point did result in some delay as I was unaware of the communication standards of the company itself. I had the assumption that a verbal request was the right way but I soon discovered I could be more demanding and send a list of actions of who I wanted to be connected with. For example, someone from a mobility provider or municipality. However, this was not as effective as I had hoped because I was dependent on getting an introduction through the team, instead of being in direct contact myself. Therefore, I switched tactics and began to approach people directly through LinkedIn. In this way I could better manage the contact, expectations and timing of the interviews. This taught me I prefer being in direct contact so I can maintain an overview of the situation and stay on top of my timing.

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Appendices