MSC. GRADUATION THESIS
STAN VAN DER MEER
2021

TU Delft Delft University of Technology

TILER

TILER CARGO

STRATEGY & CONCEPT DESIGN
FOR CHARGING LEFVs IN CITY LOGISTICS

MSc Integrated Product Design

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November 5th 2021

TILER Cargo: Strategy & concept design for charging LEFVs in city logistics

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Graduation Project (ID4190-16)

November 2021

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ACKNOWLEDGEMENTS

This graduation project concludes a six-year period of studying at the Industrial Design Engineering faculty at the Delft University of Technology, where I partook in numerous memoreable projects and acquired a valuable set of design skills that will hopefully contribute to a fruitful career in the field of design. During my years in Delft I started to develop an interest in all things mobility related, which became a recurring theme throughout my portfolio.

Starting graduation during the Covid-19 lockdown proposed its challenges, so I'm to happy to have finished this project succesfully in the end. Cycling around a deserted Rotterdam underlined the extensive effects of mobility to public space for me, which inspired me to explore the possibilities for organising distribution in a different, healthier way.

Firstly I want to thank Sjoerd van Dommelen and Ruud van Heur for the constructive and motivating sessions. Your support was invaluable throughout the project - which didn't always run smoothly. There were many moments where I had gotten off-track. Continuously showing me a different perspective and ensuring me the results were not half-bad kept me motivated to finish it off in the end. Thanks for taking me along.

Secondly, thanks to Tiler for offering me the possibility to shape my own project in a time where getting in contact with companies was a bit more complicated than usual. Without Christiaan van Nispen and the rest of the team this project would not have been possible. Their extensive experience, network and proactive energy combined with our shared vision for urban mobility resulted in a project that will hopefully be a small step towards a more sustainable future of transportation. Thirdly I need to thank all the external parties involved; Erik de Winter (Cargoroo), Joris Kerremans (Coolblue), Naiem Kadry (Marleenkookt), Willem Boverhoff (Dockr), Pieter Bouwstra (PicNic), Jan Robbert Albrechts (Gemeente Rotterdam) and Luuk Nijland (Cargo Cycling) for their time and insights regarding cargobike distribution. A special thanks to Cargoroo for lending me one of their cargobikes to use for prototyping and validation of the concept - an essential asset in this project.

Lastly, thanks to my fellow students, friends, roommates and family for supporting me in all kinds of ways throughout the project - a welcoming gift in a time where graduating would otherwise have been a lonesome process.


BAHCO
safefeet
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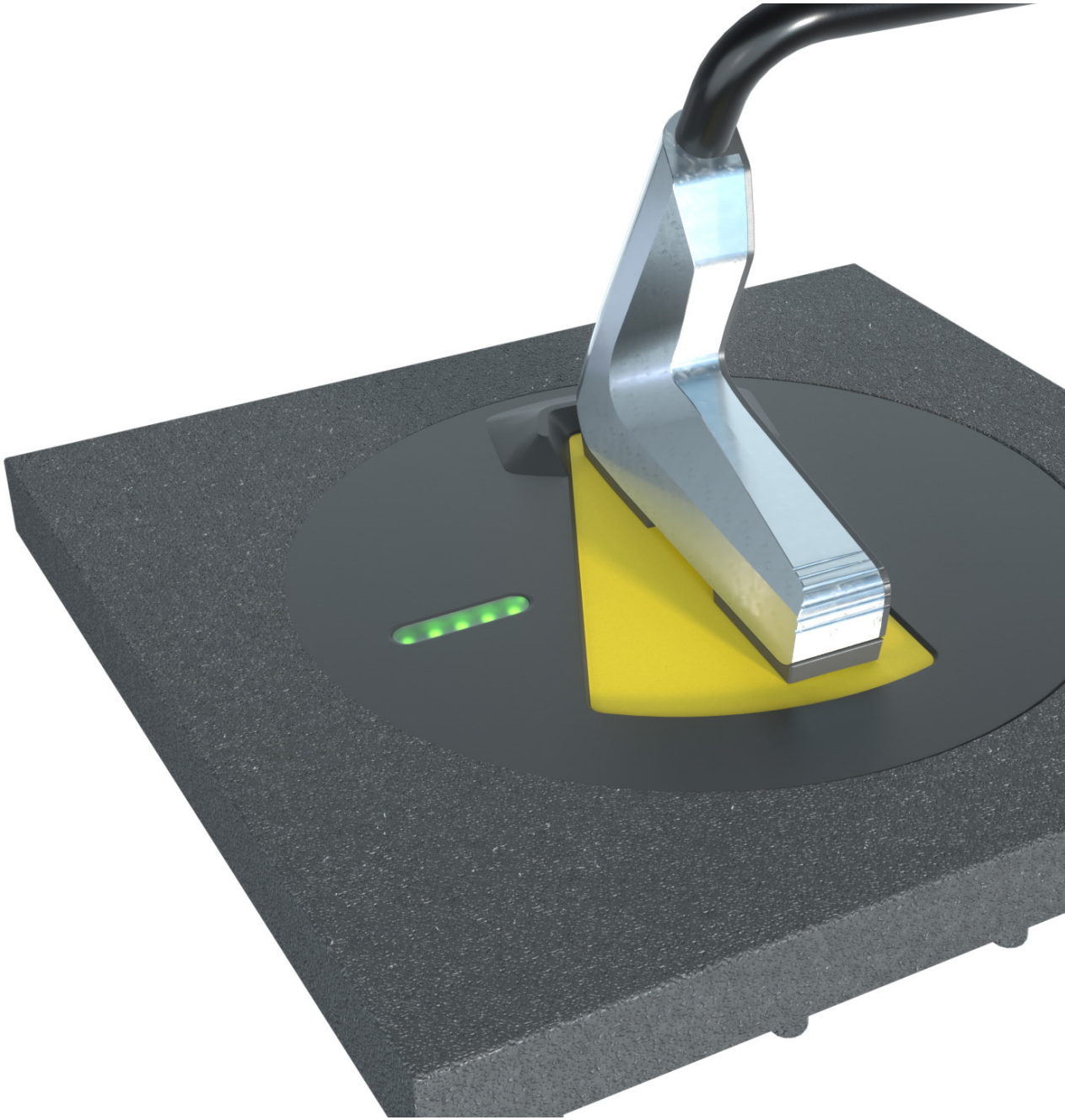
ABSTRACT

Tiler Cargo is a wireless charger for electric cargobikes. It features a charger incorporated into the existing kickstand of the bicycle. Parking the bike in the regular fashion onto the accompanying charging tile is sufficient for charging the bike. In this way, every stop at the hub is used for incremental charging, resulting in a fluent effortless charging procedure.
Additionally, the charger enables the customer to incorporate the cargobike into their fleetmanagement system by offering the possibility to transfer data through the incorporated wireless connection with the bicycle(s). Remote monitoring enables Tiler and the customer to keep track of the bicycle and the battery, preventing unpleasant surprises on the road. All powered vehicles are increasingly becoming sources of data used to optimise operations. Tiler Cargo is the connecting element to fully incorporate the cargobike into the logistic system.
The design takes away current issues with bulk charging batteries in the commercial logistic domain; chaotic charging cabinets with dozens of adapters and human responsibility to thoroughly perform charging procedures resulted in reliability and scaleability problems. Not to mention fire hazard.
The development of the wireless charger is supported by the Vision for LEFV 2031 and the accompanying roadmap, which describe the expected developments in the domain of light electric vehicles and charging in the (near-)future.



CONTENTS

** These chapters contain confidential material and have been published internally only.*

1. INTRODUCTION

City centers are becoming increasingly clogged up with cars. The transition towards more efficient, versatile and clean means of transport has started, however hasn't taken over urban transport by storm yet.
A significant part of mobility in cities consists of commercial transport, which yields interesting potential. The use of electric vehicles for delivery, retail and service purposes opened the opportunity for me to think about the urban infrastructure of the future, in which small electric vehicles could have a large responsibility. Light electric vehicles are able to solve problems for both road users and delivery personnel, as is believed by i.a. PostNL, having signed the GreenDeal. In the last decade, many different parties have been experimenting with bicycle-like vehicles in the last-mile in order to solve issues regarding nuisance for inhabitants and simultaneously further optimise the delivery process. Freight bicycles are promising in that regard, but the ideal cargobike for commercial purposes hasn't been invented yet.

The shared interest of Tiler, TU Delft and myself to accelerate the implementation of freight bicycles stimulates the development of a charging infrastructure for these vehicles.
The driving force for setting up this project is the enthusiasm for mobility and the stubborn optimism in believing that we can shift to sustainable modes of transport in a short timespan. Seeing how big corporations and governments are slowly but steadily changing their course and investing in a clean future of mobility is triggering me to be a part of this movement. I think we are getting closer to a tipping point at which this transition could quickly accelerate, proposing exciting challenges to designers to give shape to this new infrastructure in many different ways.
The combination of giving shape to a future context and proposing an accompanying concept design for use in that specific context to me is a strong method for creating design concepts driven by a moral belief.

1.1 DESIGN BRIEF

1.1.1 Company

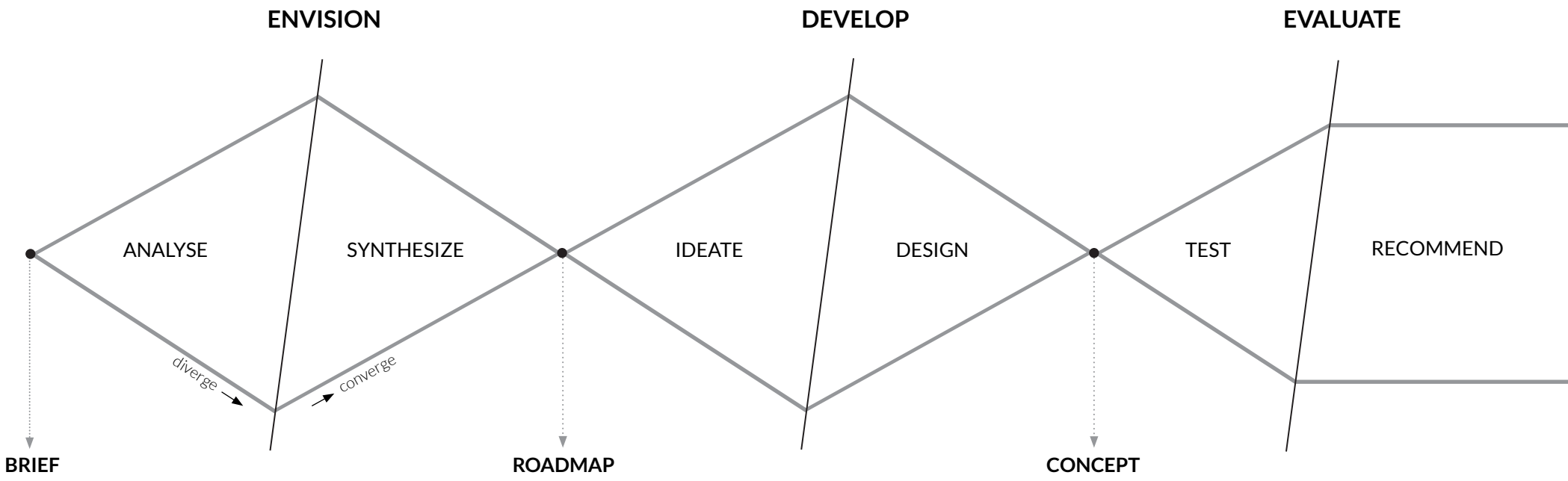
Tiler is developing the world's first wireless charging solution for e-bikes using induction technology, in the shape of an outdoor pavement tile. Their goal is to realise a seamless travel experience and be part of an emissionless infrastructure in cities. Their mission sparked from an academic project at Delft University of Technology in 2019 and the team is now located at the Yes!Delft incubator. (Tiler Charge, 2020)

The current focus of the company is to further develop their functioning prototype, consisting of a charging tile and accompanying kick-stand for regular e-bikes to move into the production phase in the coming year. Simultaneously, Tiler is looking for alternative areas in which to implement their unique technology, which has a large potential outside of the current scope to be explored still.

The goal is to map the future opportunities for Tiler in the LEFV market prior to developing a cargobike charger

1.1.2 Challenge

The goal is to find out if and how Tiler can take a role in revolutionising the use of light electric vehicles in urban distribution. This domain is young and innovative, and is characterised by its fast growth, especially in the most recent years under influence of the pandemic. Due to ongoing developments - vehicles, trends, regulations - it is essential to gather insights in the near-future of this domain and craft a plausible strategy prior to developing a charging solution. Researching wireless charging in this context should serve as a starting point for developing a concept design aimed at making cargobikes more attractive for corporate fleets.


ENVISION
DEVELOP
EVALUATE
ANALYSE
SYNTHESIZE
IDEATE
DESIGN
TEST
RECOMMEND
diverge
converge
BRIEF
ROADMAP
CONCEPT
TIME

1.2 ACTIVITIES & METHODOLOGY

To find validation for the question of 'why to develop a charging solution for light electric vehicles?', I will firstly research developments in urban mobility. The ViP framework will be used to find upcoming technologies, regulations and trends, which are used to shape a Vision for Urban Freight Transport in 2031 (Appendix chapter 9.1). This vision will display the use of light electric freight vehicles (LEFVs) and how they will be charged. The vision showcases the use of LEFVs in the industries of retail, catering, service logistics, mail & parcels and their place in the changing context of the urban environment. Chapters 2 and 3 of this report describe the results of the analysis and synthesis.

Two main deliverables are aimed for in this project; A tactical roadmap and an accompanying concept design. To achieve these deliverables, a double diamond-shaped process is followed along the way. The Vision serves as an analytical inspiration for the Roadmap, in which the Vision is translated into a strategic advice for Tiler towards the future of cargobike charging in the commercial domain; A strategic pathway to develop a unique selling proposition (USP) in the rapidly developing market of vehicle charging. This multi-stage approach will facilitate the penetration of Tiler into this new market and ensures a steady, durable position over time. The roadmap will entail a staged approach, using defined timeframes - horizons - in order to identify essential product properties in each stage.

Following-up the roadmap, a universally applicable charging concept will be developed for Tiler to be implemented in Horizon 1. The main goal of this solution is to lower the threshold for electrifying commercial fleets of vehicles by improving the charging experience. The proposed solution is aimed at the market of wirelessly charging LEFVs in the commercial semi-public and private domain.

The concept (Chapter 5) serves as a first step to enter the domain of cargobikes. The ideation is the first part of the development process, in which the domain is mapped out and the design space is explored. This phase is concluded with a concept idea, which is further detailed in the design phase. Testing of the detailed concept is necessary to craft valid recommendations for further development of the concept into a feasible product.

2. URBAN MOBILITY IN 2021

Mobility has a significant influence on the quality of life in the city. People are continuously in transit; we either travel for work or leisure, or are dependent on others delivering goods or services in the right place at the right time. The way we organise travel impacts our freedom to move, the spaces we share and the global environment we live in; City logistics is of vital importance in our lives.

2.1.1 Accessibility

Due to society's ever increasing demands, pressure on the road infrastructure is continuously growing and access to urban areas is becoming harder to maintain, while at the same time cities are likely to keep expanding.
However, cars are relatively space-inefficient. The preference for this vehicle ultimately prevents people from traveling efficiently and complicates parking at their destination. Cities are highly dependent on in- and outgoing flows of people and goods to, for instance, construction sites, restaurants, shops, offices and households. To keep ahead with all these developments, structural changes in commercial mobility are necessary.

> *Figure 1: Reconsidering the way public space is allocated could yield beneficial improvements for the health and wellbeing of inhabitants. (Harms, Kansen, 2018)*

2.1.2 Public space

Apart from accessibility, the quality of life in the city is partially dependent on the quality of public space, which are currently filled with roads and internal combustion engined cars. The way shared outdoor space is arranged has tremendous effects on the physical and mental wellbeing of the population regarding noise, air quality and green space. Additionally, the dominance of the automobile is directly proposing safety hazards for other - more vulnerable - traffic participants young and old.

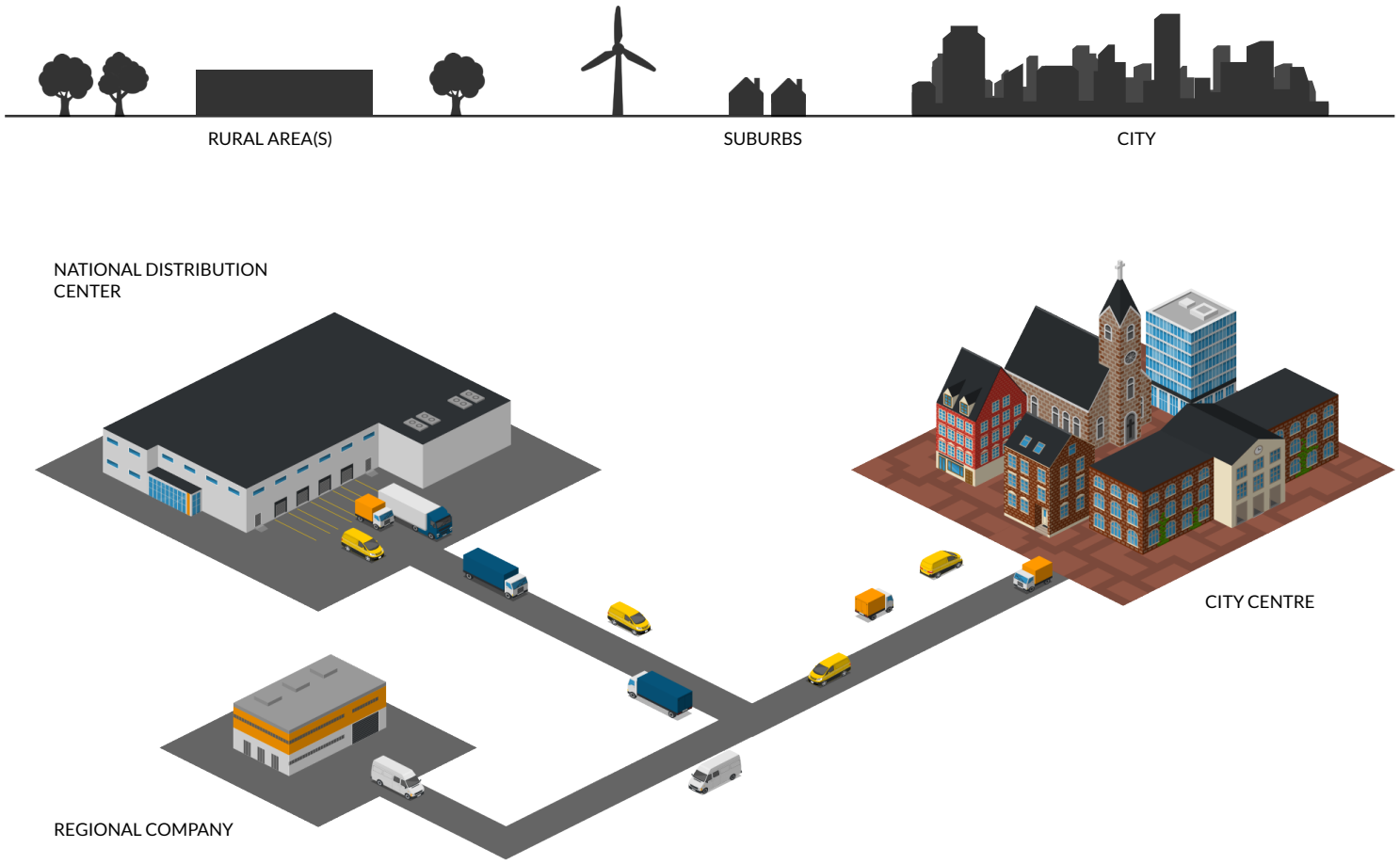
2.1.3 Policy & environment

Due to extensive effects of fossil fueled vehicles on the global environment, the EU has committed to implementing the Paris Agreement, meaning CO2 emissions caused by the mobility sector need to be drastically reduced. The feasibility of the goals regarding national reduction of emissions is debateable, since the results so far are lagging behind. Policymakers are therefore urged to establish regulations meant to reduce greenhouse gas emissions caused by the transportation sector, while ideally improving accessibility and living conditions for inhabitants. Environmental zones and time-slots for city centre-access found their introduction in the past years and now is the time for clean, quiet and space-efficient vehicles to prevail.
Mobility and society are closely related, as is expressed in the figure on the right. Current and future evelopments in logistics could have large impact on society and the way we live.

Figure 2: Electric van used for parcel delivery in the historic city centre. The share of electric vehicles in city logistics is currently still below 1% (ACEA 2017) <

	SOCIETY		LOGISTICS	
TODAY	 **13%** of the air pollution in cities is caused by city logistics. (Tol, Otten, 2019)	 **60%** of total noise pollution originates from cars (Ploos van Amstel et al. 2018)	 **49%** of PostNL customers dissatisfied with delivery timing (Kassa, 2018)	 **15-50** delivery vans per day in an average Dutch street (Ploos van Amstel, 2015)
FUTURE	 **80%** of people living in cities by 2050 (Ploos van Amstel et al. 2018)	 **60%** of emission reduction by 2050 (City of Rotterdam, 2019)	 **3-4%** of yearly growth in city logistics due to online shopping (Ploos van Amstel, 2015)	 **40-50%** of Dutch people below 40 y.o. will buy their groceries online by 2025 (Distrifood, 2018)

Figure 3: Mobility and society are closely intertwined; consumer behaviour has strong side effects for society. The sector of city logistics offers promising opportunities for improving society's overall



> *Figure 4: Traditional logistic model with vehicles travelling 80-100km from central DC or company location to the city. (Den Boer et al. 2017) Vans are used for more than 80% of all city logistics. (Ploos van Amstel et al. 2018)*

2.1.4 Commercial Mobility

In general, a large number of factors are of influence in organising the most efficient logistical chain; the average freight volume and weight, requirements for cooling or critical timing, the density of demand or the necessity to bring tools and/or materials. The current linear model is depicted above. Taking into account the large distances vans and trucks travel, it is no surprise that smaller vehicles are undesireable in the traditional logistic model. The average distances travelled explains why the delivery van is the obvious weapon of choice; big and comfortable enough to cover large distances quickly, while still being small and agile enough to manouver in narrow streets.

The result: Almost 1 million corporately used vans registered on the Dutch roads (CBS 2021). Main roads and neighborhoods suffer from chaotically parked vans blocking the road, with consequences for traffic flow and safety.
It quickly becomes clear that achieving clean and space-efficient means of transport is not just a matter of replacing vans with small electric vehicles; the complete system of commercial transportation needs to be reassessed. Hubs on the border of cities could be one of the solutions. Longer distances from (inter)national distribution centers can be more efficiently done by large trucks, while the last mile is performed best with small electric vehicles. Organising logistic systems with hubs yields big opportunities for the adoption of electric cargobikes and other LEFVs.

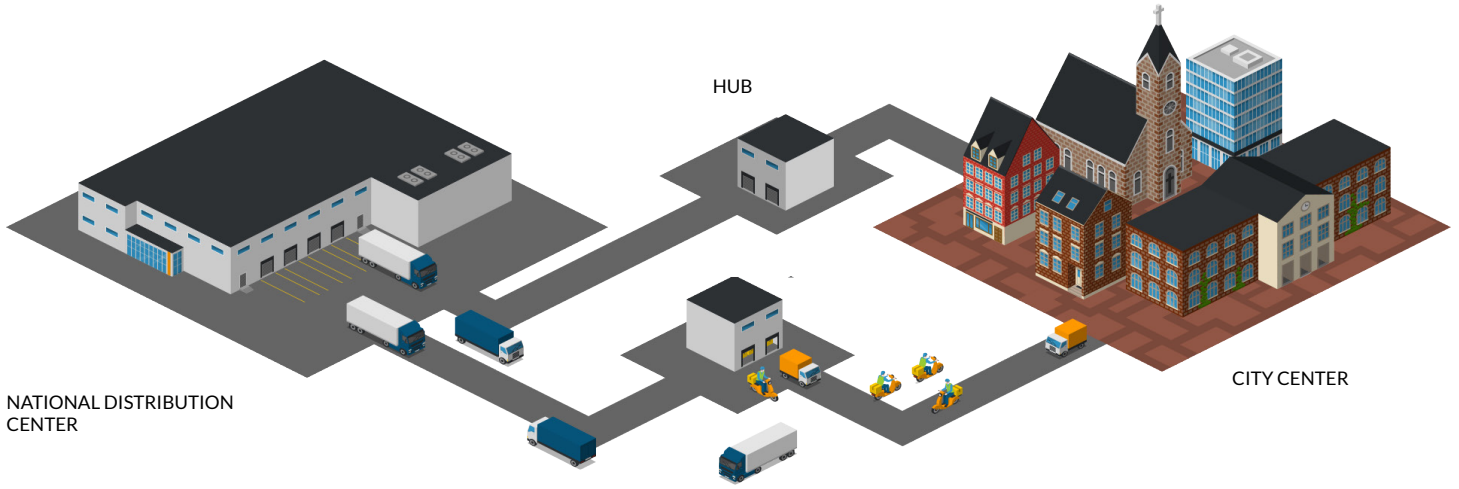


Figure 5: Potential logistic model using hubs with small vehicles travelling 20-40km to shops, offices, homes, construction sites or pickup locations in the city centre. A staged model reduces the need for vans.

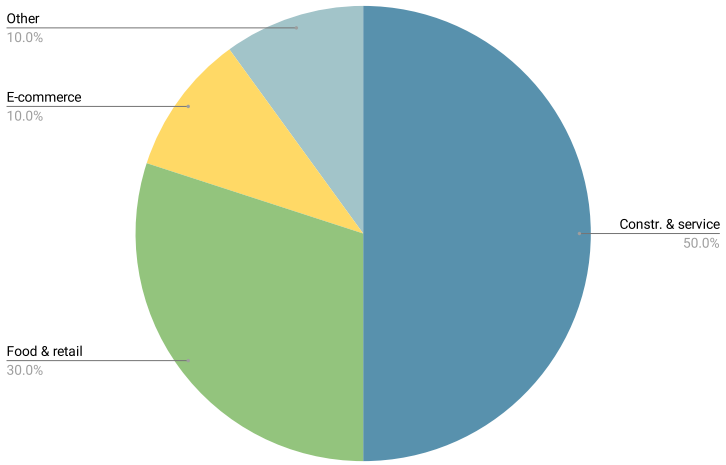


Figure 6: Three large branches can be identified based on their typical activities; E-commerce & parcel couriers, food & retail and construction & service providers. Percentages are rounded off to 5%.

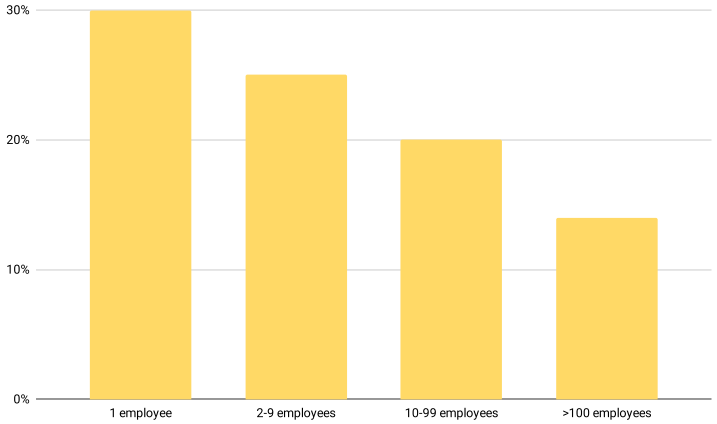


Figure 8: Vans employed by companies broken down by company size (Connekt/Topsector Logistiek, 2017).

Figure 7: Cooled transport to the customers doorstep in the city centre of Assen (Dagblad v/h Noorden)

Figure 9: Traffic jam at De Negen Straatjes in Amsterdam due to parked vans (Source: http://www.grachtennegenplus.nl). Vans are responsible for 27 million trips in and out o Amsterdam each year. (Tol, Otten, 2019)

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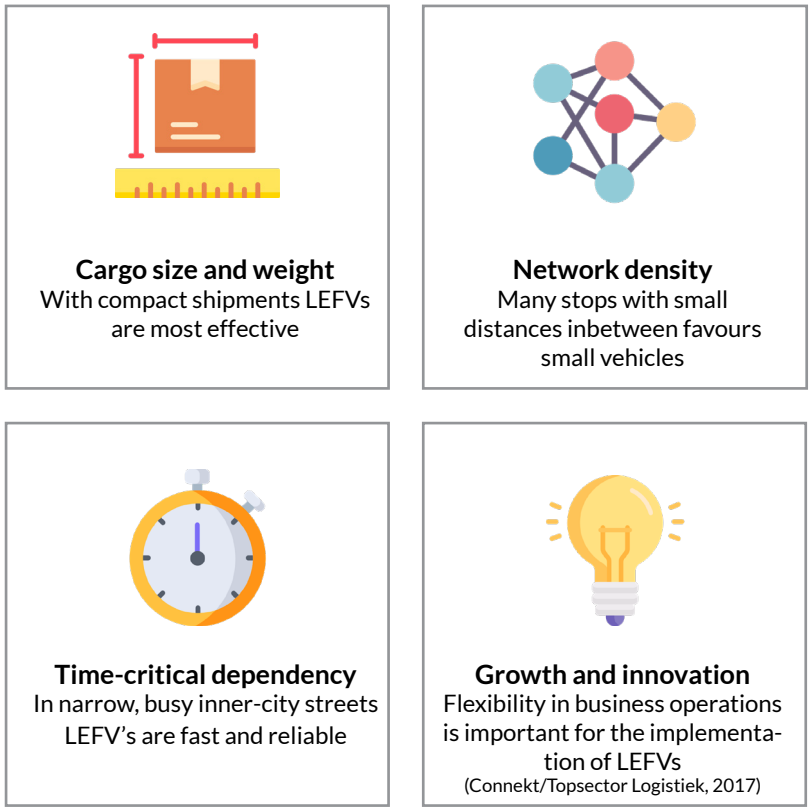
2.2 WHERE CAN A CARGOBIKE REPLACE A VAN?

For the three largest branches active in urban logistics, the rate for adoption of cargobikes was determined using the criteria on the left; Cargo size, network density, time-critical dependency and possibilities for innovation.
The varying scores per sector indicate at which term cargobike useage is expected to grow. Aside from which types of LEFV are likely to be used, the domain in which they are used has a large influence on the criteria for a potential charging solution. Useage and charging scenarios can differ significantly per domain.



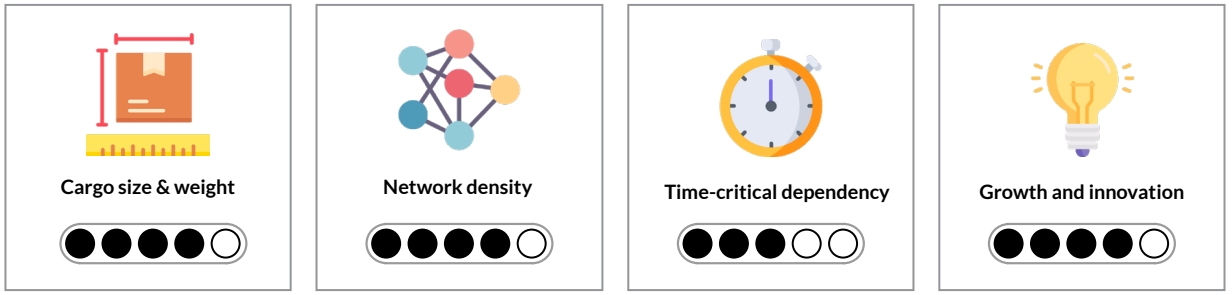
> *Figure 10: A number of criteria to gauge the potential for small electric vehicles within these categories were defined by researchers of the Amsterdam University of Applied Sciences as follows (Balm et al, 2018)*

> *Figure 11: Chaotically packet PostNL delivery van (image source: PostNL)*

> *Image source: Cycloon*

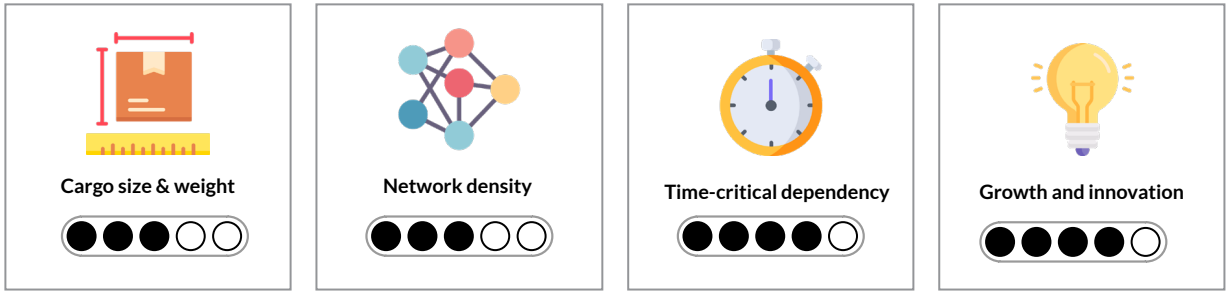
2.2.1 Logistic operators & e-commerce

At the moment, a high rate of cargobikes is already used in the sector of parcel delivery and online shopping. Cargobikes thrive well in this domain due to the small, light parcels, typically high number of destinations close together and the fact that large companies have taken a leading role in experimenting with these vehicles from early on. In the Netherlands, PostNL, DHL and UPS - to name a few - have successfully profited from the benefits of LEFVs for a while already. Their high potential is also indicated by the number of smaller, novel players entering the market, for example Fietskoeriers.nl, Cycloon and Peddler, offering local, fast delivery by cargobike.

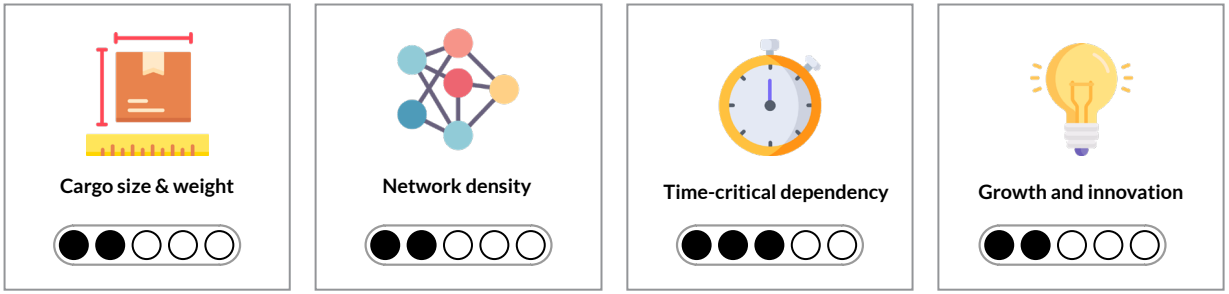


2.2.2 Food & retail

Physical stores and restaurants rarely use cargobikes. Restocking of stores and restaurants is done by large trucks, due to large shipments and cooling requirements. Restaurants that offer delivery of warm meals often use regular e-bikes, since the delivery is too time-critical to require the volume of a cargobike.
This sector can however achieve high potential when retailers adapt their retail spaces and stock keeping for local delivery. Cargobikes offer this sector a significant opportunity to compete with e-commerce webshops by organising local delivery in-house. Examples of companies already successfully doing this are MarleenKookt, Coolblue and Rechtstreex.



> *Figure 12: MarleenKookt delivers freshly cooked meals at a preferred time slot in the evening (image source: MarleenKookt)*



2.2.3 Service logistics & construction

Due to the usually heavy, large shipments, low network density, low level of opportunity for innovation and low time-criticality, the construction sector seems to be unsuited for the deployment of cargobikes. (Duic, 2018).
However, the service-sector does show opportunities for the cargobike. Service mechanics often perform specialised work at office buildings, residencies and in public spaces using limited amounts of tools. This group endures problems with accessibility, which suggests cargobikes could pose an alternative. The possibilities for cargobikes are likely depending on network density for this solution to be financially interesting enough to attract small to medium-sized companies.

> *Figure 13: The Dutch national roadservice (ANWB) dodging accessibility issues by using cargobikes (image source: ANWB)*

2.3 TYPES OF LEFVS IN CITY LOGISTICS

So far, a number of terminologies have been used to describe electric vehicles in this context: LEFVs, cargobikes, small electric vehicles, etc. Further specification is necessary to understand their differences, resemblances and future potential throughout this project. The light electric freight vehicles (LEFV) available in the market can be broadly divided in three categories, mostly based on legislation and type-approval requirements formed by the Dutch Roadtraffic Service (RDW).

Electric cargobikes with pedal assistance up to 250W
Electric cargobikes with pedal assistance
Electric motorised cargo vehicles without pedals

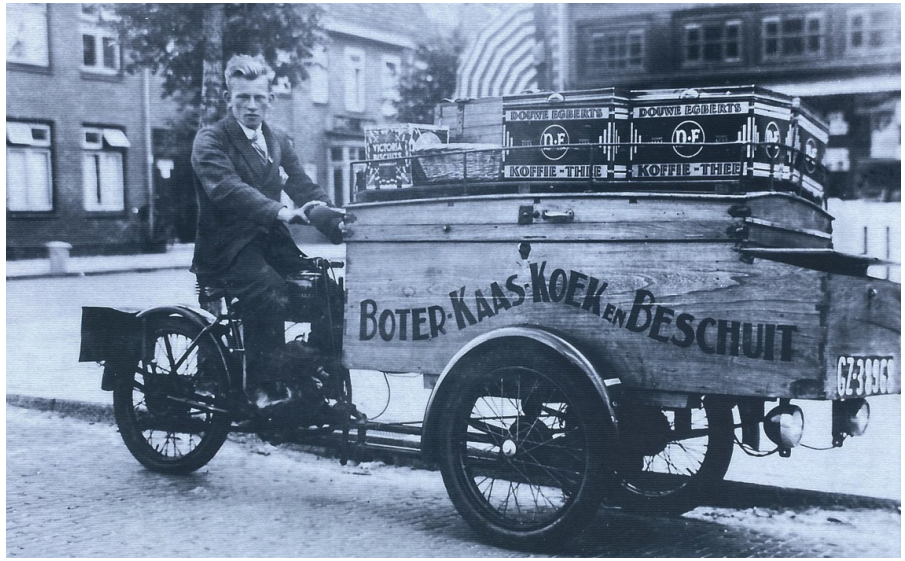
	Manufacturers	License & registration	Empty weight [kg]	Cargo capacity [m^3]	Power [W]	Max. speed [km/h]	Range [kWh, km]	Required charging speed (night) [W]
	Urban Arrow, Bullitt	-	50-80	0.3-0.6	250	25	0,6-1,2 40-80	150
	Fulpra, Cargo Cycling, Velove	L1e-A, no license, blue plate	220	2.6	1000	25	1,8-4,4 40-80	300-400
	Tripl, Stint, Carver	L1e, moped licence, blue/ yellow plate	300	0.75-1.6	4000	25-45	8 100	800-1000

> *Figure 14: Overview of the defined types of LEFVs deemed relevant for this analysis and their respective characteristics*

2.3.1 The electric cargobike

The cargobike has been around practically since the invention of the bicycle, and with the introduction of the e-bike for consumers in the 1990's, the electric counterpart of the cargobike followed shortly after. Traditionally, before the 1950's, the cargobike was already used for city logistics to deliver mail, bread and milk. Later on, the cargobike gained popularity as an alternative for cars.
Since then, the shape of the cargobike has remained largely the same; a mostly two-wheeled configuration - and occasionally a three-wheeled adaptation - with the cargo department in front of the sitting driver. The variants used for urban distribution are adaptations of the lightweight, agile cargobike made for the consumer market, typically used for hauling children and groceries.
Due to its small cargo volume, the biggest chances for the cargo bike lie in relatively lightweight, small deliveries, such as regular parcels and fresh deliveries. Another category which the cargobike is well suited to are facility maintenance and service jobs, in which specialised service technicians often do specific jobs using a compact, dedicated set of tools and materials.

> *Figure 15: Dutch network operator Stedin deploying cargobikes for installing smart energy meters in households in historic city centres*



> *Figure 16: Historic example of cargobike use for commercial purposes. The configuration of the cargobike has changed little over time*

2.3.2 Dedicated cargobike

However, since 2017, a new category for electrically powered vehicles has been introduced, allowing certain types of cargobikes on the road with up to 1kW of electrical output on the road (under the L1e-A category), allowing them to transport larger freightvolumes. This type of cargobike is allowed to either use pedal assistance or lever operated propulsion. (Visser 2018)
Capable of hauling larger volumes of cargo compared to the regular cargobike - up to 3m^3 of cargo space - this dedicated bicycle is a promising new player in the market. These powerful cargobikes feature cargo bays suited for standardised volumes, such as trolleys or containers. Usually designed from the ground up, this new type of vehicle offers extensive features for connectivity, safety and productivity aimed to fluently integrate with existing commercial logistics. These three-wheeled vehicles typically sport a tilting mechanism to remain agile under heavier loads.
Velove and Fulpra have identified these issues and have taken measures into their own hands by developing new LEFVs from the ground up, with dedicated features for smart efficient distribution. Implementing automotive-like functionalities around a CANbus system, for example live GPS location, 3G and bluetooth connectivity, vehicle speed, component- and vehicle status, battery management, a park brake controller and compartment monitoring ECU. (Fulpra 2021)

> *Figure 17, 18: The parcel-dedicated Fulpra L1 has room for loading two fully loaded trolleys in the back, achieving an unprecedented parcel capacity for cargobikes (image source: Fulpra)*

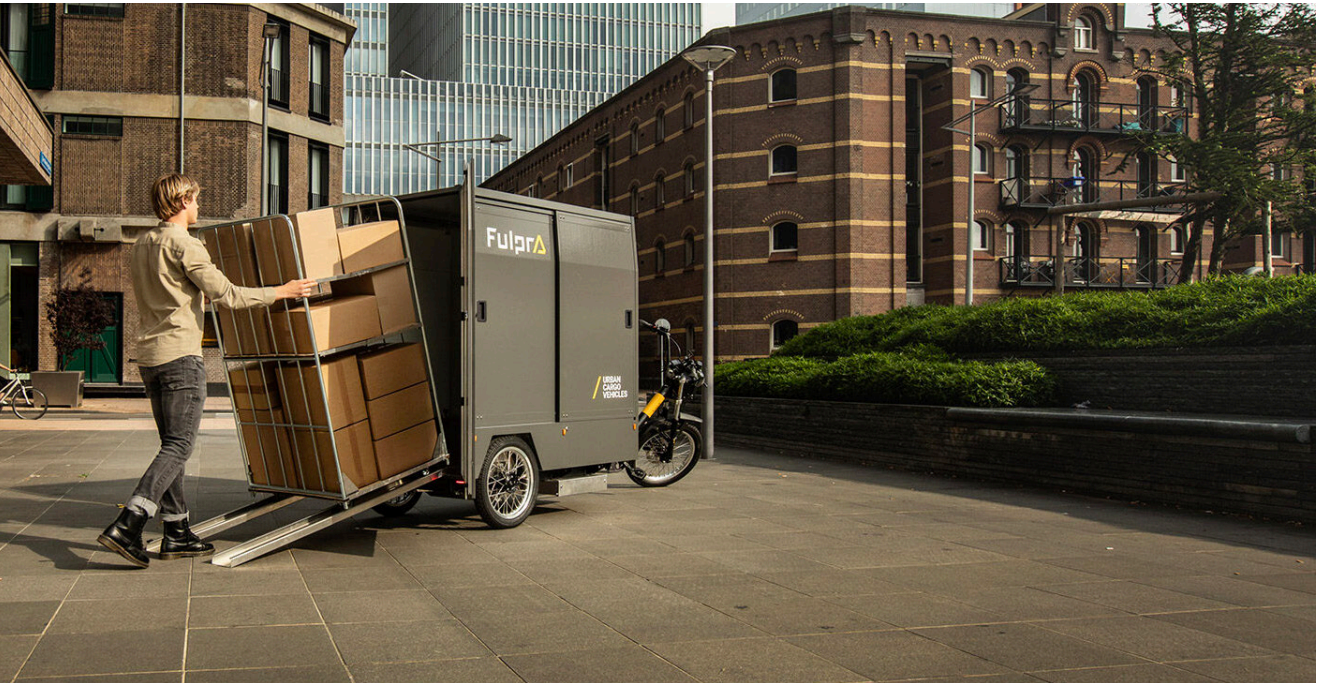


Figure 19: DHL's Cubicycle makes use of preloaded parcel containers to realise a fluent transfer from van to bicycle. The Cubicycle is a branded version of the Velove Armadillo cargobike, designed to revolutionise delivery.

> *Figure 20: A PostNL branded Stint - an electric scooter - used for delivering mail in the tight streets of the historic Amsterdam city centre*

2.3.3 Electric cargomoped

Mopeds differentiate themselves from cargobikes by the lack of pedal assistance. They come in all shapes and forms. Power output is generally controlled through a hand- or foot-operated lever. In the Netherlands, drivers therefore are required to have a license and the moped needs to be constructed conforming to a testprocedure. The electric moped does not necessarily have more cargo capacity, but does offer higher maximum speeds - up to 45km/h - and often features a more heavy-duty construction. The requirements regarding legislation & licenses generally make this vehicle less popular for financial reasons. Due to their relatively limited cargospace and higher maximum speed, these vehicles are especially suited for time-sensitive applications.

2.4 REGULATIONS

To obtain insight in how changing regulations can affect the adoption of cargobikes, the city of Rotterdam was chosen as a case-study. The aforementioned challenges regarding accessibility in cities are of high priority for city councils, so too for the city of Rotterdam. The city is planning to make up its disadvantage over other dutch cities by implementing a number of serious changes in the mobility infrastructure in the coming decade. The Rotterdam Urban Traffic Plan 2017-2030+ aims to realise a reduction of emissions while maintaining accessibility by stimulating the use of zero emission vehicles, gradually phasing the internal combustion engine out of the city center. The goal of the Rotterdam Mobility Approach (RMA) is reducing the number of freight trips in the city and making the necessary transports emissionless by using electric vehicles and hydrogen powered trucks for the large, heavy shipments. Cost-benefit analysis states that the necessary investments required by the municipality and the industry for this transformation outweigh the societal benefits (Gemeente Rotterdam, 2020)

2.4.1 Emission free zone

The municipality is dedicated to exploiting and facilitating the use of cargobikes and other LEVs for this purpose towards 2025. By then, it is estimated that 23.000 vans and 3.500 trucks will be entering the Zero Emission-zone pictured below, which will not be allowed to enter the aforementioned zone unless they do not emit greenhouse gasses. Per January 1st, new ICE-vehicles registered after that date are not allowed to enter the ZECL-zone. For existing vehicles registered before January 1st 2025, an exemption wil be made until January 1st 2030. Plug-in hybrid vehicles are allowed until 2030, provided they drive emissionsless in the zone. The ringroad ("Ring van Rotterdam") and adjacent business areas with logistic potential are exempt from the ZECL-zone for realising logistic hubs for bundling transport into the emission-free zone. The latter is one of nine solutions set up by the municipality to realise efficient, emissionless city logistics together with the logistic industry, in which the municipality aims to adopt a suggestive, monitoring role.

> *Figure 21:The Zero Emission City Logistic zone of Rotterdam will entry into force in 2025*

2.4.2 Multimodal roads

The municipality is improving the conditions for cyclists based on a number of leading principles, namely decreasing pass-through traffic and prioritising public transport, cyclists and pedestrians, rearranging main roads to create healthy arteries and lastly, increasing the range of mobility choices.
At the moment, due to the car-favourable conditions in the city center of Rotterdam, a relatively large amount of passing traffic crosses the city center, which causes unnecessary disadvantages.
To demotivate vehicles passing the city center instead of using the ringroad, a number of measures are being taken, such as lowering the speed limit to 30km/h. This decrease will stimulate passing traffic to make use of the ringroads and will create space for vehicles with a destination inside the city center.
Due to their nature cars do not mix well with other means of transportation, resulting in unfavorable conditions in traffic for alternative means of transport. Lowering the maximum speed on roads within the ring not only unfavours these routes for cars, but simultaneously allows for better opportunities to mix vehicles on main roads. This opens opportunities for cargo bikes and LEVV's to mix with other traffic, therefore increasing the amount of space on the road for these types of vehicles. Cargo bikes are currently assigned to be used in bicycle lanes, which causes delays due to the limited width of these lanes. The restricted amount of space is currently a limiting factor, since it prevents these vehicles from travelling at their speedlimit constantly due to the inability to overtake in narrow, single lanes. Additionally, mixing heavy cargobikes with other bicyclists in bikelanes results in dangerous situations.

> *Figure 21, 22: Multimodal streets in Rotterdam with lanes divided by speed - visualisation by PosadMaxwan*

> *Figure 23: Four directions for organising logistics for cities as envisioned by Roland Berger*

2.4.3 Hubs

Concluding from the expected changes in accessibility for commercial vehicles due to the ZECL-zone in Rotterdam, the demand for freight transfer locations will rise. The municipality of Rotterdam does not plan to take an active role in the realisation of hubs for consolidated freight transfer. The initiative is left to the industry to develop viable businesscases for organising efficient logistic hubs. The municipality does however assign designated areas for the parties involved (interview J.R. Albrechts, 3/5/2021). These dedicated locations are on the border of the envisioned zero emission-zone and correspond with the places where freight transfer is already performed on a smaller scale, such as Zestienhoven, Rotterdam Alexandrium, the Waalhaven District and Verenambacht. These areas are well suited because of their access from and to the existing highways around Rotterdam ("de Ruit") and already house a significant amount of entrepreneurial activities and logistics. (Rotterdam Mobility Approach 2020)
For municipalities such as Rotterdam, a number of options are at hand for regulating urban logistics. Four possible scenario's are sketched by Roland Berger in their vision for Urban Logistics 2030; "The Wild West", "Coexistence of giants", "Regulated diversity" and "City-wide platform" (Roland Berger 2018). The four scenarios differentiate based on the level of regulation by authorities and the amount of cooperation between logistic companies. If the municipality decides to continue their passive attitude in the realisation of transfer hubs, two scenario's remain; "The Wild West" and "Coexistance of Giants", which differ in the level of cooperation between companies. Cooperation could mean to share transportation systems and pool logistic traffic efficiently, resulting in a more efficient network. In this scenario, operations will be bundled together in large hubs operating as a single platform, yielding economies of scale and resulting in a breeding ground for logistic innovation, such as the development of smart vehicles and energy management.

2.5 TRENDS & DEVELOPMENTS

2.5.1 Dedicated vehicles & multimodality

Public transport operators and commercial mobility companies are steering towards clever solutions to provide fluent multimodal travelling. Multimodality; the use of multiple means of transport in a single trip, is a potential solution to the complex puzzle of keeping transport efficient while urban areas are becoming more crowded. Multimodality is necessary to offer travellers means of moving from A to B in the situation of changing accessibility for cars in cities, with Mobility as a Service (MaaS) and transfer hubs, such as the “P+R transferia” in the Netherlands as examples. Fluent vehicle transfers are especially important when moving in or out of the city, since the difference in preconditions for mobility between urban and rural areas is continuing to increase.

2.5.2 Automation

Logistical processes are continuously optimised and automated in order to handle the increasing amounts of parcels delivered, while simultaneously lowering labour costs. The physical labour required to manually run large warehouses and supply chains leads to unfavorable working conditions for employees, resulting in growing criticism from trade unions. At the moment, multinational corporations such as Amazon, FedEx or UPS are deploying fully or partially automated distribution using robotic equipment, autonomous trolleys and shelving lifts. Local grocery delivery service PicNic is supplying their floor employees with handheld orderpicking computers used for guidance and monitoring and is working towards semi-automated fulfillment centers in the near future, in a scenario where humans occupy a passive, monitoring role. (Interview P. Bouwstra, 2021)

2.5.3 Decentralisation & instant satisfaction

In order to keep up with demand for fast delivery, retailers have had to reconsider their logistical strategies. Where previously lineair delivery from a central warehouse was the norm, retailers are increasingly keeping stock locally. Decentralised delivery from flexible, local warehouses has proven to be effective in achieving shorter delivery times. The introduction of on-demand warehousing enables small and large parties to quickly establish efficient distribution networks tailored to their demand. (Baljko, 2020)
An increasing number of pop-up stores and delivery hubs are established in retail spaces freed up by large retailers outcompeted by online webstores, as an indication of how smart, efficient city logistics is not only about large robotic warehouses.

3. CARGO VISION 2031

Based on the aforementioned opportunities, trends and developments observed in the logistic sector a future vision for urban logistics using LEFVs towards 2031 was created. To ensure an accurate and relevant result, the city of Rotterdam (NL) was chosen as a representative case to study. The vision is meant to depict a broad image of the possibilities, and is therefore not Tiler-specific. The link between Tiler and cargobikes will be elaborated later on in the roadmap, in chapter 4. The vision contains three parallel movements;

3.1 Fast local delivery
3.2 Shared service logistics
3.3 Consolidated distribution

In the parcel delivery sector, consumers are brand-indifferent and the competition is fierce: High efficiency standards and high cost sensitivity among customers are characteristic for the parcel industry (Heid et al, 2018). At the moment, delivery vans are the most used vehicle used for these deliveries (Balm et al. 2018). However, pilot tests show bikes are 60% faster in city centres compared to vans, with an average of 10 parcels delivered per hour compared to 6 per hour by the typical delivery van (Carrington 2021). Additionally, municipalities are starting to enforce regulations aimed against commercial van-access to city centres, further deminishing the favoureable position of the delivery-van. To stay competitive in the future, adopting staged delivery with hubs and LEFVs is essential.
The three envisioned parallel scenario's have been depicted in figurative, simplified graphics to illustrate their characteristics, accompanied by their respective chances for cargobike adoption on the right. More heavily outlined are the traits relevant to charging for Tiler.

3.1 FAST, LOCAL DELIVERY

DIRECTION 1: SMALL, LOCAL HUBS

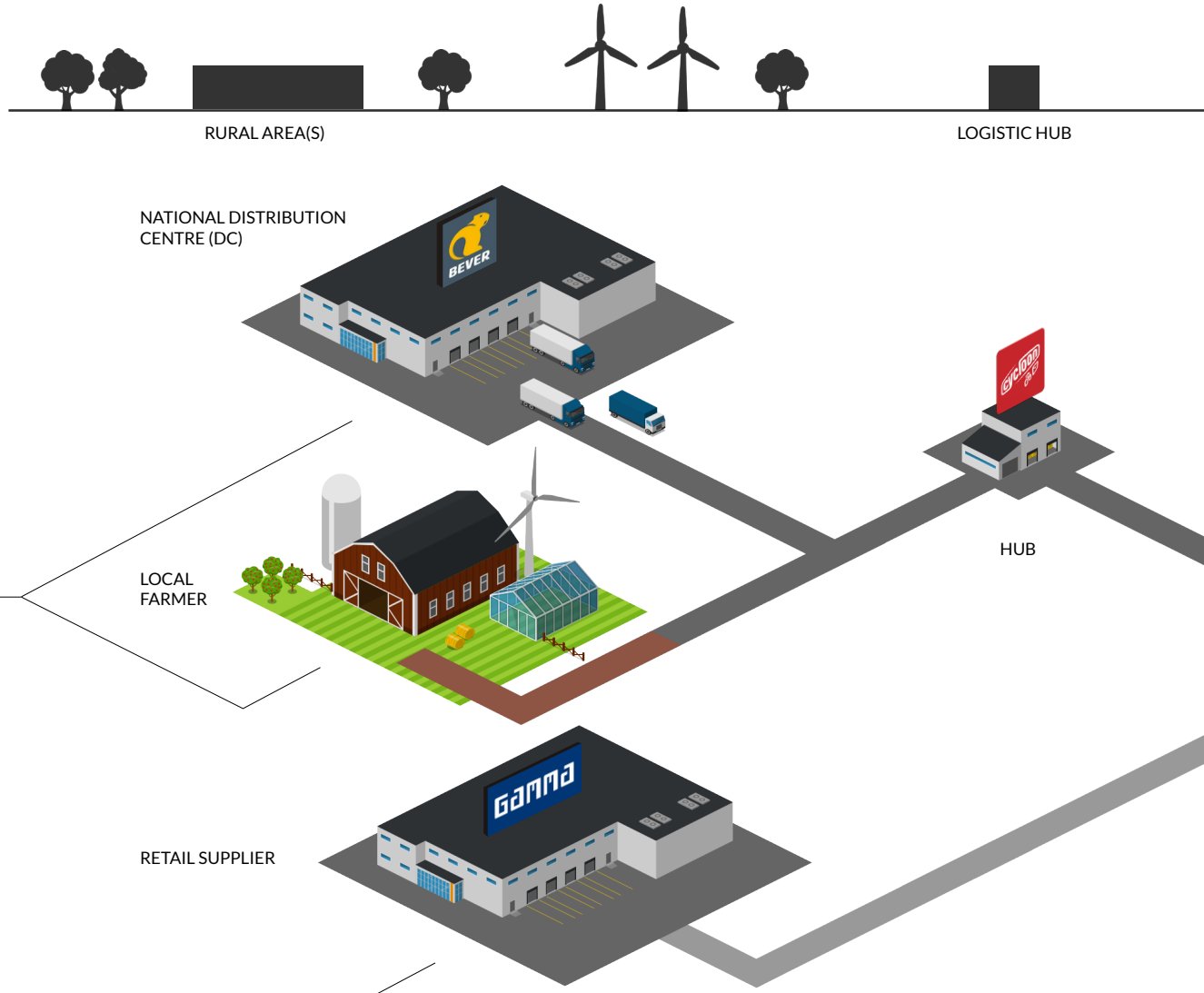
Locally operating scale-ups are introducing fast, flexible delivery in urban areas to compete with large retailers using electric bikes and cityhubs. Building on a local network of suppliers and clients they can offer grocery delivery or parcel service with a fast and sustainable delivery promise. Their formula features advanced planning systems for efficient operation and modern, digital webshop interfaces to target young customers. Unused retail space or otherwise undesired properties in and around city centres tend to be ideal for setting up small distribution locations for these parties.

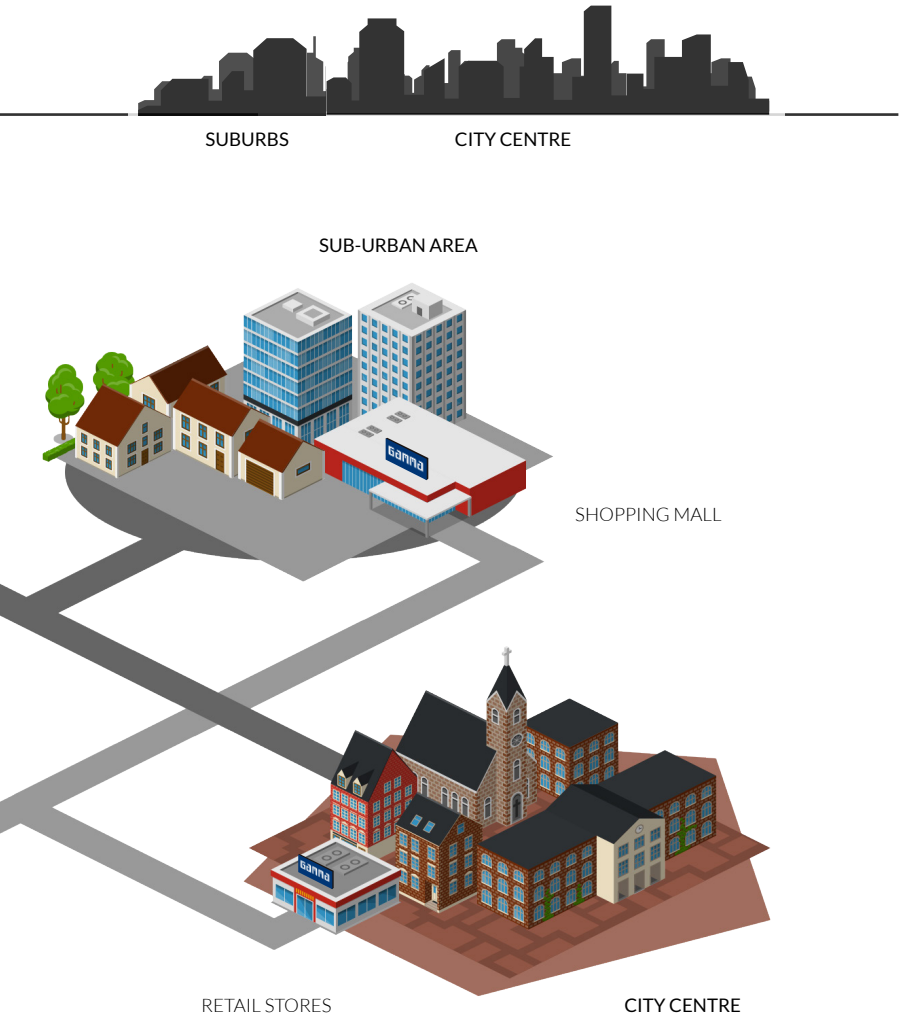
Examples: Rechtstreex, Cycloon, Peddler, MarleenKookt

DIRECTION 2: DELIVERY FROM STORES

The fast delivery trend is likely to expand to retail as well. Established retailers will set up in-house delivery from retail stock using cargobikes, basically using their stores as hubs. Both large and small stores often have sufficient click&collect infrastructure to set up a local delivery service, offering the customer a smooth webshopping experience. By adopting the LEFV, established retailers can retain their competitive position in the market relatively easily.

Examples: Blokker, Gorillas, Gamma, MediaMarkt





Cargo size & weight

Small to medium sized shipments

Parcels from retail stock
(Prepared) food/groceries from local stock

Network density

Low density

Short to medium length trips
Small to medium sized area

Time-critical dependency

High

Fast or precise delivery is key

Room for growth & innovation

High potential for novelty
Low-tech, in-house solutions

Vehicles

Regular cargobike

Agile & affordable
No license & registration

Charging

Night charging
Short fast-charge in between

Small batteries, limited distances

Figure 24: The envisioned scenario of local, fast delivery using cargobikes with hubs or stores as cargobike distribution point <

> *Figure 25: Blokker is starting a pilot with local delivery from retail stock. Source: ANP/Evert Elzinga*

> *Figure 26: Custom made charging cabinet at Marleenkookt, built by a local carpenter.*

HUBS & NETWORK

The hubs are often in affordable locations in or around the city centre in order to be close to the customer and create a high density network. Locations often include business parks, malls and shopping streets.
Currently, a typical cargobike hub houses up to 10 bikes and is often straightforward and low-tech. Due to the growth of LEV logistics, hubs are usually not permanent and required to be flexible for relocating or expanding. The versatile spaces usually accommodate for basic operations, but lack the possibility for extensive construction into dedicated efficient logistical spaces (Interview J. Kerremans, 2021).

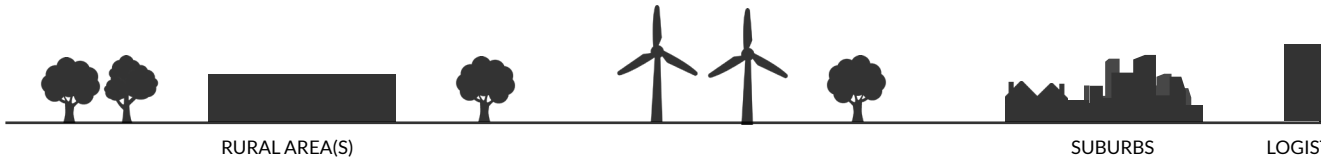
VEHICLES

With slight improvements, the currently used two-wheeled cargobike is likely to remain popular, especially for smaller, time-critical deliveries with shorter trips. These bikes are affordable and easy for companies starting with bicycle delivery to implement. With slight developments and additions of technological features and connectivity, these bikes will still be offering a desirable package for urban delivery, especially when operating within the city centre. Small companies and larger stores e.g. Blokker, Praxis or Hema are likely to be taking advantage of light, small cargobikes to offer delivery to the customer from their stores (Heijkants 2020).

CHARGING

These hubs typically employ a basic shelving cabinet, multiple power strips for charging. In the future, due to e.g. expected safety regulations and problems with scalability, these insufficient solutions are required to be replaced with an accessible, straightforward solution. Charging cargobikes used in this scenario will likely happen overnight in small private indoor storage spaces where the bikes are parked outside of opening hours. Adequate feedback and a fluent, intuitive experience for novel employees is important. The charger should be scaleable and ‘plug&play’ to offer the customer flexibility to change or expand their operations.

> *Figure 27: The future vision for charging cargobikes in local retail in 2031. A flexible, wireless setup is beneficial for streamlining operations in these small hubs.*



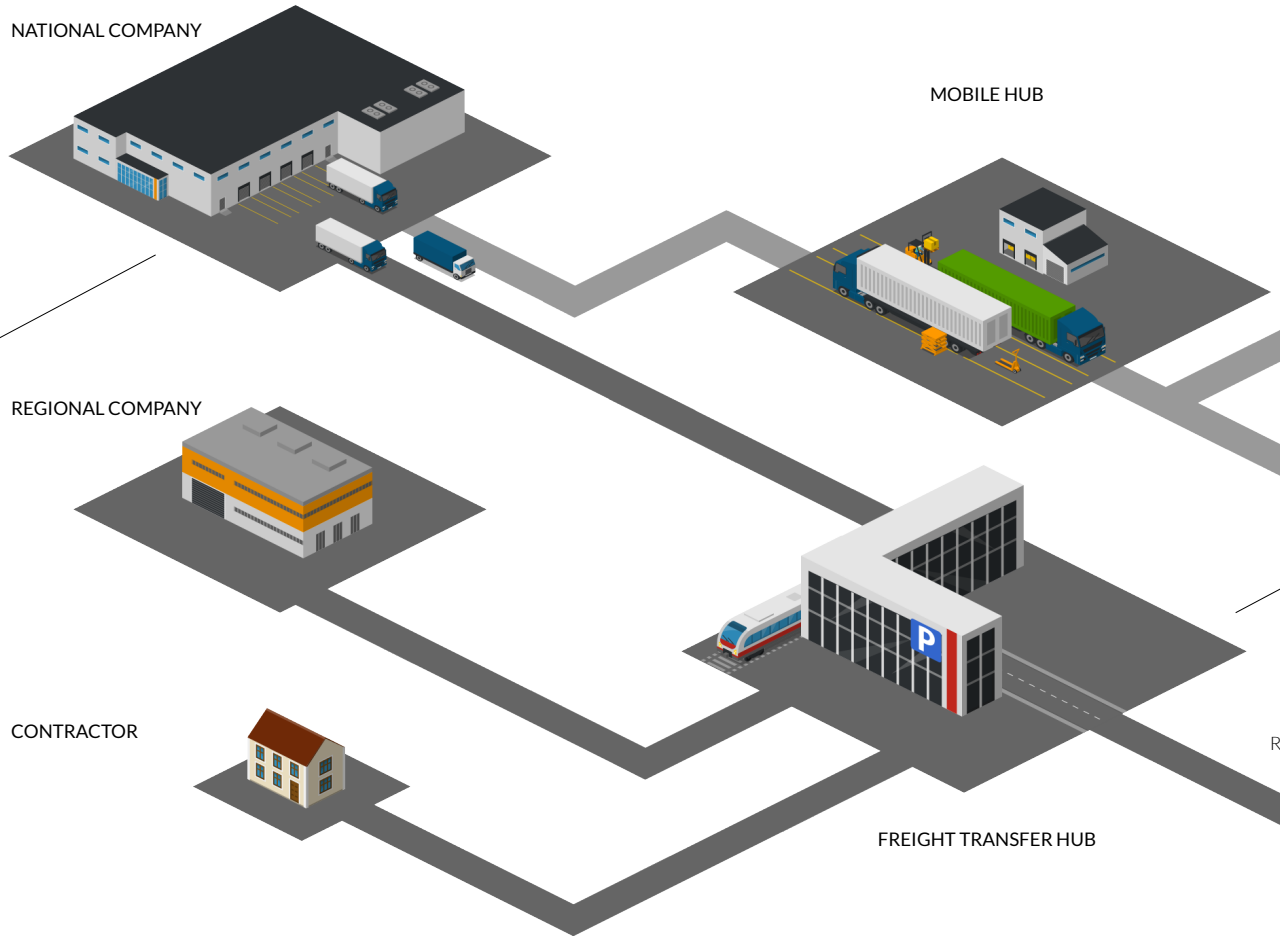
3.2 PUBLIC SHARED SERVICE LOGISTICS

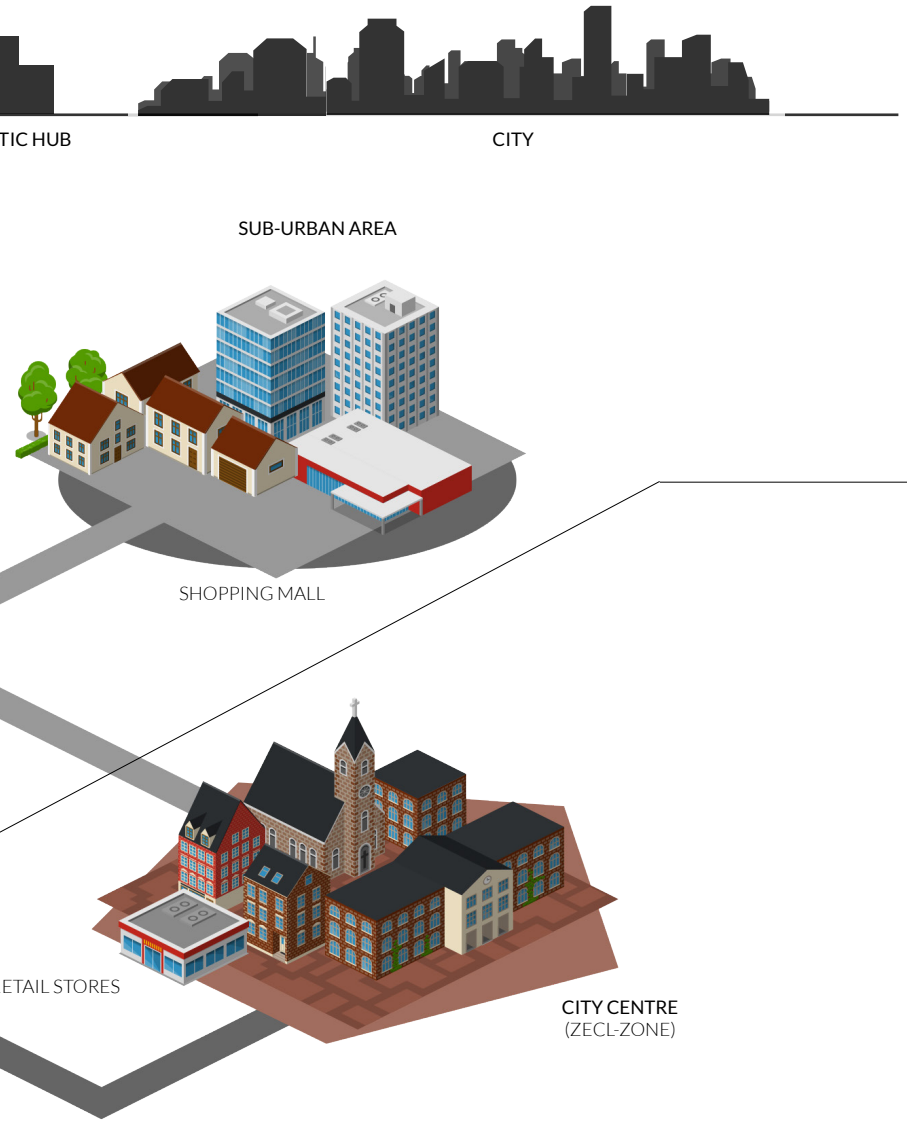
Service logistics includes activities such as installation, maintenance, repair and construction. The core of these activities are services, but often there's tools and/or materials involved dependent on the sector. The destinations, usually households, office buildings and public spaces are often located in densely populated areas where parking a van for an extended period of time is becoming more complicated and expensive.

DIRECTION 1: MOBILE HUBS

Large corporations active in the service domain are likely to set up small transfer hubs located at the edges of the city. The network density needs to be high enough with a constant amount of jobs for a permanent hub to become profitable. Alternatively, a large construction site could function as a temporary hub for materials from suppliers.
As an alternative to a fixed location, a mobile hub in the shape of a trailer-truck can be parked at the border of town. Mobile hubs can prove to be fruitful when a lot of jobs close together can be performed at once. Think of installing glass-fibre networks or installing electricity at large jobsites. E.g. Energiewacht installs smart energy meters in office buildings and households and successfully piloted a setup with a mobile hub and multiple cargobikes. Servicemen can easily access the mobile hub throughout the day to restock on new meters and specific tools. This setup can potentially save 30% in transport costs and reduce CO2 emissions bij 80% (Ploos van Amstel et al. 2018).

Examples: Stedin, Ziggo, KPN, Energiewacht, Feenstra





DIRECTION 2: SHARED TRANSFER HUBS

Half of the 25.000 vans accessing the city centre of Amsterdam on a daily basis are mechanics and contractors (Ploos van Amstel 2020). A relatively high amount of self-employed workers are active in this domain. E.g. occupancies such as plumbers, elevator technicians and home appliance repairmen. With these handymen and serviceprofessionals experiencing increasing difficulty to reach their destinations in city centres due to timebased access and low-emission zones, the coming years new locations for transfer to shared cargobikes will be introduced. Mobility company Mobian is already offering shared cargobikes at such locations in cooperation with cargobike rental company Dockr. (Ploos van Amstel 2020)

Examples: Service technicians, contractors, repairmen, Q-park, Mobian

Cargo size & weight

Heavy, large shipments
High density

Tools, parts & construction materials

Network density

Medium to high distances
Low amount of destinations, long stops

Vehicles

Regular cargobike &
heavy-duty moped

Licensed drivers w/ dense cargo

Time-critical dependency

High

Scheduled appointments

Room for growth & innovation

Little room for innovation

Traditional & slow market

Charging

Night charging
Charging at location

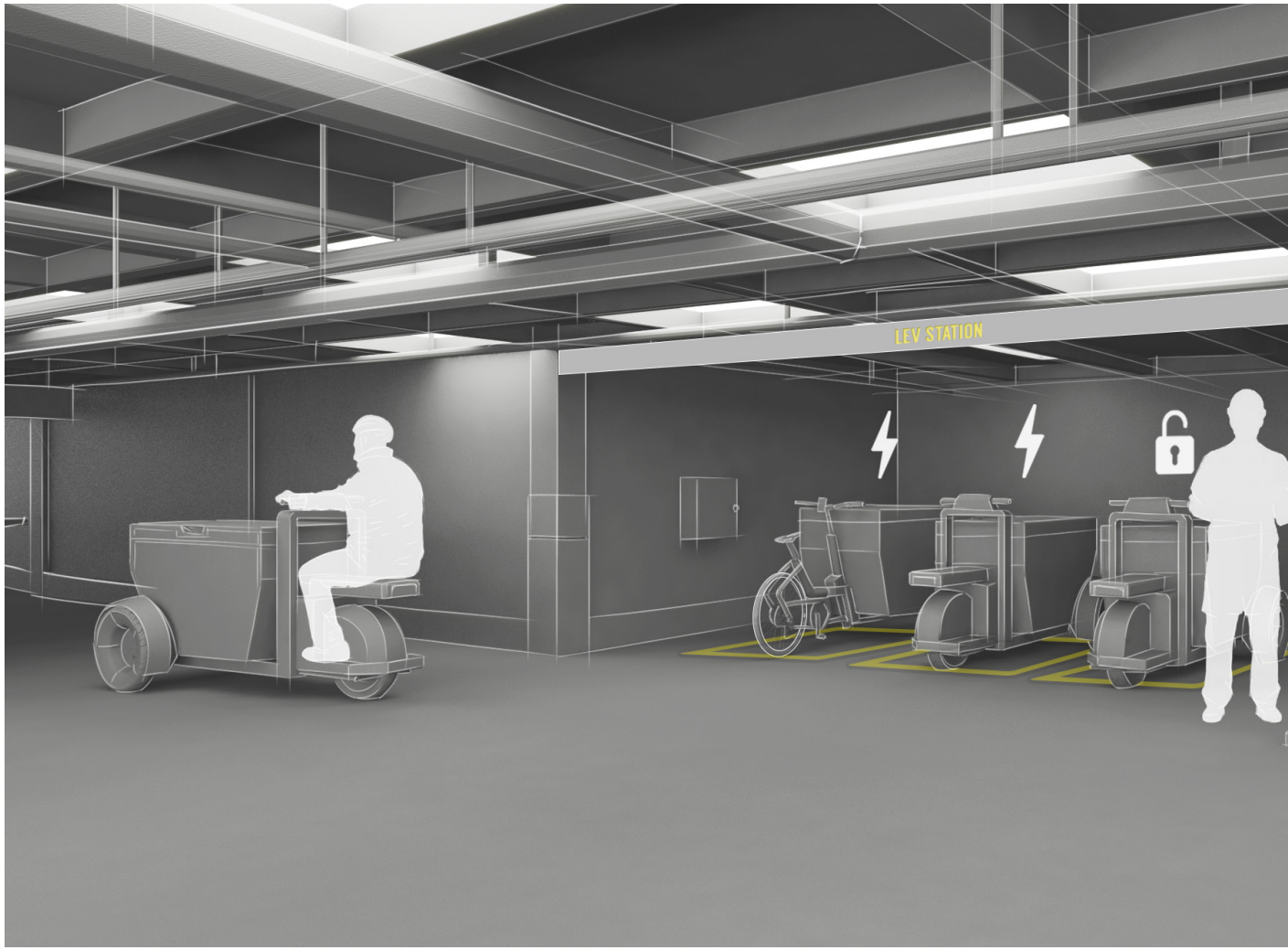
Figure 28: The envisioned options for technicians to access the ZECL-zone by switching from van to LEFV <

HUBS & NETWORK

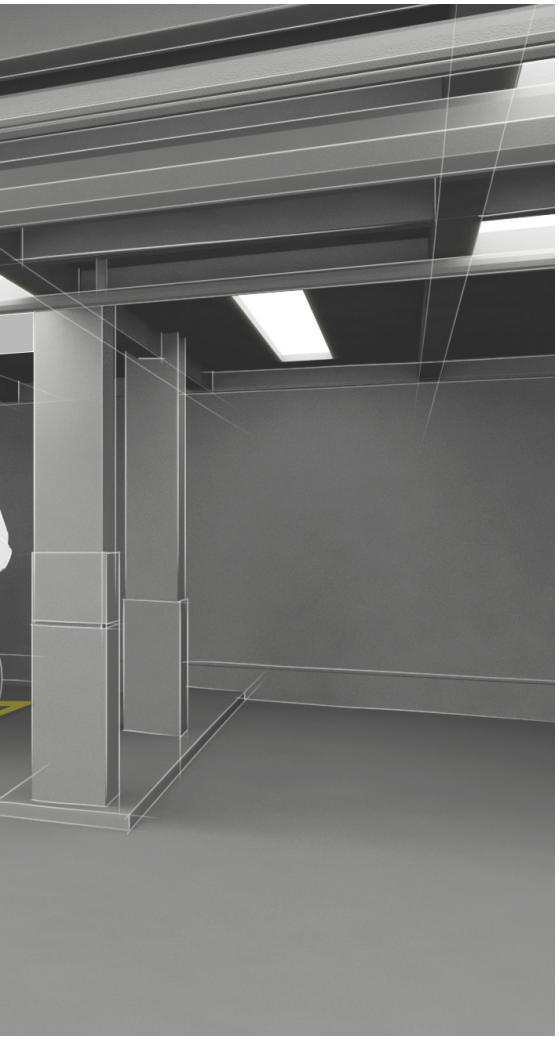
Municipalities, public transport operators and commercial parking companies are likely to start offering means to transfer from car to LEFV in convenient, accessible locations for vans to reach; near highways on the edge of the zero-emission zone. On a typical day, the average serviceman visits only a few locations and resides at the jobsite for one or more hours. For servicemen, their van is the cornerstone of their work; throughout the day their van is a mobile storage space, workshop, lunchroom and office in one. Returning to the van inbetween jobs will be desired if the distance is acceptable.

VEHICLES

While larger companies can afford to implement a significant number of cargobikes into their vehicle fleets, individuals cannot afford to have one or multiple LEFVs on the side. Using shared LEFVs is their only option. Tthese cargobikes are required to house functionalities for remote access and fleetmonitoring depending on the different demands of customers. It seems likely that multiple types of vehicles with different capacities and functionalities will enter the market.
Tools and construction materials are generally heavy and bulky compared to parcel and grocery deliveries. It is therefore unlikely for the regular two-wheeled cargobike to be suited for all professionals active



> *Figure 29: Publicly accessible locations for switching to shared and private cargobikes will become common for e.g. technicians*

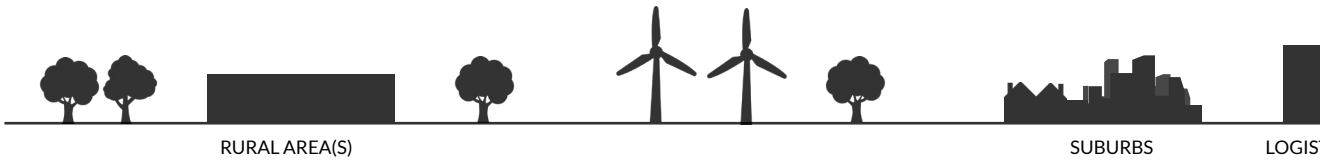


in the construction branch. With the cargobike increasing in weight capacity, it is likely for the three-wheeled configuration to become the norm in this domain. A tilting mechanism gives the bike better manouverability when carrying a lot of weight. This new set of requirements will likely spark the development of dedicated vehicles for mechanics.
Since the users are licenced drivers, moped-style LEFV's - for which a driving licence is required - will become preferable in time-sensitive situations. Especially since time spent travelling is costly for specialised personnel.

CHARGING

The three-wheeled configuration means that the traditional kickstand will not be present anymore on these bikes, so a different way of charging will be required. The variety of vehicles is simultaneously a challenge and an opportunity for developing a charger in the (semi-)public domain. Tailoring a charging solution for use in the shared market is completely different in terms of functionality and user interaction. Locking, digital access and remote monitoring becomes an important topic, aswell as a larger variety of cargobike sizes and platforms, further increasing the need for a universal solution.
It is likely for these heavier bikes to feature bigger batteries - up to 4 kWh - which means that the charging capacity will have to be improved aswell. The current chargers for cargobikes provide between 100 and 200W at an amperage of 2 to 4, which means that in the worst case charging a 4kWh battery would take 40 hours to charge. To tailor to these moped-style vehicles it is inevitable to increase the charging capacity.

3.3 STREAMLINED URBAN DISTRIBUTION



Webstores and parcel couriers are scaling up their cargobike fleets for delivery to city centers and suburban areas. Using big, combined hub locations around the city, freight is transferred from trucks to small vehicles suited for the last-mile. These LEFVs are intensively used, driving high distances every day with many stops. Cargo volume is a bottleneck.

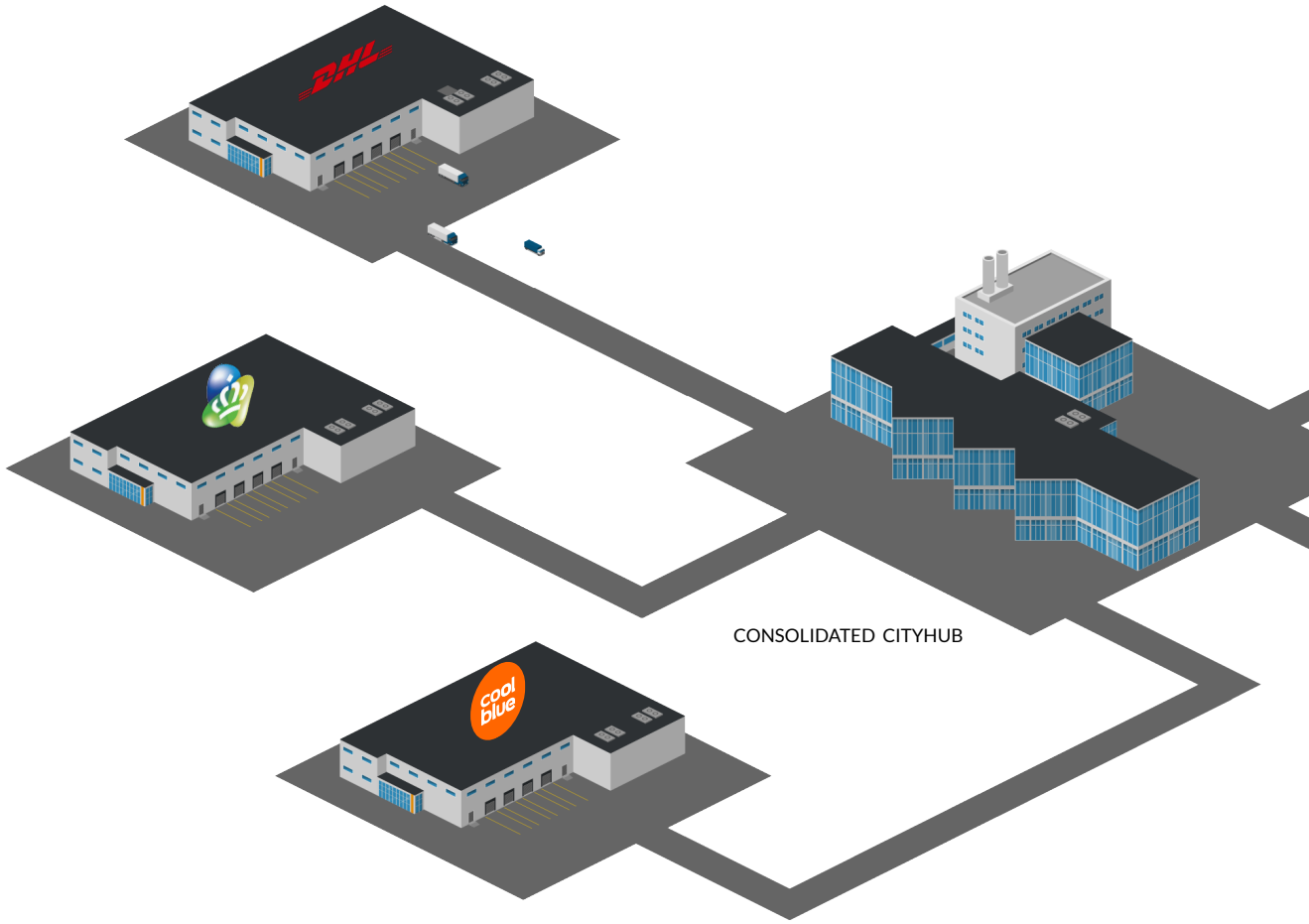
Examples:
Bol.com, Amazon, Coolblue
DHL, PostNL

HUBS & NETWORK

Combining operations offers flexibility for small and large companies while guaranteeing high-level logistic facilities with a low threshold. Examples are the Amsterdam Logistics Center (ALC) and the City Logistics Innovation Campus (CLIC). Combining multiple companies in a single building creates opportunities for shared parking space, sustainable energy supply, dedicated warehouse- and freight loading facilities and secondary activities for value addition (Ploos van Amstel 2020).

VEHICLES & CHARGING

In the scenario of advanced transfer hubs, dedicated LEFVs are likely to take a dominant position into the market and become affordable for small and/or novel businesses. The development of dedicated cargobikes with safety- and communication technology - similar as currently present in larger electric delivery vehicles - enables possibilities for fluent integration with logistic IT-systems, building energy management systems (BEMS) and automated parcel and order-picking machinery.



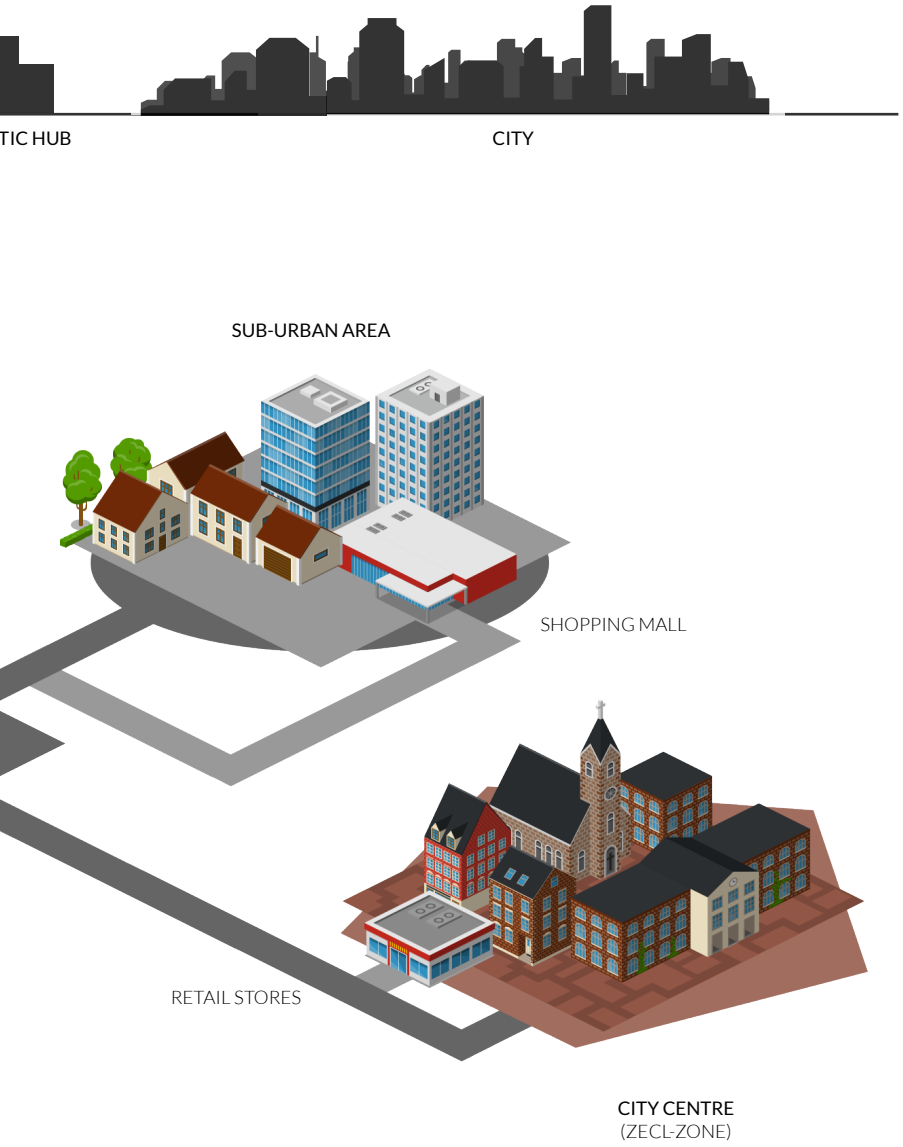


Figure 30: Large, all-inclusive locations offer means for clean, efficient distribution to the cities <

Vehicles are likely able to communicate with all kinds of devices and other vehicles in the confined space of the freight warehouse, possibly enabling restricted autonomous movement within this domain. Charging is likely to become automated, since autonomous movements of robotic machinery in industrial settings do not mix well with human involvement on the workfloor. High amounts of high-tech vehicles - evolutions of the current Fulpra and Cargo Cycling Chariot delivery bikes - will be used in these hubs.
Cargobikes are not only needed for efficient logistics, but also positively contribute to customer experience. Parcels delivered by bicycle generally score a higher experience rating, opposed to the negative experience of branded vans blocking the street. For many internet stores, the branded fleet of vehicles is a large portion of their advertising campaign. (Interview J. Kerremans 2021)

Cargo size & weight

Medium to large sized shipments

Parcel delivery
Cargo space is bottleneck (Kerremans 2021)

Network density

High density
Long trips, many destinations

Vehicles

Dedicated delivery cargobike

High cargo volume
No license required

Time-critical dependency

Low criticality

Growth & innovation

High-tech, innovative market

Charging

Night charging
Short fast-charge in between
Road-side battery swap

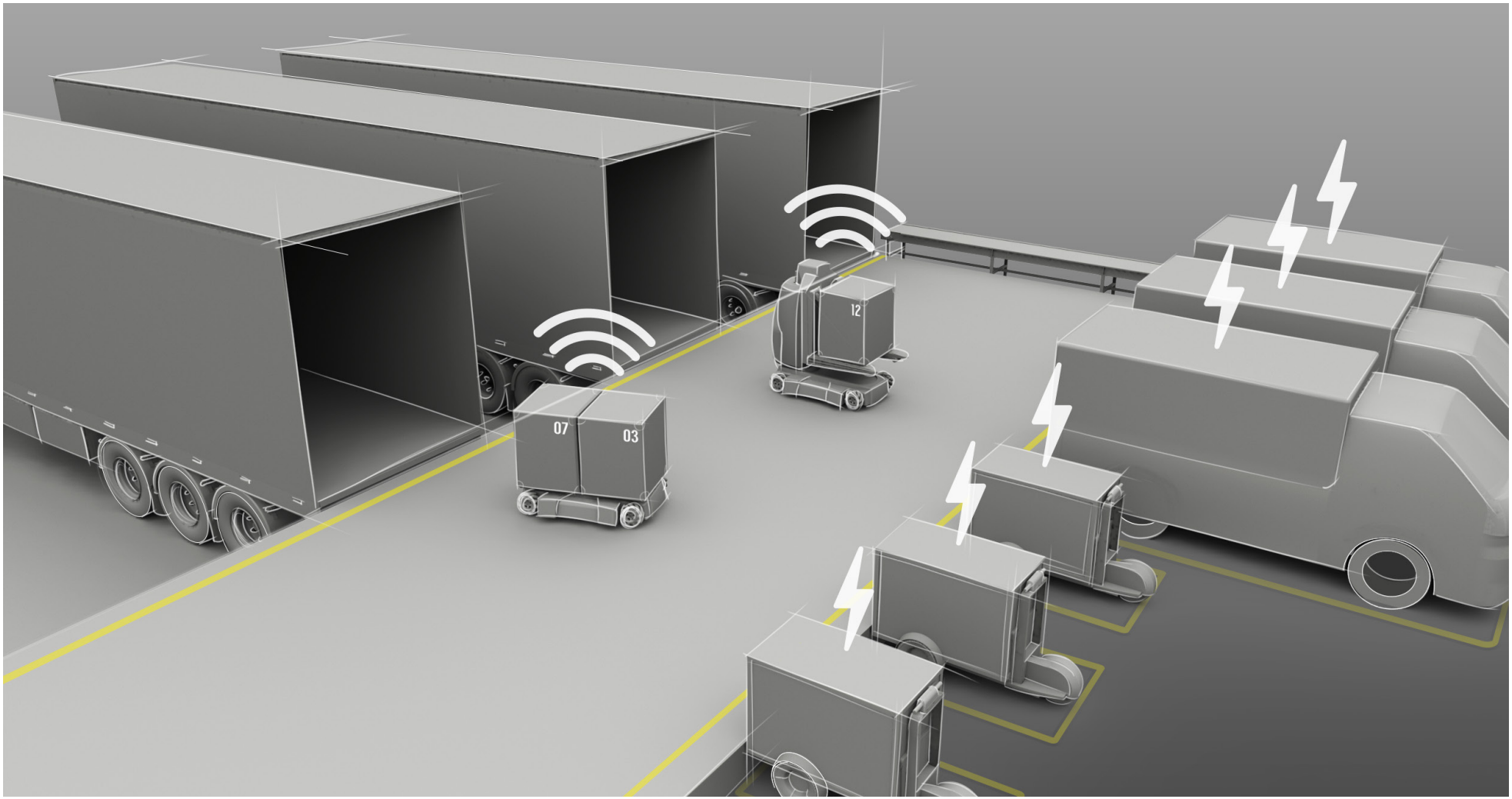
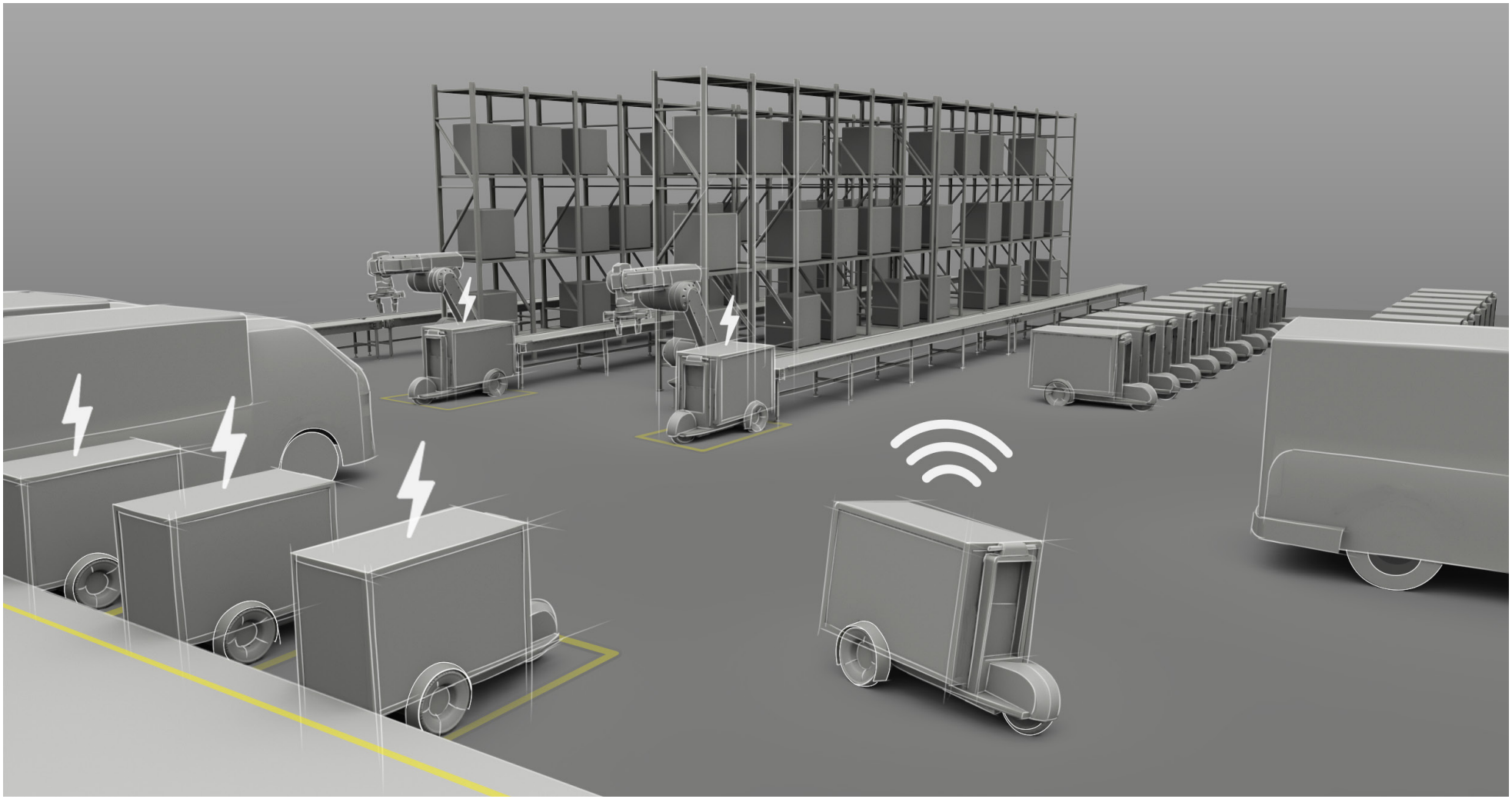


Figure 31: Mostly automated logistic centres will be commonly used by large players such as Amazon, Bol.com, DHL and others in 2031. High-tech automated freight transfer between vehicles is among the possibilities. <



> *Figure 32: Warehouse operations are already partly automated; a trend that is likely to expand towards fully automated warehousing with autonomously moving vehicles within the warehouse-domain.*

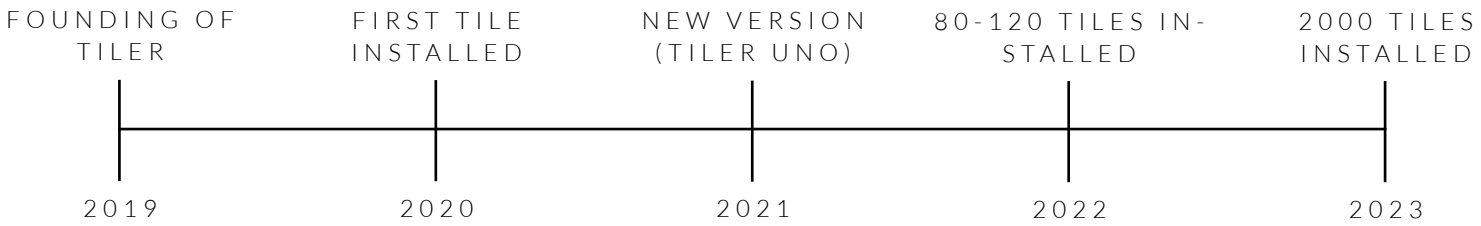
3.4 TILER

So what do these developments towards 2031 mean in terms of opportunities for Tiler? To craft a meaningful strategy, it's important to know the company's goals, expertise and current market.

3.4.1 Simplifying e-bike charging

TILER is a start-up based in Delft, the Netherlands, focussed on developing the world's first wireless charging solution for e-bikes. Frustrated with the lack of adequate charging infrastructure for shared e-bikes, TILER set out to develop a more cost-effective solution that takes up less space than the public charging stations normally used. In order to accelerate the transition towards clean, sustainable means of transportation in cities, TILER strives to offer bicyclists an easy, foolproof solution for charging their bicycle. Dedicated to boost wireless charging and green mobility in general TILER is on a mission to change the way we charge our e-bikes.
The technology - a system based on induction - originates from a patent developed at the Delft University of Technology and is currently being developed further into a market-ready product by an R&D-team of four experts. The current activities are centered around setting up pilot installations in cooperation with a variety of customers in branches from food delivery to bike rental.
Normally, e-bike batteries are being charged through the supplied cable charger, either with the battery remaining in the bicycle, or with the battery removed. This causes a hassle for users and leads to problems when ebikes are deployed in large numbers in a commercial

> *Figure 33: Historical and envisioned timeline of relevant achievements and goals of Tiler*



> *Figure 34: The first ever installed charging tile in front of the Yes!Delft office at the Molengraaffsingel in Delft*

context, for instance unexpectedly empty batteries, broken cables, corroded connectors and fire hazard. TILER is focussed on the B2B(2C) market operating with larger numbers of (shared) light electric vehicles in their fleets. (Behne, 2021)

3.4.2 Market

With TILER being founded in 2019, the company is currently still piloting their wireless charging tile. In the past two years a handful of product iterations have passed by in order to develop the latest version, of which around 10 units are currently up and running at various locations around the Netherlands for testing purposes. With the first tile being installed in the public domain at the end of 2020, TILER has set its goal to place around 80 to 120 tiles next year and is planning to scale up quickly towards 2000 tiles in 2023. (Behne, 2021)
Scaling up is necessary in order to lower production costs and make the tile more attractive as a worthwhile investment for commercial vehicle fleets. With the current retailprice of around 700,- euros, the induction tile could already be considered a worthy competitor for battery cabinets or roadside battery swapping stations.
With e-bike usage in the commercial domain rapidly increasing, the demand for a convenient and safe charging solution is far beyond what TILER can deliver at the moment. The start-up is therefore focussed on finding the use-cases holding the most potential for their solution to make a difference. Successful pilot tests as of late include a trial with New York Pizza and MAAK innovation center in Haarlem.

3.4.4 Alignment

For optimal power transfer efficiency, alignment of the ferrite cores is important. Misalignment results in a lower efficiency, resulting in heat development. The translation and angle limits of the Tiler Uno system are depicted in figure on the previous page.
The single ferrite design - opposed to the double kickstand - allows for a greatly improved acceptable angle, which makes parking the bicycle easier. The allowed translational offset differs per direction, and is most critical in the lateral direction.

3.4.5 Cloud communication

At the moment, Tiler is developing a cloud-based system to monitor the status of the charging tiles remotely. Using the CAN communication protocol and a wireless connectivity module, information from the microcontroller can be gathered in the cloud. Supervision of the Tiles' remotely is already possible with this system.

A BRIEF HISTORY OF WIRELESS CHARGING

Induction technology has been around for a long time already, but hadn't yet taken flight in commercial products until recently. The first evidence of radiowaves in the 19th century marked the beginning of Wireless Power Transfer (WPT). Its potential was showcased by its capabilities for wireless communication and remote sensing, which proved to be of good use in the application of microwave tubes during World War II. In the 1960's, trials with lower frequencies in the kilohertz to megahertz range resulted in the invention of inductive coupling with WPT. (Shinohara, 2013)
In 2009 the Wireless Power Consortium (WPC) published the now well-known Qi interface standard for inductive charging, opening the door for the application of the technology in consumer products around the globe. Well known examples of today are electric toothbrushes, waterkettles and cordless phone chargers. (Wageningen & Staring, 2010)

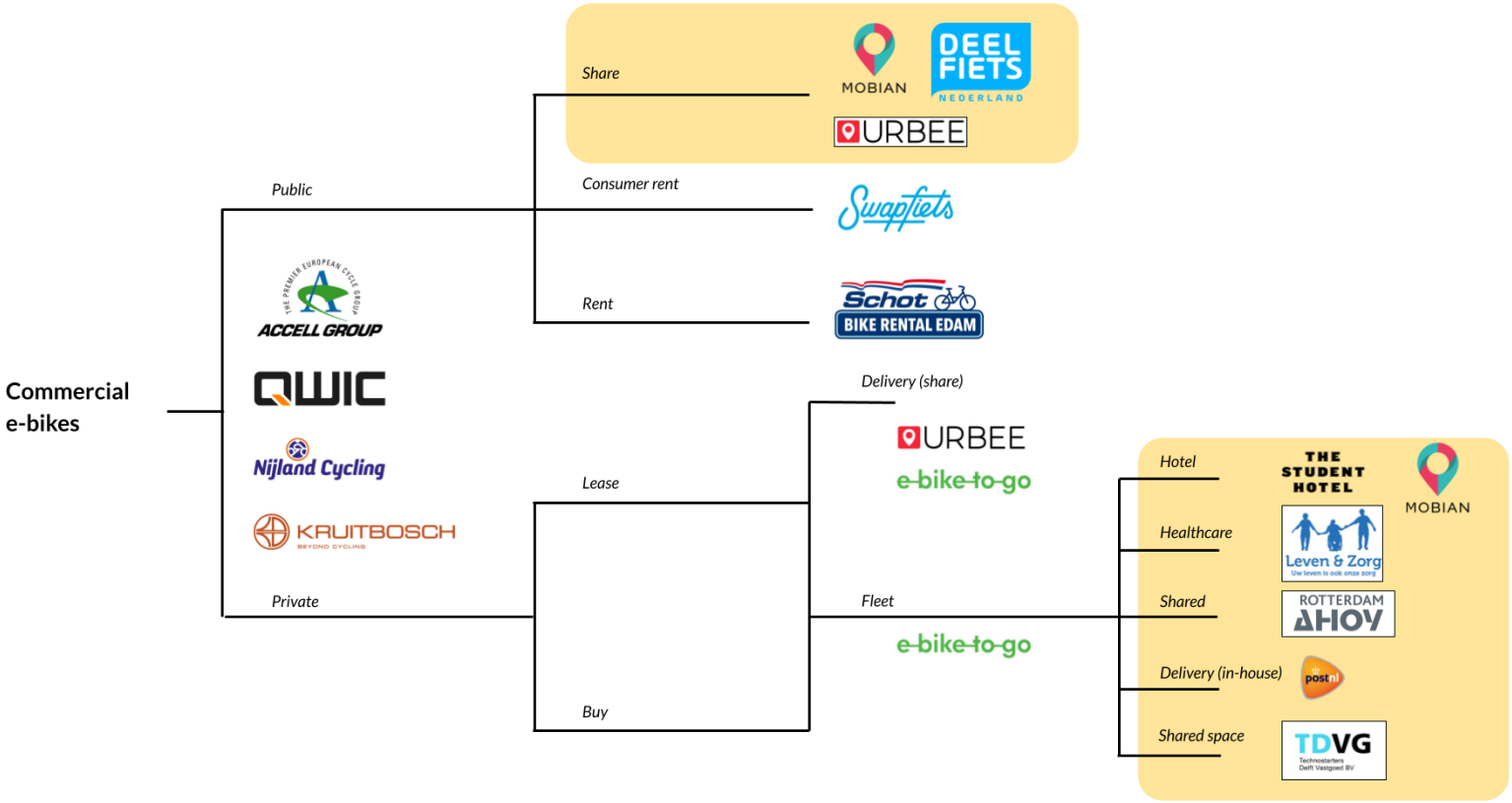
> *Figure 37: Tiler's single and dual kickstands - Uno and Duo - together at Greenvillage (TU Delft campus)*

3.4.6 Tiler Duo & Tiler Uno

Previously, TILER has been using a double-kickstand design. In this design, a closed circuit was realised using both arms of the kickstand, creating a relatively large loop. In this design, both sides of the kickstand need to be correctly aligned to the tile to achieve adequate efficiency. This geometry results in relatively low tolerances for translational alignment, but close tolerances for the angle at which the bicycle is parked on the tile.
To suit a wider variety of e-bikes, a new design was recently introduced. The new kickstand design, the TILER Uno, features a single ferrite core and eliminates the need for double ferrite cores in the setup, resulting in a more flexible, universaly applicable system that has more alignment freedom regarding the angle at which the cores are aligned, resulting in an acceptable deviation of 30 degrees for the coil alignment to maintain acceptable power transfer efficiency.

3.4.7 TILER Scope

Since the application of e-bikes varies a lot throughout different branches, it's impossible to tailor to the endless amount of use-cases imaginable in the entire scope of e-bike usage. TILER is therefore currently focussing on corporately owned private fleets from companies who offer e-bike access as a service to employees or customers - hotels, healthcare centres and event venues - and e-bikes deployed for city logistics, such as parcel and food delivery.



> *Figure 38: The current Tiler market scope for regular e-bikes, as defined by the company itsself. The yellow highlighted areas indicate potentially interesting directions. Copyright Tiler.*

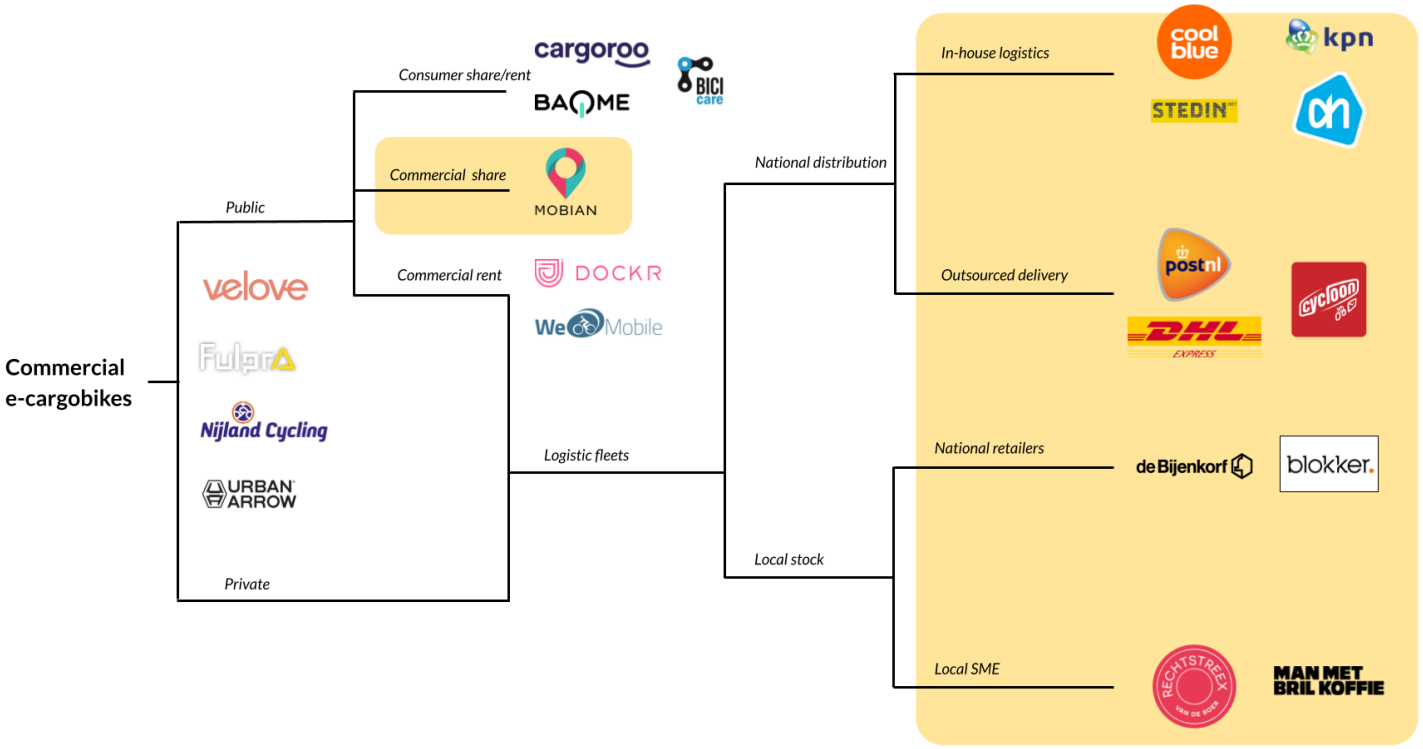


Figure 39: The envisioned scope for Tiler in the cargobike market in the current scenario. A division was made based on the conclusions from chapter 2; national distribution versus local stock-keeping.

Overall, the scope for regular e-bikes shows clear resemblance with the market for electric cargobikes. Cargobikes often use the same types of propulsion systems as regular e-bikes from manufacturers such as Bosch and Bafang. The complete electrical system and drivetrain - battery, engine, computer - are often practically the same and therefore offer a promising opportunity for market expansion.
An analysis of different scenarios is presented further in this report, discussing the most promising scenario for induction charging in the domain of cargobikes.

3.5 TECHNOLOGY SCOUTING

Logistic companies rely heavily on remote monitoring and data insights from vehicles for their daily operations. Tiler's technology could enable cargobikes to fit better to these existing logistic systems by extracting sensory data from bikes where possible. Implementing data transfer capabilities increases the chances for adoption of cargobikes in the commercial domain.

3.5.1 Fleetmagement capabilities

Fleetmanagement systems have been present for a while already in larger vehicles used for distribution. These days, it is essential for logistic operators to monitor their vehicle fleets in all kinds of aspects and gather data for improving workflow efficiency and safety. In principle, fleetmanagement is done by collecting the sensory data from systems present in the vehicle and remotely using that information to generate insights regarding vehicle status, route planning, employee training or insurance cases. Recent implementations include remote dashcam image analysis using artificial intelligence, automated proof of delivery and logging employee workhours automatically. (Verizon Connect 2021)

3.5.2 From family bike to logistic vehicle

The CANbus standard is now being used in smaller vehicles, which is necessary for combining different vehicles - cars, vans, trucks and LEVs - together in one fleet management system. For example, PicNic has been making use of this system in their small electric vans (Bouwstra 2021) and more recently, Fulpra has launched their dedicated cargobike with a CANbus system onboard as well. Integrating these features into cargobikes is an essential step for the cargobike to become a serious, integrated part of the logistic chain. Bridging the gap from experimental trial pilot-projects - which cargobike use in logistcs often still is - requires a seamless fit to the existing operation, in which Tiler could take a connecting role.
Due to the nature of the currently most used cargobike in urban distribution - the Urban Arrow Cargo - implementing a system as such is complex.

CANBUS TECHNOLOGY

The software at the base of these functionalities is the CANbus standard. CAN (Controller Area Network) is a software communication protocol that allows devices to directly communicate with eachother. This enables all the electronic control units (ECU) present the vehicle to communicate and exchange readings from the vehicle's sensors through wireless communication modules such as WLAN, bluetooth or cellular (4/5G). CANbus was first implemented in a mass production car in 1991 and is now an integral part of every logistic fleet. (CiA 2021)

With its origin in the private consumer market, the Urban Arrow platform is not originally designed for industrial use. For the drivetrain- and electrical components Urban Arrow is dependent on external suppliers (mostly Bosch and Shimano), which make consumer products as well, resulting in incompatibility for CANbus integration. Cargobike sharing platform Cargoroo has had to developed a basic tracking system in-house to implement the necessary monitoring and smart locking functionalities, but would likely benefit from more advanced options. (personal communication Niels Veenman, 30-06)
It should be clear that the approach of designing cargobikes for distribution from the bicycle industry perspective therefore leads to problems for adaptation to industrial infrastructures. With implementation of CANbus in LEFVs a seemingly endless array of possibilities comes within reach, of which a few are elaborated here.

3.5.3 Low-tech data hub

Wireless connectivity and live monitoring is beneficial in some cases, however is not necessary in most for gathering and transmitting data. Live cellular connectivity is expensive and often unnecessary for exchanging basic information. Additionally, when exchanging information through wireless connections such as bluetooth or wi-fi, interference can occur when multiple different connections are being established in a tight space with many vehicles. A promising, alternative solution is a hardwired data-coil in the tile - specific for data transfer - aside the regular charging coil. (personal communication Olivier Coops) This solution could offer an accessible, low-tech option for Tiler to offer a 'smart' tile with advanced fleetmanagement capabilities for customers with relatively 'dumb' vehicles.

3.5.4 Primary operations

Monitoring the battery state-of-charge and mileage can yield promising data for estimating range realistically for each planned route, further eliminating the need for back-up batteries. Additionally, these insights can be used to measure the decrease of battery capacity, the battery 'age', to prevent emergencies due to broken batteries along the way or while charging.
Mapping the activities of the driver during daily operations can yield profitable insights for training purposes and can help discover possible points for improvement in the logistical process where time is lost.
Monitoring of the cargo inventory in combination with GPS location could allow for automated messages to the parcel recipient and confirmation of delivery afterwards.
The ability to measure the time to find the right package from the cabinet could help load parcels more efficiently in the future, especially when this process might become automated. Remote inventory tracking is a great advantage for servicemen and contractors for tracking tools and materials as well, since having the right tool at the right job is often essential.

3.5.5 Safety

By measuring the exerted g-forces of the vehicle using a simple gyrometer, an accurate profile of the driver's courtesy in traffic or reckless parking can be generated by analysing sudden, harsh (de)accelleration and sideways movement. This data can also serve crash detection systems and automatically warn the authorities.
Smart locking systems are already on the market, as used in shared bikes, scooters and mopeds, often relying on bluetooth connectivity using a proprietary app. Alternatively, modern day cars deploy keyless access relying on radio signals sent from a transponder to a receiver when the driver is within range of the vehicle. Remote immobilisation could be used to prevent theft of the LEFV along the way, or when kept in a (semi-)public hub.

3.5.6 Maintenance

Brake maintenance is one of the most common jobs performed by GetBikeService (GBS) (personal communication) Wear on brakes is normally hard to measure, but using the brake switch - normally used to activate brake lights - combined with gyrometer data an accurate estimation of brake wear should be possible, enabling GBS to predict maintenance remotely instead of having to do regular checks. With weight capacity for LEFVs increasing, ABS systems are expected to make their entrance eventually, introducing even more sensitivity regarding brakes.
The approach of using existing hardware for extended features applies to other components as well. Analysing mileage, acceleration and cargo load figures should yield an accurate estimation of strain on tyres, bearings and drivetrain components, indicating wear.
Using add-on valvecaps with pressure sensors allows the Tile to monitor tire pressure, which is another important factor for wear & tear. In that way, maintenance to the tyres can be further reduced, resulting in less flat tyres along the route saving costs.

3.5.7 Advanced integration

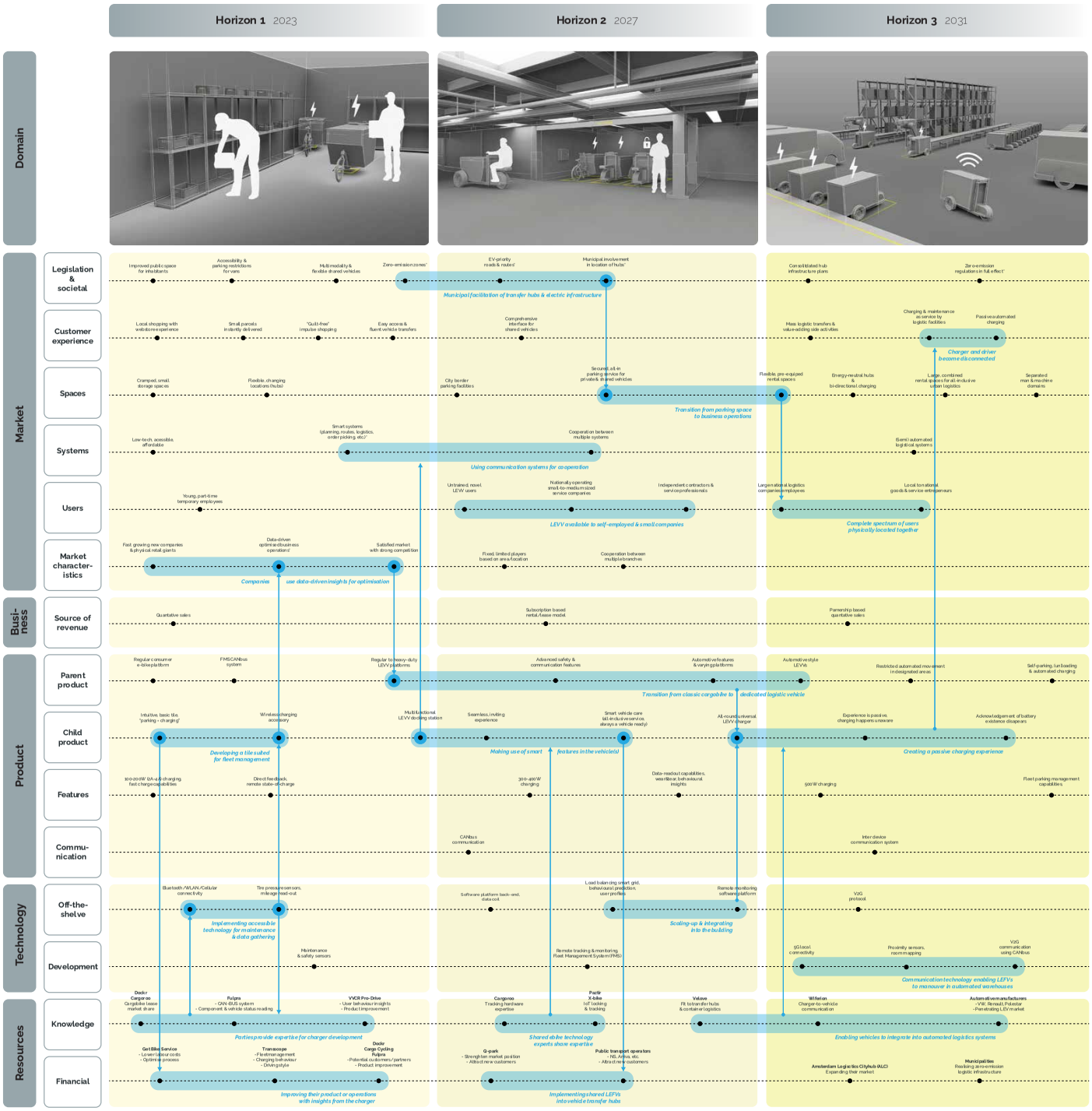
Using basic proximity sensors, which are currently already implemented in warehousing equipment, robot vacuums and cars, all kinds of vehicles will be able to perform restricted movements in familiar, pre-programmed domains, with the implementation of WLAN connectivity present in almost every building. (Labadi et al. 2016) Connectivity with the building - and the charger as the bridging element to the vehicle - offers accessible and affordable means to realise advanced functionalities, with TILER as the connecting element for integrated or retro-fit applications.

4. ROADMAP

The results from chapter 3 lead to the development of the tactical roadmap for Tiler for applying their product in the e-cargobike industry. The roadmap is a chronological matrix with three horizons; 2023, 2027 and 2031. For each horizon opportunities and challenges are described in regard to the market, product characteristics, relevant technologies and resources. All of the factors displayed in the map are divided into subcategories. Along these tracks a number of relevant developments are highlighted in blue. These clusters of factors represent key observations, which are often related to other developments over time. The path of blue arrows can therefore be seen as the 'road' in the map and represents the preferred strategy for Tiler towards 2031. Direct references to the map have been highlighted in blue. The argumentsion supporting this tactical advice originate from either internal communication at Tiler or interviews conducted with experts from the field, of which the summaries and notes can be found in appendix chapter 9.7.

TILER CARGO

STRATEGY & CONCEPT DESIGN
FOR CHARGING LEFVs IN CITY LOGISTICS



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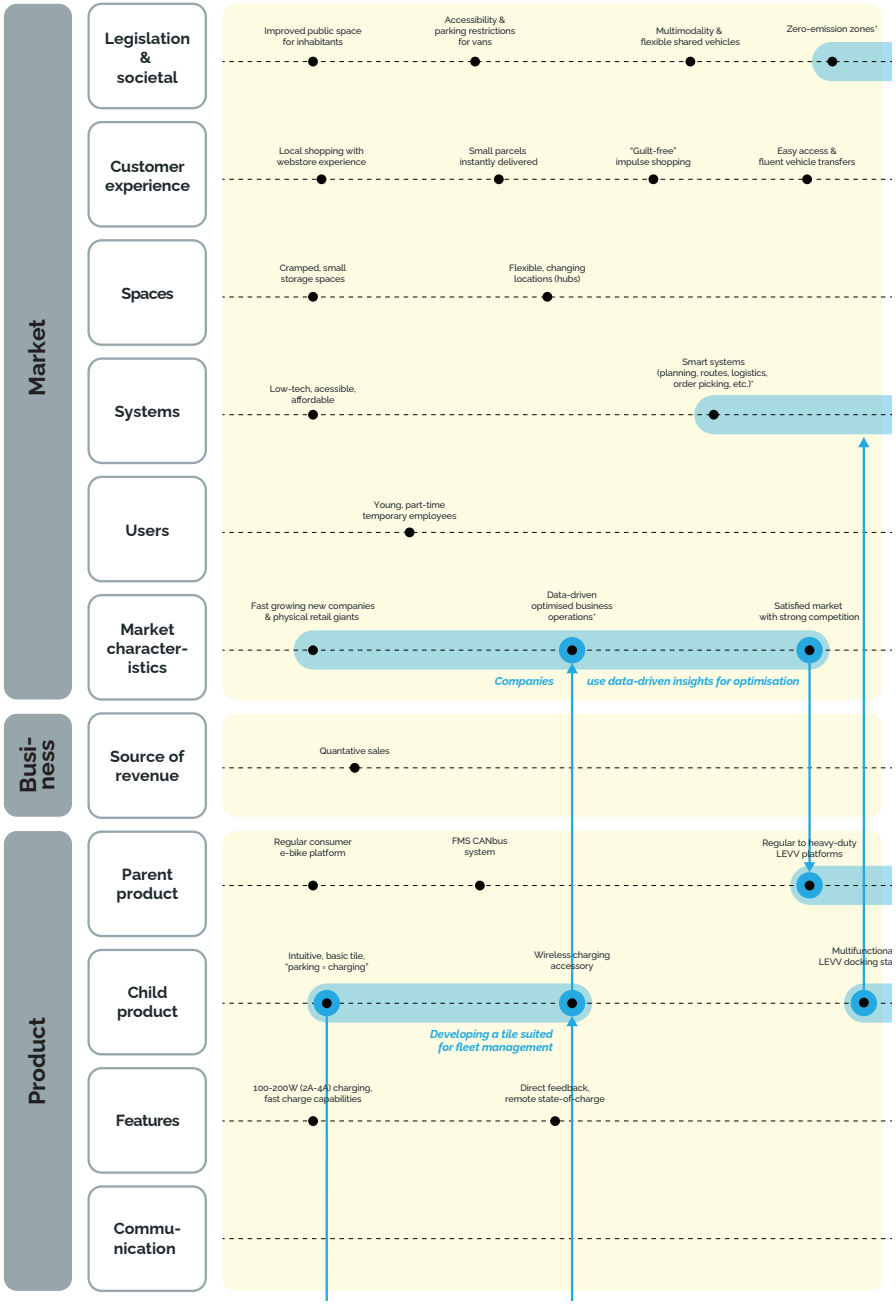


4.1 HORIZON 1 2023

4.1.1 Gaining insights from data

Over the past years there has been a significant increase of novel, sustainable urban delivery companies rivalling the establishment: Cycloon, Hubbel, Peddler, Rechtstreex; they all aim to offer a faster, more flexible and sustainable alternative to the customer by deploying the cargobike.
In 2023, companies with LEFVs in their core operation will be young, technology driven - multinationals as well as local small businesses - who keep their competitive edge by **employing data insights to streamline their operations**. Examples are Gorillas, PicNic, Coolblue and Hellofresh; Novel businesses who quickly gained large market share by effectively exploiting new demands left unaddressed by the big established firms.
However, a few of the established players have adopted in time and have been investing in digital systems, fleet management, smart planning, etc. to maintain their advantage over the 'new kids on the block'. Examples are DHL and PostNL, who have incorporated the cargobike into the core of their vehicle fleets.
The majority of businesses deploying cargobikes run into similar problems; while their digital systems - the backbone of operations - are usually advanced, the cargobike platform is straightforward and underdeveloped for its usage scenario. Operators are unable to properly track measurements from the vehicle as it is. Either adjustments need to be made, such as adding in-house or 3rd party developed IoT tracking devices, or operations are performed based on estimates.

4.1.2 Gathering sensory data

Therefore, the product for Horizon 1 should feature data-transfer capabilities in order to empower the customer to fully incorporate the cargobike into their digital system. Operators require features for live planning and monitoring, maintenance prediction, driver behaviour profiling, etc., which they are already using in other vehicles except the cargobike. These features are expected to become factory standard on cargobikes in the coming years. Making use of features present in next generation cargobikes is essential to deliver the right product to the market. Bridging the gap between advanced digital back-end systems and the increasing capabilities for **gathering sensory data from the vehicles** should be the focus for implementing off-the-shelve technology in horizon 1.

4.1.3 Charger enabling fleetmanagement

Tiler could be the connecting element to make this happen. The product for Horizon 1 should be **a tile suited for fleetmanagement**. To expect cargobikes to transform into smart data-gathering computers in two years is far-fetched, but making use of the soon-to-be-available sensor technology in cargobikes is vital for accelerationg the employment of the cargobike as a smart(er) vehicle as soon as possible. Simply being able to automatically read out mileage, speed, battery state-of-charge, position, etc. over time at every charging moment could already yield large benefits, while it requires little advanced technology and is therefore accessible and affordable.
The typical users of this product are likely to be part-time temporary employees, accentuating the requirement for an interface that leaves no room for error. The interaction should be time-efficient, but does not need to be necessarily completely self-explanatory; as an employer with a pool of employees under its umbrella it's well imaginable to provide peer-to-peer instructions if necessary. The primary goal of this product is to provide a dummy-proof experience leaving no room mistakes causing unexpected empty batteries. The principle of 'parking equals charging' is applicable.

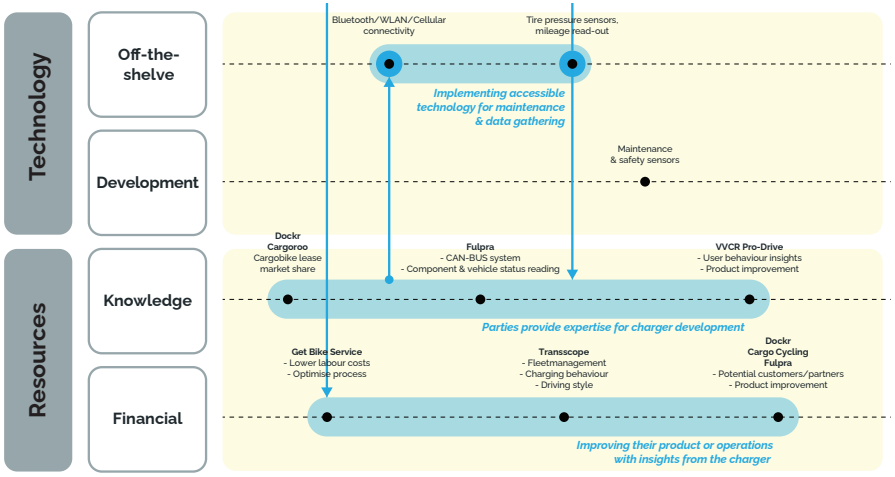
4.1.4 Partners benefit from useage-insights

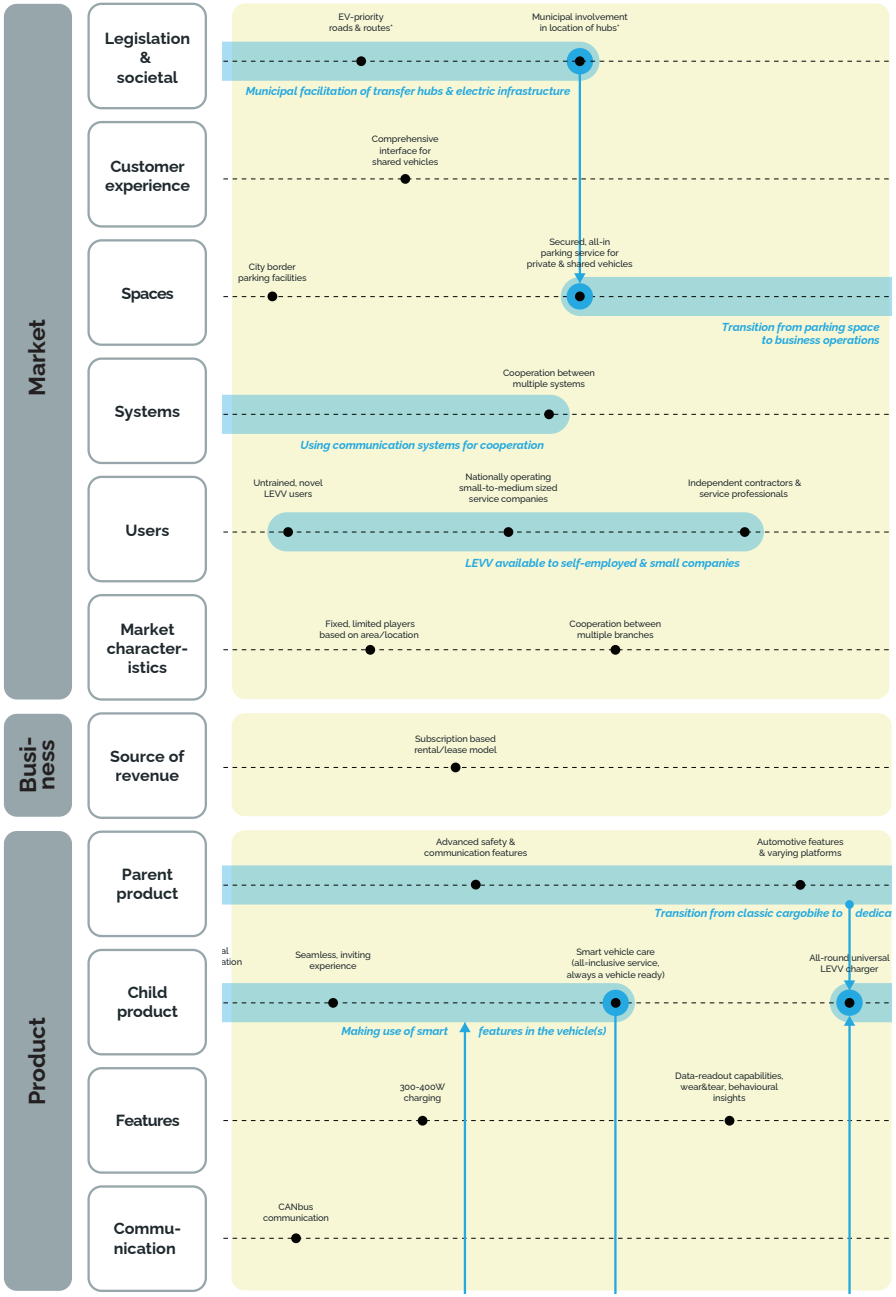
In that sense, the product is suited for addition to the product range of cargobike manufacturers and rental agencies, who currently supply tailor made bikes for usage in logistic fleets. Enabling manufacturers with the possibility to offer a charging tile with "smart" capabilities along with the bicycles is a competitive advantage. The demand from potential customers is already there, leaving the initiative to fill this gap to Tiler. (Interview Willem Boverhoff, 29/04/2021) However, partnering with said companies is essential to develop a charging solution suited for their logistic infrastructure.

Potential partners for cooperation are cargobike manufacturers who are currently implementing said sensory technology, such as Urban Arrow, Fulpra & Cargo Cycling and rental companies such as Dockr and Cargoroo, who in return benefit from a tailored product to offer to customers. **GetBikeService, Transscope and VVCR-prodrive are potential partners for financial backing due to their direct benefit from data-insights** in cargobike usage, as it can greatly optimise their workflow.

4.1.5 Legislation & societal

Accessibility restrictions for fossil-fueled cars will gradually draw more parties onboard of LEV usage, thus increasing the number of cargobikes on the road. LEV usage is not only becoming attractive for operators seeking a competitive advantage, but will also become an inevitable need for small or individual companies who simply cannot afford to replace their car(s) with zero emission alternatives.





4.2 HORIZON 2 2027

4.2.1 Shared vehicles for individual professionals

The introduction of a new target group; **service professionals and contractors, sparks the demand for ready-to-go shared LEV's** suited for vehicle transfers on the edges of town. Additionally, larger companies will want to outsource secured storage, maintenance and charging of their private LEV's on locations convenient for switching from van to LEV, such as commercial parking garages and public transport stations. These applications require cooperation of multiple parties involved in order to realise these carefree fluent transfers for the customer.
The entrance of users from varying branches to the market will likely result in an increase of vehicle types: e.g. Individual contractors, who usually bring a lot of tools and materials with them in their van, require a heavy duty electric vehicle with a large cargo space capable of handling large and bulky materials. Contradictory, a specialised elevator mechanic, switching to LEV to likely handle multiple similar emergency jobs in the area, would probably need an agile vehicle providing enough range for the day.

4.2.2 Fleetmanagement capabilities for large companies

The increased demand of different types of users - novel and experienced, shared and private vehicles, etc. - requires a high level of universality to be able to work with different LEV platforms that will have entered the market by then. Since the charger in this scenario is part of a vehicle transfer from car to cargobike or

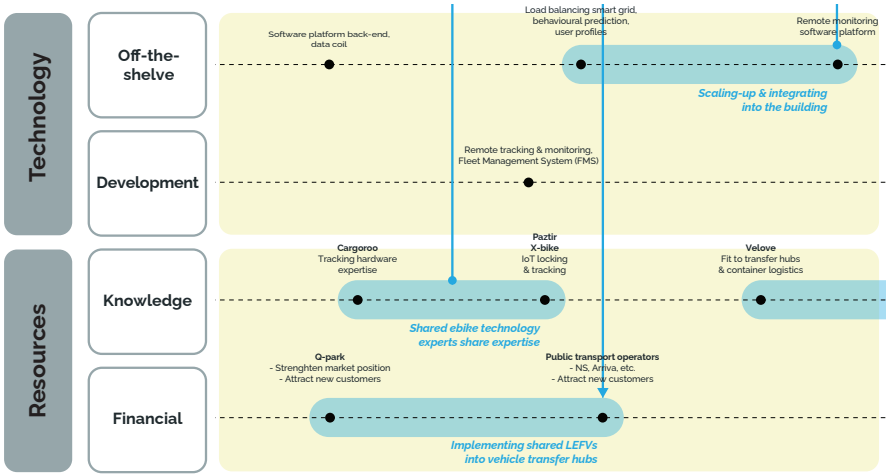
vice versa, unnecessary steps in this process should be avoided in order to provide a seamless, inviting experience for the driver. With the entrance of novel users expected to be unfamiliar with wireless charging protocols, operating the charger should be self-explanatory and intuitive. Overall, the product should function as a multifunctional dockingstation for LEVs, offering a ready-to-go LEV at all times. Further enhancing **data-transfer functionalities and remote fleet management capabilities make sense in this scenario for large service companies** with advanced vehicle fleets, although targeting small companies with little financial resources by offering an affordable, low-tech means of transferring vehicles should be prioritised.

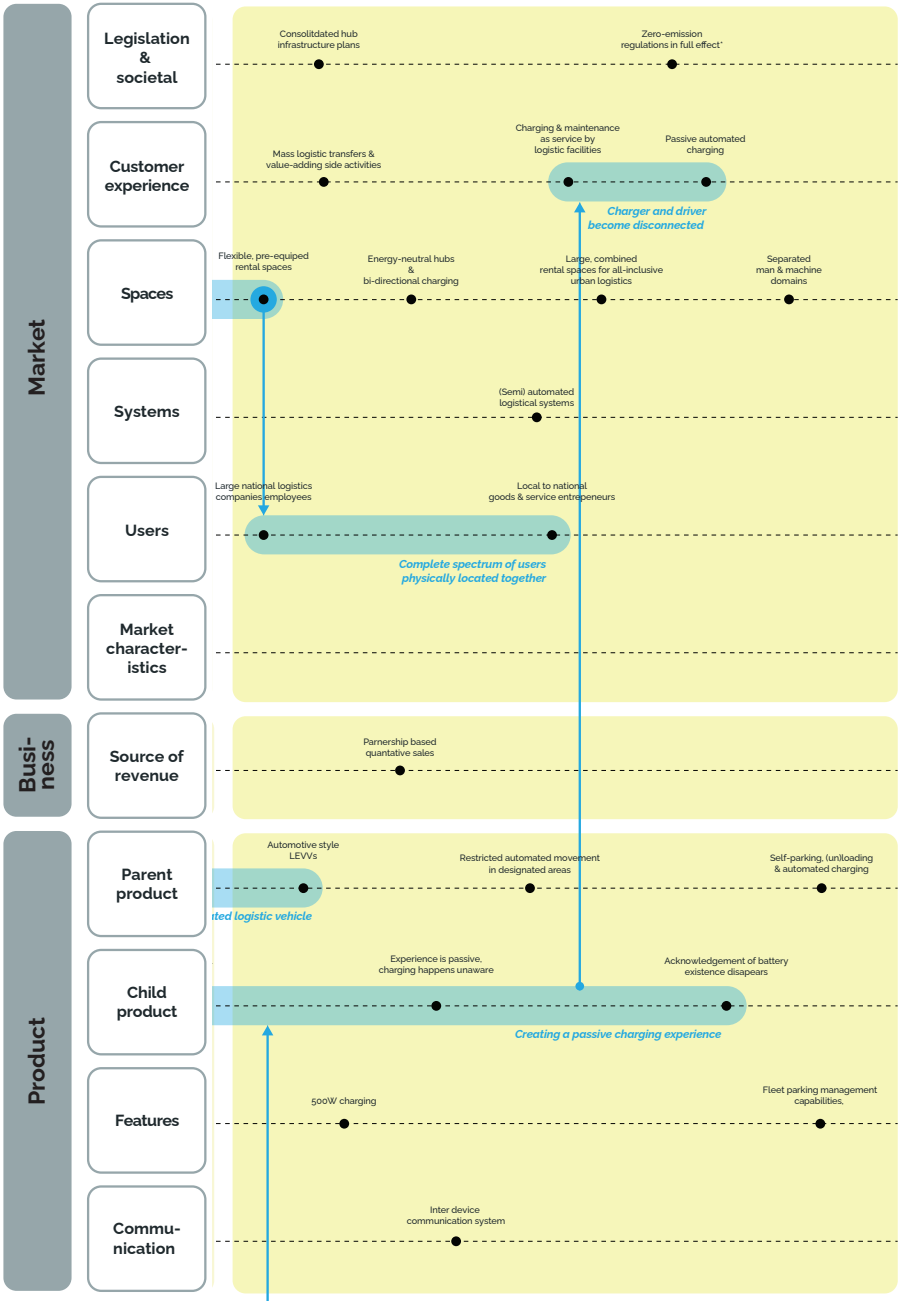
4.2.3 Integration with the building

Entering the market of shared cargobikes further complicates the interaction for the user and introduces the need for hard- and software solutions capable of handling functionalities such as locking & access, payment, remote monitoring and managing the state-of-charge levels for vehicles in order to provide the user with an adequately charged vehicle at the right time. This calls for smart load balancing, based on usage patterns and **cooperation with the building** to manage voltage peaks. This expertise will become especially relevant towards horizon 3, where distribution from large consolidated buildings becomes the norm.

4.2.4 Remote monitoring & access

Designing an adequate solution in this domain is possible when cooperating with the right partners who can provide **expertise and hard- & software for locking, remote tracking and keyless access**. X-bike, Paztir and Cargoroo are examples of parties relevant to work with at this stage. Since the domain is defined as semi-public, **partnering with parking providers (Q-park and municipalities) and transfer locations (P+R) from public transport providers (NS, GVB, RET, HTM) is essential**. The product in its initial phase should be relatively low-tech for experimenting with varying factors that are of influence on demand from users, such as location, price and ease-of-use. This enables Tiler to initiate the development of the product and attract the required partners.
Simultaneously, starting with a low-tech solution would make it easier to attract the required partners, since the initial development would impose little to no risk for all parties involved. When demand increases, the concept could be developed further to achieve more technologically advanced features, which will likely attract larger players in the industry such as Ziggo, Stedin and KPN to name a few.
Using the tile for charging of shared cargobikes dramatically reduces costs and labour currently required to swap batteries manually. Additionally, gathering data and forming insights based on the bicycles' status should be valuable for partners. Financial resources in this stage are likely to flow from subscription based or pay-per-use revenue incorporated in the use of shared cargobikes or storage subscription, either through the facility owners or cargobike leasing companies.





4.3 HORIZON 3 2031

4.3.1 Common locations for bundled distribution

As the implementation of regulations towards reducing emissions in city centres progresses, demand for convenient transfer locations will increase and consolidated logistic centres are likely to become more common. These types of buildings provide dedicated spaces for **all kinds of parties to organise their urban distribution and potential side activities in accessible locations**. The buildings are likely to offer advanced robotic equipment for logistic processes, such as order-picking, parcel sorting and stock-keeping. With large online retailers and logistic operators likely to start operating from these locations, this will be the focuspoint for LEV charging in horizon 3. However, not only large corporations with advanced technological systems will be located here. The philosophy behind consolidated logistical centres is offering space for logistic activities to a broad range of operators, thereby making it essential to keep the technological threshold low.

4.3.2 Limited automated behaviour

To supply this market with a charging solution, its functionality should be focussed on bridging the gap between the advanced logistical features in the building and the vehicle's capabilities to perform restricted automated behaviour. The foreseen environment of warehouses in 2031 will likely feature advanced automated features, such as robotic arms, automated shelf lifts, smart conveyor belts and autonomously moving forklifts. The potential customers of Tiler in

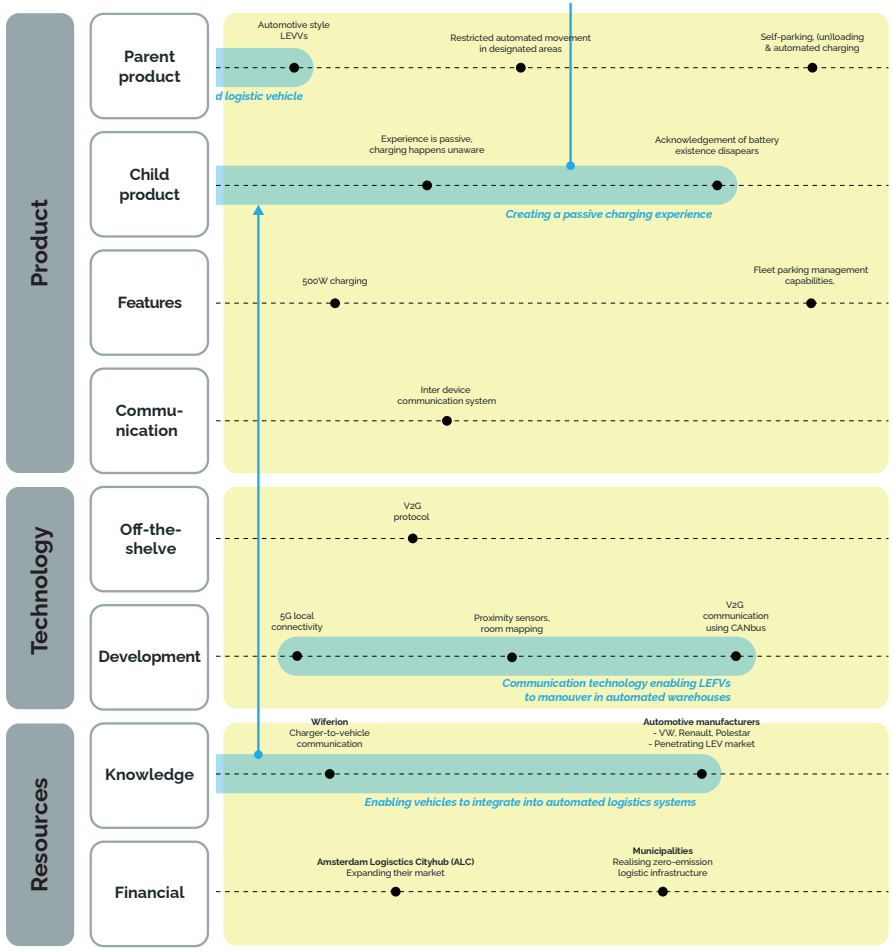
Horizon 3 are currently already innovating and implementing these features towards the scenario of automated handling, with DHL, CoolBlue and Bol.com on the forefront in the Netherlands. These parties will be looking for ways to further broaden the application of automated technology in their warehouses. Currently, the transfer of parcels and packages from the warehouse into the vehicles is still a labour intensive, manual process, which is likely to be (semi-) automated towards Horizon 3. The same goes for charging the electric vehicles that are currently used in this domain. It is therefore expected that the leading companies will be steering towards electric vehicles suited for working in an automated (un)loading and charging environment.
At the moment, small electric vans for urban logistics are already equipped with remote communication technology based on a FMS CANbus interface, for instance the fleets of PicNic, Hellofresh and DHL. The interface is expected to have made its entrance onto the cargobike by Horizon 2 and in succession is expected to **enable LEV manufacturers to - with use of basic off-the-shelf technology - realise automated functionalities**. For example, using proximity sensors, WLAN and a Vehicle2grid (V2G) software communication protocol automated movement and parking in predefined conditions could be realised.
Implementation of this technology enables warehouses to separate man and machine on the working floor, which is necessary to reduce accidents between autonomous vehicles and human employees. Ideally, drivers reside in a separated area to where the loaded and charged LEV shows up, ready for take-off.

4.3.3 Automated charging fades awareness of batteries

Keeping these developments and possibilities in the technological sector in mind, the functionality of the Tiler product for Horizon 3 should be focussed on offering communication capabilities to suit the advanced infrastructure present in the consolidated warehouses in 2031. Assuming vehicles are able to park and move independently within warehouses opens the opportunity to offer automated wireless charging to the customer, essentially **removing the need for users to think about charging** or batteries altogether. Its characteristic feature is therefore the ultimate follow-up to “parking equals charging”, since **parking and charging will be done automatically without involvement of the driver**. This principle introduces a scenario where the driver will become unaware of the actual existence of batteries in vehicles and the necessity to charge them - this responsibility will by then be completely taken over by automated fleetmanagement systems and the smart Tiler charger integrated into the building. The placement of high numbers of electric chargers in a building results in requirements for smart load balancing and peak voltage prediction in order to manage the limited power supply of these buildings, which will likely be energy neutral. Bi-directional charging is therefore a necessary functionality in order to suit the building’s energy management system.
At the same time, bundling many different companies together at a single location means dealing with a large variety of cargobikes and other LEVs, demanding a charger as universally applicable as possible. The product therefore shouldn’t have to be radically different in appearance from horizon 2, since ‘manual’ operation will still be important to a significant portion of the market, depending on the vehicle(s) used. Expanding the level of integration with the building - starting from Horizon 2 - and combining it with effective means of communication with advanced V2G systems in vehicles should yield a feasible solution tailored to the domain.
To conclude, the functionality of the product in Horizon 3 fulfills the requirements of both target groups from Horizon 1 and 2; Both shared and private vehicles, ranging from accessible to advanced technological features with integration into the buildings powergrid.

3.3.4 Fluent integration of LEFVs in automated logistics systems

In order to make use of the advanced potential LEV's will have in Horizon 3, it is essential to attract expertise from cargobike manufacturers and warehousing technology experts. Velove and Wiferion should be well suited options in this regard; Velove due to their expertise in containerised distribution using dedicated cargobikes and Wiferion for their experience with wirelesly charging warehouse robots respectively. Cooperating with Tiler should in return offer them interesting opportunities for improving their own products and broadening their market. In this scenario, Tiler fulfills the role of the connecting element between both, resulting in added value for all parties involved.
Financial resources are likely to flow from the parties who will offer consolidated logistic spaces to the market, for instance Amsterdam Logistic Cityhub as an example of a commercial business, or municipalities who will initiate the realisation of similar solutions as part of their strategy to reduce the amount of emissions and accelerate the transition towards clean mobility towards 2030.
The preferred role for Tiler to take in these collaborations is up for debate, since it could be argued that different possibilities are at hand. Simply staying with a quantitative sales strategy could prove to be beneficial in such a large, complex ecosystem with many players involved. On the other end of the collaboration-spectrum Tiler could be envisioned as a direct supplier to building operators and generate revenue as part of lease-contracts from logistics operators renting spaces.



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5. ANALYSIS

Exploring the context for Horizon 1

The goal of the project is to connect a profound strategy with a feasible product design. Following the roadmap, the first step towards expansion to cargobikes is horizon 1 - a fast-growing, innovative market where the demand for a dedicated charger is already present (J. Kerremans 2021). The concept is therefore aimed at small retail spaces and hubs, of which two locations have been analysed in this chapter. The choice for horizon 1 follows from the similarities this domain shows with the previously successful application of the Tiler charger with e.g. New York Pizza delivery; The Tiler system is often beneficial when bikes ride many short trips throughout the day (personal communication Christiaan van Nispen, 18/05/2021).
To obtain a clear view of the problems and opportunities, qualitative interviews were performed at the CoolblueFietst hub in Rijswijk and the Marleenkookt headquarters in Amsterdam. CoolblueFietst is Coolblue's in-house solution for parcel delivery using e-cargobikes, while Marleenkookt delivers freshly cooked meals in proprietary porcelain bowls in the city before dinertime. The transcripts of the interviews can be found in appendix chapter 9.7.

5.1 THE OBJECTIVE

Field research and interviews at two companies involved with cargobike delivery - Coolblue and Marleenkookt - resulted in valuable insights regarding the use and charging of cargobikes. These companies both rent their cargobikes from Dockr, who offers flexible all-in subscriptions to commercial vehicles. Following from these qualitative interviews, five opportunities to improve charging cargobikes in this domain were defined. But first, to understand the present situation better, a scenario of the current solution is depicted on the next page.

An alternative solution to charge batteries in the bicycles was tested using extension cords. The loose wires laying across the floor would quickly get damaged due to carts, trolleys and bicycles riding over them, resulting in malfunctioning and dangerous situations.
At the moment, there are no ready-made solutions available to the market for conveniently charging in-bike and both parties indicated there is no room for developing an adequate solution in-house.

Figure 40: Custom made charging cabinet for around 40 cargobikes at Marleenkookt's main location in Amsterdam. Each battery has a dedicated bike it belongs to, hence the names and

> *Figure 41: Charging cabinet as used in all CoolblueFietst hubs around the country*

5.2 CURRENT CHARGING PROCEDURE

Dismount the bike & enter the hub

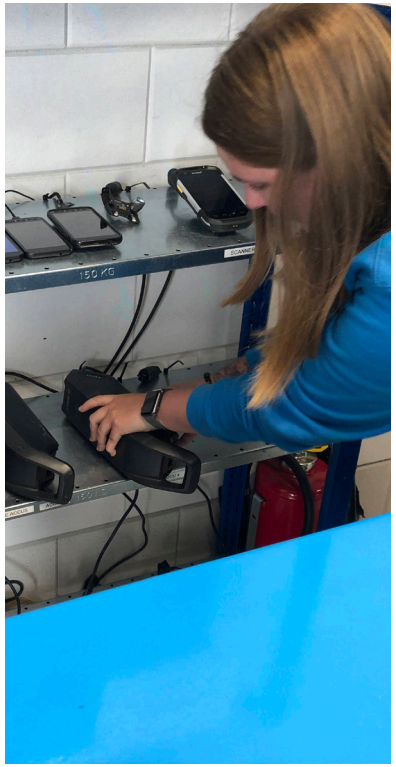
Park the bike using the propietary kickstand

> *Figure 42: The current procedure requires a lot of manual steps that require a well organised system*

The current charging procedure at CoolBlue is depicted below. In both cases, a standard cabinet is used, in which all batteries are gathered for charging. Multi-socket powerstrips are used to provide power to the charging adaptors, resulting in a lot of loose hanging cables.

Unlock the battery with the bicycle's key

Dismount the battery by pulling it out and upwards



Carry battery to the cabinet and plug it into the charger

Verify by looking at the LED-bar on the battery

5.2.1 Human error & responsibility

The problem with manually plugging in the wires is not necessarily the effort itself, but rather the risk of mistakes or irresponsible behaviour by personnel. The large cabinets often house dozens of batteries with dangling wires that easily get tangled and the proprietary Bosch connector easily drops out of the battery. The small LED-indicator on the side of the battery is often hidden from sight, so batteries that are not charging properly often go unnoticed.
It's easy to make a mistake and a small mishap can have big consequences: In Marleenkookt's unsupervised hub in Rotterdam, unexpectedly empty batteries have resulted in missed delivery windows to the customer in the past. Spare batteries are now used to compensate for this uncertainty. Between 25-70% extra batteries are purchased to accommodate for unexpected situations on the road and while charging; a precious affair. Supervision is still necessary to check if the batteries are properly connected, but in unsupervised hubs this is a challenge. The bicyclists are often flexible, part-time working youngsters who have little incentive to double check the charger for the next person to use the battery.

> *Figure 43, 44: Charging at Marleenkookt using Bosch adaptors*

> *Figure 45, 46: Logistic hubs of Marleenkookt and CoolblueFietst*

5.2.2 Scalability & flexibility

The logistic locations observed were tight on space. Either the bikes barely fit in the room (Marleenkookt) or the space is used for varying activities consecutively each day, such as parcel sorting, (un)loading and repairs (Coolblue). The opportunities for installing comprehensive devices are restricted, since the spaces are often rented and excessive drilling or carving out the floor is not possible.
Logistic hubs like these are continuously scaling up. Coolblue doubled the amount of bikes used in their hub in Rijswijk last year alone. Expanding with new hubs and moving existing hubs to larger spaces is common; Marleenkookt is moving to a new, bigger location next year too. Due to fast growth in the cargobike delivery sector, the layout of these spaces is often changed as well. A plug&play charger that is (re)moveable and can accommodate for expansion with extra bicycles is therefore preferred.

5.2.3 Safety

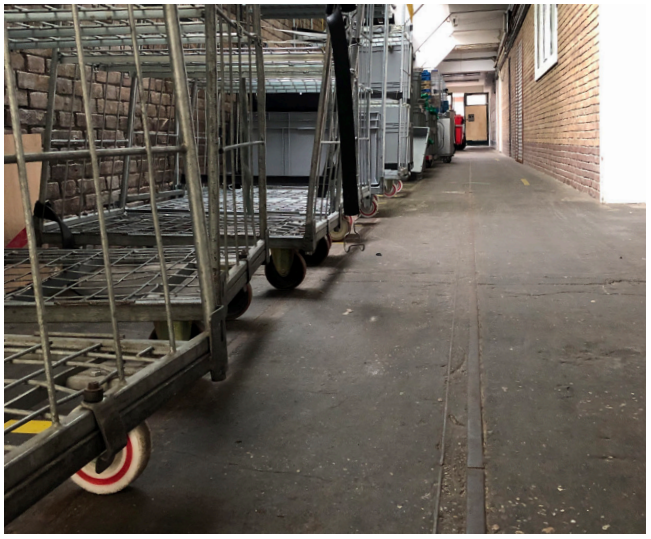
Fire-hazard was taken care of with fire extinguishers at both locations, but was not a topic of concern for staff when asked upon. The small extinguishers present do not seem to be adequate for battery fires, which are notoriously hard to put out. Placing them right next to the battery cabinet is also questionable, since in case of a fire they might become inaccessible by staff. Automated sprinkler installations were not present in all cases observed, posing a risk for potential fires at night.
Regulation-wise, the use of fireproof safety cabinets is not obligated, but advised (IFV, 2019). Storage of hazardous substances - which lithium-ion batteries are a part of - is only subject to legislation above 10.000kg, and specific regulations for bicycle batteries are not yet present (De Stentor, 2019).

> *Figure 47, 48: Fire preventive measures at both attended logistic hubs*

5.2.4 Installation constraints

Level-flooring is a standard necessity in logistical spaces. Trolleys have small castor-wheels which easily get stuck at small edges. Upright edges of around 2cm or higher already cause problems for manouvering carts packed with parcels. Any potential charging solution on the floor should therefore be easily removable or feature a smooth, gradual embossing for it to not obstruct logistical activities.
Level flooring is also preferable for parking cargobikes. When parking, the cyclist is effectively lifting the bike by exerting leverage from the kickstand. An uneven floor has a high impact on the force necessary to fold out the kickstand, especially when the cargobike is already heavily loaded. Keeping the floor free of bumps and/or cavities is therefore important.

> *Figure 49-52: Necessity for level flooring*



5.2.5 Digital connectivity

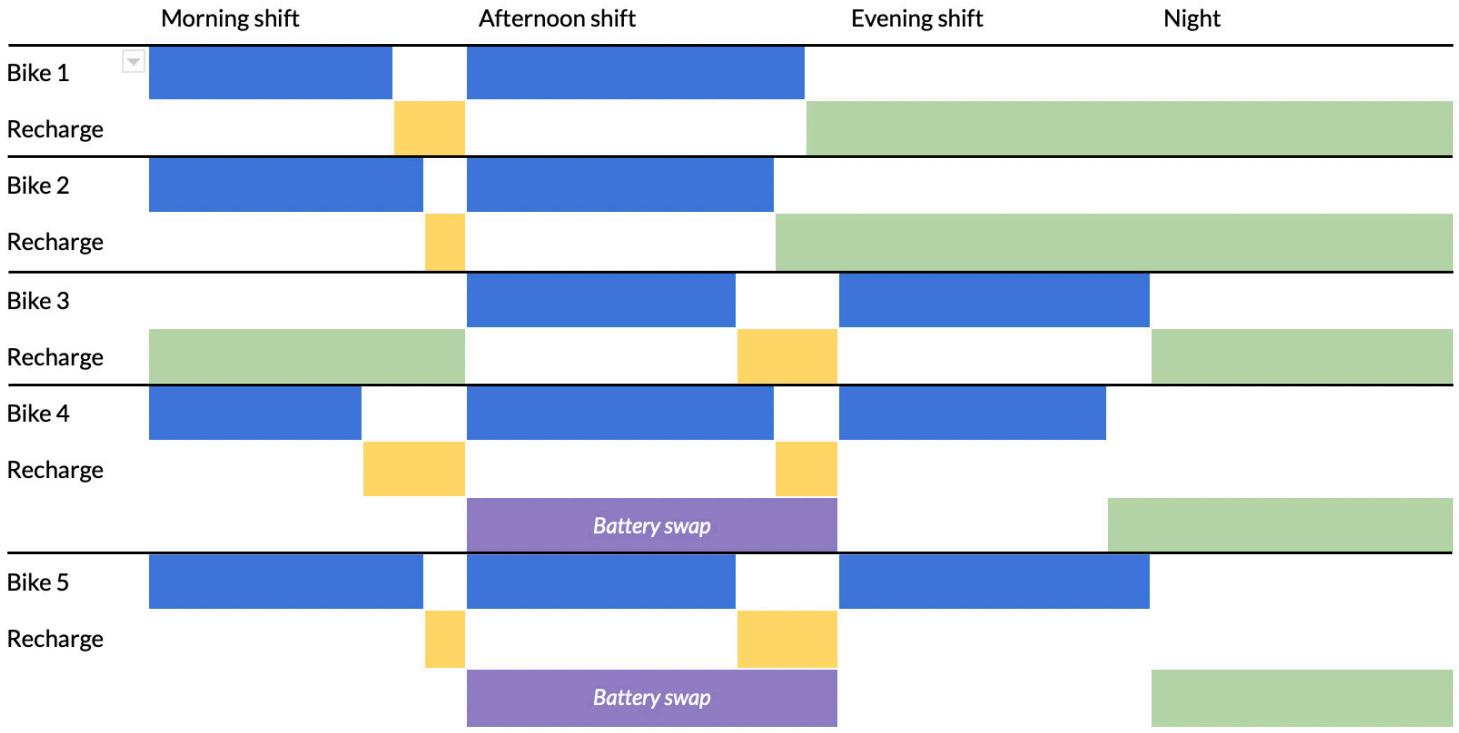
Both Marleenkookt and Coolblue indicated to have advanced IT-systems for route planning and monitoring the logistic process. Both expressed their concern for the lack of possibilities regarding monitoring the charging process and extracting data from the bicycle. An accessible, effective way of incorporating the cargobike into existing IT-systems would be greatly beneficial for streamlining operations.
E.g. A service mechanic from GetBikeService, who does on-the-spot maintenance for the Dockr bikes, indicated that they rely on estimates for planning the service intervals. The ability for GetBikeService to have access to an advanced fleetmanagement platform - allowing them to track mileage, g-forces, etc - would greatly improve their ability to do preventive maintenance on parts susceptible to wear. Currently, bikes are standing still when broken, waiting to be repaired, which is costly. At Marleenkookt, on average multiple bikes are out of order at any given moment. The ability to track how intensively a bike is used enables GBS to prevent bikes from breaking down, ultimately harnessing more potential from each bike.

Figure 53,54: Repairing of broken cargobikes at location <

5.3 USE SCENARIOS

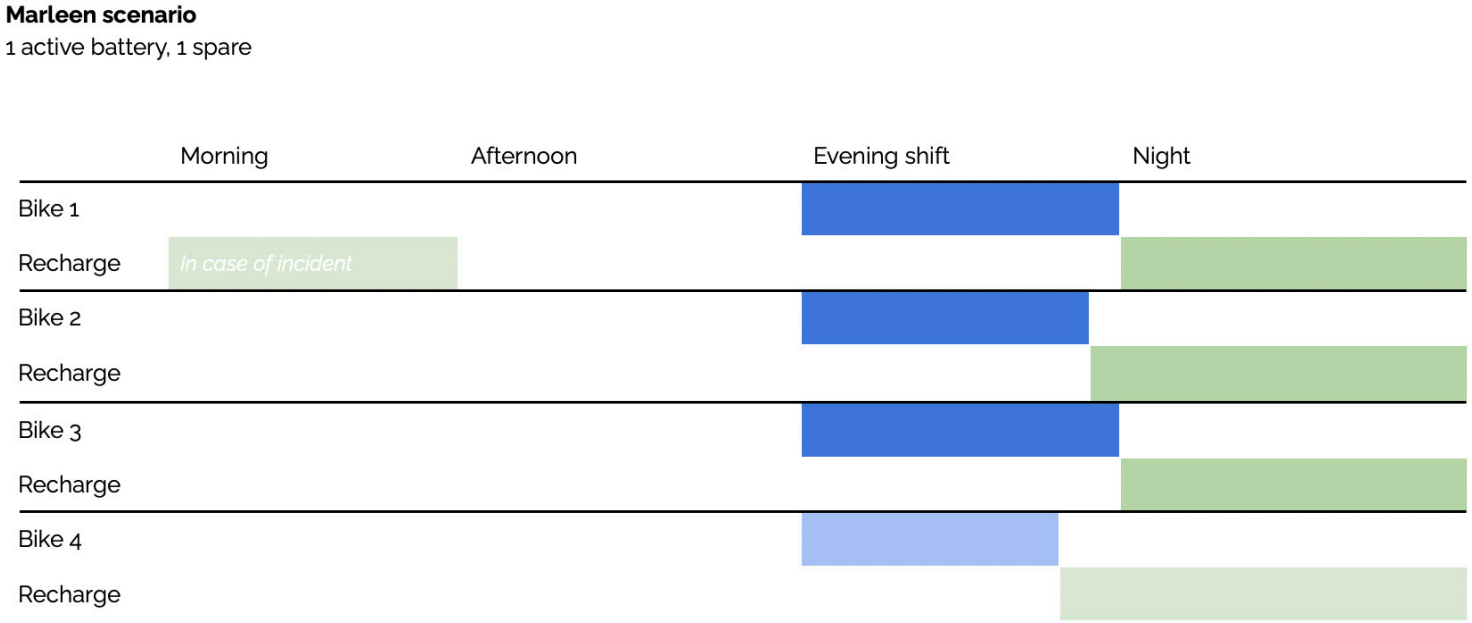
The daily operations of the two companies studied regarding charging are depicted below. Blue means the bike is out riding, yellow is charging potential for Tiler, green means current, regular charging - at night - and purple is a battery swap. In case of Coolblue, two or three shifts are performed per bike each day. A battery lasts around one shift of 40km maximum. Since the bikes have two battery slots, they are equiped with two batteries, plus a spare. A battery swap is always necessary when riding three shifts.
When the capacity is therefore fully used - for instance before busy periods such as christmas or black friday - the Tiler system is insufficient to take care of charging all the batteries used.

Coolblue scenario
2 active batteries, 1 spare



> *Figure 55: Charging scenario of five bikes used by Coolblue throughout the day*

In case of Marleenkookt, the bikes are equiped with a single battery, plus occasionally a spare one. Marleenkookt only delivers at a timeslot in the evening and each bike rides a single delivery shift each day. Charging inbetween shifts is therefore not an option.
To conclude from both scenarios, introducing Tiler system does not directly result in less batteries required in daily operations. An ideal scenario is a scenario where bikes ride two or more daily shifts, with a maximum total distance of 80km - two full batteries. The more inbetween stops, the more benefit Tiler provides, since in-between charging is more likely to happen. A scenario as such is present in retail, where delivery takes place during opening hours as described in the Vision 2031: 'Fast, local delivery' - corresponding with Horizon 1 in the Roadmap.



> *Figure 56: Charging scenario of a few of the total 41 bikes used by Marleenkookt throughout the day*

5.4 BUSINESS CASE

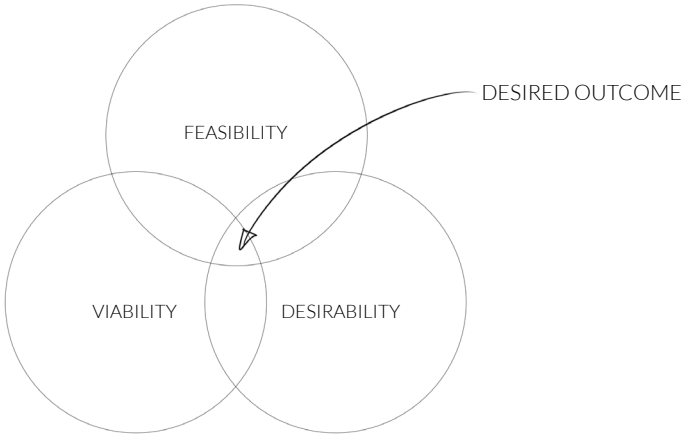
Ideal scenario
Monthly subscription, daytime riding & charging (min. 2 shifts) with 5 bikes. Examples: Blokker, PostNL, etc.

	Battery cabinet	Tiler induction
Bikes	1275	1275
Batteries		
Main	225	225
Spare/emergency	225	90
Subtotal bikes monthly	**1725**	**1590**
Charging cabinet (SafetyFirst) L (16) (PGS15 norm, EN 14470-1)	47 (2839, 2199 + 640, 5yr. write-off)	
Bag to Safe	2873 (17 * 169)	
TILER charging solution		225 (estimate based on Dockr markup)
Safety alarm & extinguisher Optional extra	23 (1376/60)	23 (1376/60)
Subtotal charging monthly	**70**	**248**
Totals monthly	**1795**	**1838**

> *Figure 57: Financial estimation of the potential Tiler solution versus using charing cabinets. Amounts in EUR.*

From the two field visits at Coolblue and Marleenkookt, two financial scenarios were sketched out. To get a better idea of where the Tiler system can be most beneficial, an ideal scenario was sketched additionally. The conclusion from the figures is that the Tiler system is not a direct financial advantage in this case. However, the numbers also do not outrun eachother far, especially in comparison to the total costs of e-bike operations. The ideal scenario on the left is based on a monthly subscription model, which could be an option in the future in cooperation with lease-company Dockr. Hypothetically, in a hub with five cargobikes the costs for the total solution would barely differ opposed to using a battery cabinet. Conversely, an induction system could yield significant improvements in daily operations and offer added functionalities. All-in-all, Tiler could prove to be a beneficial solution to the market. The full financial overviews can be found in Appendix chapter 9.6. Source figures originate from the interviews, personal communication with Willem Boverhoff (Dockr, 29/04) and recommended retail prices available online. An estimate was made for the Tiler system based on the current retail price of the Tiler Uno system, which houses similar components. The sketched scenarios are two hypothetical situations for charging cargobikes either with a Tiler system or using a charging cabinet - compliant with modern safety regulations. For both scenarios, a 5 year write-off period was chosen, as is the minimal requirement for the product (see chapter 5.5).

> *Figure 58: Parcel trolleys, shelving units and cargobikes at the CoolblueFietst hub in Rijswijk (South-Holland). The floorspace is normally used for parking the bikes - out for delivery at the time this photo was taken - and sorting incoming shipments of parcels.*



5.5 DESIGN CRITERIA

The extent to which the design meets the criteria defines quality of the charger. The criteria result mostly from the user research at the aforementioned company visits and scenario's. The most important criteria are listed here - divided in regard to desirability, feasibility and viability.

Desirability
- Ease of use & accuracy: 'Parking equals charging'
- Does not cause obstruction to ongoing logistical activities, e.g. trolley handling, parcel sorting and (un)loading (interview Coolblue, appendix chapter 9.7)
- The charger is resistant against rough handling typical for logistic domains (interview Coolblue, appendix ch. 9.7)
- The product is ready to read out data from the cargobike and send it to the cloud

Feasibility
- The product can be engineered in-house by the existing Tiler team
- The design is ready for short term development into a market-ready product for pilot purposes in low quantities
- Production and assembly of pilot series is possible with means of manufacturing & expertise accessible to Tiler, e.g. CNC-milling, 3D-printing and low-quantity moulding processes.

Viability
- Can be (de)installed and relocated on a flat concrete floor without the need for special tools
- A multiple of the product is suited for charging up to 15 vehicles on a single location
- Incremental expanding of the amount of chargers is possible without major adjustments
- The kickstand is a universal fit for the existing Tiler charging tile
- The product should last a minimum of 5 years without the need for extensive maintenance or replacement of housing components.
- The internal components are accessible through the use of - standardised tools
- Replacing and upgrading of electrical components is possible without damaging the product
- Wear-subjective components, e.g. contact surfaces or moving parts, are replaceable with standardised tools

6. TILER CARGO

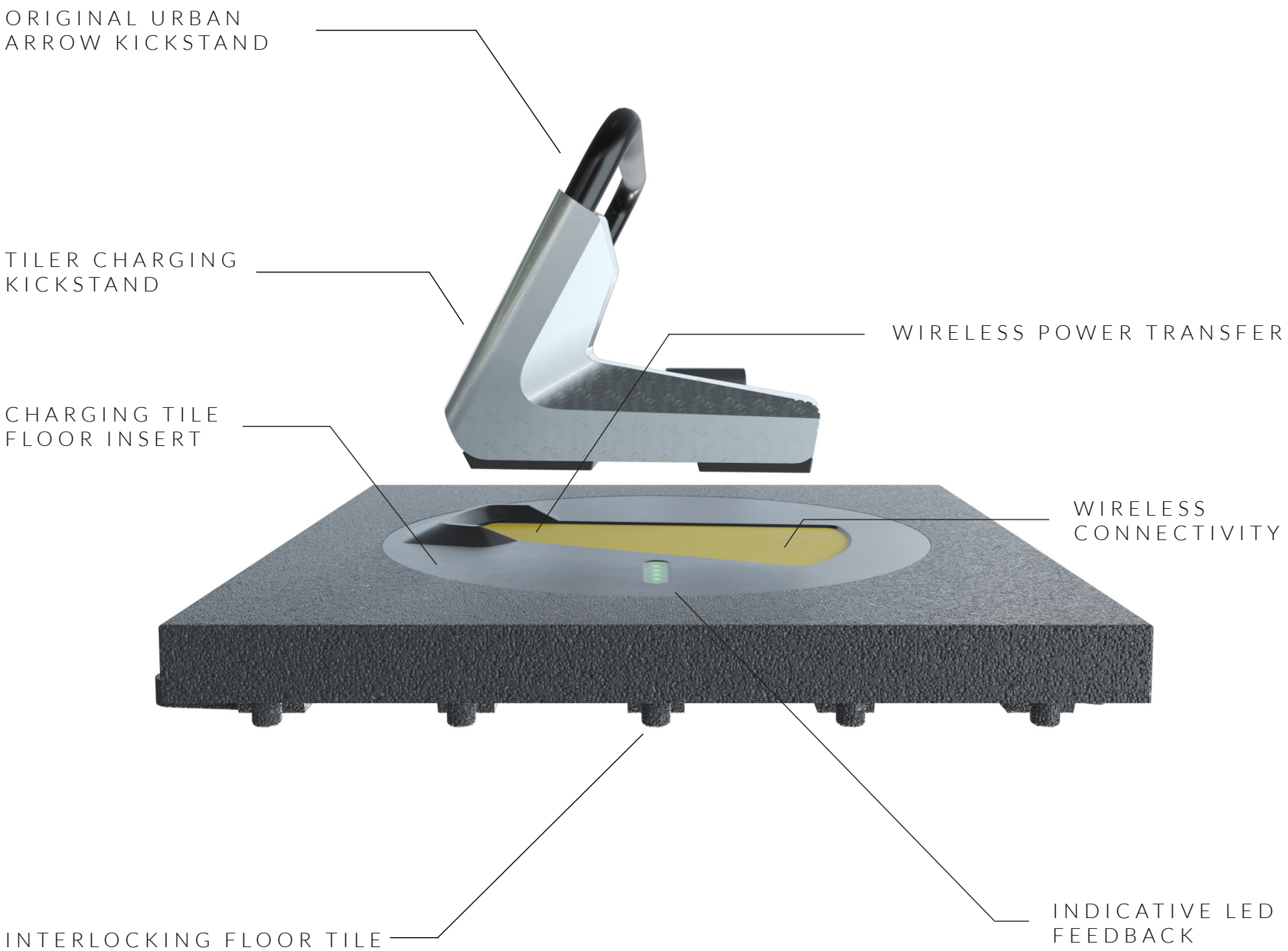
CONCEPT DESIGN FOR CHARGING CARGOBIKES IN CITY LOGISTICS

TILER Cargo is a wireless charger for commercially used cargobikes. Intended for use in small to medium sized logistic hubs - 5 to 15 bikes - the concept is aimed at fulfilling the needs for charging in Horizon 1 from the Tactical Roadmap. The integrated solution provides an effortless way of charging the batteries while leaving them in the bicycle. The concept consists of an induction kickstand mounted on the cargobike and a raised floor with multiple integrated charging points. The system floor involves a grid-layout and is able to house the chargers without protruding, keeping the floor flat and even. Implementing the electronics in the floor enables the customer to charge their bicycle(s) in their predetermined parking spot withouth cables laying exposed. By making use of induction charging, the need for separate charging cabinets or battery swapping disappears: Bikes are charged through the floor, simply by parking them on the charger.

The concept applies to the existing kickstand present on the Urban Arrow Family cargobike. Many different types of kickstands are used on cargobikes and even Urban Arrow has multiple types. The decision for the Urban Arrow and this type of kickstand follows from the fact that it is the most used cargobike and kickstand in the market, therefore having the biggest likelihood for adoption in the future. The concept was further detailed by validating with 3D-printed prototypes on an actual Urban Arrow Cargo cargobike, provided by Cargoroo. Cargoroo offers shared e-cargobikes conveniently placed in public locations in cities in the Netherlands and was kind enough to provide a cargobike for development purposes throughout this project.

> *Figure 59: TILER Cargo in the envisioned scenario of 5-10 cargobikes in a small logistic hub.*

> *Figure 60: This physical prototype built for validation purpose illustrates the the placement and dimensions of the charging tile and kickstand relative to the bike*

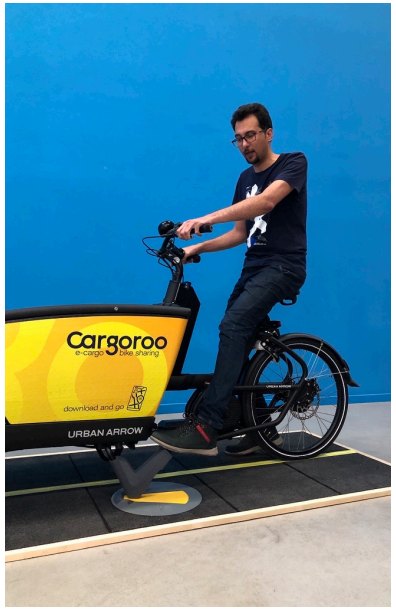

ORIGINAL URBAN ARROW KICKSTAND
TILER CHARGING KICKSTAND
WIRELESS POWER TRANSFER
CHARGING TILE FLOOR INSERT
WIRELESS CONNECTIVITY
INDICATIVE LED FEEDBACK
INTERLOCKING FLOOR TILE

6.1 NEW CHARGING PROCEDURE

Dismount the bike & enter the charging area

Approach a free charger & line up the bike

A green light indicates availability. Line-up the wheels of the bike colinear to the yellow line on the floor

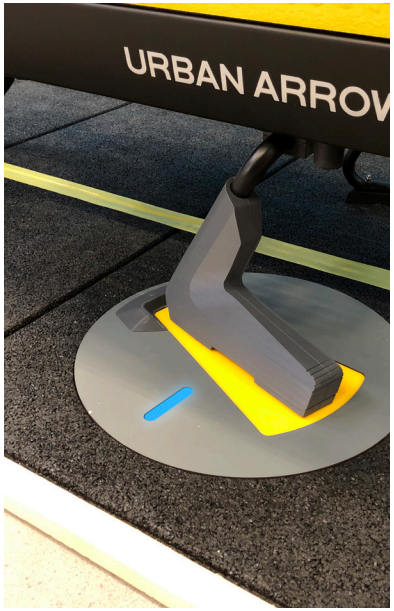


Move forward & fold out the kickstand by foot

Aiming for the front to fall into the embossed cavity on the tile in the floor

Park the bike & verify alignment

Park the bike in regular fashion by exerting force by foot on the back-end of the stand



Verify by looking at the LED-bar in the tile

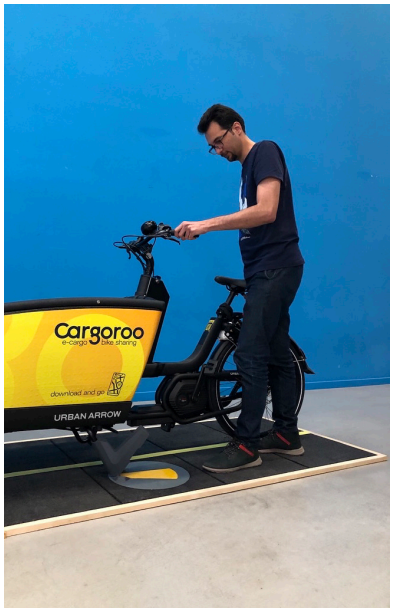
Ensure proper placement on the indicated yellow area. A blue light indicates the charger is working.

> *Figure 6 1: The new procedure requires a little amount of steps to start charging the bike*

TILER Cargo eliminates the need to take the batteries out of the bike for charging. The new procedure for charging essentially comes down to parking the bike in the correct spot. Yellow elements on the floor and charger are used to guide the user towards correct placement.

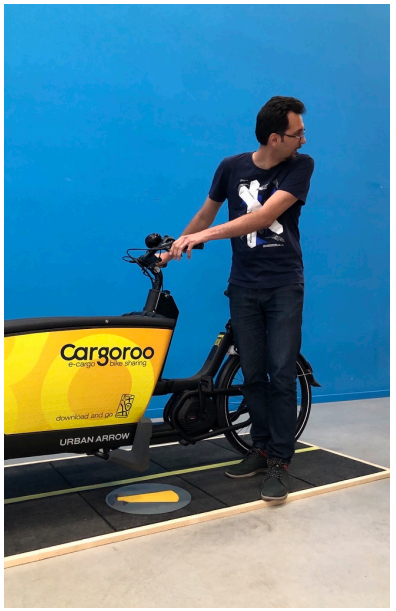
Identify & approach e-cargobike

Verify sufficient charge from the LED-light

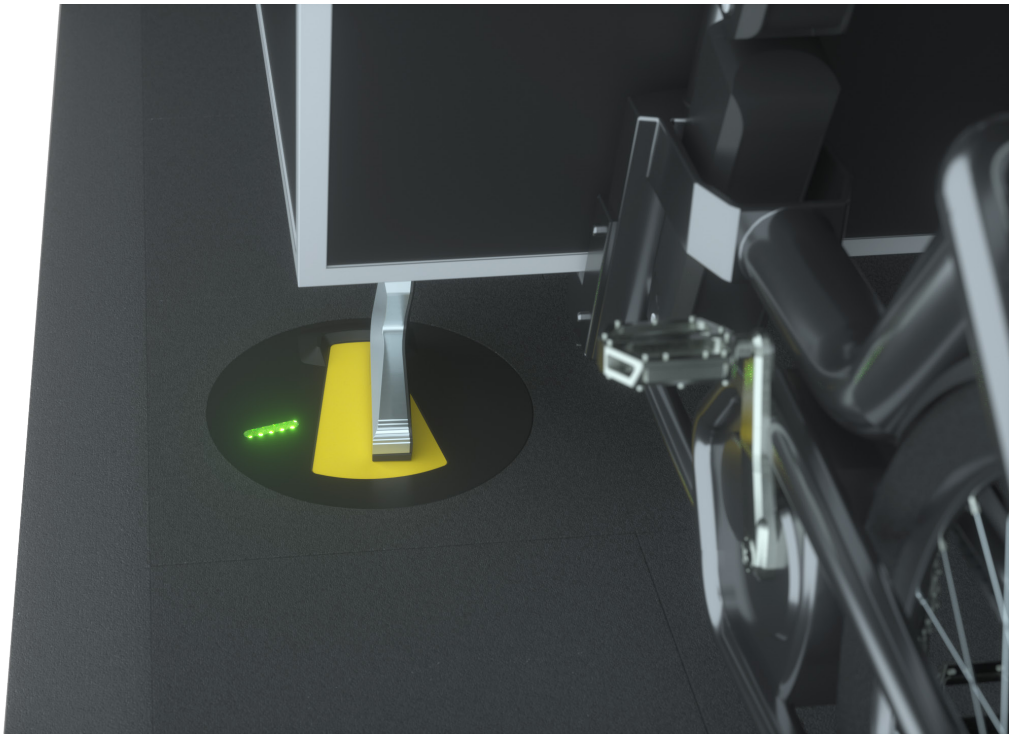


Dismount from the kickstand

Simply move the bike forward. The kickstand will fold up automatically due to the counteracting edge around the kickstand.



Reverse out & embark on the trip



> *Figure 62: Parking equals charging*

6.2 CORE VALUES

6.2.1 Parking equals charging

TILER Cargo eliminates the need to take the batteries out of the bike for charging. Currently, supervision at the location is necessary to ensure all batteries are being properly plugged in. Removing and plugging in the batteries are operational steps prone to human error, resulting in unexpectedly empty batteries causing frustration and the need to buy expensive back-up batteries.
TILER Cargo introduces the powerful concept of ‘parking equals charging’; by wirelessly charging through the kickstand, the most pressing problems occurring with charging cargobikes in the commercial domain are resolved. The fully automated charging process takes away the need for cyclists to actively take care of charging. Instead, parking the cargobike in the right spot is sufficient. By simplifying the charging process, TILER Cargo makes charging easy and carefree.

6.2.2 Scaleable & flexible

The currently used - often home-made - charging cabinets are a hassle. Intended as an intermediate, temporary solution, problems start to act up when charging more than a handful of batteries. With the ability of TILER Cargo to charge the batteries in-bike, adding more bikes does not add complexity; the system is suited for a single to several dozen cargobikes.
Since companies using cargobikes often operate from flexible rental spaces with varying lay-outs and continuously increasing number of bikes, the concept is designed to be easy to fit and adjust. By using standard size 50 by 50cm interlocking rubber tiles, TILER Cargo can be applied in practically any level floored space. Laying down the rubber tiles requires no tools or adjustments to the building.

The design works incrementally, since the charging tiles are interconnected within the floor grid. Adding more chargers is easy: simply swap out a regular floor tile with a charging tile and plug it in to the closest charging tile nearby.
Furthermore, while TILER Cargo is aimed at use indoors, the kickstand is also suited to work with TILER's regular outdoor charger: the TILER Uno. TILER Uno is currently in development and is TILER's compact solution for charging regular ebikes from the pavement outdoors. Universality is one of TILER's core values. Ensuring compatibility between their products adds flexibility in useage for the client. Potentially, fast-charging on the road becomes a possibility in the future.

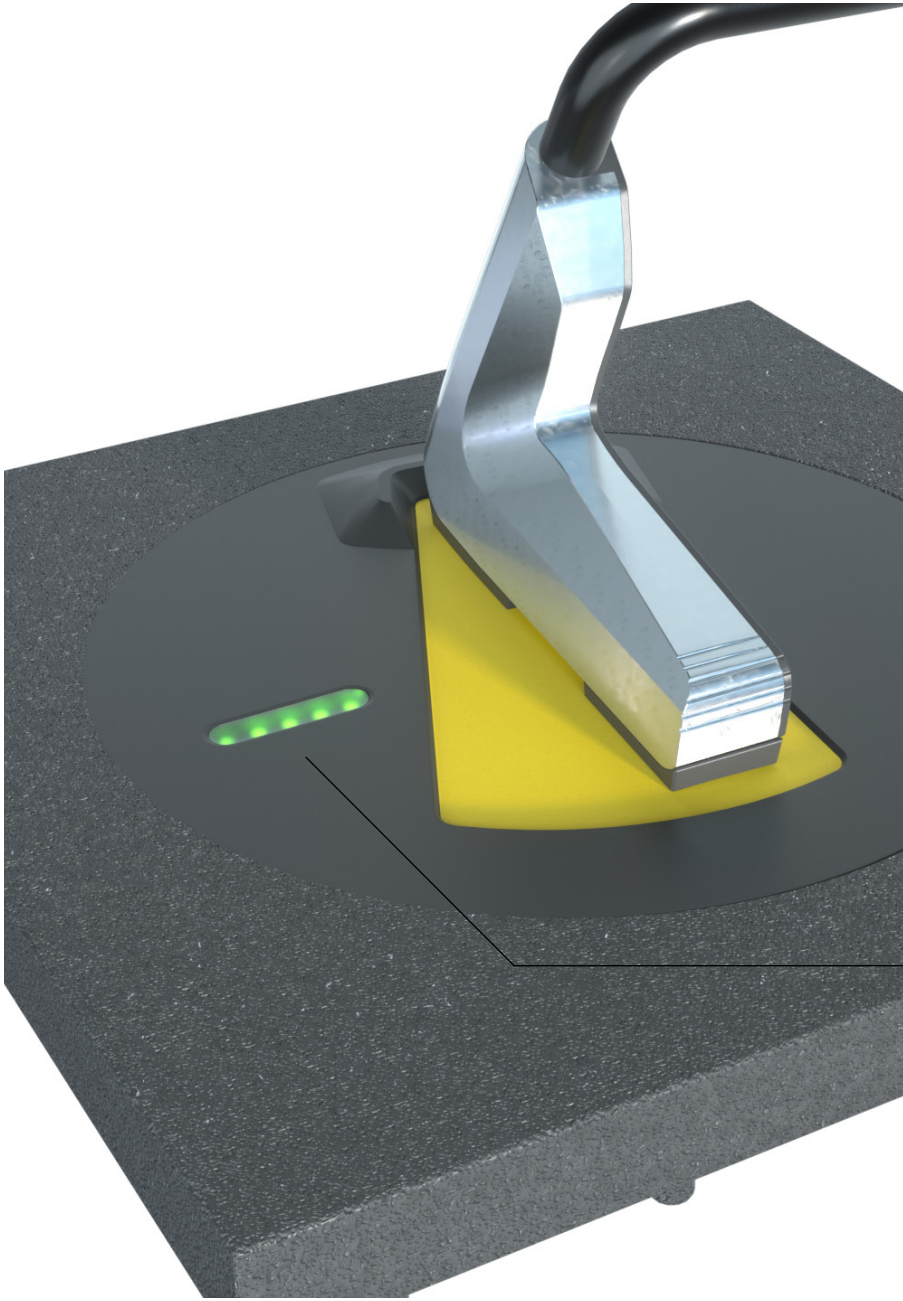
> *Figure 63: The customer is free to decide where and how close to eachother the charging tiles will be placed in the floor: Closely side-by-side or with a tile-width of room inbetween.*

6.3 INTERACTION

Cargobikes are a lot bigger and heavier than regular bikes. Their increased wheelbase and weight makes them harder to maneouver. Guiding the user is therefore important Using a three-stage interaction, parking the bike is guaranteed to go successfully: Pre-adjust, align, confirm.

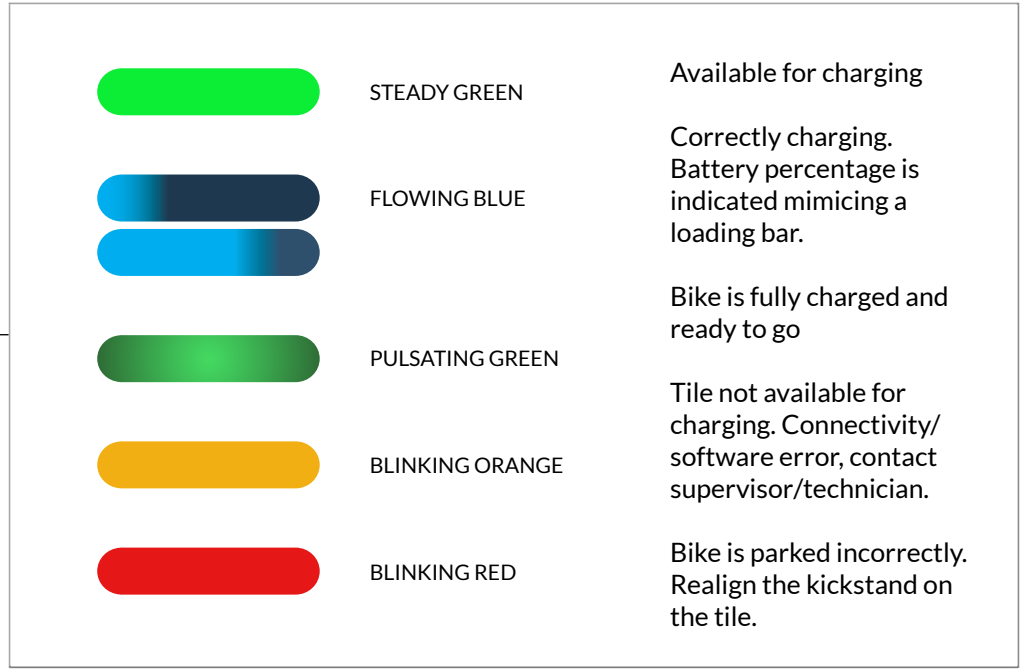
6.3.1 Guidance & direct feedback

Three indicative elements are applied in the design: A yellow line on the floor, a yellow surface indication on the tile and an LED-display to confirm it's working or not.
The yellow line reminds the cyclist to anticipate from a distance. Pre-adjusting the bike while approaching the charger is necessary for correct alignment; cargobikes are heavy and hard to move sideways. The yellow line intuitively suggests the cyclist to align the bike along the longitudinal axis.
Approaching the charger, the second indication comes into view: the yellow patch on the charger suggests the correct placement of the kickstand on the tile. It's basically a footprint of the kickstand. When placed correctly, little area of yellow should remain visible.
Thirdly, the charger provides clear feedback to the user through an LED-bar in the tile. The LED indicates if the bike is charging properly, or if something is not right. Different colours are used for varying situations (see figure 64).

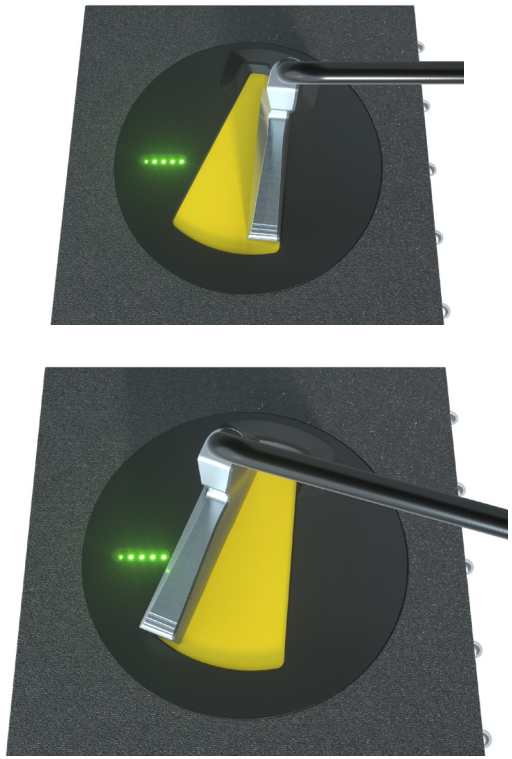


6.3.2 Indicative colours & movements

A 'multi-channel' approach was applied in defining the indicative feedback. Using different colours and movements, colourblind users are still able to read the feedback correctly. By applying multiple animations, the users is alerted when action is required. For instance, when the charger is available and no action is required, a steady green colour was chosen. In case of suggestive action; when a bike is fully charged (take me!) a pulsating green light was applied to attract the users' attention in a subtle way. When the bike is charging, a flowing animation is applied to indicate the battery's percentage. The subtle movement indicates correct functioning, but does not alert the user. In case immediate action is required - when the tile is not working or the bike is incorrectly parked - a blinking animation is applied to attract attention.
The colours were chosen based on common principle in the automotive industry. A conscious decision was made to not apply auditive alerts, since multiple chargers will be placed in the same space, which would quickly lead to confusion and irritation.



> *Figure 64: Different colours and 'movements' are used to inform the user of the chargers' status*



> *Figure 65: The two maximum allowable angles at which the kickstand can be placed for the charger to still work successfully*

6.4 SHAPE

6.4.1 Appearance

Designed to blend in with the Urban Arrow cargobike, the charger follows the primary shape of the original kickstand. Not only to retain the kickstands functionality, but also to demonstrate how little aesthetic adjustments are necessary to implement induction charging in the bike. The original kickstand's tube is optically extended by the rounded front of the housing. The sweeping curve on the side refers to the original shape - still present on the oposite side - to induce a sense of symmetry. The back-slanted face along the middle makes the charger look optically slimmer than it is and the cut-out in the bottom insinuates a certain lightfootedness.

> *Figure 66: A form collage was used as inspiration to shape the tile and kickstand*

Figure 67, 68:The geometry of the design impacts the angle of the cargobike during parking <

6.4.2 Outline

The global shape of the charger is a result from the working principle of the kickstand that needs to stay the same, while the charging components - driverboard and ferrite core - need to be housed inside. Kickstands on cargobikes are wide, double kickstands which operate similarly to moped kickstands; foot-pressure is applied to the rear of the stand to lift up the rear of the bike, using the kickstand as a lever. The geometry of the charger is chosen to retain the original pivot-point of the kickstand with the ground, to make sure the cargobike stays upright while parking, so it cannot tip over and fall.

The new kickstand design retains the original four points of support with the ground, guaranteeing a stable parked bike. The original functionality of the kickstand is therefore kept unchanged with the addition of the charger accessory.
Since the lower front part of the kickstand acts as the rotational contact point with the ground, it's important for this part not to start sliding during parking. The original feet of the kickstand are made of a softer rubber material compared to the new design, so precautions need to be made to guarantee smooth operation of the kickstand on the tile. The tile therefore features an embossed geometry, aimed at 'locking-in' the kickstand during parking. The added 8mm high geometry not only functions as a mechanical stop, but also indicates the user where the kickstand should be placed.

6.5 CONNECTIVITY

6.5.1 Remote monitoring & fleetmanagement

Battery information is transferred via the built-in bluetooth connection between the kickstand and tile. Via Can - already used by Tiler at the moment - the charger can be monitored remotely by using a 4G cellular connection. The cloud connection in the tile enables fleetmanagement systems to automatically alert the driver responsible for parking in case of a mishap, by sending alerts through smartphone in case of a malfunctioning charger or an incorrectly parked bike. Remote monitoring is necessary to avoid empty batteries at inconvenient moments, especially in unsupervised hubs as used by MarleenKookt (amongst others). The bluetooth module is also suited for connecting with the CANbus system present in some delivery bikes. In the near future, all cargobikes are expected to feature a similar system. This enables Tiler to transfer data from the bike, while charging, without the need for cellular connectivity in the bicycle. Tiler can share relevant data from the bike with 3rd parties for maintenance, safety and training purposes.

6.5.2 Safety

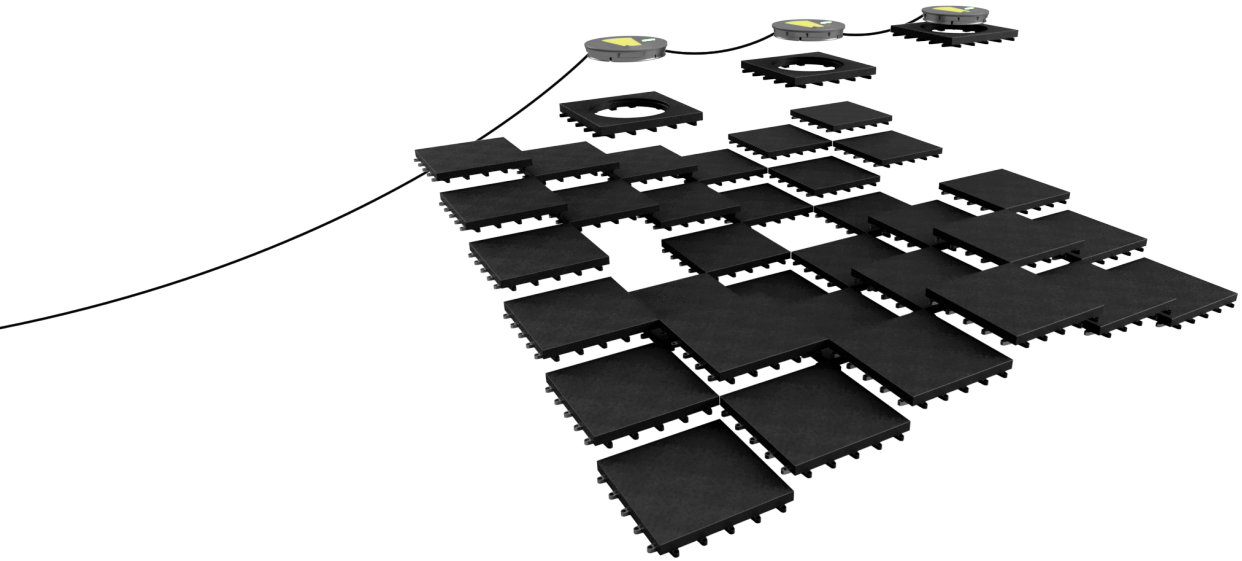
To prevent dangerous situations, monitoring temperature is important. Batteries develop heat when charged and regulating the temperature is necessary to prevent the risk of fire or premature wear. Through the bluetooth connection, the tile is able to identify the bike, the battery's state of charge and battery temperature. By temporarily lowering the voltage and amperage, temperatures beyond a certain limit can be avoided to prevent fire. This is a technique already applied in the current charger and - as can be concluded from the requirements - is just as important in the cargobike domain.

6.6 USE IN CONTEXT

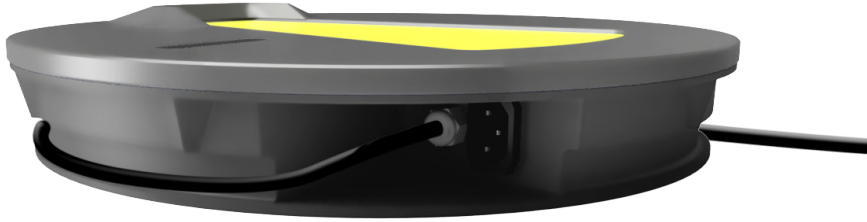
6.6.1 Logistic hubs: Level flooring

The concept of raising the floor originates from the need for flat, level flooring in spaces used for logistics. Trolleys and carts with small swivel wheels are commonly used here and are difficult to move around on uneven flooring. TILER Cargo presents the customer with the option to choose: It's possible to either raise the complete room's floor or partially apply the raised floor at a designated bike-parking area. Small spaces are often multifunctional and need to be flexible. Throughout the day, cargobikes enter and leave, while in parallel the same room is used for alternative activities (Interview Coolblue).

It is beneficial for these locations to apply a raised floor, since there is no separate, dedicated room for parking the cargobikes. CoolBlue and other small distribution hubs are an example.
In another scenario with more room and dedicated bicycle storage space, a partially raised floor might be beneficial (Interview MarleenKookt). An example is Marleenkookt, where a structured floor plan is applied with dedicated walkways and storage space. Applying the TILER Cargo solution in the shape of a charging 'mat' is likely easier, cheaper and just as effective in larger spaces. The ability to offer the customer a non-permanent choice



> *Figure 71: Laying out the tiles on the floor*



> *Figure 70: The charger features a cable gutter to manage excess cable, aswell as a power-plug to connect the adjacent charger*

6.6.2 Installation & service

The installation is simple; no technician is required for installation. As mentioned previously, the tiles are designed to be interconnected. When multiple tiles need to be hooked up to a single power outlet, this design minimises cable length and simplifies the setup to a single cable design. The tiles are connected in parallel to limit the amount of voltage drawn from the outlet (personal communication Ronald Kievit 10/09/2021). When hooked up to a dedicated power group from the circuit breaker, up to 12 tiles can be used on a single power outlet. (personal communication C. van Nispen 5/11/2021)
Once the lay-out of the charging points in the room has been determined and plugged in, the rubber tiles are ready to be layed out across the floor, covering the cables that run underneath. The tiles feature a slotted structure in the bottom to leave space for cabling and small imperfections in the floor. The result is a flat floor with built-in chargers without any cables visible. Due to the housing's round shape, the charger can be installed at different angles to allow customers to use their preferred lay-out.

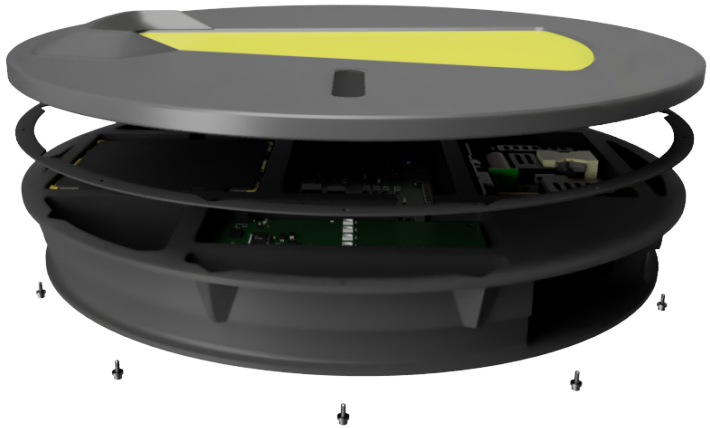
6.6.3 Weatherproofing

KICKSTAND

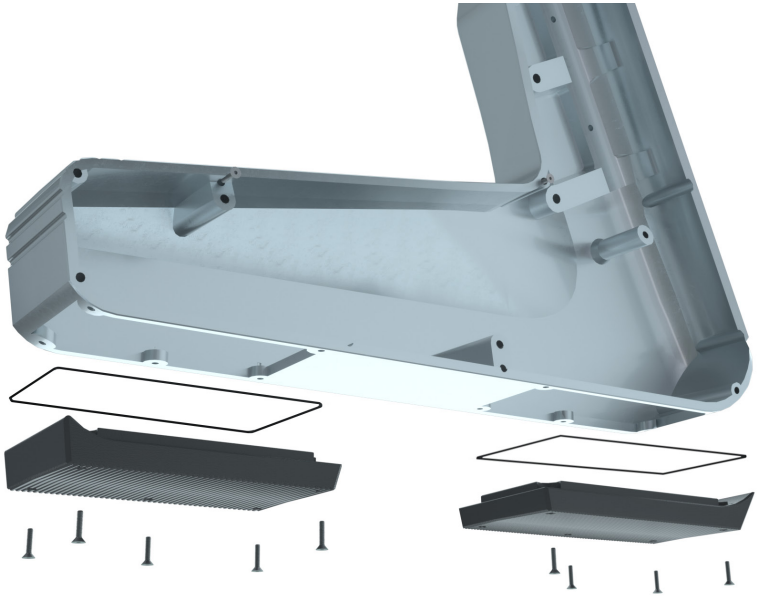
To realise a spray water-proof fit around the kickstand, the plastic cover ensures a snug, watertight fit. The embossed ridge creates a seal with the aluminum housing, preventing rainwater from protruding. In the top section, a rubber grommet is installed around the kickstand to guarantee a good seal between the metal parts. The cover's extending geometry further ensures a tight seal around the kickstand when bolted on due to its flexible properties. Since the feet are the lowest point of the kickstand and are in contact with the ground, they are the most prone to standing water. Being submerged in a puddle therefore not only requires resistance against spray water, but immersion aswell. The feet are therefore mounted with a thin rubber gasket in between, ensuring a watertight fit to prevent standing water from entering the enclosure.

TILE

The charging tile is used in indoor areas and is normally not exposed to weather influences. Water ingress could only originate from cleaning; manually or by a floor mopping device - as used by Marleenkookt. To ensure sufficient water ingress resistance for occasional cleaning, the tile is fitted with a subber seal inbetween.



> *Figure 72: A gasket between the two halves is used to ensure watertightness*



> *Figure 73: The two 'feet' - susceptible to wear - are easily replaced by loosening fasteners.*

In case of failing hardware or other problems, both devices are easily opened by removing the mechanical fasteners for internal access. While the internals do not require planned servicing, the feet need to be replaceable for wear purposes. The plastic feet are needed to provide grip on hard surfaces, such as wet pavement or concrete floors and serve as a soft protection layer between the ground and the aluminum housing. Parking the heavy cargobike repeatedly causes the feet to wear out over time, so replacement of these parts over time is inevitable.

> *Figure 74, 75: The often tightly layed-out logistic hubs rely on the limited amount of space to perform multiple activities consecutively.*

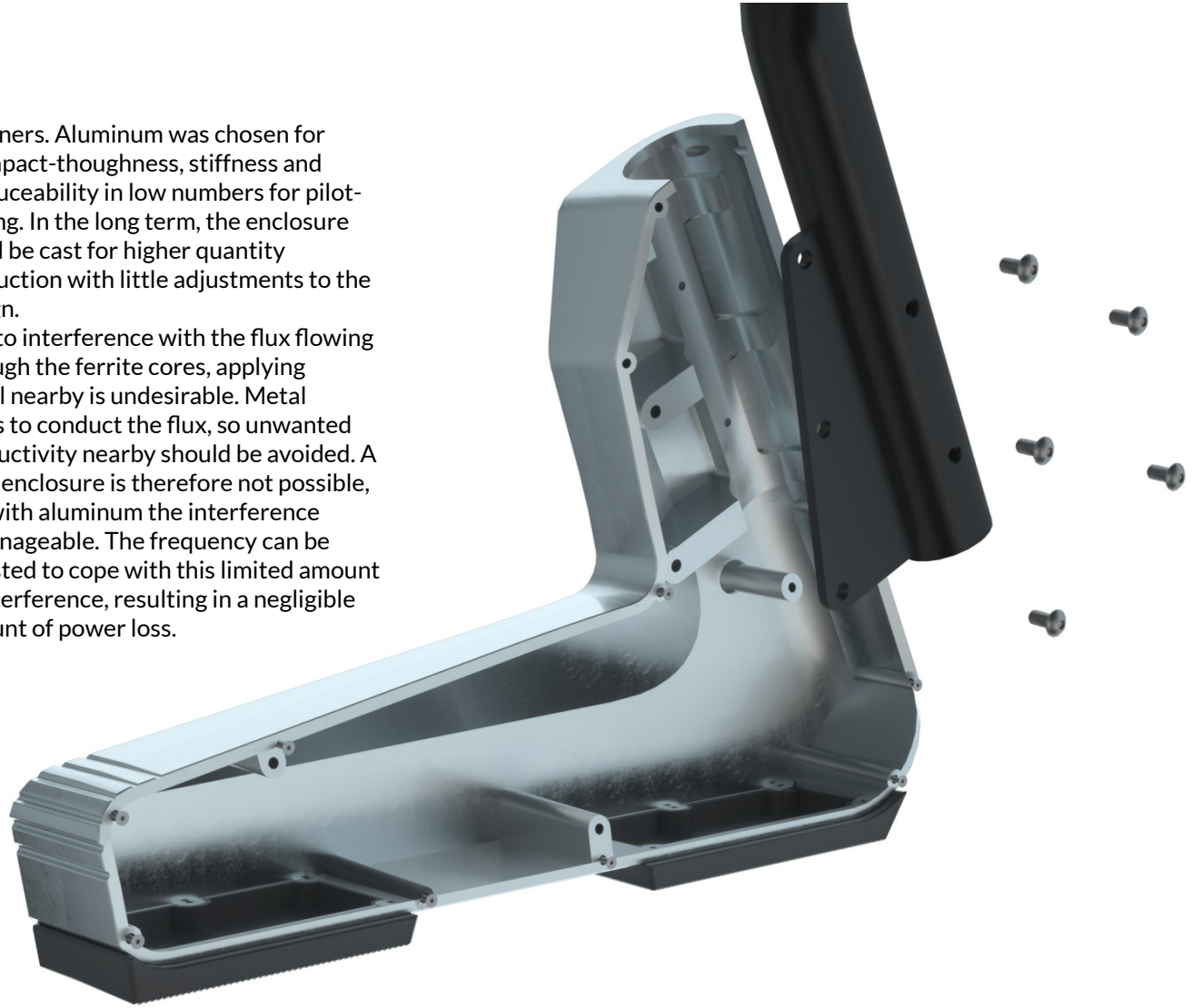
6.7.4 Materials & manufacturing

KICKSTAND

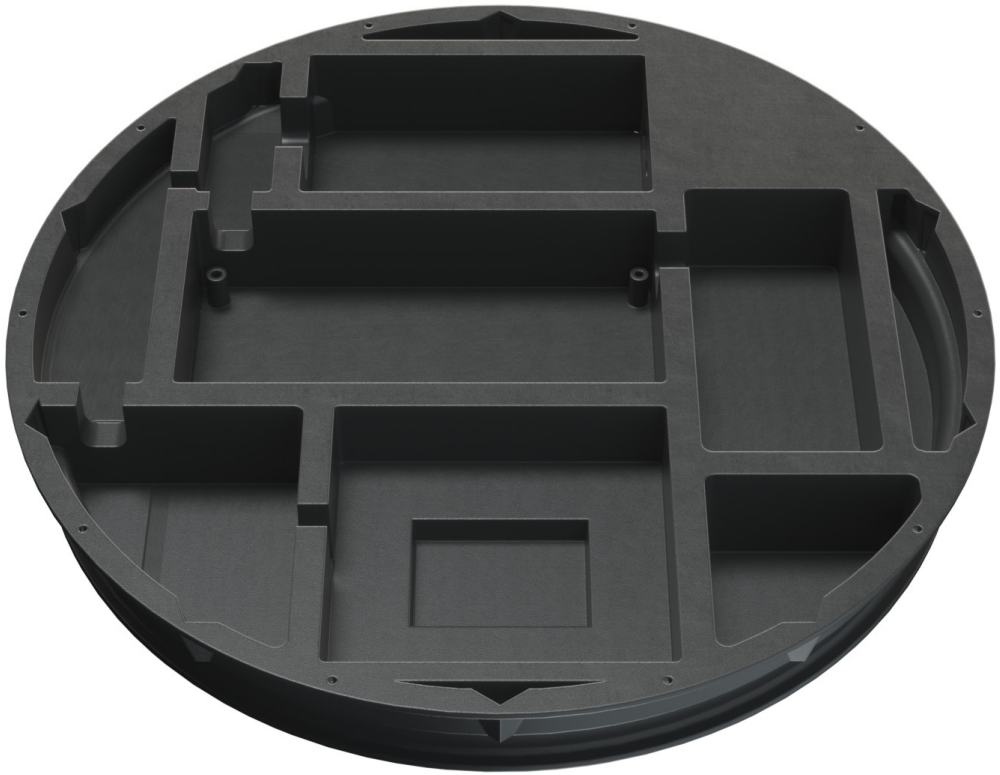
For the installation of the charger, the original Urban Arrow kickstand needs to be adjusted. It's necessary to shorten it from the bottom half and welding on a steel 'fin' to the remaining tube for torsional strength, as is pictured on the right. A strong internal geometry of three ribs is applied in the housing to mechanically enclose the kickstand in the charger to ensure a solid connection with the tube.

To maintain adequate mechanical strength of the kickstand, a 3mm thick single piece housing was designed to transfer the exerted forces properly without excessive deformation. The front of the housing was rounded, to retain the stiffness properties of the tube down along the kickstand. The slanted curvature helps with sideways stiffness of the enclosure along the rear. The CNC milled aluminum housing is designed to guarantee structural integrity of the kickstand, which is mounted to the tube and added 'fin' using mechanical fasteners. Aluminum was chosen for its impact-thoughness, stiffness and produceability in low numbers for pilot-testing. In the long term, the enclosure could be cast for higher quantity production with little adjustments to the design.

Due to interference with the flux flowing through the ferrite cores, applying metal nearby is undesirable. Metal tends to conduct the flux, so unwanted conductivity nearby should be avoided. A steel enclosure is therefore not possible, but with aluminum the interference is manageable. The frequency can be adjusted to cope with this limited amount of interference, resulting in a negligible amount of power loss.



> *Figure 80: Robust aluminum kickstand housing attached to the original Urban Arrow kickstand using mechanical fasteners*



> *Figure 81: The tile housing is designed as a single mouldeable piece with multiple ribs to ensure adequate stiffness to support the cover.*

TILE

Since the tile will be subject to high forces from bikes and trolleys riding over it, the lid is supported by ribs in the housing to improve its stiffness. A 2mm uniform wall-thickness is applied to the housing to achieve sufficient strength.

The tile housing is designed as an injection moldable part with a lid bolted on top. For low-quantity production for pilot testing SLS 3D printed parts should suffice. Alternatively, CNC milling or urethane casting are options for low quantity production. The design is specifically made for the current components, to achieve an optimally sized package, so changes might need to be necessary when components are changed or upgraded.

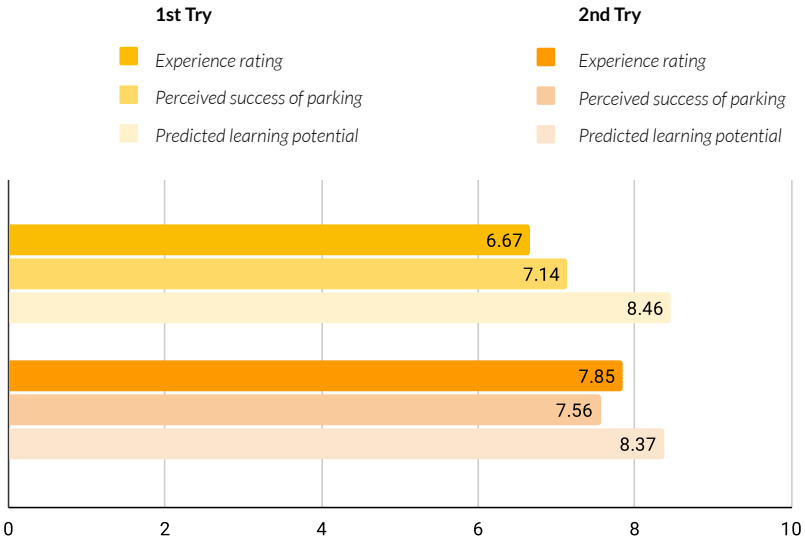
The piece is produceable with a relatively simple mould, although two mold inserts are needed to produce the cavities of the cable gutter and cooling block inserts on the side. Testing with a functional prototype will result in insights for either of these features to remain necessary in a future design, which could further simplify the design for production.

6.8 VALIDATION & PROTOTYPING

In order to find out if the proposed concept idea is in fact intuitive and easy to use, a test-setup with a visual, non-functional prototype was built at Yes!Delft, after which passers-by - unfamiliar with handling cargobikes - where asked to park the cargobike and share their experiences. Participants where asked to rate the pleasure of their experience, the success of their parking action and their perceived potential for learning on a gradual 'Likert'-scale. See appendix ch. 9.6 to view the test-sheets and full results. Afterwards, comments and remarks where freely discussed. The test-results are displayed below, which are the averages of the 21 participants who took part in the test. With an average age of 27.2 and a gender-breakdown of 19 males over 2 females, the participant group cannot be called representative, however yielded interesting results still.

"The yellow indications almost feel like cheating, they make it very easy!" *- Anonymous test participant*

These novel users rated their first experience of parking a cargobike predominantly positive; The experience was rated a 6.7 out of 10 on average for the first try and a 7.9 the second try. Users found the yellow elements helpful and clear. Concluding from verbal feedback during and afterwards, less positive experiences mostly originated from the high weight of the cargobike, which was especially an issue for smaller, less strong participants.
Users rated their parking action succesful when they succeeded in parking in the yellow area, which the majority of participants did in their first try. When participants partly missed the yellow area, they indicated they felt the need to correct the parking action.
In reality, 19 out of 21 participants parked well enough for the charger to be working in in a real-world situation; a result far better than expected for users new to handling cargobikes.
Lastly, a high potential for learning was perceived. Users rated the potential for learning high, which remained constant after trying a second time. Correspondingly, participants rated their experience and success higher the second time they parked, further underlining the potential for learning.



> *Figure 82, 83: Results of the user-test performed with 21 participants - scores from 0 to 57mm as indicated on the Likert-scale on the test-forms were converted to a 0 to 10 grade. The full results of the user-test are available on request.*


Perception of success
Very successful
Very likely
Likelihood for learning
Very successful
Very likely
Perception of the interface
Very positive
Very likely
Likelihood for learning
Very positive
Very likely
Perception of success
Very successful
Very likely


Cargoroo
e-cargo bike sharing
download and go!
URBAN ARROW


Cargoroo
e-cargo bike sharing
URBAN ARROW

7. CONCLUSIONS

With the Vision 2031, the Roadmap and lastly, the concept, the initial goal ‘To map the future opportunities for Tiler in the LEFV market prior to developing a cargobike charger’ was achieved. Using expert interviews, on-site investigation and the Roadmapping method a Strategic Roadmap towards LEFV charging in 2031 was crafted. The three-staged map includes short term opportunities as well as a longer-term outlook into the future of light electric transport, providing Tiler with a substantiated pathway into the domain of commercial cargobike charging.
The first stage of the roadmap - Horizon 1 - was underlined with the presentation of a feasible design package, aimed at lowering the threshold for Tiler to enter the cargobike market. The concept was tailored to the envisioned domain of a small (retail) hub, which will likely become a large market in the near future. The charger should provide an added benefit for users in this branch in terms of convenience, reliability and connectivity features. The most critical characteristic of the design - correctly parking the bike on the charger - was validated through a user test with novel participants. Hypothetically, experienced personnel should be able to consistently park the bike correctly based on the expected learning curve of participants, although this should be validated.

7.1 DISCUSSION & EVALUATION

Designing is all about making choices and throughout the project there have been a number of questionable choices that deserve clarification on hindsight, since sometimes seemingly small decisions have a large impact on the outcome later on.
The process from roadmap to concept idea was relatively fuzzy, meaning that the choice for this concept idea was slightly ill-validated. The approach of staying close to Tiler's current product resulted in a tendency towards the feasibility aspect of the design process, while the desirability side remained underexposed. The design could possibly have been more novel and refeshing when desireability would have been taken as a starting point, which in my opinion should be at least equally as important.
Secondly, the design is focussed on a specific type of kickstand manufactured by Urban Arrow. Multiple types of kickstands are available on Urban Arrow cargobikes and since the design of the kickstand itsself was left out of scope, a choice had to be made on which one to focus on. Due to the availability of a testbike provided by Cargoroo, the choice fell on the more slim kickstand made for the consumer market, while cargobikes in the commercial sector feature stronger, more heavy-duty kickstands. This choice allowed me to validate quickly and apply a hands-on approach, but negatively impacts the applicability of the kickstand for the commercial market.
Lastly, creating a well substantiated roadmap for a startup that was launched only two years ago is quite a challenge, especially without roadmapping experience. The decision to implement the roadmap into the project brief together with the concept design results in two deliverables that could have benefitted from a more comprehensive approach, for which there was simply no time. On hindsight, it remains arguable if choosing either one instead of both could have yielded a more valuable result for Tiler and/or TU Delft.

7.2 RECOMMENDATIONS & FURTHER DEVELOPMENT

The first and foremost recommendation is to validate the design with an actual target-group. While testing with novel users yielded beneficial insights, receiving feedback from the market is necessary for further development. Building a pilot-setup to validate functionality is advised for this purpose.
Additionally, a number of concept areas have not been addressed in the current design which need further development. Designing or outsourcing of the floor tiles was disregarded, as well as the cable connection of the kickstand to the bicycle.v
The design of the kickstand itself was left out of scope in this project, but in the future it might be beneficial to revise the design with the kickstand together as an integrated whole. A custom kickstand with integrated housing for the charger could be beneficial in terms of waterproofing, strength and durability.
For example, watertightness between two metal components at top part of the kickstand is complicated and was left unadressed. Aditionally, the kickstand driverboard could potentially be mounted on lid instead of in the housing, further decreasing the complexity of the CNC-milled aluminum part, potentially lowering costs.
Moreover, environmental impact has not been assessed in this project. An LCA is necessary to find directions to minimise the sustainable impact of the design. This will become more important when the product goes into large volume production, e.g. in choice of components, materials & circular approach.
Participants of the user-test indicated that a clear area on the kickstand on which to place the foot would be beneficial for intuitiveness. They also indicated that due to the rotational movement of the kickstand, it's hard to predict where to line-up the kickstand in the longitudinal direction. Some form of indication would be beneficial.

7.3 PERSONAL REFLECTION

Although the results of the project seem decent and the initial goal was met, in terms of projectmanagement there was more to be desired. Timewise, it was mostly a conscious decision to extend the project, alternatively having to cut down on activities. Leaving out one of the two parts - roadmap or concept design - would have been necessary to complete the project in the initial planning of 100 days and to me, that would impact the result in an unsatisfactionary way. Out of personal belief I think taking more time was the way to go for me, but I hope to manage time better in the future.
Moreover, communication and keeping proactive attitude has been a challenge. At IDE, especially in the IPD master, rarely any project is performed individually from start to end. Managing the project through communication with external parties, the supervisory team and teammembers at Tiler could have been better at times. The amount of expertise and knowledge from everybody involved could have been put to better use for information and validation along the way. Developing myself more as an individual designer and project manager is what I hope to achieve in the future still.
Although it can be said that starting a graduation project during lockdown is not ideal, it also offered a great opportunities. I've had the honor to interview many experts over video-connection after sending out emails or Linked-In messages; something that would not have been so easy in the pre-pandemic era.
This project was definately the most challenging and confrontational study-related undertaking I've ever committed to, and without a supportive supervisory team it would not have ended succesfully. All-in-all I'm satisfied to have finished the project with the results as planned from the beginning and am delighted to continue to work in the field of design after graduating.

8. SOURCES

Bakker, S. Huhn, A, Crul, S. Korsten, P. (29 april 2021) Toekomstverkenning Digitalisering 2030. Published by Freedom Lab, Digitale Rijksoverheid

Baljko, J. (January 31, 2020) Come Together: Logistics and the Sharing Economy. Retreived from: https://www.inboundlogistics.com/cms/article/logistics-and-the-sharing-economy/

Balm, S., Moolenburgh, E., Ploos van Amstel, W. & Anand, N. (2018). The Potential of Light Electric Vehicles for Specific Freight Flows: Insights from the Netherlands. Retrieved from https://www.researchgate.net/publication/326052664_The_Potential_of_Light_Electric_Vehicles_for_Specific_Freight_Flows_Insights_from_the_Netherlands

Behne, T. Nooit meer geklooi met accu's; fiets op standaard zetten en laden maar. Published by Algemeen Dagblad (AD) on 14 february 2021. Retrieved from: https://www.ad.nl/tech/nooit-meer-geklooi-met-accus-fiets-op-standaard-zetten-en-laden-maar~a7b73354/?referrer=https://tilercharge.com/nl/nooit-meer-geklooi-met-accus-fiets-op-standaard-zetten-en-laden-maar/

Bezema, M., Klaase, D., Lijbers, A., van der Made. J. Journey to the future: A Passenger Experience. Published by Mecanoo & NS, 2019. Retrieved from https://www.mecanoo.nl/Projects/project/248/NS-Journey-of-the-Future

Boer, den, E., Kok, R., Ploos van Amstel, W., Quak, H., Wagter, H. (2017, April) Annual Outlook City Logistics 2050, Topsector Logstiek. Retrieved from http://resolver.tudelft.nl/uuid:c1e44ebd-833d-4515-9760-f4a47eddf53a

Britannica, T. (2013, September 6). Faraday's law of induction. Encyclopedia Britannica. https://www.britannica.com/science/Faradays-law-of-induction

Centraal Bureau voor Statistiek, CBS (2021) Bestelauto's; gemiddelde leeftijd, leeftijdsklasse, hoofdgebruiker, regio's. Retrieved from https://www.cbs.nl/nl-nl/cijfers/detail/81365ned?q=bestelauto

Centraal Bureau voor Statistiek, CBS (2021, January 21). Redenen om te reizen: hoe vaak? Centraal Bureau voor de Statistiek, Verkeer en Vervoer. Retrieved from https://www.cbs.nl/nl-nl/maatschappij/verkeer-en-vervoer/ov-monitor/reden-om-te-reizen/redenen-om-te-reizen-hoe-vaak.

CiA, 2021: History of CAN technology. Retrieved from https://www.can-cia.org/can-knowledge/can/can-history/

City of Rotterdam. Moving towards Zero Emission City Logistics (ZECL) in Rotterdam in 2025. Published June 2019. Retrieved from https://www.rotterdam.nl/wonen-leven/stappenplan-zero-emissie/Roadmap-ZECL.pdf

CIVITAS, Institute for Transport Studies, University of Natural Resources and Applied Life Sciences (BOKU), (2010). Cycle-friendly cities – How cities can stimulate the use of bicycles. CIVITAS GUARD – Evaluation, Monitoring and Dissemination for CIVITAS II. Retrieved from http://civitas.eu/sites/default/files/civitas_ii_policy_advice_notes_03_cycling_and_walking.pdf

Connekt/Topsector Logistiek (2017). Gebruikers en inzet van bestelauto's in Nederland. Topsector Logistiek, Delft. Retrieved from: https://www.topsectorlogistiek.nl/wptop/wp-content/uploads/2017/04/20170516-Gebruikers-en-inzet-van-bestelautos_bericht-42.pdf

Fulpra, 2021. Retrieved from https://fulpra.com

Gemeente Rotterdam. Convenant ZES, Samen op weg naar nul. Zero Emissie Stadslogistiek Rotterdam. Published December 2020. Retrieved from https://www.rotterdam.nl/wonen-leven/stappenplan-zero-emissie/Roadmap-ZECL.pdf

Gemeente Rotterdam. Rotterdamse Mobiliteits Aanpak
Published Februari 2020. Retrieved from https://www.rotterdam.nl/wonen-leven/mobiliteitsaanpak/Rotterdamse-Mobiliteitsaanpak1.pdf

Gutsche, J. (2021) 2022 Trend report, the roaring 20's are coming back. Retrieved from https://www.trendhunter.com

Harms, L. and Kansen, M. (2018). Cycling Facts. Ministry of Infrastructure and Water
Management. Retrieved from https://english.kimnet.nl/publications/publications/2018/04/06/cycling-facts

Henry H. Wilmer, Lauren E. Sherman and Jason M. Chein.(25 April 2017) Smartphones and Cognition: A Review of Research Exploring the Links between Mobile Technology Habits and Cognitive Functioning. Department of Psychology, Temple University, Philadelphia, PA, USA.

Hoogendoorn, F., Lonkhuizen, van, R., Ree, van der, R., Sjouke, T., Visser, F. (2018, april 10th) Cargo Bikes in Rotterdam, an infrastructural perspective. Retrieved from http://www.cargobikesinrotterdam.nl/wp-content/uploads/2018/04/Cargo-Bikes-in-Rotterdam-EN.pdf

Labadi, H., Sabo, A., Kuljic, B. (June 2016) Autonomous Devices to Map Rooms and Other Indoor Spaces and Storing Maps in the Cloud. Retrieved from https://www.researchgate.net/publication/304918740_Autonomous_Devices_to_Map_Rooms_and_Other_Indoor_Spaces_and_Storing_Maps_in_the_Cloud

Lepelaar, S., Meijer, M., Berg, van den, M. (2019) Handreiking Opslag Li-ion energiedragers (accu's en batterijen). Published by IFV. Retrieved from https://www.ifv.nl/kennisplein/Documents/201901-VRH-VRR-LIOGS-Handreiking-opslag-Li-on-energiedragers.pdf

LogistiekProfs. Dit is het nieuwe geautomatiseerde dc van Jumbo. Published 4 august 2020. Retrieved from https://www.logistiekprofs.nl/nieuws/dit-is-het-nieuwe-geautomatiseerde-dc-van-jumbo

Megens, N., Veltmaat, S. (2019) Regelgeving opslag brandgevaarlijke accu's komt er snel aan. Published by De Stentor. Retrieved from: https://www.destentor.nl/nunspeet/regelgeving-opslag-brandgevaarlijke-accus-br-komt-er-snel-aan~ad6c0cd6/?referrer=https%3A%2F%2Fwww.google.com%2F

O'Dea, S. Number of mobile (cellular) subscriptions worldwide from 1993 to 2019
Published by Statista, Dec 3, 2020 Retrieved from: https://www.statista.com/statistics/330695/number-of-smartphone-users-worldwide/

Pierce, F. The Top 10 Automated Warehouses. Published May 17, 2020. Retrieved from https://supplychaindigital.com/supply-chain-risk-management/top-10-automated-warehouses

Ploos Amstel, van, W., Balm, S., Warmerdam, J., Boerema, M., Altenburg, M., Rieck, F., Peters, T. (2018, August) LEFV-LOGIC: Research On Light Electric Freight Vehicles. Faculty of Technology, Amsterdam University of Applied Sciences. Retrieved from https://www.hva.nl/binaries/content/assets/subsites/kc-techniek/publicaties/lefv-logic.english.pdf

Ploos van Amstel, W. Amsterdamse primeur voor P + R met e-cargobikes voor servicelogistiek. Published on 06/11/2020 Retrieved from https://www.waltherploosvanamstel.nl/amsterdamse-primeur-voor-p-r-met-e-cargobikes/

TNO (2018, 15 mei). Elektrische bestelauto's in Nederland – Marktontwikkelingen 2017-2025 Retrieved from: https://publications.tno.nl/publication/34626474/BONhu1/TNO- 2018-P10518.pdf

Shinohara, N. (30 December 2013) History, Present and Future of Wireless Power Transfer (WPT). Retrieved from: https://onlinelibrary.wiley.com/doi/10.1002/9781118863008.ch1

Tol, E., Otten, M. (2019, September) Charging infrastructure for electric vehicles in city logistics. CE Delft. Retrieved from https://cedelft.eu/wp-content/uploads/sites/2/2021/04/CE_Delft_4T28_Charging_infrastructure_ev_FINAL.pdf

Verizon Connect. (2021) Fleet Technology Trends Report 2021. Retrieved from https://www.verizonconnect.com/resources/ebook/fleet-trends-report-2021/

Visser, A, 22 feb 2018 Onbekende categorie e-bikes met meer power Published by Tweewieler.nl Retrieved from https://www.tweewieler.nl/elektrische-fietsen/nieuws/2018/02/elektrische-fietsen-met-hoog-motorvermogen-bezig-aan-opmars-10133805

Wageningen, van, D. Staring, T (2010) The Qi wireless power standard, Published by IEEE.
Retrieved from: https://ieeexplore.ieee.org/abstract/document/5606673

Weijer, van de, B., Hotse Smit, P. Historische uitspraak in klimaatzaak: Shell moet CO2-uitstoot drastisch verminderen. Published by Volkskrant, May 26, 2021. Retrieved from https://www.volkskrant.nl/nieuws-achtergrond/historische-uitspraak-in-klimaatzaak-shell-moet-co2-uitstoot-drastisch-verminderen~b27cd4be/

Yulia Vakulenko, Poja Shams, Daniel Hellström & Klas Hjort (2019) Online retail experience and customer satisfaction: the mediating role of last mile delivery, The International Review of Retail, Distribution and Consumer Research. Published 04 Jun 2019. Retrieved from https://www.tandfonline.com/doi/full/10.1080/09593969.2019.1598466

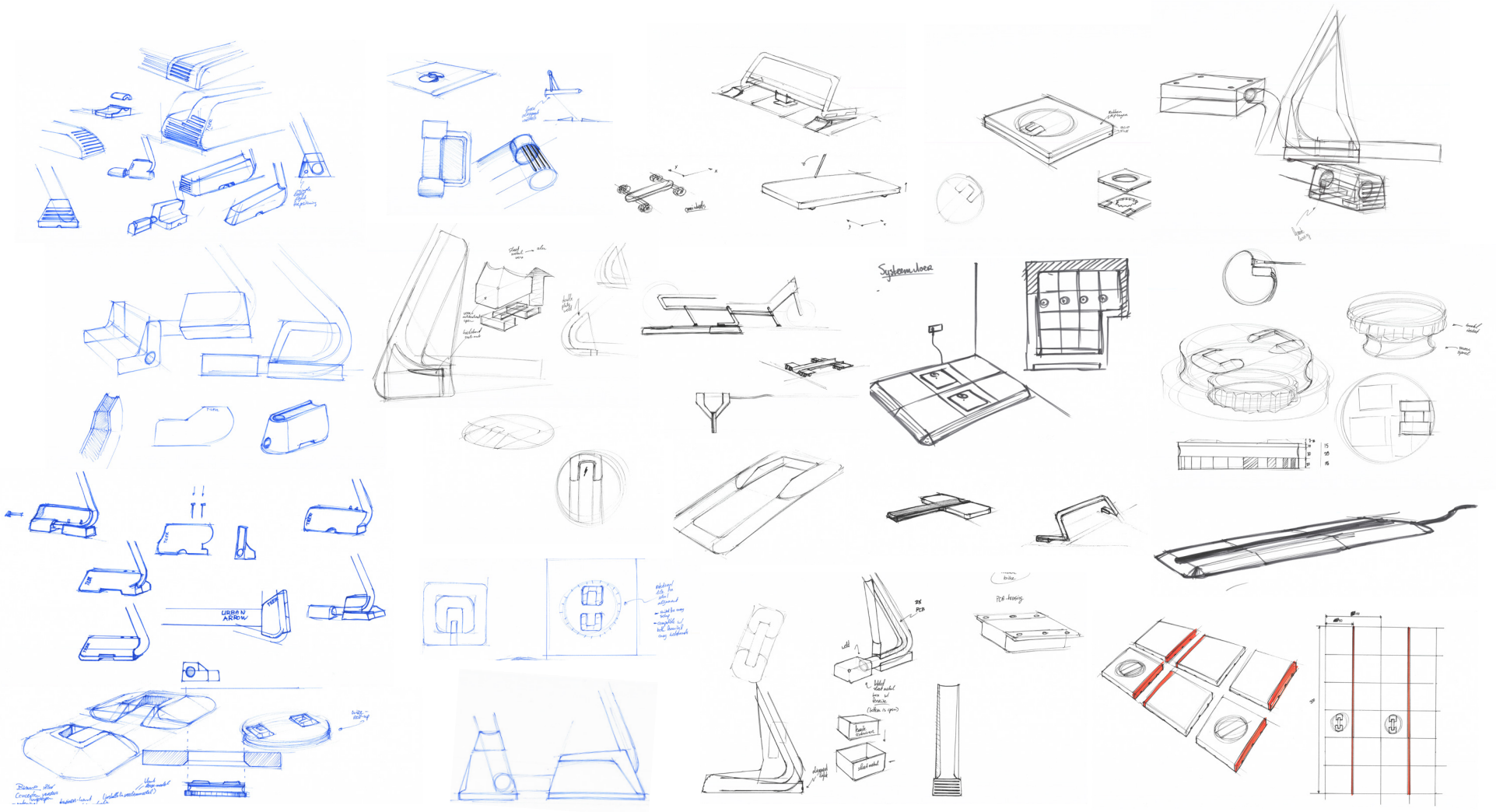
9. APPENDIX

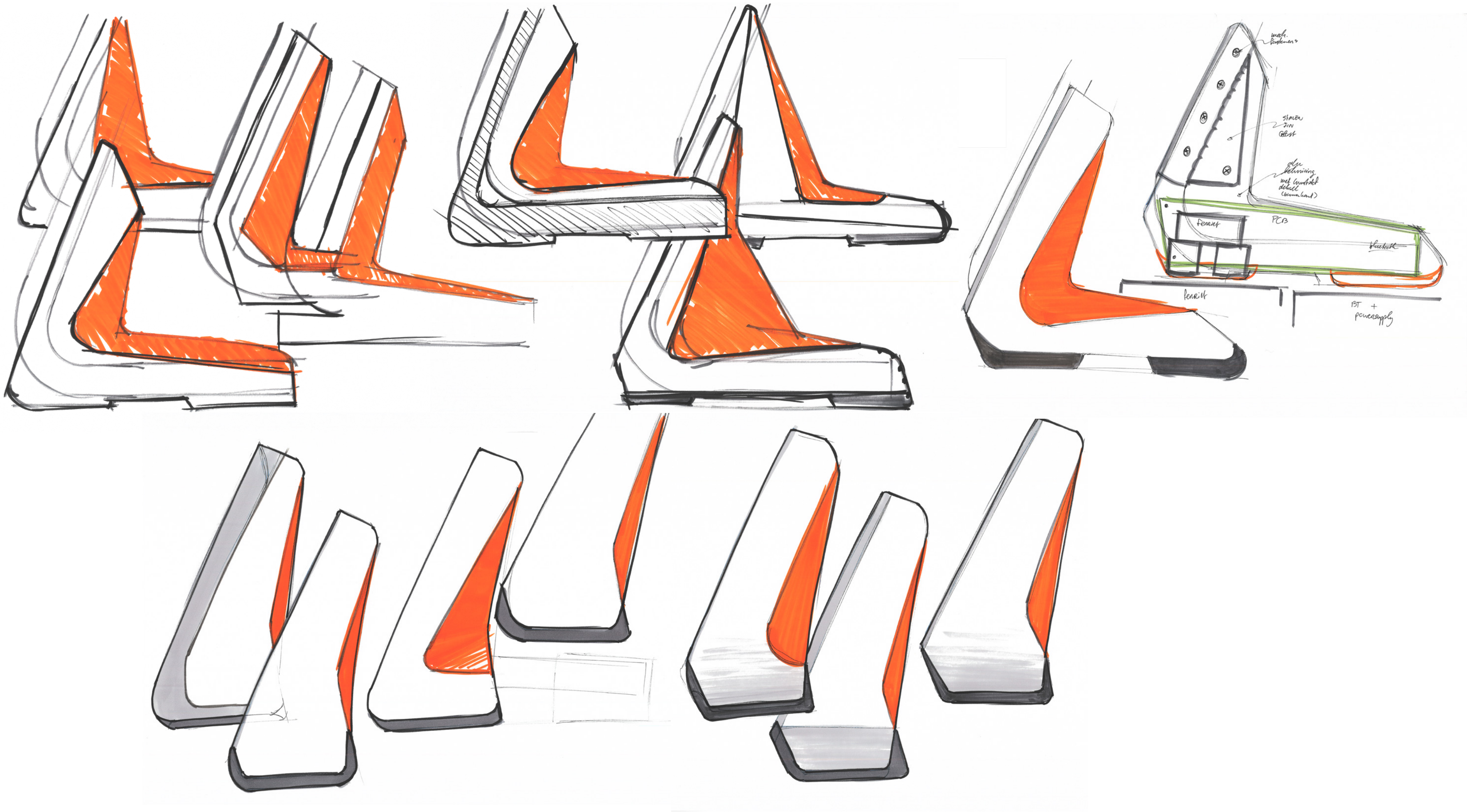

SCHWALBE
BIG BEN
PLUS


cargoroo
e-cargo bikesharing

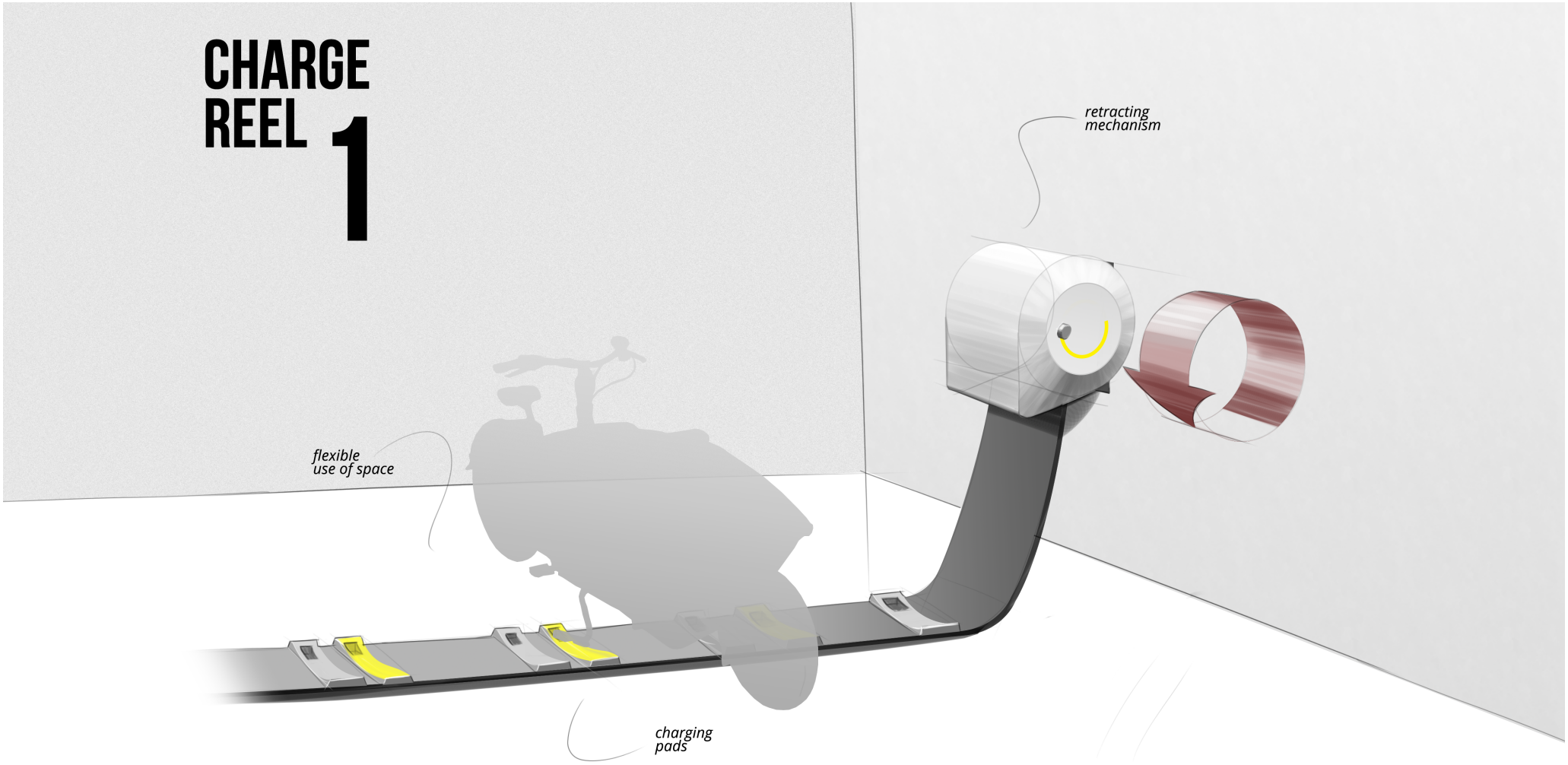
9.1 FACTORS & CLUSTERS FOR TREND ANALYSIS

9.2 IDEATION

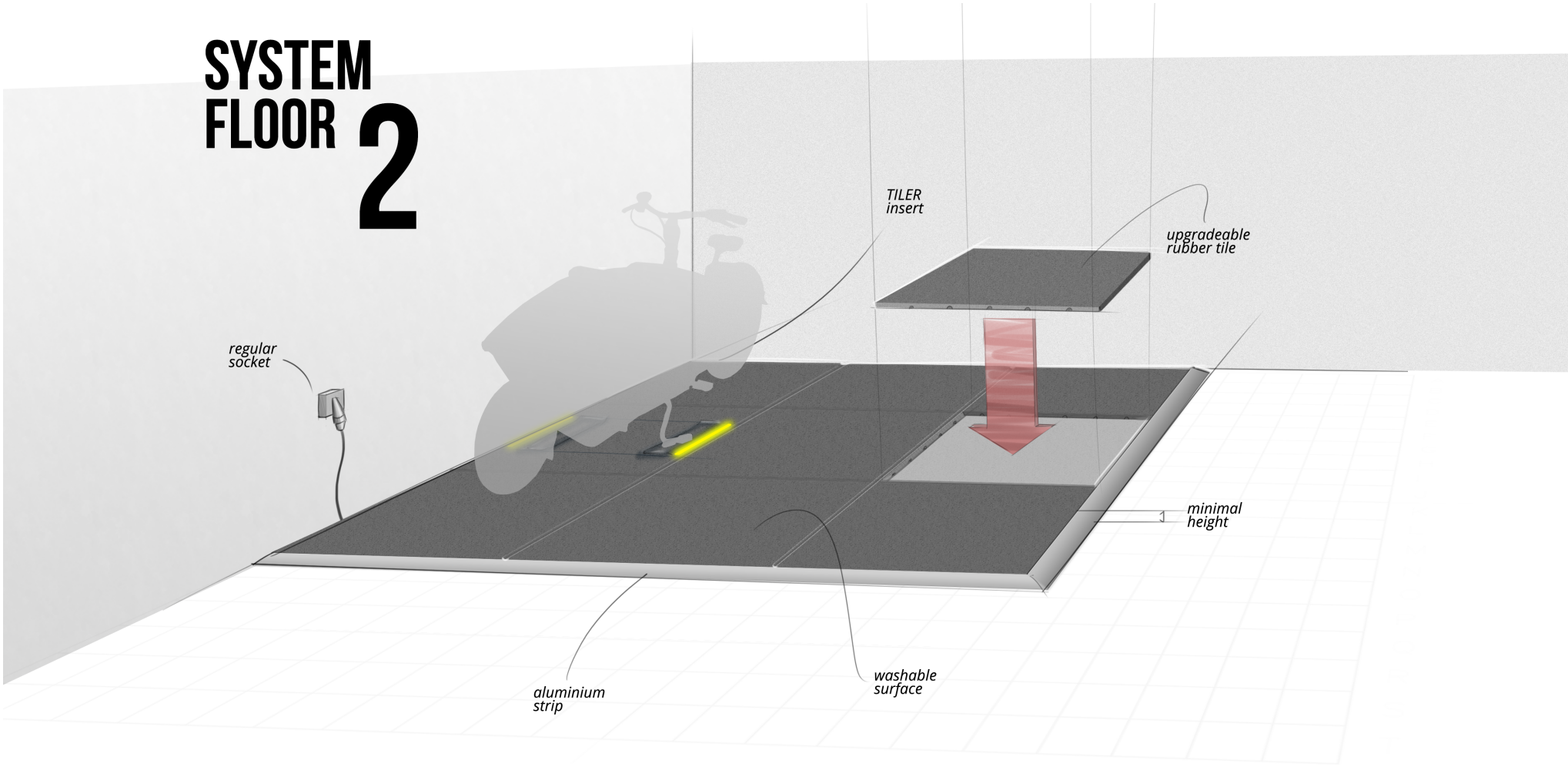



mech. fasteners
PCB
bluetooth
BT + powersupply

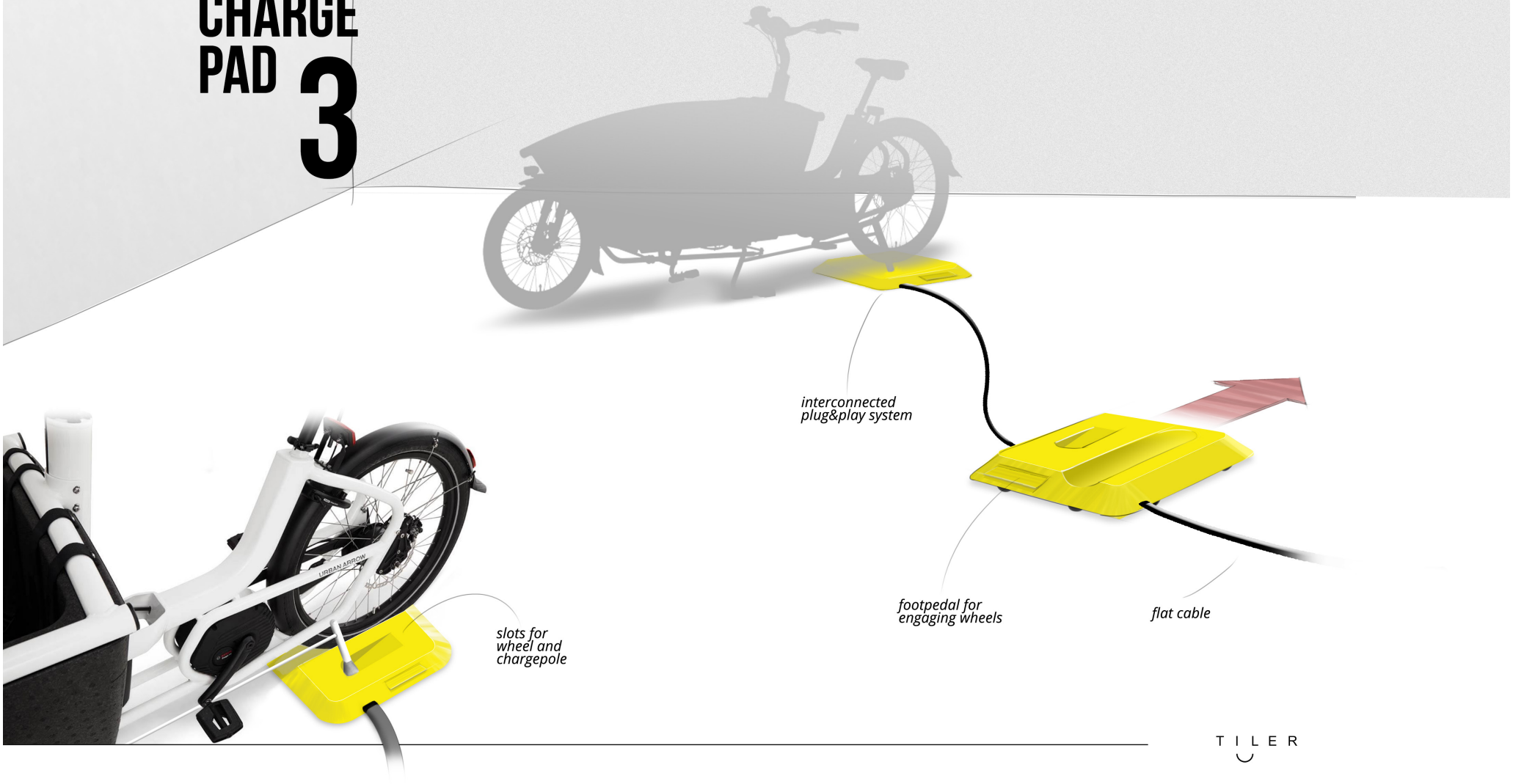
9.3 CONCEPTS


CHARGE REEL 1
retracting mechanism
flexible use of space
charging pads

SYSTEM FLOOR 2



CHARGE PAD 3



TILER

9.4 CONCEPT ASSESSMENT

	Concept 1 — Charging Reel	**-2**	**-1**	**0**	**1**	**2**
1.	Ease of use & accuracy: 'Parking equals charging'				■	
2.	Passive use (logistic domain, flexible use of space, level flooring)				■	
3.	Feasibility (engineering, production, costs)			■		
4.	Ease of installation & scalability				■	
5.	Fit for TILER charging ecosystem					
6.	Maintenance & longevity				■	

	Concept 2 — System floor	**-2**	**-1**	**0**	**1**	**2**
1.	Ease of use & accuracy: 'Parking equals charging'					■
2.	Passive use (logistic domain, flexible use of space, level flooring)				■	
3.	Feasibility (engineering, production, costs)					■
4.	Ease of installation & scalability			■		
5.	Fit for TILER charging ecosystem				■	
6.	Maintenance & longevity			■		

	Concept 3 — Charging Pad	**-2**	**-1**	**0**	**1**	**2**
1.	Ease of use & accuracy: 'Parking equals charging'			■		
2.	Passive use (logistic domain, flexible use of space, level flooring)				■	
3.	Feasibility (engineering, production, costs)			■		
4.	Ease of installation & scalability					■
5.	Fit for TILER charging ecosystem					
6.	Maintenance & longevity				■	

9.5 BUSINESS CASE

Marleenkookt
5 year scenario

	Battery cabinet	**Tiler induction**
Bikes	10.710 (42 * 255)	10.710 (42 * 255)
Main batteries	-	-
Spare/emergency batteries*	450 (10 * 45)	360 (8 * 45)
Subtotal bikes 5 years of use	**669.600**	**664.200**
Charging cabinet (SafetyFirst) 60 battery capacity (XL + L)	6665	
TILER charging solution		29.400 42 * (600+100)
Safety alarm & extinguisher (optional extra)	2536	2536
Subtotal charging 5 years of use	**9201**	**31.936**
Totals	**678.801**	**696.136**

*2 spare batteries are deemed redundant due to Tiler implementation based on estimate

Coolblue
5 year scenario

	Battery cabinet	**Tiler induction**
Bikes	1275 (5 * 255)	1275 (5 * 255)
Main batteries*	225 (5 * 45)	225 (5 * 45)
Spare batteries	225 (5 * 45)	225 (5 * 45)
Emergency batteries	90 (2 * 45)	90 (2 * 45)
Subtotal bikes 5 years of use	**108.900**	**108.900**
Charging cabinet (SafetyFirst) L (16) vs. M capacity (PGS15 norm, EN 14470-1)	2839 (2199 + 640)	2138 (1999 + 139)
TILER charging solution		3500 5 * (600+100)
Safety alarm & extinguisher (optional extra	1376	1376
Subtotal charging 5 years of use	**4215**	**7014**
Totals 5 years of use	**113.115**	**115.914**

*In busy months, all bikes ride 3 shifts and need spare and emergency batteries

9.6 VALIDATION TEST-SHEETS & RESULTS

Cargobike parking testsheet 29/10/2021

FORM OF APPROVAL

"Study for evaluating the parking experience of a cargobike with the purpose of charging"

I take part in this research performed by Stan van der Meer voluntarily. I understand the research is executed to evaluate the parking experience of a cargobike with the purpose of charging.

I consent to take written notes and photo-recordings. These recording are allowed to be used anonymously / unanonymously* in presentation and reports about this research.
(*cross what does not apply)

I consent for employees of the researchteam involved with the project and employees of the department Industrial Design Engineering of the Technical University of Delft to claim insight in the photo-recordings.

I consent to store the information for a maximum of 10 years after the research and use for research purposes.

I acknowledge there will be no financial compensation given voor taking part in this research.

I acknowledge that Stan van der Meer has explained to me the purpose of the study, has answered my questions and supplied me with the necessary time to agre with partaking. At any given moment I can ask questions in regard to the study.

With my signing I confirm I have read all information regarding the study and I understand the core of partaking. I understand I can refuse and end partaking during the study without any consequences.

_____ _____ _____
Name Initials Date

_____
Signature

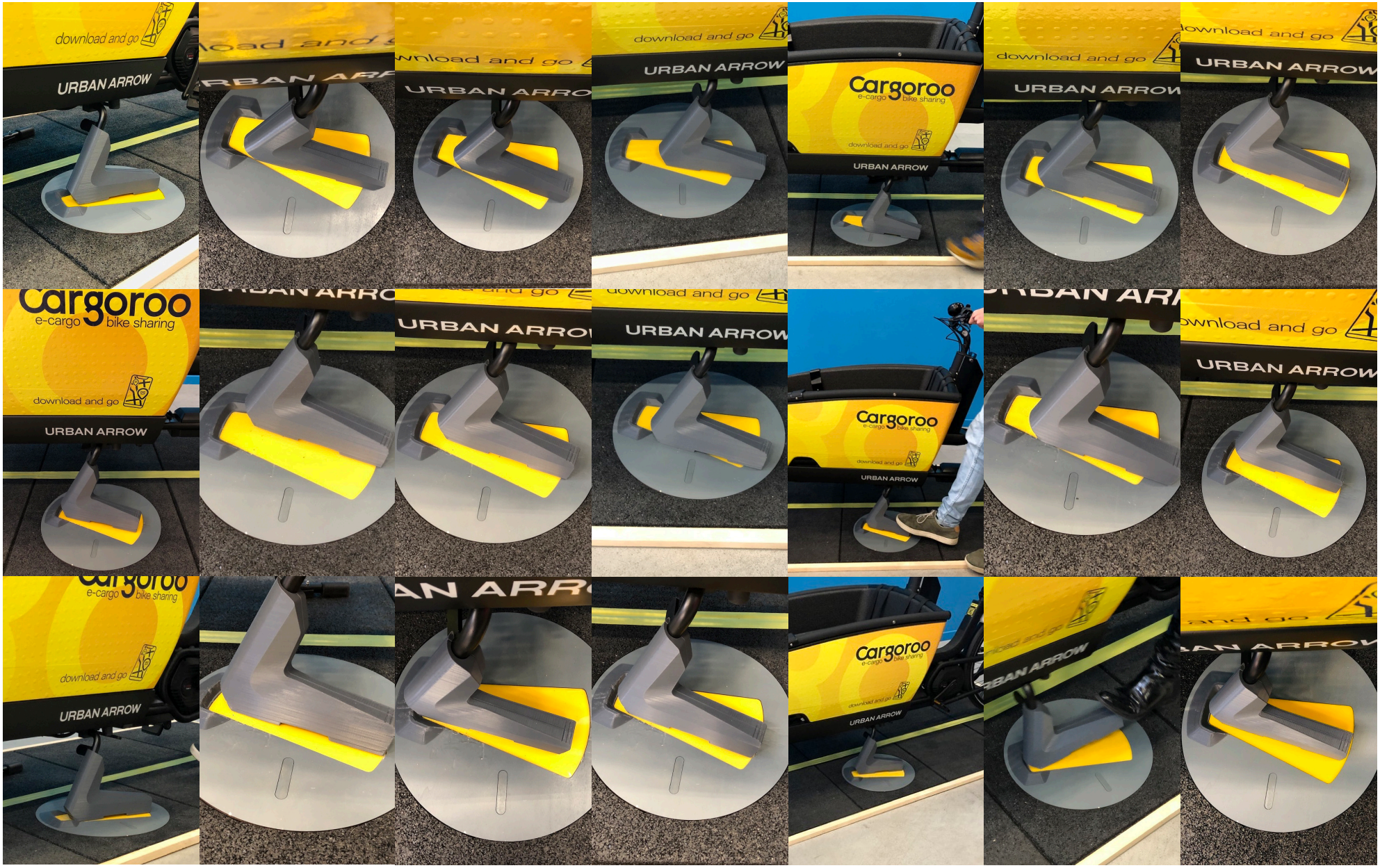
Cargobike parking testsheet 29/10/2021

RATING THE EXPERIENCE & SUCCESS OF PARKING A CARGOBIKE FOR CHARGING

AGE: _____ TEST #: _____

GENDER: M / F / X

1	**Perception of the experience**	Very positive 😄 _____ Very negative 😩
	Perception of success	Very succesful 😄 _____ Very unsuccesful 😩
	Likelyhood for learning	Very likely 😄 _____ Very unlikely 😩
2	**Perception of the experience**	Very positive 😄 _____ Very negative 😩
	Perception of success	Very succesful 😄 _____ Very unsuccesful 😩
	Likelyhood for learning	Very likely 😄 _____ Very unlikely 😩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9.7 INTERVIEW TRANSSCRIPTS & NOTES

Interview Renato Silva Laporte
Ploegleider Den Haag & Delft @ Coolblue

Interviewee functie/expertise:	*Ploegleider CoolblueFietst Den Haag & Delft*
Datum:	*07/05/2021*
Tijd:	*10:00-11:30*
Locatie:	*Rentmeesterstraat 35, Rijswijk*
Toestemming opname:	*Ja*

00:12 Hoeveel extra accu's hebben jullie?
00:17 Twee fietsen zijn nu weg, die hebben allebei twee accu's erin en twee extra in de bak, dus dat zijn er zes. In deze zitten er twee, ik denk dat we grofweg 6 of 7 extra accu's hebben, omdat we vaak lange ritten rijden en het vaak handig is om een extra accu te hebben zodat stel dat er een leeg is er een back-up is.
00:58 We hebben vijf fietsen in totaal
01:04 Dus aan het einde van de dag zijn de accu's leeg? Op het moment dat je de fietsen gaat opladen, wat doe je dan?
01:33 Ja, meestal wel grotendeels. Ik zal het demonstreren.
01:48 Je komt terug van je rit, je hebt alles gedaan. Je haalt de accu eruit. We leggen hem aan de oplader, dan weet je dat voor degene die er morgenochtend is dat de accu's weer zijn opgeladen. Je checkt dan of hij opgeladen is. Bij deze moet het laatste streepje nog vullen, dus dan weet je dat hij nog aan het opladen is. En bijvoorbeeld deze die knipperen niet meer, dan zie je dat hij vol is en dan kan hij bij de volle accu's op de plank.
02:41 's Ochtends staan alle fietsen hier zonder de accu's, wat gebeurt er dan?
02:56 Het gaat ook wel eens fout, er zijn wel eens mensen die ze vergeten eruit te halen, dus als we hier aankomen controleren we nog even of dat de fietsen met volle accu's staan of dat ze nog aan de oplader moeten. Het is nog nodig om dat 's ochtends te controleren omdat dat nog wel eens fout gaat. Daarom hebben we ook de back-up accu's.
03:19 Hoe vaak gaat het gemiddeld fout?
03:21 Ik zou wel zeggen dat het een keer in de week wel fout gaat, best wel veel eigenlijk.
03:28 Dan is het een accu die leeg is die dan gewisseld moet worden? Of hoe wordt het dan opgelost?
03:37 We kunnen het eigenlijk altijd wel goed oplossen, we zorgen dat iedereen dan relatief volle accu's hebben, en bijvoorbeeld mensen die dan een rit hebben met minder kilometers nemen dan geen reserve accu mee of pakken twee accu's die niet helemaal vol zijn. Op die manier lossen we het dan op.
03:55 Dus er komt nog wel aardig wat management bij kijken?
04:02 Er komt nog wel behoorlijk wat logistiek bij kijken dus. Is er iemand die daar verantwoordelijk voor is?
04:10 Het is in principe eigen verantwoordelijkheid, maar we hebben hier sowieso eigenlijk vier dagen in de week dat er een leidinggevende aanwezig is, dus die zorgt dat het geregeld is. En anders zijn het de mensen die hier al iets langer werken die dat regelen.
04:26 Het is natuurlijk ook geen grote taak, maar het is wel belangrijk dat het geregeld is.
04:36 Is het wel eens gebeurd dat iemand onderweg is gestrand?
04:42 Ja, dat gebeurt wel eens. Voornamelijk als iemand niet heeft opgelet of hij/zij wel volle accu's heeft gepakt. Soms leggen mensen lege accu's wel eens hier gewoon neer [op de plank voor volle accu's, red.] En dan checken mensen niet of de accu vol is door op het knopje te drukken. Dat gebeurt wel eens.
05:05 Het is ook wel gebeurd dat een accu kapot ging, of dat de accu's door tegenwind ineens heel snel leeg gingen. Dat soort dingen.
05:10 Het is natuurlijk over kapotte accu's gesproken.. Ik kan me voorstellen dat dit zo wel werkt, maar je hoort wel eens dat accu's in de brand vliegen. Speelt dat wel eens mee? Wordt dat als probleem ervaren in de huidige situatie?
05:36 Dat idee heb ik niet. Ik heb me daar nooit zorgen over gemaakt. Soms geeft onze computer op de fiets een error of iets wat met de accu te maken kan hebben, of een accu die constant tussendoor uitvalt. Die leggen we dan even aan de kant omdat die kapot is. Die leggen we vaak boven in de kant, zodat het niet fout kan gaan.
06:34 Ik zie dat jullie deze telefoons gebruiken, is dat voor de route?
06:43 Ja, dat is voor de navigatie en daar scannen we de pakketjes mee.
07:09 Heb je wel eens gemerkt dat een accu heel heet is geworden?
07:22 Ze worden wel gewoon warm, als je terug komt dan merk je dat wel. Ik heb nog nooit meegemaakt dat een accu echt heel heet is. Als dat zou gebeuren zou ik wel denken dat we erop moeten letten de volgende keer. Of het misschien een oude accu is of iets in die richting.
07:46 Je noemde dat er nog wel iets wordt gevarieerd met de indeling van waar de fietsen staan.
08:02 Ja klopt, we hebben best veel fietsen en het is niet super groot, dus je moet de ruimte benutten die je hebt. Dus daar spelen we wel eens mee. Ze hebben wel eens zo gestaan en nog eentje hier. Uiteindelijk is dit nu het makkelijkst denk ik voor iedereen. Uiteindelijk belanden we toch weer in deze indeling. Hier staan altijd twee fietsen in dezelfde indeling naast.
08:35 Dus het is uiteindelijk gewoon wat handig voelt en wat er in de praktijk gebeurt.
08:41 Ja, dit is in principe het handigst, maar het enige vervelende is dat.. Het is het handigst als je overal een acculader hebt die je in de fiets kunt steken. Dan heb ik meer het idee dat het minder vaak voorkomt dat er accu's vergeten worden of dat er fouten gemaakt worden. We moeten daar nog iets efficiënts voor zien te vinden
09:14 Dus je zou zeggen dat het ideaal zou zijn als je de accu in de fiets kunt laden zitten maar dat je wel de flexibiliteit houdt voor het kunnen veranderen van de indeling van de ruimte?
09:24 Ja, we hebben zelf al na zitten denken over een soort rails, dat je de accu's vanaf boven af op kan laden zodat je er niet overheen rijdt. Maar het is lastig. Als die draden op de grond liggen kan het, maar dan moet je de draden daarna aan de kant leggen en veel mensen doen dat niet en dan gaan ze kapot en dat is zonde.
09:46 Vandaar dat we nu weer hebben gekozen voor dit systeem.
09:50 Want de vorige setup, hoe hadden jullie dat ingedeeld? Want daarbij moest de stroom ook vanaf een punt komen?
10:02 We hebben hier twee stopcontacten en daar hadden we een verlengsnoer in die hier in het midden lag. En dan hadden we nog een stopcontact over voor een fiets die hier staat. En de andere fietsen werden vanuit het verlengsnoer opgeladen. Alleen die bleef dan altijd liggen en daar werd dan overheen gereden.
10:30 Dus die werd permanent laten liggen.
10:37 Het was wel de bedoeling dat die weggehaald werd, maar door gemakzucht werd dat niet gedaan. Erg jammer, want als dat consequent werd gedaan was er niets aan de hand.

10:55 Doen jullie het sinds jullie hier zitten met vijf fietsen en is dat wat permanent genoeg is of zijn er meer fietsen bij gekomen?
11:07 We zitten nu nog pas sinds eind Juli [2021] hier en we zijn begonnen met twee fietsen. Twee of drie. Toen ik begon waren we met drie. Dus we zijn telkens gaan uitbreiden.
11:43 Omdat er meer behoefte kwam?
11:46 Ja als je nu kijkt, met drie fietsen is er nog wel veel ruimte over. We hebben wel de capacteit voor vijf fietsen, maar nu is het wel vol.
12:01 Je zou zeggen dat er nu niet meer uitgebreid kan worden, maar het is wel snel opgeschaald.
12:11 Volgens mij is er wel de ambitie om er een fiets bij te nemen, maar het is de vraag waar we die moeten laten, want we zitten ook met die vrachtkarren.
12:18 Zeker 's ochtends hebben we drie karren, met normaal staan we hier met negen karren. Dat is best wel chaotisch.
12:27 Die komen 's ochtends binnen met de vrachtwagen?
12:31 Ja, om half 8 staan ze voor de deur en dan laden degenen uit de vrachtwagen die uit. Dan begint het ochtendproces.
12:44 Staan de fietsen dan niet in de weg?
12:47 Ligt eraan hoeveel karren we hebben. Soms staan de fietsen hier en dan moeten we zorgen dat we een soort looppad hebben. Soms zetten we deze fietsen dan buiten zodat we de ruimte hebben om te kunnen voorsorteren.
13:00 Hoe verloopt dat proces van inladen 's ochtends? Is daar een proces voor
13:08 Onze ochtendritten leggen we hier [op de grond] in rijtjes zodat we ze makkelijk kunnen inpakken en de rest leggen we in de kasten [tegen de achterwand]. Dan doen we gewoon van achter naar voren alles in de fiets. Een beetje wat mensen zelf fijn vinden eigenlijk.
13:31 Hoe komt alles binnen? Is het al voorgesorteerd op route?
13:38 Nee, het komt kris-kras allemaal in grote blauwe kratten gegooid binnen. Wij moeten dan alles scannen en alles sorteren op rit.
13:49 En hoe werkt het plannen van de ritten? Doen jullie dat ook zelf?
13:56 Nee, dat wordt gedaan voor ons. 'S nachts voordat we de rit gaan rijden wordt dat ingepland.
14:04 Is er dan software waar je per persoon kunt zien wat je gaat doen?
14:12 Ja klopt, dat hoeven we niet zelf te doen. Dat zou erg veel werk zijn.
14:20 Hoe lang zijn jullie 's ochtends bezig met sorteren?
14:27 We beginnen rond 07:30 wanneer de vrachtwagen aankomt. Eerst moeten dan de lege karren mee en dan krijgen we volle karren daarvoor in de plaats. Dan zijn we vaak wel een uur bezig met alle pakketjes scannen en zorgen dat alle ritten compleet zijn. Soms zijn we in een halfuurtje klaar, maar soms zijn we ook om 09:00 nog niet klaar. Ligt eraan met hoeveel mensen we zijn en hoeveel ritten er zijn, en hoeveel pakketten per rit.
15:09 Nu is het heel weinig, normaal zijn er wel 35-40 pakketten per rit, en nu hebben we er 20. Dus dat is weinig eigenlijk.
15:17 En dan zijn jullie per rit hoelang ongeveer bezig?
15:22 Nu in de ochtendrit zijn we 3,5 uur bezig uit mijn hoofd. Om 8:40 gaan we weg en om iets voor 12 komen we terug. Dan is er driekwartier pauze in principe. En dan in de middag is er ook een shift van 3,5 uur.
15:46 In de middag vaak iets korter. Vaak drie uur ongeveer.
15:51 Dus je pauze is dan driekwartier
15:56 Ja, halfuur pauze en een kwartiertje om je fiets opnieuw in te laden.
16:03 Ga je dan wel een tussendoor opladen of is dat niet handig?
16:09 Ja, ik haal ze er eigenlijk altijd even uit, want een ochtend en middag fietsen op twee accu's is vaak krap. Dus als je ze dan tussendoor nog even oplaadt kan dat net nog dat stukje zijn waardoor je het net wel redt.
16:29 Dus je zou wel zeggen dat dat wel vaak nodig is om net wel twee shifts te kunnen doen?
16:37 Ik doe het eigenlijk altijd wel, maar als er nog nieuwe accu's liggen dan hoeft het niet. Soms heb je nog zoveel kilometers over dat je het wel redt.
16:53 Dus dat hou je dan een beetje in de gaten?
16:53 Ja
16:53 Hoeveel range laadt je dan meestal bij als je in de pauze bijlaadt?
16:59 Ik zou zeggen zeker wel 20 kilometer extra range. Dus dat is nog best veel eigenlijk voor dat halfuur wat 'ie in de lader zit.
17:13 Dat kan natuurlijk net het verschil maken.
17:17 En jullie hebben ook een avondshift toch? Hoe zit het dan met de rest van de dag?
17:25 Wij zijn om 16:00 klaar met onze middagrit. Er zijn ook mensen die een lange middagrit doen, die zijn om 17:00 klaar. Bij ons zijn er twee soorten shifts, ochtend-middag of middag-avond. Als je middag-avond hebt, heb je een lange middagrit. Die is 4,5 uur, tot 17:00. Dan begint die om 13:00 ook. Die heeft er dan een avondshift bij, van 17:30 tot meestal 20:30 en dan tot 21:00 heb je tijd om te zorgen dat alles hier in order is.
18:07 En dat is het moment dat mensen verantwoordelijk zijn om alles na te lopen en te checken of alles goed opgeladen wordt?
18:25 In principe wel, maar mensen die alleen avondshifts werken die maken weinig uren en die hebben vaak zoiets van; ik ben er morgenochtend toch niet dus het maakt me weinig uit. Althans, dat idee heb ik soms. Ze zijn er zelf nooit in de ochtend dus ze zien het probleem niet zo.
18:45 Dus er zijn wel mensen die de verantwoordelijkheden minder zien.
18:53 Ja klopt, vandaar dat we 'ochtends moeten kijken of de telefoon en accu's wel goed opgeladen zijn. Er zijn veel mensen die gewoon gelijk naar huis gaan.
19:09 Ergens begrijpelijk, maar wel typerend.
19:15 Ja zeker, maar voor de mensen die veel werken is het wel erg vervelend.
19:22 Als je zo'n middag-avond shift doet heb je dan eenzelfde soort pauze?
19:30 Ja, een halfuur pauze en een kwartier om nieuwe pakketten te laden.
19:37 En een avondshift duurt dan..?
19:39 Ongeveer drie uur. Ik doe ze heel soms. Ik denk drie uur.
19:47 Alle fietsen zijn van hetzelfde type toch? Allemaal dezelfde accu's?
20:21 Ja klopt. Dat gelukkig wel.
20:24 Toen jullie zelf.. Jullie zijn ook bezig met ook nadenken met wat nu handig is. Wat was voor jullie gevoel het grootste probleem wat in de weg zat waar iets aan gedaan moest worden?
20:48 Met die accu's dat ze nu in de kast liggen?
20:52 Ja of we gaan nu met stekkers iets doen, wat is voor je gevoel het grote nadeel de oude oplossing of het voordeel van de oplossing zoals het nu gaat?
21:05 Het voordeel dat we nu geen kapotte snoeren hebben. Het nadeel is dat mensen gemakszucht nemen om de accu's niet in de oplader te leggen en de fietsen gewoon te laten staan. En we hebben dus een fiets waarvan de onderste accu niet eruit kan.
21:25 Want is het slot kapot?
21:27 We hebben de sleutel daar niet van. Dus die kunnen we er niet uit halen. Dat zou een reden zijn om die fiets altijd hier te zetten, omdat die maar een accu heeft die eruit kan. Dus anders is die accu altijd leeg.
21:46 Hoe werkt het als een fiets kapot gaat?
21:51 Toevallig komt er zo om 11:50 iemand langs. We hebben nu twee kapotte fietsen. Dan hebben we een bedrijf van buitenaf, GBS [GetBikeService], en die komen dan de fietsen

repareren.
22:03 Dit zijn fietsen van Dockr, en we hebben Urban Arrow.
22:10 Die komen direct gebrand bij Urban Arrow vandaan?
22:19 Ja, dit is onze reserve fiets. Wel met dezelfde oplader en accu's gelukkig. Nu ik het zie is het ook gewoon Urban Arrow.
22:24 Ja, Dockr heeft ook Urban Arrow. Maar dat maakt voor onderhoud niet uit dus?
22:48 Nee, we hebben gewoon een eigen service partner.
22:54 Ik zou verwachten dat als je huurt bij Dockr dat ze zelf komen repareren.
23:04 Nee, maar Dockr valt gelukkig wel onder GBS.
23:10 Zou je verwachten van Dockr of Urban Arrow dat ze beter zouden nadenken over wat voor jullie een handige oplossing zou zijn voor het opladen? Of zou je zeggen dat je dat liever zelf doet?
23:28 Ik denk dat dat per plek nogal verschillend is. Wij krijgen de fietsen gewoon geleverd, maar meer ook niet. We hebben ook onze eigen systeempjes, maar ik durf niet te zeggen of ze dat ook aan zouden kunnen bieden. Dat weet ik niet.
23:53 Ik kan me voorstellen dat het voor jullie, jullie zijn CoolBlue, jullie bezorgen.
24:03 Nee, wij zijn geen fietsspecialisten.
24:06 Het voelt voor mij soms alsof je een auto zou kopen en dat je dan zelf maar moet bedenken..
24:29 Ja precies. Ik denk dat zij ook zoiets hebben van, accu's eruit halen en dan opladen.
24:44 Er kan natuurlijk ook wel iets mis gaan met zo'n opstelling. Ik wil natuurlijk geen angst zaaien, maar je hoort natuurlijk wel eens dingen. Er zijn ook ontwikkelingen in regelgeving om het veiliger te maken. Stel er zou iets fout gaan, zou je dan vinden dat de schuld ligt bij de leverancier van de fietsen?
25:12 Nee, de fout ligt dan bij ons. Wij kiezen voor deze opstelling. De fout zou dan denk ik bij ons liggen.
25:22 Maar het is niet jullie product, toch?
25:25 Het heeft een verhaal met twee kanten denk ik.
25:32 Ja precies, maar als je je telefoon thuis oplaadt en het gaat fout, kijk je wel naar de telefoonfabrikant.
25:48 Er zijn ook bijvoorbeeld bedrijven die een brandkast aanbieden met allerlei functionaliteiten erin, hebben jullie daar wel eens naar gekeken.
26:00 Dat zou ik niet weten. Er gebeurt vanalles achter de schermen waar wij niets van weten. Wie weet, ik zou het wel kunnen navragen.
26:14 Er zitten allerlei overwegingen achter, maar uiteindelijk gaat het erom dat er een aantal concrete problemen op de werkvloer zijn, maar sommige dingen liggen iets minder voor de hand.
26:37 Dat is wel iets om te gaan overwegen wellicht ja.
26:57 Je noemde dat de kabel vaak kapot gaan, omdat je met de karren aan het rijden bent.
27:08 Ja, en met de fietsen eroverheen.
27:11 Ik neem dan aan dat het wel belangrijk is dat het belangrijk is dat alles gelijkvloers is?
27:20 Jazeker, stel er zou bijvoorbeeld een hobbeltje zijn dan zou dat niet erg zijn, bijvoorbeeld een hobbel waar een kabeltje onder ligt, dat zou niet erg zijn. Maar we moeten niet opstapjes of rechte hoeken hebben. Dat is voor die fietsen niet wenselijk.
27:45 Ja precies, je hebt wel van die beschermende goten, dat zou dus nog wel gaan?
27:54 Dat zou wel een oplossing kunnen zijn, maar dat is uiteindelijk wel weer met die karren lastig, die kunnen daar niet overheen. Daar moet je dan wel weer rekening mee houden.
28:08 Dit is een volle kar toch?
28:11 Deze is niet echt vol, hij is nog best wel licht. Soms zijn ze ook behoorlijk zwaar. Soms heb ik al moeite om hem over een mini-heuveltje te krijgen. Hier hebben we een heel klein richeltje [bij de ingang], en dat is soms al een heel gedoe. Eigenlijk is dat niet ideaal, het zijn ook geen rubber banden die meegeven. De wieltjes zijn gewoon hard.
29:07 Zou je dat eens kunnen demonstreren hoe dat normaal gaat? Met zo'n kar zou je normaal aan komen rijden, en dan?
29:22 Ja, normaal gaat het meestal wel, maar als ze zwaar zijn is het wel lastig. Deze kun je nog wel makkelijk eroverheen duwen. Als ze wat zwaarder zijn dan doen we vaak dat iemand aan die andere kant de kar optilt zodat je net over dat hobbeltje heen komt.
29:58 Dat wordt dus al vrij snel veel geklooi. Nu is dit randje ook recht, haaks.
30:06 Ja, als hier gewoon al een klein schuin randje zou zitten zou het al een stuk makkelijker gaan.
30:13 Dus dat is wel interessant.
30:31 Als jullie aan het fietsen zijn of erna, wat voor dingen kun je dan normaal zien van de fiets; je kunt batterij percentage zien en range, wat nog meer?
30:53 We hebben verschillende standen qua ondersteuning; tour, eco, turbo. Als je dat even laat staan geeft hij daarna de range aan.
31:06 Is die accuraat voor je gevoel of wordt je welleens verrast?
31:13 Soms gaat hij in de eerste 5km 20km naar beneden in range en vanaf dan gaat het heel langzaam om af te bouwen of hij loopt weer op. Het ligt eraan, als je tegen de wind fietst merkt hij dat en dan past hij het aan. Bij wind mee heb je dan ineens weer veel meer range.
31:43 Als je in een tunnel naar beneden fietst loop hij weer op. Maar meestal klopt het wel aardig.
31:54 Verder kun je zien of het licht aan staat, je kunt zien hoeveel kilometer in het totaal gereden is.
32:02 Doen jullie daar iets mee? Ik kan me voorstellen dat je onderhoud hebt en dat je de kilometers afleest?
32:13 Weet ik niet, misschien dat die mensen van GBS daar wel naar kijken.
32:25 Komen ze langs als er iets kapot is of komen ze langs om dingen te checken.
32:32 Er is bijna altijd wel een kapotte fiets. Vaak checken ze de bandenspanning en andere afstellingen.
32:44 Het gaat dus meestal zo dat er iets kapot is dan komen ze langs?
32:51 Ja, maar ze komen zeker wel eens in de week langs. Ze zijn er erg vaak. Deze week al voor de derde keer. Ze worden ook intensief gebruikt. Dit is voor ons doen een vrij nieuwe fiets, we hebben deze zo'n vijf maanden. Er is nu al 11.000km op gefietst. Ze worden erg veel gebruikt. Er zijn wel eens preventieve afspraken met GBS, vaak voor belangrijke weken of voor Black Friday komen ze langs om te checken of alle fietsen wel goed zijn. Of voor kerst.
33:45 Meestal zijn er ook geen grote dingen kapot en kun je er nog wel mee fietsen, maar is er een spatbord kapot of maakt hij een raar geluid.
33:59 Wel intensief dus qua onderhoud. Kun je op afstand dingen uitlezen van de fiets? Of wordt daar de telefoon voor gebruikt?
34:13 Nee, ze moeten op locatie alles bekijken.
34:19 Ik kan me voorstellen dat jullie de telefoons hebben en dat de regiomanager op afstand kan zien waar iedereen is.
34:29 Ja, er wordt via de telefoons gevolgd waar we zijn.
34:34 Kan er dan gecheckt worden of je op schema bent?
34:39 Ja, als er 's ochtends problemen zijn met een fiets of als de vracht later is of als we er langer over doen, dan krijgen we een bericht met; "We zien dat jullie nog niet vertrokken zijn, kunne we iets voor jullie doen?"
34:58 Wordt dat centraal geregeld?

35:02 Ja, er zijn ploegleiders per dagdeel het aanspreekpunt zijn die dit soort dingen in de gaten houden.
35:14 GPS dus, maar wordt er verder nog data van de fietsen uitgelezen?
35:22 Nee, niet dat ik weet.
35:43 Hoe zitten de laders nu aangesloten? Gewoon met een stekkerdoos in het stopcontact?
35:55 Ja, zo te zien wel. Hier hebben we een stekkerdoos liggen en we hebben er nog meer. Het vertakt allemaal.
36:35 Dus je bent wel, als je zelf iets wil veranderen gebonden aan of er ergens een stopcontact zit.
36:47 Ja, daarom hebben we ook zoveel stekkerdozen. We hebben op andere plekken ook stekkers nodig.
36:56 Is dit een huurpand? Zijn jullie in die zin gebonden aan de ruimte zoals die is? Hoe ging het op het moment dat jullie in dit pand kwamen? Is er dan een ploeg die komt verbouwen die de indeling bepaald?
37:15 Ja, we hebben dit kaal gehuurd met niets erin. We hebben door een bedrijf een standaard indeling laten maken.
37:34 Dus als je het huurt is er niets, maar dan komt er een ploeg langs intern die het “CoolBlue” maakt?
37:55 Ja, bijna een soort stylisten die bepalen wat waar kan, en dan sturen ze een externe vakman hierheen.
38:35 Zijn zij dan ook verantwoordelijk dat er zo’n stellingkast komt en dergelijke?
38:44 Ja, zij zorgen dan dat die stellingkast hier wordt bezorgd. Wij zijn wel zelf leidinggevend daarin wat we willen. We geven het bij hen aan.
39:10 Het is maar net wat hier handig wordt bevonden, specifiek voor deze situatie.
39:17 Ja
39:18 Denken jullie wel eens na over een indeling met die stellingkasten?
39:38 We hebben het wel eens geprobeerd aan te passen, toen hadden we die stellingkasten aan deze kant gezet en toen moest ik de dag erna zelf werken en toen vonden we het uiteindelijk helemaal niet handig. Het was niet functioneel. Ze hebben ook wel eens geprobeerd de fietsen tegen deze muur te zetten, maar dat wilde niet met de karren van het ochtendproces. We hebben van alles omgegooid en geprobeerd maar dit werkt gewoon het best. Er zal vast iets efficiëntere zijn, maar die hebben we nog niet gevonden. Het blijft een beetje spelen.
40:34 Kan ik me voorstellen.
40:38 Ik vind het niet erg om er zelf over na te denken. Ik werk hier drie dagen in de week, dus als het efficiënter kan dan sta ik daar wel voor open. Soms denk ik wel eens dat we dit of dat kunnen proberen en dan doen we dat.
41:29 Heb je het gevoel dat het handiger zou kunnen met laden als het groter werd aangepakt? Zelf is het lastig te bedenken hoe dat grondig anders kan.
41:56 Ja, we kunnen wel ergens aangeven als we iets denken, maar uiteindelijk komt er vaak weinig van. Zelf actie ondernemen heeft meestal meer resultaat. Kabels uit het plafond hangen is wel een idee dat speelt, maar uiteindelijk gebeurt er niets mee. Je gaat niet zelf in het plafond boren of iets.
42:32 Dus je denkt wel dat er vanalles mogelijk is, maar dat het ontstijgt wat mogelijk is om zelf te regelen.
42:45 Ja klopt, de mensen op de werkvloer hebben vaak het beste idee om te weten wat het best is, maar het beland vaak op de grote hoop, dus wie weet komt het ooit nog eens ter sprake.
43:02 Het idee om vanuit het plafond iets te doen zou dus vanuit de ervaring logisch zijn, zijn er nog andere ideeën die voor de hand liggen voor jullie?
43:17 Ik denk zelf vaak dat in de grond het handig is. Dat er een hapje uit de grond zit, een geultje vanwaaruit je op kunt laden. Dat is dan wel weer een grote onderneming. En je huurt het pand ook, dus je kunt ook niet echt grote veranderingen maken.
43:35 Weet je hoe dat werkt? Kun je dingen veranderen?
43:40 Je kunt wel dingen veranderen, maar tot op zekere hoogte. En als je dingen verandert heb je de kans dat als je de huur opzegt dat zeggen dat als je een geul in de vloer maakt dat je die weer moet dichten. Als je huurt moet je daarover nadenken.
44:03 Dat is wel beperkend in die zin dat je niet je eigen gang kunt gaan.
44:08 Ik denk dat er zeker mogelijkheden zijn. Een soort heuveltje waar een kabel onderdoor loopt zou een optie zijn, maar dat is met die karren lastig. Ik denk er wel eens over na, maar dan zijn het als je er verder over nadenkt vaak dingen die niet heel praktisch zijn.
44:38 Het moet inderdaad in het geheel werken, niet alleen voor een aspect goed zijn en voor iets anders weer een probleem.
44:50 Ik maak nog een aantal foto’s, dankjewel.

48:15 Vereist Dockr dat de fietsen binnen staan?
48:25 We willen ook niet dat iedereen weet dat hier allemaal pakketjes binnenkomen, en dat CoolBlue hier zit. Vanwege diefstal of andere motieven.
48:48 Dus diefstal is wel een punt van aandacht?
48:56 Ja, het zijn wel dure fietsen.

1:00:20 Is het qua gebruik van de fietsen en parkeren vaak moeilijk om de fietsen op de standaard te zetten als hij vol is?
1:00:34 Als hij helemaal vol is gaat het wel, maar de fiets zelf weegt al zo’n 250kg dacht ik, en als die bak helemaal vol zit dan heb je wel 300kg aan gewicht.

Interview Naiem Kadry
MarleenKookt Amsterdam

Interviewee functie/expertise:	*Voertuig design data analyst*
Datum:	*19/05/2021*
Tijd:	*10:00-11:00*
Locatie:	*Gerard Schaepstraat 6, Amsterdam*
Toestemming opname:	*Ja*

00:13 Wat is je rol hier?
00:29 Ik werkte hier al naast mijn studie, en toen ben ik hier gebleven. Ik ben werkzaam als expansiemanager, het is een leuk project, we zijn een snelgroeiend bedrijf.
00:43 Hier is de keuken, we zijn naar meer ruimte op zoek. Ik zal kort uitleggen hoe het hier gaat. We hebben dit geprobeerd op te delen in een warme en koude kant. Dit is Marleen, dit is Stan. Hij heeft een leuke innovatie voor zijn scriptie, dus hij komt kijken hoe wij hier te werk gaan.
01:09 Hier worden de maaltijden voorbereid. Alles komt hier 's ochtends vers binnen. We hebben ook een magazijn, maar dat is alleen voor alle lang houdbare dingen. En ook een koeling, daar wordt alles dan ingereden.
01:56 De koks beginnen al om 7:00 ' s ochtends, later komen de assistenten. Hier is de afwas. Kleine schaaltjes, grote schalen.
02:14 Jullie halen al het servies ook weer op, toch?
02:14 Ja, dat wordt hier dan weer allemaal afgewassen.
02:18 Dus de retourstroom is behoorlijk belangrijk in jullie logistiek.
02:19 Jazeker, 's avonds komt hier ook echt een apart team dat alles weer uitpakt en afwast voor een dag. Logistiek is dat een beste uitdaging.
02:37 Dat is best uniek in die zin, dat de retourstroom zo'n groot deel van de logistiek beslaat.
02:40 Ja, en het is ook een arbeidsintensief proces. Je bent er zo met 15 man mee bezig.
02:51 Hier is iedereen bezig om alles klaar te maken, zodat het zo de portioneerstations in kan. Vervolgens gaat het die kant op. Het gaat er hier in en alles komt er hier weer uit.
Hier staan alle bakfietsen, alle bakfietsen hebben leuke paardennamen.
03:24 Jullie hebben verschillende types, zie ik.
03:30 We hebben allemaal Urban Arrows, dit is nog een ouder type. Met een cargobox. De nieuwe zijn de high-tech, die zo open gaan. Dat zijn de twee types. Verder hebben we daar nog een XL staan.
03:46 Dan komen 's middags alle bezorgers hier om ongeveer dezelfde tijd. We hebben daar een tv hangen, daar staan de vertrektijden op. De inpakkers zorgen dat alles in de bakken staat. Dan ligt er een briefje op met de naam van de bezorger, die pakt daar de telefoon met het nummer van de fiets en die pakt een accu en die gaat fietsen.
04:16 Want jullie hebben vaste tijdsslots voor bezorging toch?
04:22 Mensen kunnen bij ons tussen 16:00 en 19:30 ongeveer bestellen in een bezorgblok van een halfuur.
04:27 Dat kiest men dan vantevoren?
04:28 Ja, ze kunnen tot 11:00 bestellingen wijzigen.
04:35 En daarna worden de routes gepland?
04:35 Ja, dan gaan we daarna routes maken. We hebben daar software voor, sinds een paar weken. Vandaag voor het eerst in Amsterdam gebruikt nu. We hebben een routeplanner, die zit hier.
04:59 Laurens, kun je een tel laten zien hoe de interface eruit ziet?
05:00 Want dat is een bestaand pakket?
05:03 Ja, dit is hoe het eruit ziet. Laurens importeert alle bestellingen voor vandaag in het overzicht. Hij gaat dan de meest efficiënte route bepalen. Hij doet dat voor alle steden, niet alleen voor Amsterdam.
05:31 Gaat hij zelf verzinnen wat de meest efficiente route is?
05:36 Het gaat automatisch, maar soms komt het voor dat hij niet alles erin krijgt. Dat kan komen doordat er te weinig mensen op de planning staan vandaag, of dat de tijd qua planning niet uitkomt. Dan moet hij handmatig gaan kijken hoe hij het oplost.
05:55 Als alle routes gemaakt zijn gaat het terug naar onze eigen back-end. De routes worden dan allemaal geprint. Alles gebeurt dus op de dag zelf. Na 11.00 moet alles gebeuren. Als er een ding vastloopt dan gaat het mis.
06:20 En rijden jullie alles op een enkele accu?
06:25 Ja, we hebben dus hier de accu's. Dockr heeft zelf een nummering voor de fietsen, maar wij hebben voor elke fiets heeft een vaste batterij met nummers. We hebben ook weer verschillende types, 400 of 500 [wH]. Als bezorgers een route langer dan 30km fietsen hebben, dan krijgen ze vaak een reserve batterij mee.
07:11 Die neemt hij gewoon los mee?
07:15 Ja, hij kan dan on-the-go switchen.
07:22 Hoeveel batterijen hebben jullie per fiets extra?
07:27 We hebben een batterij per fiets, we hebben hier 9 reserve batterijen erbij. Dat heeft er ook mee te maken dat we alleen bezorgen tussen 16:00 en 19:30, dus we kunnen ook maar maximaal 4 uur rijden. We zijn geen fietskoerier die shifts van 8 uur heeft.
07:57 Dus jullie rijden gewoon een enkele route op een avond?
08:04 Ja, de inpakker pakt de tas in, het zijn er vaak twee. De fiets is ook gemaakt op de hoogte van onze bestellingen.
08:29 Dit verzorgt Dockr?
08:33 Ja, zij hebben deze hele bak zelf ontwikkeld. Die oude dat is standaard Urban Arrow. Zij hebben hier een soort zacht materiaal gebruikt. Als je dan tegen een paal of iets aanrijdt met het hoekje blijft het ingedeukt. Als deze bak kapot gaat moet je de hele bak vervangen. De harde bak kun je nog onderdelen vervangen. Het is wel een gaaf ding, dubbele bodem ook. We zijn er erg blij mee.
09:31 Deze laadoplossing, is die door jullie zelf gemaakt of is Dockr erbij betrokken?
09:46 Deze kast hebben we door een meubelmaker custom laten maken. Dit is gewoon zelf gemaakt. Het is verre van ideaal, we zijn nog bezig met hoe we dit beter kunnen doen.
10:08 Hoe zou je omschrijven wat er niet handig is aan het gebruik nu?
10:08 Het is rommelig en je hebt heel veel draden. We hebben 41 batterijen en dat betekent 41 opladers en dat is rommelig. Je zou eigenlijk willen dat je dit bijvoorbeeld gewoon daar in kan pluggen. Dan trek je het gewoon eruit bijvoorbeeld. Dan heb je ook niet dat dit draadje er net uithangt, waardoor hij niet wordt opgeladen.
10:42 Hoe werkt het nu qua feedback? Krijg je feedback als je de kabel er insteekt?

10:53 Ja, je ziet dat dit lampje knippert, maar dat kun je niet zien als hij in de kast ligt. Je moet dus handmatig alles nalopen. En soms loopt iemand ertegenaan en dan schuift de kabel eruit. Maargoed, dan kun je zeggen dat je een iets andere kast had moeten maken. Wat voor hun heel stom is dat we met twee verschillende nummers werken.
11:20 Wat is de reden dat je een specifieke accu per fiets wil hebben?
11:28 Het heeft de financiële reden dat accu's die Dockr meelevert, die je dus ook least, die willen ze op een gegeven moment weer terug hebben. En bepaalde routes duren 4,5 uur met zo'n grote fiets, maar er zijn er ook van een uur en driekwartier. Die wil je niet een 500wH batterij meegeven. Dat is reden.
12:03 Dus er is een balans voor kortere routes met kortere accu's wat dat betreft? De accu's zijn dus wel gelinkt aan de fiets?
12:21 Ja, ze praten niet met elkaar maar ze horen wel bij elkaar.
12:28 De nummering is dus voornamelijk organisatorisch?
12:35 Ja. Je hebt natuurlijk ook wel eens dat een bezorger iets kapot maakt, dan is het wel handig dat je kunt zien dat die accu bij die fiets door een bezorger is gebruikt. Zodat we het terug kunnen vinden dat als de sleutel kwijtraakt.
12:49 Gebeurt het vaak dat een accu niet is opgeladen?
12:55 Ja, ja, ja
12:59 Door menselijke fout of door andere redenenen?
12:58 Wat we sowieso doen is alles 's ochtends nog controleren. Omdat ze vanaf 15:00 pas gaan fietsen hebben we eigenlijk nog de hele dag om op te laden, maar 's ochtends moet er wel een goede controle plaatsvinden om zeker te zijn dat alles goed is.
13:17 Als je er dan achterkomt dat hij niet geladen is is er nog genoeg tijd om te laden?
13:30 Als je er om 15:00 achter komt is het te laat. In andere steden daar zijn hubs maar is niemand op locatie. We zijn vrij klein. Daar staan zo'n 5 tot 8 fietsen, afhankelijk van de locatie. Daar bezorgen we met een sleutel. Daar komen ze aan, zorgen dat alles goed zit maar daar werken allen bezorgers, daar zit niemand. Als daar 's avonds iets wordt vergeten om op te laden, danwel een telefoon danwel een accu en er komt de volgende dag iemand, dan is het echt een groot probleem.
14:08 Dus de verantwoordelijkheid van de bezorgers is dan belangrijk?
14:08 Die is dan heel belangrijk ja. Er hangen dan grote posters met: "Wat doe je als je weggaat?", maar we zijn nog te klein om daar fulltime iemand te hebben zitten de hele week.
14:21 Dit probleem speelt wel vaker merk ik, ook waar ze het al langer doen.
14:28 Ik zou zeggen dat het niet heel vaak fout gaat, maar als het fout gaat is het heel erg balen, want die telefoon en die accu dat is onze lifeline. Het is echt nodig dat er met een batterij gefietst kan worden.
14:56 Als je die negen extra accu's neemt, is dat aantal afgestemd op hoevaak het misgaat in de praktijk?
15:12 Nee, het is echt voor langere routes om als extra mee te nemen.
15:18 De indeling zoals die nu is met de fietsen, is dit zoals jullie al het eten inladen?
15:33 We hebben hier deze karretjes, deze koelbakken rijden ze naar de fietsen. Maar dit is zo superonhandig, want we zijn in een jaar tijd iets van 80% gegroeid. Er staan nu 41 fietsen, vorig jaar hadden we er 25. Dus nu als zij een fiets moeten inladen dan staan ze hier zo overheen te hangen. Met zijn tween om het hier provisorisch in te hangen. Eind van de zomer gaan we verhuizen. Puur zodat we meer ruimte hebben. We kunnen niet meer doorgroeien. Deze fiets staat hier al in het midden.
16:27 De indeling is dus wel heel veranderlijk?
16:33 Nee, het staat elke dag zo. De routes zijn gekoppeld aan een bezorger en een fiets. Als zijn met een karretje hieruit komen hebben ze al op die koeltas staan welke fiets het in moet. Dat heeft de routeplanner bepaald. Deze volgorde van de fietsen staat altijd zo, op nummer.
16:59 Op dagelijkse basis staat het dus altijd zo. Heeft elke fiets ook een vaste plek?
17:01 Ja, van 1 tot 37, alleen nu staat het even raar vanwege de ruimte. Maar je kunt zo aftellen.
17:12 Maar omdat jullie snel groeien wordt de indeling nog wel eens aangepast?
17:17 Jazeker, we hebben hier ook zeer lang over nagedacht want wat nou als je het nummer loskoppelt van de bezorger, en je zet alle fietsen zo neer, en dat je een pad aan de buitenkant houdt, en dat je zorgt dat de fietsen in die volgorde weggaan.. Er zijn allerlei mogelijkheden waar we over na hebben gedacht, maar het blijft een moeilijk verhaal omdat er ook veel IT systemen mee gemoeid zijn. Om je vraag te beantwoorden; het staat in principe allemaal zo.
17:56 Hebben jullie ook andere oplossingen overwogen voor het opladen te organiseren of was dit het enige wat je kunt doen?
18:08 Dit was echt de enige oplossing. Nou, een andere oplossing die we vroeger hebben overwogen was, die dingen kun je ook opladen in de fiets. Maar dit was zo'n oud pand waar je niet overal stroom hebt. Dan moet je weer overal stroom regelen. Je ziet daar allemaal stekkers op bepaalde punten. Dat leek ons niet ideaal.
18:32 Puur installatie-technisch dus lastig?
18:36 Ja, en dan heb je weer overal snoeren die makkelijk kapot kunnen gaan. Dit is toch wel makkelijk. En hier kun je wel snel zien wat er oplaadt en wat niet oplaadt. Als zo'n stekker in een fiets zit moet je alle fietsen nalopen. Dit werkt toch iets efficienter.
18:50 Ahja, die die feedback is wel belangrijk.
18:57 Jullie hebben een tegel toch begreep ik?
18:57 Ja, wat Tiler maakt is een tegel. Tot nu toe is het meestal inbouw in de grond, buiten. Bijvoorbeeld voor New York Pizza. Die zit dan voor de deur in de stoep. Een kabel loopt dan onder de grond en wordt aangesloten op het gebouw. Op die manier boek je veel winst omdat ze constant in en uit-rijden en kun je telkens een beetje bijladen en kun je uiteindelijk met minder accu's uit. Waardoor het economisch interessant is, omdat je naast minder accu's ook een handige oplossing hebt. Er zitten natuurlijk ook veel menselijke onhandigheden aan, maar ook veel accu's bij elkaar zitten ook risico's qua brandgevaar wat nog wel eens speelt.
20:02 Is het rendement wat je haalt met die 10 of 15 minuten, schiet dat een beetje op?
20:04 Ja, dat is gebleken dat dat net het verschil kan zijn met net niet meer een extra accu mee te hoeven nemen. Dat is uiteindelijk waar het interessant wordt. Dat is de uitdaging aan dit domein. Ik neem dat dit een huurpand is?
20:29 Ja
20:30 Je ziet vaak dat logistiek met bakfietsen wordt georganiseerd vanuit huurpanden. Je kunt dan niet even in de vloer gaan graven. Dat moet je ook niet willen denk ik, maar het fenomeen van parkeren..
20:48 Het werkt hetzelfde als met je telefoon toch?
20:48 Ja, met inductie. Het fenomeen van parkeren = opladen, als je dat kunt realiseren dan kun je een groot deel van die foutmarge die mensen hebben kun je er dan uithalen. En dan kun je, maar dat is wellicht voor dit typische gebruik minder interessant, kun je constant wanneer je pauze hebt even automatisch bijlaadt waardoor je daar makkelijk winst uit kunt halen. Maar ook die frustratie van 's ochtends erachter komen dat de accu niet is opgeladen voorkomen. Daar zit de winst in.
21:24 Je zou het ook met een soort mat kunnen doen misschien? Waar je je fiets op plaatst?
21:25 Ja dat kan, dat is een optie die ik overweeg. Ik ben benieuwd wat je daarvan denkt. Vaak in de logistiek worden rolcontainers gebruikt, zoals ook hier. Overal rijden die rond.

Gelijkvloersheid is dan altijd erg belangrijk, anders dan loop je te klooien. Dat zie je vaker.
De flexibiliteit van de indeling is ook vaak belangrijk, dat zou voor zo'n mat ook goed kunnen werken, afhankelijk van hoe dik die mat wordt. Wat ik probeer uit te zoeken is of een soort basic systeemvloer realistisch kan zijn. Je zou dan geen losse matten hoeven hebben, maar zou je in een ruimte zoals deze de vloer in zijn geheel licht ophogen, zodat je op elke plek waar je de fiets wil parkeren de laadtegel erin klikt.
22:43 Oja, zodat je wel overal een gelijke vloer hebt. Eigenlijk moet je een sportschoolvloer hebben.
22:50 Ja precies, het materiaal moet daarvoor geschikt zijn. Je hebt dan wel flexibiliteit van de indeling..
23:05 Waar ik dan meteen aan denk is aan de centen. Vloeren zijn meestal niet goedkoop. Zo'n tegel klinkt dan al wel goedkoper. Als ik dan zo'n hele vloer zou moeten leggen, dan denk ik ai. Dat kan me nog wel eens iets kosten.
23:27 Dat is denk ik afhankelijk van zo'n rubber tegel, dat hoeft niet duur te zijn.
23:46 Maar een gehele rubber vloer dan weer wel
23:50 Klopt, dat is denk ik de afweging.
23:56 Je zou eigenlijk een berekening moeten maken op basis van return of investment, eens kijken hoe lang het duurt om zo'n vloer terug te verdienen.
23:57 Ja klopt. De marges zijn natuurlijk relatief krap, die paar extra accu's zijn niet gratis maar dat is ook geen fortuin.
24:15 Nou, die accu's zijn vrij duur
24:19 De winst zit hem ook vooral in dat je tijd en ongemak voorkomt door geklooi van personeel.
24:34 Jazeker, als iemand een uur te laat weggaat door een lege batterij betekent soms dat 18 mensen met een orderwaarde van 25 euro per bestelling hun eten te laat krijgen wat je moet gaan vergoeden, dat is ook iets.
24:51 Dat is wel een interessant punt.
24:55 Ben je nog andere opties aan het overwegen?
24:59 Ja, de uitdaging ligt hem erin dat je een normaal een katrol uit het plafond wil hangen die je erin plugt. Dat is een manier om het laden in de fiets te realiseren, zodat je de accu niet eruit hoeft te halen.
25:25 Dan heb je wel feedback nodig.
25:26 Klopt, en de overweging is ook dat ik voor Tiler iets wil realiseren waarbij ik een universele oplossing maak, zodat al die tegels die op een gegeven overal liggen door alle fietsen gebruikt kunnen worden. Door de bakfietsen in het logistieke domein, maar ook publiek. Bijvoorbeeld zoals Cargoroo, die deelfietsen. Het zou dan mooi zijn als dat gedeeld werkt, overal.
25:57 Een heel gaaf idee!
26:00 Feedback is inderdaad interessant zoals je zegt
26:06 Ja, je wil makkelijk weten of de fietsen zijn opgeladen, of zijn ze nog aan het laden.
26:16 Dat is inderdaad het gemakkelijke aan alle batterijen centraal bij elkaar laden. Moet je de feedback dan verplaatsen naar de personen die bezorgen of naar degene die verantwoordelijk is aan het eind van de dag om het te controleren? In het scenario van een onbemande hub kan het weer goed werken om feedback direct aan de bezorger te richten. Als je bij het parkeren de feedback duidelijk implementeert..
26:45 Het is gewoon een hele gave, makkelijke oplossing.
26:51 De tegel op zichzelf is ook nog niet eens zo heel duur
26:57 Wordt hij al gebruikt in de praktijk?
27:02 Ja, er lopen een aantal pilots waarbij wel is bewezen dat het echt iets toevoegt.
27:13 Zo'n tegel zou nog niet eens zoveel uitmaken als je met bakfietsen werkt dat je dan die tegel los hebt, dat zou prima zijn. Hij hoeft van mij niet eens gelijkvloers te zijn. Als hij maar niet teveel uitsteekt. Je kunt er gewoon met je rubberen wiel overheen rijden.
27:32 Dat heeft ook te maken met het feit dat je hier natuurlijk vaste plekken hebt ook? Een locale verdikking zou dan niet eens een probleem zijn.
27:53 Nee, stel je hebt hier direct onder de accu een rubberen tegel waar je met de fiets overheen kunt.. Het enige is dan wel dat je de draad hebt die er ligt.
28:01 Dat is de uitdaging. De gaat dan weer toe naar een situatie waar je overal snoeren hebt. Dat kan wel, maar is zoals je zegt lastig om installatiewerkzaamheden te doen. Is de oplaadlocatie gekozen aan de hand van de plek waar toevallig al stroom was.
28:28 Nee, die is speciaal daarvoor aangelegd. We hadden het eerst op een andere plek. Dat was ellende. Toen is daar een nieuwe groep aangelegd. Deze locatie was handig om het te kunnen monitoren.
28:50 Heb je enig idee of het duur is om een installateur een groep aan te laten leggen?
28:58 Dat zou ik even na moeten vragen. Ik weet wel dat het arbeidskosten en materiaal is. Het is geen vermogen, maar met een kleine marge wil je dat soort kosten liever niet continu blijven maken.
29:21 Hoe werkt het hier op het moment dat er schoongemaakt moet worden? Qua water?
29:33 Hier wordt alleen geveegd. Puur met de reden dat hier ook geen afvoerput is.
Straks in het nieuwe pand gaan we gewoon met de dweilmachine aan de gang. Hier wordt alleen geveegd. Het is eigenlijk een soort buitenvloer. Kijk, in de keuken moet het allemaal hygienisch zijn, maar hier staan toch al die fietsen. Het is toch een betonvloer, dus die hoeft niet megaschoon te zijn.
30:09 Water is natuurlijk nog wel een ding met elektronica in de grond. De tegel zelf is waterdicht, maar met een vloer is het een ander verhaal.
30:27 Want de tegel ligt niet overdekt?
30:34 Nee, die ligt gewoon in de buitenlucht. Het is een soort afgesloten bak die in de grond ligt ingegraven.
30:55 Hoe werkt het met het onderhoud van de fietsen? Want jullie leasen ze toch?
31:03 Ja, we hebben een deel eigen fietsen, dat zijn die met die [harde] bak. En alle Dockr fietsen leasen we. Daar zit een onderhoudscontract bij. Die besteden dat uit aan GBS [GetBikeService]. Die komen met een busje.
31:24 Komen die periodiek langs?
31:24 Ja, we hebben periodiek onderhoud, eens in de maand. Daarnaast komen ze alle reparatieverzoeken die we hebben binnen 48 uur repareren. Wij hebben daarnaast onze eigen fietsenmaker, die kwam hier net ook. Eerst hadden we zelf twee fietsenmakers in dienst, maar toen kwamen we erachter dat we, toen we een rekensom hadden gemaakt, dat als we twee fietsenmakers hebben die we fulltime in dienst hebben, plus de onderdelen die je zelf moet kopen, dat het niet meer uitkwam. [Dockr] boodt toen zo'n servicecontract aan. Die Urban Arrow fietsen zijn mooie fietsen, maar alles is peperduur eraan. Toen in Februari met die sneeuw allemaal, voornamelijk die ketting, die carbon belt, dat was ellende. Die gingen allemaal stuk voor stuk kapot. We kwamen erachter dat er in de handleiding stond dat dat niet kon. Als er sneeuw tussen komt rekt 'ie te hard en breken ze. En die zijn aardig duur. Toen kwamen we erachter dat een servicecontract beter was.
32:49 Wat gaat er normaal gesproken vaak kapot?
32:55 Welke reparaties komen er veel voor?
Monteur:33:04 Remmen. Voornamelijk wanneer de bezorger die bak zo neerzet, raakt de remhendel die bak. Als die kabel dan zo knikt dan is die lek.

33:16 En banden, wielen, daarmee vaak gezeur?
33:25 Remblokken, remschijven, daarmee rijden we zo'n twee, twee en een halve maand normaal. Als je er op een normale manier mee rijdt, met normale hoeveel kilometers haal je zo'n halfjaar.
33:47 Bepaal je door constant te kijken of ze versleten zijn of check je de kilometerstand voor een indicatie?
33:45 Op het begin, toen we er nog 30 hadden deden we het nog op kilometerstand, omdat het dan gewoon veel werk is om het te checken. Nu ik minder fietsen doe, dan ik per fiets gaan kijken hoeveel slijtage er is. Dat is een stuk preciezer.
34:11 En we hebben een reparatiebord waar bezorgers opschrijven wat er eventueel mis is met de fiets.
34:15 Ah, zodat je meteen feedback hebt.
34:18 Ja, dan kunnen we 's avonds meteen de fiets repareren.
34:27 Staan er wel eens fietsen stil die staan te wachten op reparaties?
34:34 Ja, GBS moet natuurlijk binnen 48 uur die reparties doen, maar dat betekent dat we vaak het zadel omdraaien van de fietsen die gerepareerd moeten worden. Er zijn er altijd wel een paar die niet gebruikt kunnen worden omdat ze een reparatie nodig hebben.
35:07 De kilometers aflezen wordt dus wel eens gedaan of niet? Lezen jullie verder dingen uit aan de fiets of uit de telefoons voor het onderhoud?
35:28 Nee, we deden dat dus zelf wel eens, maar GBS via Dockr geven we wel eens een schatting door. Op basis daarvan wordt die periode onderhoudscontrole bepaald. Dat is grofweg hoe het gaat. Toevallig heeft een oude fiets nu 37.000 kilometer heeft gehaald, dat is voor zo'n fiets echt wel veel.
36:25 Het zou dus opzich wel interessant kunnen zijn om via een tegel ook data uit te lezen die gedeeld kan worden met externe partijen zoals GBS, zodat zij precieser kunnen werken.
36:47 Misschien tracken ze wel heel veel, ze kunnen wel de computer uitlezen, dat weet ik wel. Als er een error is dan lezen ze de computer uit, dat kunnen ze ook bij de maandelijkse controle doen. Zo kunnen ze inzicht krijgen in hoe de fiets wordt gebruikt. Dat doen ze dan met de hand. Verder checken de bezorgers zelf de bandenspanning met de compressor, dan doen ze zelf.
37:43 Ik kan me voorstellen dat het voor Dockr belangrijk is dat jullie daar zelf goed voor zorgen.
37:46 Jazeker, we hebben afspraken over wat wiens verantwoordelijkheid is. Als we nalatig zijn in klein onderhoud of dingen negeren, dan hebben we een probleem. Kleine dingen zijn onze eigen verantwoordelijkheid.
38:25 Je had het net over data en dat lijkt me wel erg interessant, dat je dan een soort programma hebt waarin je in een oogopslag de data van de fiets kunt zien. Zo van, deze fiets heeft zoveel gereden.
38:46 Een soort repair-dashboard
38:53 Ja, misschien dat je ook notificaties krijgt wanneer onderhoud er weer aan zit te komen. Dat je kunt voorkomen dat iets kapot gaat. De fiets heeft nu nog geen app namelijk. Zoals je bij een elektrische auto hebt.
39:22 Klopt, dat vind ik ook altijd erg bijzonder als je ziet hoe de bakfietsen gebruikt worden in de logistiek. Het is eigenlijk een huis-tuin-keuken systeem wat commercieel gebruikt wordt. De kern blijft dat het heel algemeen is wat niet gemaakt is voor dit soort toepassingen. Daarvan denk ik dat er nog veel te halen valt.
39:52 Ja klopt, meer technische snufjes.
40:03 Bedrijven die met grotere voertuigen bezorgen halen veel meer data uit hun voertuigen waarmee ze veel verder gaan om te monitoren. Bijvoorbeeld op basis van g-krachten een profiel schetsen voor het gebruik van de voertuigen. Als je eenmaal een systeem hebt om al die data uit te lezen, zijn er zoveel mogelijkheden.
41:15 Eigenlijk wil je meer sensoren in je fiets hebben zitten.
41:20 Ik vind het altijd erg opvallend hoeveel die kleine bezorgautootjes kunnen, terwijl bakfietsen op dezelfde manier gebruikt worden en die hebben een heel basic systeempje. Grote bedrijven hebben vaak een complexe technisch systeem, terwijl de bakfiets daar niet op aansluit.
41:51 Maar dat zal ook voornamelijk een geldkwestie zijn. Zo'n bakfiets kost zo'n 6000 euro, maar een auto al snel 20.000 als het niet meer is. Dan is het de vraag of dat zin heeft om zo'n systeem te willen adopteren.
42:07 Klopt. Maar op bepaalde manieren zou er wel op makkelijke manieren meer mogelijk moeten zijn.
42:21 Ja, dat zou zeker interessant zijn.
43:00 Bij wie zou je zeggen dat de verantwoordelijkheid ligt voor het aanbieden of ontwikkelen van een handige laadoplossing voor in de bezorgsituatie? Want jullie leasen de fietsen en je kunt er op lease-basis servicecontracten en van alles extra bij nemen. Dockr heeft bijvoorbeeld als insteek dat ze een ontzorgende rol hebben, zou je verwachten dat zij verantwoordelijk zijn om een handige oplossing te bieden? Of is dat niet logisch?
43:55 Ik zou het niet verwachten, maar ik zou het wel tof vinden. Het zou de service nog completer maken. Het verhaal van hun nog meer kracht bijzetten. Het zou zeker een pluspunt zijn. Er zit natuurlijk ook altijd ergens een grens aan.
44:27 Zou je wel denken dat het voor jullie interesssant zou zijn om dat erbij te leasen?
44:36 Ja daar zouden we absoluut voor open staan. Als ze ze dan ook nog komen installeren dan zou het helemaal ideaal zijn.
44:51 Ze komen de fietsen natuurlijk ook op maat, custom afleveren, dus zo gek zou dat niet zijn.
44:56 Nee, het enige gevaar is dat het wel snel allemaal duurder wordt. Ik zou misschien nu wel denken dat ik eerder gewoon de tegel zo zou aanschaffen. Het hangt gewoon van de kosten af. Voor een tientje in de maand, prima. Maar komt er 100 euro in de maand bij wordt dat op jaarbasis echt te gek.
45:38 Snap ik. Zoals ik het zie is de grootste benefit voor jullie dat je dan een betrouwbaar systeem hebt of dat je minder handelingen hoeft te doen?
45:50 Ja, dat bezorgers die batterij niet meer uit die fiets los op hoeven te laden. Gemak, je zet de fiets op z'n plek en die wordt dan opgeladen. Gemak en efficiëntie.
46:12 Dat is denk ik de kern. De bezorgers hebben niet altijd de toewijding om het ten alle tijden netjes te doen. Is het goed als ik nog een aantal foto's maak?
46:40 Ja, mocht je iets nodig hebben, laat het me weten.

Interview Willem Boverhoff
Business Development Manager @ Dockr

Interviewee functie/expertise: *Cargobike Business Development*
Datum: *29/04/2021*
Tijd: *10:30-11:30*
Locatie: *Delft (via Teams)*
Opname: *Nee*

Kleine winkeliers willen buiten parkeren, zij hebben vaak geen ruimte binnen
- Binnen gaan de e-bikes veel langer mee
- Afwijkende belangen Dockr en klanten

Marleen Kookt (Joris Keijzer): 50 fietsen voor maaltijdbezorging
- Heel duurzaam
- Hub systeem met cargobikes
  - Amsterdam 35, Haarlem 5, Utrecht 5 fietsen
- Rijden vaak grotere rondes, tussentijds laden minder aantrekkelijk
- Wat kan je oplossen:
  - Inboedelverzekering
    - Dure batterijen liggen vaak op een grote stapel
  - Batterijen op een rij (brandveiligheid)
    - Bijv.: Lader slaat af bij te hoge temperatuur batterij
  - Bezorgers maken fouten met laden/inpluggen
- 1-op-5 fietsen behoeft extra batterij
  - 30-45 euro per maand voor extra batterij
  - Eerste zit er bij: 289 euro
  - 30-40km range per fiets
- Opschaling is groot probleem
- Behoeftes:
  - Zorgeloosheid
  - Altijd een opgeladen fiets

Lokale marktplaatsen (laten bezorgen vanuit winkels naar klanten):
- Bringly, Peddler
  - Stalling van fietsen nu bij kantoor of buiten
  - Andere, overdekte plek zou beter zijn
- In de openbare ruimte parkeren
  - Gemeente kan dit faciliteren
  - Q-park faciliteert bewaakte stalling voor bedrijven
    - Flexibel & ontzorgd
- Flexibele hubs of laadpleinen buiten
- Uitdagingen: Legt de bezorger de fiets wel aan de lader? Wordt de accu van de fiets afgejat?
- Interactie en bediening kan zeker efficiënter

Is er een case voor slim laden van cargobikes als tussentijds laden lastig is?
- Is enkel de benefit van vloeiendheid en ontzorging voldoende?
- Publiek domein lader interessant?

Toekomstige case: Nieuwe gebouwen, wisselende gebruikers, aannemers:
- Service-logistiek op parkeerplaats/garage voor sharing
- Grote vraag naar, nu nog toekomstmuziek
- Vb. Structon: Busjes mogen niet voor het project neerzetten
  - Elektrische fietsen liggen dan voor de hand
- Mobian sharing voor service-logistiek
  - Pilot niet van de grond gekomen
  - Veel potentie, pas 2024 (richting invoering ZE-zones)
  - Mobian en Dockr kunnen service aanbieden voor cargobikes

Openbare ruimte: Cargoroo
- Tiler als accessoire? Korte termijn in podium?
- Platform heel interessant

Tiler levert een product aan Dockr, Dockr biedt Tiler aan, per maand en flexibel
- Simpele platform versie
- Rond de 5 cm dikte
- Plug&play accessoire mogelijk? Of installatie benodigd?
- Directe markt aanwezig voor plug&play ‘deurmat’ oplossing
- Financieel plaatje van belang

Interview Luuk Nijland
Management & Product Development @ Cargo Cycling (Nijland Cycling)

Interviewee functie/expertise: *Cargobike Product Development*
Datum: *07/05/2021*
Tijd: *14:00-15:00*
Locatie: *Rotterdam (via Teams)*
Opname: *Nee*

PostNL: Business-case
- Hele dag rijden op grote accu of veel kleine stops met tussendoor laden?

Zorgfietsen
- Mensen die slecht ter been zijn
- Op maat gemaakte ebikes
- Kleiner qua volume
- Lastig op te laden, accu bij voorkeur niet uit de fiets

Focus op onderhoud, berijder en connectivity
- GPS, electronisch slot, verlichting
- Accu los (kunnen) halen is niet handig
- Stilstaande en gestrande voertuigen zijn duur

Opladen
- Accu laten zitten is USP
- 's Nachts laden binnen in voertuig niet gewenst
- Verzekering wordt steeds moeilijker
- Verrijdbaar laadplatform met wieltjes is laagdrempelig
  - Evt. 's ochtends naar buiten te rijden
- Steeds meer vraag naar all-in-one complete oplossing (fiets+lader)
- Uiteindelijk is genoeg stroom om te kunnen rijden belangrijkst
- Menselijke handelingen beperken
- Laadkasten voor accu's
  - Meet kwaliteit van de accu
  - Veilige lader
  - Protectie met sprinkler
  - Smart & connected
- Swabbee als alternatief
- Bij zware fietsen met grote accu's heeft winter grote invloed

Fiets eigendom vs. lease
- Veel partijen willen fiets in eigendom vanwege vandalisme
  - In eigen hand nemen van nalatigheid door personeel
  - Grote accu's zijn duur, veel invloed op aanschaf
  - Fiets ontworpen om onderhoudsvrij/arm te zijn
    - Bandenspanning controleren op afstand
    - CANbus
  - Fleetmanagement partners van belang
    - Fleetco, Paztir: Connectivity
    - Dockr: Shortlease
    - Pro-drive: Personeels-training

Pilot-setup met deelfiets bij Ahoy of Subway zou interessant zijn

Interview Elbert Jochemsen
Bezorger @ Coolblue Witgoed DC Utrecht

Interviewee functie/expertise: *Bezorger*
Datum: *16/03/2021*
Tijd: *11:00-12:00*
Locatie: *Rotterdam (via Teams)*
Opname: *Nee*

DC zit in Tilburg, vanaf daar komen rolcontainers en witgoed naar hub in Utrecht
Vanuit de hub rijden fietsen, busjes en boxtrucks
- Op de hub vindt geen opslag plaats, enkel overslag
- Kleinere pakketten gaan met bakfiets, CoolblueFietst
- Grotere pakketten in de stad met de bus
  - Witgoed altijd met 2 pers. Bezorgd
  - Airco's, grasmaaiers, kleine koelkasten en tv's t/m 35kg
  - Rest gaat extern via PostNL in buitengebieden

Bezorghubs hebben een afgebakend postcodegebied
Overslag is nog handmatig
- Vrachtwagentrailer wordt handmatig door bezorgers uitgeladen

Voertuigen en routes zijn al gepaald en verwerkt in de barcode op het pakket
- Vb. voertuig #3, route #6
- Alles komt door elkaar binnen, wordt door bezorgers gesorteerd en ingeladen
- Gem. 30 min. overslag door alle bezorgers
- Retouren en niet-thuis wordt apart gehouden in de vrachtwagen

Controles vinden plaats op max. gewicht met B-rijbewijs
Verbruik, g-krachten, snelheden worden bijgehouden
Iedere werknemer heeft een prestatie overzicht met een rij-score en klant-tevredenheidsrapport
Voornamelijk belonend ingezet
- Er is wel een wall-of-shame in het DC

Routes zijn vooraf gepland en in telefoon geladen, incl. Pauzes en tijdsvakken voor toegang in stadscentra
Menselijke foutmarge is getracht zo ver mogelijk eruit te ontwerpen
Onderhoud van de voertuigen is op basis van zelf wegbrengen naar partner garage
- Planning via leidinggevende
- Er is een algemeen opbouwcentrum waar custom bussen en vrachtwagens worden afgeleverd voor o.a. AH, Jumbo, etc. met branding, livery en accesoires.
- Klein onderhoud wordt ter plekke in hub gedaan door interne regio werknemer
- Motorisch werk via garage

Interview Joris Kerremans
Head of CoolblueFietst @ Coolblue

Interviewee functie/expertise: *Head of CoolblueFietst*
Datum: *12/03/2021*
Tijd: *13:00-14:00*
Locatie: *Rotterdam (via Teams)*
Toestemming opname: *Nee*

In totaal nu zo'n 150 bakfietsen op de weg onder CoolblueFietst
Grootste deel via Dockr
Keuze voor 2-wiel bakfiets
Snel, wendbaar
- Ziet er vlot en toegankelijk uit
  - Uiterlijk en uitstraling is van groot belang
- Nadeel is minder volume bij 2-wiel setup
  - Idealiter zo'n 3m3 laadvolume
- Veiligheid is ook een issue
  - Omvallen, parkeren
  - Gladheid in de winter legt hele operatie stil

Laadvolume van de bakfiets is beperkende factor
Onderhoud wordt gedaan door GetBikeService (GBS)
Vroeger werd er bevoorrading vanuit de winkel gedaan
- Kon niet meer vanwege ruimtegebrek, winkel zit vaak op dure locatie
- Niet rendabel om daar ruimte voor bakfiets logistiek te hebben
- Zou eventueel ook met normale ebike kunnen voor kleine zendingen
- Nu direct vanuit DC naar de hubs met bus/bakwagen
- Locatie van de hub wordt bepaald aan de hand van bereikbaarheid voor personeel en vrachtwagen vanaf de snelweg vanaf DC naar hub
  - Veel vraag naar personeel, dus locatie moet geen hindernis zijn

Bij bezorgen is het tijdsschema de limiet, volume minder grote factor
Accu's nog niet beperkende limiet
- Ongeveer 40km op 1 accu

Huidige oplossing voor laden is stellingkast met brandblusser ernaast
- Brandkasten zijn duur en niet optimaal in gebruik
- Huidige organisatie is acceptabel, maar niet schaalbaar
- Bij inzet van grotere getallen fietsen niet haalbaar

Qua voertuig zit er een gat tussen bezorgbus en fiets
- Coolblue wil PicNic-achtig voertuig voor randgebieden
- In-house bezorggebied moet uitgebreid worden
- Technologisch gat tussen bezorgauto's en bakfietsen

Routeplannen is volledig geautomatiseerd met software
Data uitlezen is belangrijk voor logistiek proces
- Automatisering en optimalisatie essentieel in logistiek
- Kilometerstand belangrijk voor onderhoud
  - Nu op basis van tijd, erg inefficient
- MIND Mobility fleet management wordt gebruik voor de rest van het wagenpark (https://mindmobility.nl)

Bakfiets is daarmee niet compatible
- Ideale oplossing is Fulpra fiets
- Automotive-achtige functionaliteiten voor logistiek

Snel, wendbaar en toch veel volume (3m3)
Gemaakt voor standaard rolcontainers die Coolblue al gebruikt
Perfecte oplossing voor naadloze aansluiting op geautomatiseerde systemen
Cargo Cycling (Nijland) is ook interessant, maar heeft kleiner laadvolume en minder geavanceerde functionaliteiten
Grotere bakfietsen vaak duurder qua verzekeren en rijbewijs vereisten
Nijland heeft invloed in adviesraad RDW
Toekomst scenario: 'Fiets-aspect' aan LEVV is enkel 'loop-hole'
- Balans tussen spierkracht vs. motor-vermogen ver uit elkaar
- Pedalen zijn enkel een controller/hendel voor bedienen motor
- Voertuigcategorie is bepalend voor rendement Fulpra/Chariot

Integratie van de bakfiets in het systeem loopt achter door ontbreken van ideaal voertuig
- LEVV logistiek is compleet gescheiden van alle andere logistiek
  - Toekomst: Integraal onderdeel in het systeem

Elke ochtend zijn 3-5 werknemers 1 uur bezig met het overladen en sorteren van alle pakketten voor de bezorgshifts voor de hele dag
Coolblue wil een alles-in-1 aankoop of service model
- Het klopt niet dat Coolblue moet investeren in het ontwikkelen van geschikte laadoplossing
- Wens is de aanschaf van een geschikt pakket, LEV met lader

Grote hub heeft zo'n 15 fietsen (Amsterdam)
- Er is een standaard blauwdruk voor DC's en hubs, algemeen toepasbaar en schaalbaar
- Huidige hubs zijn huurlocaties, waarbij mogelijkheid tot aanpassingen en installaties beperkt is

Belangrijkste aspecten zijn veiligheid en gebruiksgemak
- Brandveiligheid
- Foolproof

Toekomstige Coolblue logistiek bestaat uit
- Witgoed: direct vanuit DC's
- Winkel bevoorrading: Busjes/boxtruck
- Pakketjes aan huis: Via hubs met kleine EV of bakfiets naar klanten in stad of metropoolregio

Interview Pieter Bouwstra
Business Analyst @ Distribution team, PicNic

Interviewee functie/expertise:	*Voertuig design data analyst*
Datum:	*24/3/2021*
Tijd:	*15:00-16:00*
Locatie:	*Rhenen (via Teams)*
Toestemming opname:	*Nee*

Distributie verloopt van DC naar fulfillment center naar hub.
- Er is een aantal centrale DC's, en meestal per regio of grote stad een fulfillment center
- In de fulfillment centers worden de order gepickt, waar ze in de rekken met kratten per auto worden geladen. De rekken gaan dan in anonieme vrachtwagens, waarme ze over de hubs worden verdeeld.
- In de hubs vindt enkel de overslag naar de PicNic ePV's plaats en is plaats voor (ge koelde) opslag
- De keuze voor losse fulfilment en meerdere hubs is een afweging in klantdichtheid
  - Meer hubs is dichter bij de klant, dus minder rijden
  - Maar hubs zijn duur, dus soms is grotere hub goedkoper
  - Het optimum ligt nu op 40 ePV's per hub, bij meer wordt het organisa torisch ook lastig

Voor fulfillment wordt een semi-automatische fulfilment systeem gebruikt; Okado.
- Deze interface helpt de 'shoppers' om de artikelen te vinden
- De shoppers lopen rond met karretjes om de kratjes met tasjes te vullen
- In de toekomst willen we de shoppers passiever maken, waarbij karretjes rondrijden die de artikelen aan de shoppers aanbieden. De shoppers checken dan enkel of de bestelling compleet is.
- Op het moment worden de shoppers gemonitord door managers die alles soepel draaiende houden
- De hubs zijn relatief oninteressant voor automatisering door hun beperkte handelin gen
- Het automatiseren van laden is lastig door de beperkt mogelijke interactie tussen mens en machine op dezelfde plek, dat kan voor ongelukken zorgen
- Er wordt nagedacht over een veilige uitschuifarm als laadoplosing
  - Harde/bedrade connectie heeft nu nog voorkeur, laadsnelheid is kritiek 5kW laden is niet genoeg, er is tussen 10 en 100kW nodig
  - Autonome bewegingen in de hubs is technisch goed haalbaar met huidig voertuig
  - De vraag is wanneer het rendabel is, innovatie is pas interessant als het geld bespaart
    - Het moet dus genoeg arbeids-uren besparen voor automatisering plaats kan vinden

De overslag van vrachtwagen naar ePV kan in zo'n 10 minuten
- Er zijn 5 bezorgshifts, 2 in de ochtend, 3 in de middag
- De ePV's kunnen niet een hele dag op 1 accu, hij gaat zo'n 3 trips mee.
- Er wordt bijgeladen op de hub als een trip kort uitvalt
- Over het algemeen wordt altijd tussendoor bijgeladen als het kan
- De routes worden gepland op basis van het batterijpercentage van de ePV
  - Het laden wordt meegenomen in de planning
  - Met het laden zijn momenteel weinig problemen
  - Nu wordt er 1 fase, 16 amp, 2-3kW geladen, de hele nacht door
  - Een vrije shift gebruiken om bij te laden levert 30% accu op

Inladen van de ePV en opladen kan niet tegelijkertijd
De ePV heeft een AC/DC converter, die ook bi-directioneel laden mogelijk maakt. De Hubs zijn zoveel mogelijk energieneutraal.
De afweging voor het onwikkelen van een slimme laadoplossing ligt vooral in de balans tussen de kosten van een bepaald formaat accupakket en de kosten voor laadpaal infrastructuur
Gelijkvloersheid is door de stellingen met wieljes die in de ePV's worden geladen met een schaarlift essentieel in de ruimtes
PicNic's service draait om klanten blij maken, bezorgen is groot deel van klantervaring
Bij het design van de ePV is uiterlijk het grootste concern, het aanzicht van de ePV moet vriendelijk zijn, het is het uithangbord
Het uiterlijk van de ePV is van grote invloed op de herkenbaarheid, reclame en klanttevredenheid
Op het moment rijdt de ePV maximaal 50km/h, in de toekomst 80km/h (op N-wegen)
- Er komt meer focus op regionaal bezorgen, metropoolgebieden rondom grote steden
- Voor communicatie wordt CANbus gebruikt, nieuwste versie obd2 voor communi catie met monteurs
  - Dit gebeurt via 4G simkaart
- De nieuwe ePV (eigen design PicNic) gaat in een nieuwe voertuigcategorie vallen, en krijgt meer kreukelzone

DESIGN FOR our future

TU Delft

IDE Master Graduation

Project team, Procedural checks and personal Project brief

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

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

USE ADOBE ACROBAT READER TO OPEN, EDIT AND SAVE THIS DOCUMENT

Download again and reopen in case you tried other software, such as Preview (Mac) or a webbrowser.

STUDENT DATA & MASTER PROGRAMME

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

family name: Meer, van der
initials: S.R. given name: Stan
student number: 4287886
street & no.:
zipcode & city:
country:
phone:
email:

Your master programme (only select the options that apply to you):

IDE master(s): (x) IPD ( ) DfI ( ) SPD
2nd non-IDE master:
individual programme: - - (give date of approval)
honours programme: ( ) Honours Programme Master
specialisation / annotation: ( ) Medisign ( ) Tech. in Sustainable Design ( ) Entrepeneurship

SUPERVISORY TEAM **

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

** chair: Heur, van, R.J.H.G. dept. / section: HCD/AED
** mentor: Dommelen, van, S. dept. / section: SDE/KInD
2nd mentor: Nispen, van, C.
organisation: TILER Charge (Fesla Charge B.V.)
city: Delft country: The Netherlands

comments (optional)

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

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

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

TU Delft

Personal Project Brief - IDE Master Graduation

Developing a universal charger for commercial cargo LEV's for TILER — project title

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

start date 15 - 02 - 2021 02 - 07 - 2021 end date

INTRODUCTION **

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

Tiler is developing the world's first wireless charging solution for e-bikes using induction technology, in the shape of an outdoor pavement tile. Their goal is to realise a seamless travel experience and be part of an emissionless infrastructure in cities. Their mission sparked from an academic project at Delft University of Technology in 2019 and the team is now located at the Yes!Delft incubator, surrounded with other start-ups. (Tiler Charge, 2020)

The current focus of the company is to further develop their functioning prototype, consisting of the charging tile and accompanying kick-stand for regular e-bikes to move into the production phase in the coming year. Their charging solution works together seamlessly with the industry leading e-bike propulsion platforms from Bosch and Bafang, which account for a large share of e-bikes sold in 2020.
Simultaneously, Tiler is looking for alternative areas in which to implement their unique technology. The aforementioned e-bike propulsion systems are nowadays applied in a wide range of vehicles, ranging from speed pedelecs (45km/h) to commercial service vehicles. The charging technology therefore has a large potential outside of the current scope to be explored still. A projection of the possibilities is displayed below (figure 1).

As the transition towards electric mobility is evolving, the mobility sector is attracting new attention from players from different sectors. In the coming years large tech corporations such as Apple, Google, Samsung and Amazon, amongst others, are expected to make their entrance to the mobility industry (Perlow, 2021), likely resulting in a flood of new technologies and expertise. With the development of autonomous driving, electric vehicles are becoming the new data sources, making use of their sensory and edge computing capabilities while providing a seamless experience to the user. Additionally, car manufacturers are venturing into the LEV-sector as well in order to defend their market share in the increasingly car-shy city centers. All in all, wireless charging is expected to play an important role in the development of the electric infrastructure, therefore attracting new players to the scene.

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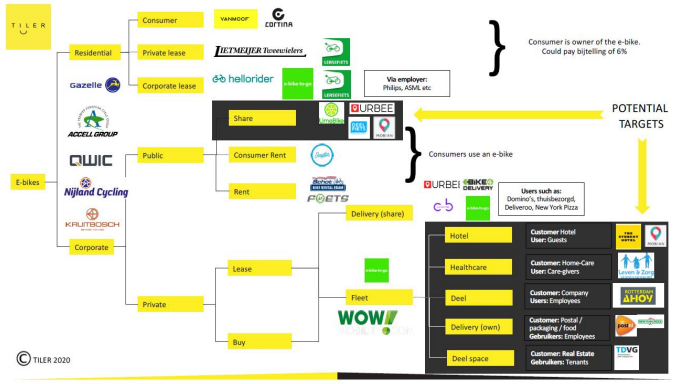

image / figure 1: Tiler's current scope of potential targets

image / figure 2: Example of a future urban mobility vision (Bike Europe, 2020)

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PROBLEM DEFINITION **

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

City centers are becoming increasingly clogged up with space-inefficient and air-polluting cars. The transition towards more efficient, versatile and clean means of transport has started, however hasn't taken over urban transport by storm yet. A significant part of mobility in cities consists of commercial transport, which yields interesting potential. The use of electric vehicles for delivery, retail and service purposes opens the opportunity to think about the urban infrastructure of the future, in which small electric vehicles could have a large responsibility (an example is provided in image 2). The shared interest of Tiler, TU Delft and myself to accelerate the implementation of this type of mobility stimulates said parties to be involved in the development of a charging infrastructure for these vehicles.

Examining the possible role of wireless charging in this context should result in a concept design focused on an intuitive and hassle-free user experience for employees operating LEVs, in order to make electric vehicles more attractive for corporate fleets. Sustainability-wise, the reduction of emissions by electric vehicles may be clear, but the impact of wireless charging technologies should be assessed. A fair consideration regarding energy efficiency, material use and recyclability throughout the life-cycle of different charging technologies is necessary to defend the implementation of induction charging.

ASSIGNMENT **

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

In this project the current & future use of urban electric cargo vehicles will be explored in order to develop a concept product for the commercial domain using the TILER wireless charging technology.

Firstly, I will research the changing infrastructure, upcoming technologies, regulations and trends in order to shape a Vision for Urban Freight Transport in 2031. This vision will display the complete cycle of use throughout the day, for vehicles made to transport small freight (68 kg minimum capacity, (FedEx®, 2021)) with varying movement patterns (Otten, M., 2019). This vision will showcase the use of light electric cargo vehicles (LECV's) in the industries of retail, catering, service logistics, mail & parcels and their place in the changing context of the urban environment.
Secondly, a product roadmap will be proposed, translating the Vision 2031 into a concrete strategic pathway in order to develop a unique selling proposition (USP) in the rapidly developing market of mobility. This multi-stage approach will facilitate the penetration of Tiler into this new market and ensures a steady, durable position over time. The roadmap could contain four layers; Technological developments, major and upcoming players in the market, projected developments in the context of urban transportation and lastly, the role of the product. The roadmap will entail a staged approach, using defined time-frames (horizons) in order to identify essential product properties in each stage.
Thirdly, deriving from this, I will develop a universally applicable charging concept for Tiler to be implemented in Horizon 1. The main goal of this solution is to lower the threshold for transforming commercial fleets of vehicles towards electric by facilitating an automated charging experience, while at the same time optimising for a low ecological footprint through its life-cycle. The proposed solution will serve as a business-case for penetrating the market of wirelessly charging LECV's in the commercial semi-public and private domain.

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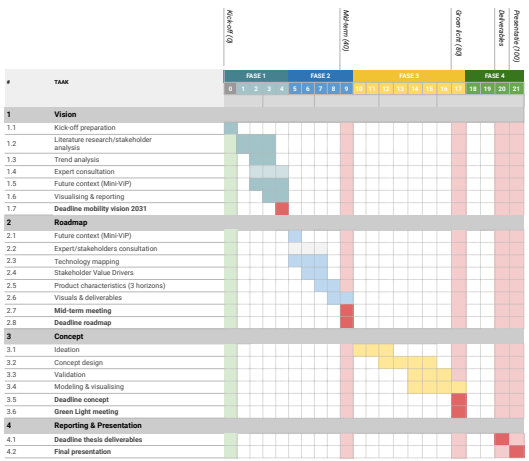
TU Delft

PLANNING AND APPROACH **

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

start date 15 - 2 - 2021 2 - 7 - 2021 end date



The project planning is divided in four phases; Vision, Roadmap, Concept and Finalising. Since the activities during the concepting phase are dependent on the outcomes of the vision and roadmap phases, the activities during phase 3 are still indefinite yet. The essential dates (under precondition) for meetings are planned as follows:

Feb.12th: Kick-off
March 12th: End of phase 1
April 12th: Mid-term meeting
April 16th: End of phase 2
June 11th: Green-light meeting & end of phase 3
July 2nd: Final presentation

A full print of the project planning should be attached with this document.

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TU Delft

MOTIVATION AND PERSONAL AMBITIONS

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

The driving force for setting up this project is the enthusiasm for mobility and the stubborn optimism in believing that we can shift to sustainable modes of transport in a short timespan. Seeing how big corporations and governments are slowly but steadily changing their course and investing in a clean future of mobility is triggering me to be a part of this movement. I think we are getting closer to a tipping point at which this transition could quickly accelerate, proposing exciting challenges to designers to give shape to this new infrastructure in many different ways.
Looking back on the projects and courses I followed during my masters and bachelors at IDE, TU Delft, I've acquired a set of skills and a methodological mindset which I'm excited to apply during this final project; People in Transit, Vision in Product (ViP) and Advanced Concept Design (ACD) to name a few. Having a critical look on sustainability aspects in projects is essential to stay on track towards a better living environment in the future. The combination of giving shape to a future context and proposing an accompanying concept design to support it is something that in hindsight occurred often during the projects I've done.

Sources (in order of appearance)

Tiler Charge (2020) Retrieved from: https://tilercharge.com/nl/

Perlow, J. (February 4th, 2021) "2024 will be the year Apple and Amazon release us from our automotive prison". Retrieved from: https://www.zdnet.com/article/independence-day-well-be-prisoners-of-our-cars-no-more/

Bike Europe (November 11th, 2020) "Exploring the e-bike of the future: 9 trends" Retrieved from: https://www.bike-eu.com/market/nieuws/2020/11/exploring-the-e-bike-of-the-future-9-trends-10139163

FedEx® (2021) "Freight Shipping" Retrieved from: https://www.fedex.com/en-us/shipping/freight.html

Otten, M. (August 2019) "Charging infrastructure for electric vehicles in city logistics" Retrieved from: https://www.cedelft.eu/en/publications/2356/charging-infrastructure-for-electric-vehicles-in-city-logistics

FINAL COMMENTS

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