MEGO

Modular mobility

Master thesis
Integrated Product Design

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Master Thesis
Mego: Mobility for redundant individuals in 2025

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Executive Summary

Everyone can, to a certain extend, imagine what the future of transportation holds; delivery drones, high-speed trains and autonomous vehicles that will provide us with the experience of having a private chauffeur. One of the shared characteristics between these concepts of future mobility; is that they improve efficiency, e.g. when we can let go of the steering wheel, the time gained can be spend to send out one last e-mail or have a more social commuting experience. Developments in the light rail industry like the Hyperloop concept improve time efficiency, and therefore allow us to arrive at our destination much sooner than before. Yet, comfort, quality time and time efficiency are not the only concerns when it comes to mobility. New challenges manifest themselves, and my initial goal has been to understand the active role mobility could play to solve the challenges that we will meet in a future scenario. To specify the scope of this project I decided to choose Amsterdam as the domain in the year 2025. To generate a future vision that includes factors that are relevant to the domain, a context based analysis has been conducted. The methodology that has been used is the Vision in Product Design (ViP) methodology. ViP supports the designer in creating a future vision by including relevant context factors. This has resulted in retrieving six factors that are of significance to the domain. These factors have become the ingredients for the future vision and are: automation of jobs, product service systems, gentrification, introduction of a Low Emission Zone in Amsterdam, flexible working and the sharing economy. These factors describe demographical-, socio-economical and technological phenomena, and are relevant to the described domain. The title for the future vision is the road to self-redundancy, and describes a transition from a centralized economic system that labels private property as success to a decentralized system of collaborative commons. These phenomena will eventually affect us all, but especially phenomena that are of socio-economical nature will affect the low social class of society first. Automation appears to make people lose purpose especially those with a lower income. It is necessary to secure these individual's positions in society, i.e. provide a purpose. This study concentrates on how mobility can mediate in this transitional process where jobs are made obsolete via automation. This thesis therefore concentrates on how mobility can mediate in this transitional process where jobs are made obsolete via automation.
The mission is to create a mobility concept that incorporates the recognized phenomena and provides the low-schooled of society with flexibility and the opportunity to generate an income by using the product to provide services, in Amsterdam. The outcome has become a shared product service system, named Mego. Mego consists out of an online marketplace, a hub network and scooter. This system is based on the premise that individuals should be given the opportunity to become autonomous and self-providing by earning an income on a flexible basis. This objective has been translated into an electrical modular cargo scooter. The scooter itself has been designed with as dominant design factor transporting cargo. This has influenced the design from the bottom up and resulted in a new archetype of scooter. Mego enables its users to transport different types of cargo due to the concept of modularity.
By using the scooter as a cargo transporter, individuals are enabled to generate an income by working for different types of service providers, like in the parcel and food delivery industry.

This report follows the structure of the ViP methodology and consists out of four phases; the goal of phase one is to construct an image of relevant developments and factors. The second phase aims at making sense of the revealed phenomena and link them to mobility, the third is to translate the findings in a relevant mobility concept and the final step consists out of detail design and a reflection and discussion of the outcome.

Content

Introduction 12

1.1. Methodology 14-15

1.1.1. Formulating the domain 14
1.1.2. Deconstruction 14
1.1.3. Exploring the future 14
1.1.4. Clustering and future vision 14
1.1.5. Mision statement 15
1.1.6. Interaction 15
1.1.7. Qualities and characteristics 15

1.2. Strategic framework 16-17

1.2.1. Significant factors 16-17

2.1. Making sense of the present, and the future of urban transport 18-23

2.1.1. Physical context 19
2.1.2 Low Emission Zone 19
2.1.3. On the road with a helmet 19
2.1.4. User 21

3.1. Discovering opportunities 24

3.1.1 Qualities & characteristics 24
3.2.1. The Scooter - Product level 24
3.2.2. The Scooter - Interaction level 25
3.2.3. The Scooter - Context level 25
3.3.1 The Segway - Product level 25
3.3.2. The Segway - Interaction level 25
3.3.3. The Segway - Context level 25-26
3.4.1. The electric bicycle 26
3.4.2 The electric bicycle - Product level 26
3.4.3. The electric bicycle - Interaction level 26
3.4.4. The electric bicycle - Context level 26
3.5.1. Conclusion 26

4.1. Collecting relevant factors 28

4.1.1. Domain 28
4.1.2. Domain as scope 28
4.1.3. Clustering 28

4.2. The road to self-redundancy 29-41

4.2.1. The individual in the centre 39
4.2.2. Industrial Revolution synonym for more labour? 30
4.2.3. The want for more 34
4.2.4. The meaning of work: Work to live or living to work 34
4.2.5. Replaced by robots 34
4.2.6. Source of purpose 34
4.2.7. Non-consecutive path 34-36
4.2.8. A sustainable future 36
4.2.9. Growing awareness 37
4.2.10. Moving to a sharing economy 37
4.2.11. Sharing industries 37
4.2.12. Passing on the baton 38
4.2.13. Incentive to share 38
4.2.14. The 5 minute city 39
4.2.15. The purpose of mobility 39-40
4.2.16. New way of working 40
4.2.17. Vision conclusion 40
4.3.1. Studying the domain: The Netherlands and Amsterdam 42
4.3.2. Creating a well functioning organism 44
4.3.3. Amsterdam - Smart city 44
4.3.4. Traffic in Amsterdam 44-45
4.3.5. Creating space, quality and efficiency 45-46
4.3.6. Public transport 46
4.3.7. Gentrification 46
4.3.8. Urban districts 47-47
4.3.9. Conclusion 47
4.4.1. Effects on Amsterdam 48
4.4.2. Gentrification unique to Amsterdam? 48

5.1. Statement 50-55

5.1.1. Postion in society 50
5.1.2. A shift in the diffusion of innovation 50-51
5.1.3. Alternative offerings of mobility 52

6.1. Interaction 56-59

6.1.1. Product qualities 56-57

7.1. Three levels: network, market-place and product 60-68

7.1.1. Modular mobility 61
7.1.2. The ecosystem 61
7.1.3. Marketplace 62
7.1.4. Network type 65
7.1.5. Network design 66
7.1.6. Difference with existing sharing services 68
7.1.7. Shared system - hypothetical usage 68

7.2. Business model 69

7.2.1. Incentives to use Mego 69
7.2.2. Revenue model 69

8.1. The product 70-77

8.1.1. Conceptualisation 70
8.1.2. Ideation 70-72
8.1.3. Introducing Mego 73
8.1.4. Form hierarchy model 73
8.1.5. Platform & segment 73
8.1.6. Form language 73
8.1.7. Detail design 73-74
8.1.8. Colour & trim 74
8.1.9. Design 77
8.2.1. Main adjustments 81-83
8.2.2. Handlebar 84-85
8.2.3. Headlight 86
8.2.4. Side mirror 88
8.2.5. Rim design 89
8.2.6. Footstep 90
8.2.7. Conclusion Detail Design 93
8.2.8. Colour scheme 93
8.2.9. Dimensions 95
8.2.10. Embodiment design 96
8.2.11. Battery pack 96
8.2.12. Cargo module 97-98
8.2.13. Cargo module design 98
8.2.14. Helmet 99
8.2.15. Steering concept 100
8.2.16. Charging hub 101
8.2.17. Wireless charging applied to Mego 102

9.1. Individual and collective benefits 104

9.1.1. Scenario 105
9.1.2. Scenario 1 106
9.1.3. Scenario 2 107

Evaluation 108

Reflection 110

Recommendations 111

Glossary 116

Appendix

Appendix A - History of the scooter
First generation 1915-1930
Brand image & identity
Second generation 1936-1968
Brand image & identity
Third generation 1946-1964 and beyond
The Mods
Brand image & identity
Modern era 2017 - and beyond
Appendix B - Scooter Historical timeline
Appendix C - Delft Product Innovation Method
Appendix D - Case studies
Sinclair C5
Conclusion
BMW C1
Conclusion
Witte Fiets
Conclusion
SMS
Conclusion
Mini disc
Conclusion
Conclusion Case studies
Appendix E - Strategies
Commercialization of innovation
Horizon 2020 - Valley of Death
MAYA
Conclusion
Appendix F - ViP process
Appendix G - Transcript of records
Appendix G2 - Transcript of interview Luud Schimmelpennink, 2017, De Witte Stad.
Appendix H - Amsterdam Thermometer van bereikbaarheid 2016
Appendix i - Uitkeringen p.187 - Amsterdam in cijfers 2016
Appendix j - Battery pack argumentation and calculation
Appendix k - Modal split - gemeente Amsterdam 2013
Appendix L - Business model
Appendix M - Amsterdam developments
Appendix N - Most popular professions that require a low education
Appendix O - Transcript of records Municipality of Amsterdam Joyce Zwaan & Lizann Tjon 20-02-2017
Appendix P - Highest completed level of educational
Appendix Q - Dimensions Primary and Secondary coil
Appendix R - Increase in registered scooters
Appendix S - Letter sent to scooter owners in Amsterdam by municipality
Appendix T - Stint & Urban Arrow
Appendix U - Comparison: scooter ownership vs shared use

“In order to design a future of positive change, we must first become expert at changing our minds” Jacque Fresco

Introduction

Both my bachelor and master program have revolved around transportation design. During my studies at the faculty of Industrial Design Engineering at the Technical University of Delft, I have participated in automotive classes ranging from strategic analysis to design. I studied automotive design at the School of Art and Design in Coventry, and I have been fortunate enough to do my internship at the Daimler Brands studio in Böblingen. With my genuine passion for transportation design, it was therefore clear from the start that this thesis would focus on mobility related challenges.

The purpose of this thesis is to act as a springboard to start a new company in transportation design, and has therefore not been conducted based on an assignment provided by a third party. The objective has become to create a concept based on a thorough contextual analysis. A second objective has become to accumulate the network that would enable me to continue to work on this project, even after finishing my studies at the Technical University of Delft.

As there was no assignment or brief, I used the Vision in Product Design methodology (ViP), by P. Hekkert and M. van Dijk, to add structure to the project and generate a mission statement. ViP is a context driven design methodology, which is used to analyse phenomena and create a future vision. One of the first objectives of ViP is to specify the domain that the product will be used in. The domain consists out of two segments: the environment and the intended user of the product. Having lived all my life in Amsterdam, made me decide to choose Amsterdam as a domain and study the contextual developments. The goal has been to recognize challenges where mobility could potentially provide a solution. The initial literature study that focused on mobility in Amsterdam, present day, indicated that the municipality would be introducing a Low Emission Zone (LEZ) in 2018, and that scooters that were allowed on the bicycle lane would be moved to the main road. These phenomena affect scooter owners today, yet the product should provide a long-term solution rather than only solving today's challenges. Therefore the intended timeframe has become 2025, to address both today's and tomorrow's challenges. As the context and timeframe have been determined the unknown factor is the intended user.

The first phase of this report aims to create an understanding of the current context and collect influencing factors to create a profile of the future user. In this phase the challenges with regards to scooter usage in Amsterdam will be analysed and the products that are currently available in the same domain will be deconstructed to create an understanding of why they have been designed the way that they have.

The ViP methodology is based on the premise that products influence and are influenced by the context in which they are used. These can be factors of socio-economic, demographic or technological nature. Therefore the second phase of this report describes the process of collecting factors that are relevant to the future context. Transportation is not limited to the mere urge for displacement, it is dependent on many factors; like social behaviour, employment, urbanization, and describes an emotional experience. When someone uses a mode of transportation to travel to his or her work the economical factor of earning an income dominates the requirement of displacement, thus when someone loses his/her job that specific need for displacement is also lost. In order to establish a successful product; the future context needs to be understood, and factors that are of potential impact on the product, in that context, should be included (Hekkert, P., & Dijk, van, M.,). The ViP methodology provides a guideline in collecting these factors and helps to create a structure and eventually results in formulating the mission statement.

Six phenomena have been allocated as most significant to the domain. The combination of these six phenomena became the ingredients of the future vision, which eventually has led to the formulation of the mission statement. The future vision that has been created, appears to describe an environment that is beneficial to a greater part of Amsterdam, but when taking a closer look one understands that these developments mainly benefit inhabitants with a high educational background and/or high income. This resulted in the question; what are the socio-economic perspectives for those that are financially less well off, and how could they benefit from future transportation, to remain relevant in a future economic environment?

1.1. Methodology

This thesis is structured according to the methodology that has been used. For the reader to create an understanding of the logic and objective of working with this methodology the following will provide a brief introduction. The methodology on which the structure of this report is based is the Vision in Product Design (ViP) method by P. Hekkert and M van Dijk. ViP is a context driven approach and supports the designer to create a mission statement by following six steps. The methodology is based on the idea that the success of a product innovation depends on the quality of its interaction within the context. It therefore provides a tool for the designer to generate a vision and a product or service with a well-funded reason of being. This thesis was not started based on a provided design brief, therefore the methodology has been slightly altered to fit this thesis better.

1.1.1 Formulating the domain

The objective of ViP is to formulate a mission statement that encapsulates the goal of the product to be designed, i.e. what challenge needs to be solved. Prior to formulating the mission statement several steps need to be taken. The first step is to formulate the domain. This is formulated as the physical context that the product will be placed in, and whom will be using it. During ViP the domain is used to as a scope; expanding the horizon while providing boundary conditions.

1.1.2 Deconstruction

The second step is to explore what products currently exist in the present context. Can these products solve the future challenges in the chosen domain, or is a new alternative required? This phase helps the designer to understand the reasoning of why an existing product has been designed the way it has, and what characteristics and qualities contribute to its success. This is conducted on a product-, context-, and interaction level.

1.1.3 Exploring the future

After clearly establishing the domain the following step is to collect context factors. These context factors are value-free descriptions of world phenomena that are of relevance to the domain (Hekkert, P., & Dijk, van, M., P.141, Vision in Design, A Guidebook for Innovators). According to the ViP methodology these factors can be divided in to four different kinds, based on the timespan of relevance. Within the ViP methodology there exist four different types of context factors, namely: developments, trends, principles and states. The main difference between the four is the time span of significance. Within these four categories, the factors themself can be of different natures, e.g. financial, demographical, technological, cultural etc. A more elaborate meaning of the context factors, as described in the ViP methodology, can be found in the image below (Hekkert, P., & Dijk, van, M., Glossary, Vision in Design, A Guidebook for Innovators).

1.1.4 Clustering and future vision

The retrieved factors have to become the ingredients for a future vision, but before formulating a story the ingredients need to be clustered. The objective of clustering the individual factors in to groups is to create a clearer overview, without losing the strength and originality of the individual factors. At this point links between the clusters can be recognized and should provide insights on the future vision in the created domain

1.1.5 Mission statement

The future vision that has been formulated based on the retrieved context factors should tell an objective story that has not been complemented or mixed with the designer's opinion. The subjective perspective of the designer is required after establishing the vision by formulating a mission statement. The mission statement is the designer's response to generated vision, and addresses one or more challenges that have been uncovered.

1.1.6 Interaction

The following step describes formulating the desired interaction between product, context and user. ViP is based on the premise that human behaviour can be influenced. The goal of the product to be designed is embedded in the mission statement, and the interaction acts as a means to achieve this goal. For the potential success of a product innovation it is therefore key to specify and conceptualize the desired human-product interaction.

1.1.7 Qualities and characteristics

The final step in ViP, before designing the concept, is to formulate the product qualities and characteristics. The purpose of the qualities and characteristics is to support the desired interaction, to achieve the goal embedded in the mission statement.

Before immersing in the ViP methodology it is important to understand whether the adoption of a new product innovation is also dependent on other factors than the interaction with the context and user. If these exist, in what stage of the innovation process do these factors occur. This will be discussed in the following paragraph.

Meaning Context factors

Developments
Changing or unstable pattern in the environment or in the concerns of people in general. Developments can refer to technological, economic, societal, environmental, cultural, etc. changes in the world around us.

Trends
Trends are reflections of developments in human behaviour and can also be considered as factors in a context.

Principles
The more or less stable patterns in life, from physical and biological to social and psychological; they can be laws of nature and - most often - fundamental human concerns or patterns of behaviour.

States
Refers to phenomena that appear as fixed, but do not need to be so in the long run.

1.2.1. Strategic framework

The ViP method is based on the premise that user, product and context interact with one another and that the success of the product depends on the quality of this interaction. Yet, are there more factors that contribute to a successful adoption of novel product innovations, and at what stage of the innovation process do they occur? To provide an answer to this five case studies have been conducted based on products of a variety of industries. The products that have been selected are the BMW C1, SMS, Mini disc, Witte fiets and the Sinclair C5.

To structure this process, and understand at what stage during the innovation process products tend to fail or succeed the Delft Innovation Method (DIM) has been used. The DIM helps to provide people who are going to be involved in an innovation process. It is a roadmap of what steps and actions need to be executed. It puts the company in the middle of a hostile environment of the consumer market and competition, and considers what is inside or outside the control scope of the company (Buijs, J., 2012). According to the DIM there are four phases during the product development process: the Fuzzy Front End of Innovation, New Product Development, Muddy back End, and finally the product use (Appendix C). During all four phases maintaining a dialogue between the company and environment are necessary to test decisions and note how the market responds to these changes. The process of research, conceptualisation and product development are phases that, when conducted best for that particular product, contribute to potential success. After that comes market introduction, which can make or brake a product. Yet products that seemed to share great potential, failed in hindsight. What factors influence the success or failure of a product? The four phases of the DIM have been used as a framework. Factors based on theoretical and empirical literate studies, describing the potential success or failure of a product innovation, have been integrated in this framework and five product innovations have been tested based on these factors. The goal is to conclude what factors contribute most to the success of a product. This will be used as an input for the following phase and to review the generated ideas. Appendix D provides an overview of the strategies. Due to differences in terminology and approach the factors have been discussed separately.

1.2.2. Significant factors

It can be concluded from the literature research, that one of the main contributors to the market acceptance and success of new product innovations is to understand socio-economic developments and communicate with the stakeholders. These factors can be abstracted to an interaction level, which is the premise of the ViP methodology. Based on the conducted case studies it can however also be concluded that not only a positive interaction between context, user and product should be established, but that a designer should also interact with the stakeholders during the fuzzy front end of the innovation process. According to the case studies the biggest contributor to the success or failure of a product innovation is understanding and communicating with the context, and understanding the socio-economical developments that shape the context. This takes place in the Fuzzy Front End of innovation in the Delft Innovation Model. As can be concluded from some of the examples the product did not fit the context, or the required infrastructure was not present. As can be seen in the example of the Mini disc; standardization contributes to market acceptance.

"The adult public's taste is not necessarily ready to accept the logical solutions to their requirements if the solution implies too vast a departure from what they have been conditioned into accepting as the norm."
- Raymond Loewy

Another factor that resulted to contribute in a significant manner is the MAYA principle. Designing according the principle of Most Advanced Yet Acceptable (MAYA) means that any type of future design innovation should deliver the future gradually (Dam, R., 2016). This can be achieved on different levels and does not only apply to product design, but also for learning new skills in general. The Danish philosopher Søren Kierkegaard stated; that when you want to teach someone a new skill, you need to know what the individual's present skill level is. When introducing a new product, intermediate steps can be introduced on the road towards the future concept. On a detailing level this can be achieved by using familiar use cues, patterns and colours. A golden rule is that if you have to explain your product design and if you need to include a manual or elaborate "help" features, your product is overly advanced or too complex to use. When the product is too complex users will lose confidence in themselves and the product, and will potentially lead to a failed product (Dam, R., 2016).

The MAYA principle was not properly applied in the cases of the Sinclair C5 and BMW C1, as individuals were not able to categorize the product. When introducing a new product innovation the market will search for an existing product that comes remotely close, and use this as a benchmark to judge the new product. When it operates or handles inferior to that what we already know that the product will be viewed as inferior as a whole. This resulted in the C1 being viewed as a heavy scooter with a headliner or motorcycle with poor performance and the C5 as a very unsafe car. The same phenomenon caused the range anxiety in electric cars. The same principle was/is one of the factors that limits the electric cars from gaining in popularity. Unlike vehicles with an internal combustion engine (ice) the range of an electric vehicle is "limited", therefore it is seen as inferior to that what already exists in the market.

SMS technology clearly is the winner and can be used as a benchmark to get an understanding of which factors are most important for success. This does require mentioning that SMS was not successful from the start, as when it was first introduced almost no one was using the service. Only when the providers were able to provide the required charging system and infrastructure it was accepted by the majority of society. The factors where SMS performed well and all other technologies poorly are; understanding of domain and future social context, strategic timing, positioning, competitive pricing, interaction with the customer and customer acceptance. All these factors have in common that they are context and user dependent. The market needs to understand the product as well as value it. This is achieved by strategically positioning it in the market and providing information about the potential, and create desire.

These case studies indicate that the success or failure of a new product innovation is mainly due to the understanding of and communication with the context and users that the product will be used in and by. This is the exact premise on which ViP is based, and in ViP this is referred to as the domain.

The following step will focus on the first step of ViP; establishing the domain by specifying the context and the intended user.

Strategy	Technological development				
	BMW C1	SMS	Mini disc	Witte Fiets	Sinclair C5
Fuzzy Front End of Innovation					
Core dependent on developments instead of trends					
Understanding of domain and future social context					
Sufficient technological research					
Design according to MAYA					
New Product Development					
Strategic timing					
Market research and communication					
Partnerships - aliances					
Standardization					
Muddy Back End					
Positioning					
Distribution					
Competitive manufacturing					
Competitive pricing					
Product Use					
Interaction with customer					
Customer acceptance					

yes
no
not applicable

Table: Strategies vs technological developments

2.1. Making sense of the present, and the future of urban transport

The objective of this phase is to explore the two contextual phenomena that have led to starting this thesis, and choose the intended user to formulate the domain.

For this thesis I decided not to graduate for an existing company, but rather utilize this graduation project as a springboard to start a new company. I started this project with the knowledge that the municipality of Amsterdam will introduce a Low Emission Zone, and has submitted a bill; which states that all scooters should be prohibited from using the cycling lane and drive on the road instead. It has been assumed that this will require significant changes and challenges will arise in the process, making room for new product innovations. The first step is to formulate the intended user and the environment that the product will be used in, this is referred to as the domain in the ViP methodology. The objective of the domain is to inspire and broaden the perspective of the designer, while providing boundaries for the following step; collecting context factors.

Image: Amsterdam

2.1.1. Physical context

According to ViP a product receives its value and meaning through the context it is used in. To design a product for a future scenario, it is therefore important to specify the context and study it today to recognize challenges and opportunities. Therefore the physical context of thesis should be known from the start. Having lived all my life in Amsterdam, and experiencing its congestion challenges personally, it was decided that Amsterdam would be the appropriate context to start this thesis with. It has been chosen to design for 2025, as it is assumed that this will result in a product that addresses both today's and tomorrow's challenges. To specify the intended user research has been conducted on what phenomena will directly be effecting the scooter. This has led to two phenomena; the introduction of the LEZ and the mandatory wear of a helmet and the ban of scooters driving on the cycling lane.

2.1.2. Low Emission Zone

There are over 60.000 scooters registered in Amsterdam (iamsterdam.com). On June the 22 2016 the Dutch government decided to introduce a Low emission zone (LEZ) in Amsterdam, based on the increased air polution in the city (Gemeente Amsterdam, 2017). As a result of the LEZ scooters with a date of first admission before the first of Januari 2010 will be prohibited from entering the entire city of Amsterdam, starting from the first of January 2018 (amsterdam.nl-2). According to the Dutch department for road transport this means that 40.000 scooters, currently being used in Amsterdam, will not be allowed to enter the city centre anymore (scooterbelang.nl-3). For the coming years scooters that comply with the new legislation will be allowed to enter the city, yet the final objective has become: an emission free city by 2025 (parool.nl, 2016). This means that all vehicles with a combustion engine will be prohibited from entering the city.

The objective of the municipality is to enhance the air quality by prohibiting older, and often more polluting vehicles. As in 2017 the NO2 particle count has been monitored, in many streets, on average exceeded the maximum European value of 40 µg/m3 (ggd.amsterdam.nl). The image on the following page shows that the LEZ is not only limited to the historical centre but covers the entire city. In fact, the LEZ for the scooter is significantly larger than other modalities like trucks taxis or passenger cars.

2.1.3. On the road with a helmet

The Netherlands is one of the few countries in Europe that allows people to drive on a scooter without wearing a helmet (Schoon, C., 2004). These scooters are limited to a maximum speed of 25km/h, and are often allowed to drive on the cycling lanes. According to (Appendix O) these scooters have become increasingly popular in Amsterdam, due to the increased parking costs associated with owning a car. One of the qualities is that these type of scooters are allowed to be used on the cycling lane, without the mandatory use of a crash helmet. Yet, it appears the 25km/h scooter will lose these qualities due to the amount of accidents involving these vehicles (amsterdam.nl). The municipality has filed a bill that states that wearing a helmet should become mandatory and all scooters should be banned from driving on the cycling lane. While writing this thesis it is still unclear when this legislation will be approved and introduced. Besides Amsterdam, other cities in the Netherlands are also considering the introduction of this new legislation. In fact, according to a small-scale research conducted by the environmental defense, 9 of the 20 largest municipalities in the Netherlands are seriously considering a total ban of the 25km/h scooter (scooterbelang.nl-4). The Amsterdam department of the D66 is pro a complete ban of the this vehicle, and wants to include their proposal in the national program (scooterbelang.nl-2).

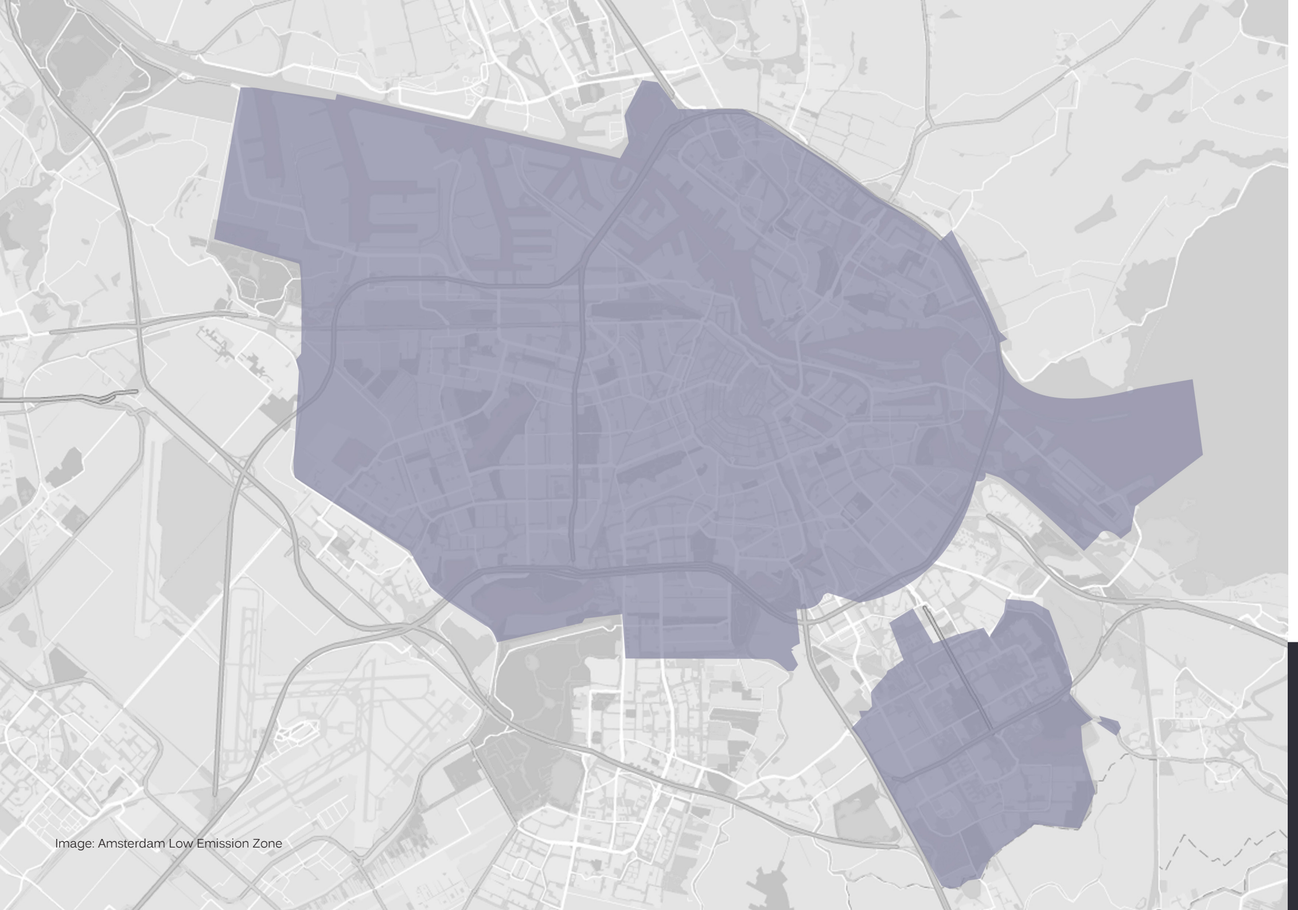


Image: Amsterdam Low Emission Zone

2.1.4. User

Based on the measured concentrations of fine dust in streets in Amsterdam, initiatives should be started to improve the air quality and living experience. One of the initiatives is the introduction of a Low Emission Zone (LEZ). This zone is introduced to exclude vehicles of a certain age, or have been classified as polluting from entering the city. The LEZ affects owners of all types of vehicles; passenger cars, lorries, taxis and scooters as well. Those who own a scooter that has been classified as too polluting have therefore lost the right to enter the city with their scooter. To compensate for their loss; a financial compensation will be offered to these inhabitants by the municipality (Appendix G) Yet, not all scooter owners that are affected by the LEZ can expect a compensation. The compensation will only be offered to inhabitants owning a CityPass, with a green dot. The CityPass exists to financially support registered inhabitants of the lower social class in Amsterdam. The requirements for receiving a CityPass with a green dot is that you earn a combined income below 120% of the minimum income and have a low financial capital (amsterdam.nl-3). According to the municipality there are 2300 inhabitants that comply with the compensation requirements (Appendix G). This means that of the 40.000 scooter owners that lose the right to enter the city with their scooter 5,75% will be offered a financial compensation. The options that are offered to those that are entitled to receiving a compensation are listed in the image below.

According to (Appendix O) inhabitants with a lower educational background and income will be affected most by the introduction of the Low Emission Zone. The reason for this is because they are often dependent on less expensive, older and more polluting vehicles. There does exist the opportunity to apply for an exemption, yet it remains a question whether the individuals that are affected by this new legislation will understand their rights and approach the municipality with their concerns (Appendix O) This argument is supported by the number of individuals that have been offered a compensation, and the number of individuals that has responded to the offer. On the 14th of November 2017 the municipality of Amsterdam communicated that 60 of the 2300 inhabitants have applied for a compensation, of which 80% has decided to accept funds to purchase an electric scooter (Appendix G). According to the municipality; forcing all scooter drivers to wear a helmet and drive on the road will result in fewer accidents involving the scooter (amsterdam.nl-2). An additional challenge is that the maximum speed on the road differs with the maximum speed of the 25km/h scooters, namely 45km/h in urban environments. Therefore scooters with a maximum speed of 25km/h will need to be tuned and re-registered as a 45km/h scooter, and the owners are forced to purchase a helmet. It is yet unclear by whom these costs will be covered. It can be concluded that it are those with fewer financial resources and lower educational backgrounds that will be affected most by the introduction of these changes. The municipality admits that the offered compensational options do not fully cover the purchase of a new vehicle, and the owner himself is therefore required to bridge the difference in price (Appendix G). When you are depending on a limited budget that can already become a limiting threshold. Based on the two described phenomena, and the assumption that this will influence inhabitants with a lower income and/or educational background it has been decided to complement the context of Amsterdam in 2025 with the user; low income individuals. The combination of the physical context and the intended user allow for the formulation of the domain:

"Mobility for individuals with fewer financial resources, living in urban environments in 2025"

Based on the two phenomena it has been concluded that this thesis will focus on the relationship between low-income inhabitants of Amsterdam and scooters. The scooter is a vehicle that can be used in urban environments by a driver and one passenger. Yet within the domain the scooter is not the only available modality. To increase the scope of this study three different modalities will be explored in the following phase, namely: the Segway, electric bicycle and the scooter. The objective of this phase is to create an understanding of what qualitative characteristics of these products contribute to a successful interaction between context, user and product.

“Mobility for individuals with fewer financial resources, living in urban environments in 2025”

Domain

3.1. Discovering opportunities

3.1.1. Qualities & characteristics

The objective of this phase is to find out why the products that exist in urban environments are designed the way that they are, how they are used and in what conditions?

Before designing a product that takes advantage of the opportunities it is important to create an understanding of the products that are currently available, and understand why they are designed the way that they are. What qualities and characteristics do we associate with the products, how do we interact with them and in what conditions are they used? This embodies the deconstruction phase of the VIP methodology. The deconstruction phase of the ViP methodology covers three levels; the context-, interaction-, and product level. For this process three modalities have been selected that are currently being used in the chosen context: the Segway, scooter and electric bicycle. These modes of transport have been chosen due to their difference in dimensions, interaction with its user and context and the technology that propels the vehicle. The concepts will be abstracted to retrieve their qualitative characteristics, to provide an answer to what factors are responsible for the success of personal mobility. The objective is to create an understanding of what personal urban mobility should offer us in the future. What qualitative requirements does mobility need to meet, and what do we expect from personal urban mobility, both consciously as unconsciously? The attained qualitative aspects will be used as an input for the concept phase, as they will function as guidelines for the design.

3.2.1. The Scooter - Product level

As the birth of the scooter goes back several decades, it is important to understand how it was designed and for what context it was intended. A timeline has been created that highlights the birth and all relevant milestones until today (Appendix B). Appendix A provides a complementary historical background of the scooter, up to present day.

According to the dictionary the definition of a scooter is a vehicle that has a step-through frame, where the feet of the driver are positioned between the handlebar and a seat, that is positioned over an enclosed engine (dictionary.com).

It can be concluded that since its birth the archetype of the scooter has not experienced profound changes, since a seat was placed on the Autoped around 1919. The modern scooter can be used by one driver and one passenger. Personal belongings can be stored in the compartment underneath the seat. Leg shields visually and cognitively protect the driver from possible impact but the main function is to protect the driver from bad weather conditions, and dirt, and allows women to use the scooter while wearing a dress or skirt, and men to wear their neat clothes. According to (Mercanti, L., 2009) a scooter is rational, response to urban mobility needs and because of its agility and proportions is the ultimate product to pass traffic jams. It is reliable, functional, provides safety and comfort, value for money, less crisis sensitive than a car and shows quick reaction to economical incentivess. According to (Mercanti, L., 2009) the scooter will hold the following qualitative characteristics in the future: improved functionality and safety, a real car alternative in urban environments, eco-sustainable and beneficial in terms of social costs.

3.2.2. The Scooter - Interaction level

Mobility, or products that provide us with physical freedom have an emotional capacity that is not present in other products. Emotion is an important factor as mobility provides a feeling of liberation and independence.

The interaction on a user level can be divided in a physical and cognitive level. The physical interaction is dependent on the dimensions of the product and user, e.g. sitting height and leg space. The cognitive interaction concerns visual indication, e.g. speedometer and fuel level. The cognitive and physical interaction are dependent on one another, as looking at the information presented on the handlebar requires rotation of the head and eyes, which influences the driver's posture. The driver has an upright position, without any back support, with the feet positioned next to each other between the handlebar and seat. This provides the driver with confidence as he or she has a clear overview on the traffic. Due to the upright position and high H-point a scooter driver is also clearly visible for other road users. The physical and cognitive interaction developed over time due to changes in context. This also influenced the scooter on a physical product level. It has become user-friendlier, and the focus is now on styling and ergonomics. Yet, according to the marketing advertisements the scooter still shares the qualitative aspects of a cheap and fun alternative to other available types of motorized mobility. The interaction between user and product can best be described as an efficient environment explorer. Enabling you to reach your destination efficiently while experiencing the environment during the journey due to the open architecture.

3.2.3. The Scooter - Context level

The first generation of the scooter was marketed as a safe, cheap and comfortable alternative to a car. The modern advertisements show that Vespa is leaning on their heritage. Being Italian and European and using nostalgic and vintage design elements in the styling of the product. Modern marketing channels like social media have been accepted and are integrated in the nostalgic feeling advertisements. When parked on the street the scooter becomes part of the public space and the contextual interaction becomes important. This also counts for when the scooter is in use as then there is also an interaction with other road users. The physical contextual interaction consists out of the place on the road while driving and the volume of space it occupies when being parked. The cognitive contextual interaction that can result from the scooter are emotional and can cause frustration and irritation.

Product, interaction and context are not static concepts, they are dyncamic and evolving over time. Context with regards to legislation and infrastructure are influencing the product and the way that it is used. With legislation changing and infrastructure developing opportunities for new interactions on both a user as context level occur.

3.3.1. The Segway - Product level

The Segway is part of the Single Occupancy Vehicle (SOV) segment. It is a self-balancing two-wheeler with an electric motor. It was first introduced to the market in 2002, and was invented by Dean Kamen. It was the result of his balancing technology, which was being developed for the self-balancing wheelchair called the Ibot (segway.com). The Segway consists out of two wheels, a floorboard and handlebars. Gyroscopes located in the floorboard assure a balanced ride. Unlike the scooter the two wheels are parallel to one another, resulting in a very compact and space efficient architecture, achieving the same footprint as that of a pedestrian.

3.3.2. The Segway - Interaction - level

The Segway is a special case in the way that it does not belong to the category scooters, but special scooters. According to (rijksoverheid.nl,) the following rules apply to this category of vehicles:

- It does not require a driving license
- You do not need a license plate
- A crash helmet is not mandatory
- Place on the road is as far right as possible
- The vehicle has to be insured and should carry an insurance plate and frame number - Maximum speed is 25km/h
- Lights are mandatory during the evening/night and in bad weather circumstances. These are not required to be permanently be part of the vehicle architecture - Mandatory to carry red and white/yellow reflectors
- If there is a scooter/cycling lane than this is the place to drive
- Disabled under 16 are allowed to drive a special scooter
- Disabled are allowed to drive on the pavement with a maximum speed of 6 km/h

An interesting conclusion can be made; as the Segway is an example where the legislation that exists influences the product, interaction and context. The user or driver has to stand while driving on the Segway. Either leaning forward or backward can control acceleration and braking. Cornering is also achieved by leaning in the desired direction. The Segway solely consists out of a platform with a handlebar attached to it, which does not provide any protection against rain or other bad weather conditions. It also lacks driver protection in the situation of a crash or impact with another vehicle.
Even though sharing a similar technology like the Segway, examples like the Hoverboard & Oxboard are prohibited on public roads. These products are not part of the category special scooters as they lack a handlebar which results in dangerous situations (Wokke, A., 2015). According to the ministry these products are powered two wheelers that do not comply with the admission requirements for this category.

3.3.3. The Segway - Context - level

According to Dean Kamen the Segway was a the result of a happy accident (segway.com). The technology was proven with the Ibot wheelchair. The biggest challenge was that it could provide a piece of a solution to a fairly big problem. The start was to think of the context where technology is being applied.(Kamen, D., 2002) It resulted in being a search to solve the first and last mile problem. Dean Kamen believes long-range transport of humans has been solved by cars, trains, aircrafts etc. Yet the first and last mile remained an issue that the Segway could solve. Due to the high price tag the Segway is not as popular as an electric bicycle or scooter among the consumer market. But this is also not the objective for Segway, as they claimed a vertical market integration targeting walking tour operators, police departments, commercial warehouses and Epcot in Disneyworld. (Lipe, J., 2006)

3.4.1. The electric bicycle

The increase in sales figures of the electric bicycle show that it is gaining in popularity among the Dutch market. 57% of all new bicycles that are sold are electric (fietsen.123.nl, 2016-B). The electric bicycle has long suffered from an unfashionable image, as it was associated with elderly and disabled (matrabike.nl). With the society becoming more aware of the importance of physical exercise this hybrid is gaining in popularity as it fits a healthy lifestyle.

Due to the new legislation that affects scooters and scooters, the electric bicycle is also starting to receive more attention from the youth. Due to new designs and financing plans they accept it as a serious alternative to public transport (fietsen.123.nl, 2016-C). According to (Mobiliteitsbeeld, 2016) the E-bike has resulted in individuals increasing the amount of cycling trips, travelling greater distances and increasing their average speed. The report also states that 40% of the respondents say that they now use the car and public transport less frequently.

3.4.2. The electric bicycle - Product level

In the Netherlands a distinction is made between the so-called speed pedelecs (maximum speed of 45km/h) and the normal pedelec (maximum speed of 25km/h). The most important differences are that for the speed pedelec a crash helmet has become mandatory since the first of January 2017, and drivers will become obliged to ride on the main roads instead of the cycling lane, within the city ring of Amsterdam (fietsersbond.nl, 2017). For the pedelec with a maximum speed of 25km/h no helmet is required, and cyclists can use the cycling lane. The pedelec consists of the same elements as a normal bicycle, except for the fact that an electric motor and battery pack have been added. The location of the electric actuator results in three variants: a motor located in the front wheel, located in the centre or located in the rear wheel. (fietsen.123.nl, 2016-D) The front wheel powered bicycle is for short distances like doing the groceries. It is cheaper but also less stable as the cyclist feels like being pulled. This also results in less powerful engines. The motor starts to work at the point that you start cycling Bicycles with a centre motor provide the most natural and comfortable experience. The motor is directly connected to the peddle axle and can be more powerful. The motor output is dependent on the gear the cyclist choses to peddle. Due to its low centre of gravity is feels more stable. The electric bicycles with a rearwheel mounted motor provided the feeling of being pushed in the back. They are very comfortable and are most popular among recreational cyclists.

3.4.3. The electric bicycle - Interaction level

The electric bicycle or e-bike is the only hybrid of the three modalities that are discussed in this graduation project, as it requires the user to peddle, and while doing so an electric motor provides assistance. The interaction can be described as a commuting workout, with a gentle push in the back. The e-bike allows for greater distances to be travelled than the normal bicycle, yet due to its hybrid nature requires a physical workout from the user. Commuting on an e-bike is less expensive than a car, and is often faster in urban environments due to its physical dimensions and agility. According to (fietsen.123.nl, 2016-E) 60% of the respondents state that the e-bike holds a positive image. Whether it fits their personal image is uncertain as 25% states that it is completely unfit to their personal image.

3.4.4. The electric bicycle - Context level

The electric bicycle is designed to bridge a greater distance than the regular bicycle. According to (anwb.nl) the electric bicycle becomes a convenient alternative to the car when the daily commute from home to work lies around 15km.

3.5.1. Conclusion

Products are designed and used differently in different environments. This is an important fact, and always needs to be considered when designing a product, as both context and interaction influence the design and the product itself. Even though the three products share many similarities they are designed with different intentions, to meet with different requirements or provide different services. The scooter is designed to relieve the user from physical exercise and carry additional luggage or a passenger. Context wise the scooter can be used in the urban environment and between suburban areas. It allows the driver to cover larger distances in a relative time efficient manner. The electric bicycle aims to stimulate physical exercise with a small push in the back. Initially it was used as a recreational vehicle by elderly, but is currently gaining in popularity in urban environments and is used as a door-to-door solution, and with more sharing initiatives being introduced the electric bicycle is also used to solve the first and last mile problem. The Segway is specifically designed for the urban environment as a solution for the first-last mile problem. Dean Kamen believed that long distance travel was already solved, yet urban mobility allowed room for improvement. The goal was to develop a product of which the footprint was no larger than that of a pedestrian. All three products fit the personal transport category and work very well in urban environments. The required interaction and context are decisive of which one will fit the user better.

The scooter is the only one of the three modalities that has the objective of providing an affordable alternative to a car. This is what it was designed to be and still is to many people (Appendix A). Yet, with the introduction of the LEZ it seems that many people will lose the qualities of this modality. Where the Segway is an expensive gadget and the electric bicycle an expensive bicycle the scooter provides a more pragmatic solution to urban challenges. Therefore the qualitative characteristics and interaction of the scooter will be used as an input for the ideation and design phase of this thesis. The image on the following page provides a comparison of the three modalities on an interaction and qualitative level.

			
Place on the road	On the road	As far right as possible on the cycling lane	Cycling lane
Physical position driver	Sitting upright	Standing, slightly leaning forward	Active sitting
Additional mandatory safety products	Crash helmet	No mandatory safety products	Not for normal electric bicycle, for speed pedelec
Type of travel	Door-to-door & first mile/last mile	First mile/last mile	Door-to-door & first mile/last mile
Single or double person	Driver and passenger	Single	Single
Price	€3099 (Vespa Primavera 50)	€8399 (PT i2 SE)	€1649 (Batavus Genova E-go 7)
Dimensions	1860 x 743mm	480 x 630mm	185mm
Range	260 km	38 km	30-70 km
Speed	45 km/h	20 km/h	25 km/h
Type of actuation	Internal combustion engine	Electromotor	Electromotor

4.1. Collecting relevant factors

4.1.1. Domain

The domain of this thesis is “Mobility for individuals with fewer financial resources, living in urban environments in 2025. To explore all relevant context factors a diverging approach has been used; firstly, phenomena on a global scale will be explored, and secondly phenomena that will influence the chosen domain in specific. This approach assures that all phenomena, that are potentially relevant, are included in creating the future vision.

In the ViP methodology the domain describes for whom the product is that you are designing, and where it will be used. During the literature research it appeared that socio-economic developments in the domain are mainly in favour of the highly educated of our society. These developments, in combination with the phenomenon of automating our labour market resulted in exploring the potential role of mobility for the lower educated, and to help secure their position in society and an automated future.

4.1.2. Domain as scope

In order to sketch an image of a probable future context factors need to be collected. These factors are value-free descriptions of world phenomena (Hekkert, P., and Dijk, van, M., ViP). The factors have been retrieved from papers, news websites, Tedtalks, trend forecast agencies etc.

The purpose of the domain is to create a framework that encapsulates a search area where relevant context factors can be discovered. The domain decides which factors are irrelevant, yet it should simultaneously inspire and broaden the view. To find relevant factors the domain has been deconstructed in the following fields of relevance:

- Inequality
- Urban environments
- 2025
- Cycling
- Pedestrians
- Public transport
- Collective v.s. individual
- Alternative user scenarios

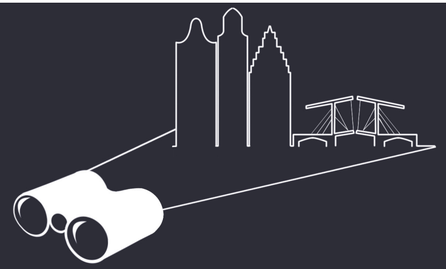
4.1.3. Clustering

After collecting sufficient context factors, the phenomena should be clustered in to groups. The clustering process resulted in a combination of Common-quality clusters and Emergent-quality clusters. Clusters consisting out of context factors with conflicting qualities resulted in interesting insights. Eventually the clusters consisted out of a combination of trends, developments, principles and statements. For this thesis this step has been repeated multiple times to come up with the most original cluster descriptions. As these clusters consist out of a wide variety of context factors, they are capable of conveying, to a certain degree, an objective future vision within the chosen domain. This process eventually led to the context statement, which holds a subjective reaction to the envisioned dystopian or utopian future.

An interesting observation is that a certain coherency presented itself between the collected factors, yet these did not necessarily provide new insights. Therefore the next step was to try to combine factors with different qualities, with as objective to generate a cluster with a new quality. The future vision that was retrieved is the product of a storyline. One cluster communicates the main story line, and the other clusters have become chapters of that story. Some of these chapters describe developments that would be characterised as positive, where others fit a more dystopian future. An overview of the clustering process can be found in appendix F.

Domain

The domain acts as a pair of binoculars; it generates a searchfield within bourders. The contextfactors within the bourders are relevant to the domain



4.2. The road to self-redundancy

A summarized version, including the most important clusters, will be discussed in the following paragraphs. At this point in the process it is, according to ViP, key to remain as objective as possible. It should therefore be noted that the clusters leading to the future vision do not necessarily illustrate the personal opinion of the designer, but are an objective result of the process.

4.2.1. The individual in the centre

Mobility facilitates in activities that contribute to the welfare and prosperity of the people and companies inhabiting them. Simultaneously it puts a pressure on both aspects; it consumes scarce space, requires financial investments, resources and virgin materials, and influences the social safety and perceived quality of our physical environment (STT, 2013, p.76). Our displacement behaviour is not only bound to the need to travel, but also to global phenomena on a technological and socio-economical level. The main socio-economical phenomena that we will witness to develop are: individualization, globalisation urbanization and computerization (STT, 2013, p.21).

As a result of the individualizing society the market share of bespoke products that are tailored to the individual’s requirements and wishes, is expanding. Technological innovation will allow for personalized consumption patterns. 3D printers are an example of the key enablers for this bespoke lifestyle (E. Ehrhart Ag, 2012, P.68). Ease of use unburdens the individual and will create more comfort and efficiency. In the service sector; providing bespoke services can be challenging, as it often requires data harvesting, before being able to provide the required service. This can potentially lead to privacy concerns among consumers. As an example: sensor nodes are being installed in home environments to monitor and control different variables, like temperature and humidity. But when the house is owned by a landlord, who is in control of these variables and will the tenant feel comfortable with the idea of all variables being monitored (van Woensel and Archer, 2015, P.18)? On the other hand, data harvesting can also lead to positive outcomes. An example of this are the personalized advertisements that we receive when browsing on the Internet.

Servitization describes the process of creating value by adding services to products (Dinges et. al, 2015, P.6). One of the benefits of the IoT is that products become smart, enabling manufactures to collect valuable data and the products to become a product service system. These integrated product-services offer a route to sustaining competitiveness (Dinges et. al, 2015, P.4). Intelligent parts will only have value due to the information that they process. These systems have to be capable of receiving, processing, interpreting and sharing data (STT, 2013, p.37). Beyond its integration role, technology is important with respect to the customisation of offerings, the administration of products and effective customer service delivery through communication channels (Dinges et. al, 2015, P7). This supports the socio-economical individualisation trend, and allows for providing bespoke services. Advanced customer relationship management (CRM) tools, in conjunction with consumption monitoring and analysis, help to facilitate in the development of providing personalised services (Dinges et. al, 2015, P10).

4.2.2. Industrial Revolution synonym for more labour?

Before products can be designed that require human interaction, an understanding of human behaviour is required. What factors trigger or influence human behaviour? Learning from the past it can be observed that changes in the economic system are a key trigger in human behaviour. In the first and second Industrial Revolution machine made production allowed for economic growth that changed human consumption behaviour and behaviour in general, see image on page 29. Will the Internet Of Things (IoT) bring us another Industrial Revolution, and more job possibilities?

The Industrial Revolutions of the 1800's and 1900's mark the birth of modern day globalisation. Factories were established and resulted in the first signs of urbanisation and international trade (Britannica.com). By creating an understanding of what factors contributed to the Industrial Revolutions of the 1800's and 1900's, and reading future scenario's one might be able to create an understanding what disruptive technology is required to meet with future transportation requirements, and how it should be implemented.

The Internet supports the development of globalisation. With product development taking place on one side of the world; and physical production on the other, companies are no longer limited to their direct environment as the Internet has become a communication tool that aids in the process. Both the first and second Industrial Revolution teach us that employment attracts people. During the first Industrial Revolution the realization of factories attracted people; employees and their families moved closer to the factory, which led to the first signs of urbanization. The development of machines allowed for a higher production efficiency, which allowed for national and international trade. A distribution network was required, which resulted in the development of railroad systems that eventually led to globalisation due to the trading opportunities (Ferreira, P., et al. 2012). The first and second Industrial Revolution increased the production efficiency, allowing for some individuals to thrive financially. The revolutions allowed for a higher quality and efficiency of live; due to the telegraph and later electrical power and the telephone. Machine manufactured products allowed for lower prices and more efficient production. The wealth of both the middle and upper class went up, and had purchasing power left to spend on leisure activities and luxury products (Loftus, D., Dr, 2011). The Industrial Revolutions are accompanied by disruptive technological developments. According to Jeremy Rifkin an Industrial Revolution can be characterized as a phenomena where communication technology revolutionizes and energy becomes organised (Rifkin, J., 2016). Coal and oil were accompanied by the telegraph and later the telephone. Today we witness an externally driven focus on renewable energy due to severe environmental changes as a result of green house gasses (Eurostat, 2011). The focus on renewable energy resources is accompanied by a new form of communication; the Internet, which acts as a supporting factor of the novel technology. Yet, it will be the synergy of these technologies that will lead to the Internet of Things (IoT) and is assumed to eventually initiate a third Industrial Revolution (Waghorn, T., 2011).

It would be naive to rely on events that took place in the past to repeat themselves in the future. In other words; a Third Industrial Revolution does not guarantee to generate more employment opportunities, like the first two industrial revolutions. But, it does not prevent it from happening as well.

The main characteristic of the IoT, and fundamental difference with the previous two Industrial Revolutions is computational thinking. It is this characteristic that will prevent the third Industrial Revolution from generating jobs for the masses. Automated systems will be able to receive and process data and make appropriate decisions, without any human interference. In the process of doing so, these systems will become smarter, in terms of autonomous decision making, and will eventually be able to take up new tasks. This means that jobs will be generated in the sectors that are active in the development of these systems, e.g. software developers, mechanical-and-electrical engineers and product designers (qz.com, 2017). On the execution end of the scale; these systems will relieve individuals from their work. According to the Dutch Institute for Employee Insurance (UWV) between 2008-2012 90.000 jobs were replaced as a result of automation (motherboard.vice.com, 2015). It can be concluded that jobs will be generated as a result of the Industrial Revolution, yet the skills required to conduct these professions are not equal to the ones that automation makes redundant. It is the additional layer of computational thinking that gets in the way of creating more job opportunities for everyone.

Difference between the Industrial Revolutions of the past and the one that we witness today

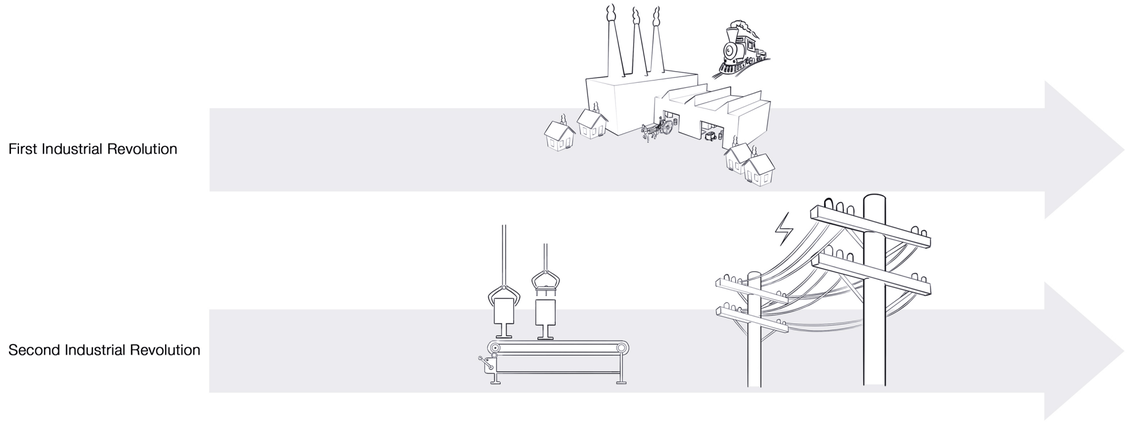


Image: Impact of the IoT

“Machinery that gives abundance has left us in want”

Charlie Chaplin, The great dictator 1941

4.2.3. The want for more

Automation will not only impact those that directly lose their jobs, but it will affect our economy as a whole. We are moving to a near zero marginal cost society (Rifkin, J., 2014). This means that the production of a single unit, after all investments have been paid off, is almost for free. This has been initiated by multiple phenomena, of which the race to automation is one. The market desires more affordable products, which has resulted in a volatile playing field where companies compete on price and marginal profits. This resulted in outsourcing production to low cost countries and eventually automating the production process. (See image self redundancy timeline) Automation will occur at the cost of self-redundancy and will result in an abundance of physical products (AlGergawi, M., 2017). Humans lose it from machines when it comes to output, efficiency and precision. In a world where we have abundance, but no job, a new economic system is required for people to use the abundance that is the product of automation.

4.2.4. The meaning of work: Work to live or living to work

Work consumes our lives; in 1759 Voltaire stated that work saves us from three great evils: boredom, vice and need. This has led to a society that is constantly focused on work and living up to expectations set by themselves and society. Living to work has become the product of an economic system that stimulates and applauds financial success and private ownership. We entered a paradox where we work for long hours to buy products that we do not need to impress people that we do not like (Pistono, F., 2012). Work brings meaning and helps us to efficiently organize our lives, but with regards to quality it appears to be a very inefficient form of efficiency. The phrase; 'choose a job you love and you never have to work a day in your life' by Confucius, does not seem to apply to a world where at least 48% of society dislikes their job (Ansuya, H., 2013). According to David Graeber, anthropologist at the London School of Economics, many of today's jobs are low-and mid-level screen-sitting ways of pastime that serve simply to occupy workers for whom the economy no longer has much use. The decision of maintaining employment for this group is not made from an economical perspective, it is solely for the ruling class to keep control over the lives of others (Economist.com, 2014). This is not a sustainable solution in the long-term, as automation seems to find its way in taking over many tasks. A change is visible that is disrupting our economic system and will change human behaviour in the long term.

4.2.5. Replaced by robots

With the Internet of Things machines will become able to communicate, creating a network of nodes. Robots will replace factory workers and relieve them from heavy jobs. This will increase production speed and efficiency (Robotics tomorrow, 2013). Software will allow trucks to drive autonomously on motorways, and will eventually lead to truck drivers becoming obsolete (McDermott, J., 2017). During the first Industrial Revolution an environment of production in one location, and market demand for goods in other locations required for the development of a distribution network. This created jobs and initiated modern globalisation. Due to an increased level of globalisation, technology is being developed faster than ever before, resulting in some jobs being replaced by automated machines. How will this affect human labour, when manufacturing does not require human interference, and transportation is conducted autonomously? We already write software that allows us to design in virtual 3D environments. Designs that are made in CAD programs can easily be translated to physical objects via production techniques, like 3D printing. Will the only thing that we produce be software? Software to steer products that work more precisely, more efficient and can repeat tasks x times without mistakes and risks of fatigue? The position of many humans in society is uncertain, as automated systems will be able to handle the complete sourcing, manufacturing, distribution and logistics, eliminating the demand for human labour completely (Robinson, A., 2015).

4.2.6. Source of purpose

The common thread that creates the framework for the future vision is: *"The road to self-redundancy"*. As a result of the race to automation for increased efficiency, humans have started making themselves redundant in professional fields (AlGergawi, M., 2017). As an effect of the road to self-redundancy individuals are starting to lose their purpose. In the past our profession was the source of our purpose, brand identity and provided us with meaning (Shaffer, L). It will be daunting at first, but when our profession is not the primary source of identity anymore, we will realize that we are multi-dimensional and will find other sources to describe who we are and what we value. On the other hand the loss of personal identity can potentially lead to a life without a purpose. Individuals will be questioning themselves: yesterday I was a carpenter what am I today? Will this lead to disordered lifestyles of bored individuals that do not know how to organize their daily routine anymore?

4.2.7. Non-consecutive path

Human productivity and human meaning will significantly alter over the coming decades as a result of automation. According to recent research, the substitution of capital through labour via automation is increasingly attractive (economist.com, 2014). This has resulted in owners of capital capturing more income, while the share going to labour has decreased (Economist.com, 2014-2). Automation leading to mass unemployment will not happen over night, yet we will witness stages were certain tasks are taken over by machines to achieve a higher yield and profit. Globalisation is one of the causes of automation and will lead to an uncontrollable advance of humanity that drives the entire context. The road to self-redundancy happens in multiple stages, and we currently find ourselves in the first phase. It is assumed that in 2025 we will be on the verge of entering stage two (theguardian.com, 2017). The challenge with automation is that it does not follow a consecutive path, which starts at one end of the scale and works its way up to the other end. It is based on the complexity of tasks that need to be executed to perform a certain profession. In phase one we witness repetitive tasks, both of physical and cognitive nature, being the easiest to automate and replace (inverse.com, 2017). The second stage is computational thinking, of which in 2017 we already witness the first steps towards. The third and most difficult is that of jobs that require soft skills, like human emotion.

This means that the group that will lose their jobs first consists out of a mixture of individuals with different educational backgrounds. For the individuals that lose their job as a result of automation, alternatives need to be found, or they require re-schooling in order to remain relevant in our society. Indicated is that eventually 47% of the jobs that exist today are susceptible to automation (O'keefe A., 2016). In 2017, we can already witness robot doctors (nos.nl, 2017), solicitors, waiters, factory workers and police officers. The graph on this page shows an approximation of which jobs will become subject to automation, and in what point in time they are suspected to become redundant. One of the issues with automation is that it does not only consist out of a technological challenge, but probably even more so out of ethics. Therefore the more important matter is: what do we feel comfortable with automating, rather than what are we able to automate? Jobs that require social skills appear to be less susceptible to automation, and the reason for this is that society will still value personal interaction in the future, which is a distinctive humane characteristic (fastcompany.com, 2016). Currently it is unclear to what degree these jobs will disappear, as some say we value the soft skills of a waiter over that of a robot, while the physical actions of the profession can be replaced by robots easily (Mcafee, A., 2015). Therefore there are still some unanswered questions concerning what jobs can be replaced and which would we like see being replaced? For many occupations involving cognitive thinking and skilled labour it is mentioned that the objective is not to replace human labour completely, yet to provide the best support possible (Donnelly, L., 2017). According to the Oxford paper "The Future Of Employment: 'How Susceptible Are Jobs To Computerisation?' (Benedikt Frey, C,, and Osborne M., 2013). This can currently be witnessed

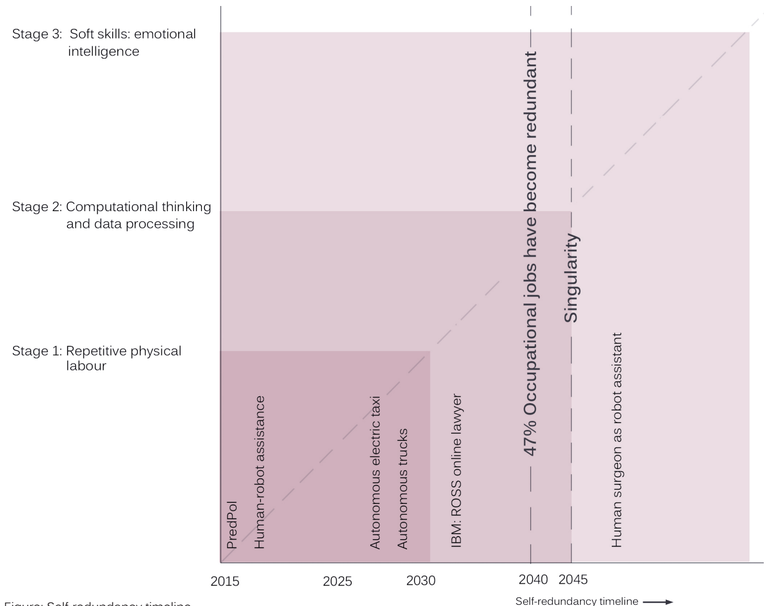


Figure: Self-redundancy timeline

in production related professions, where industrial workers are reallocated becoming service and maintenance workers, or being substituted completely. In practice technological changes do not affect all workers the same way. Some workers have skills that are complementary to automated processes, where others do find themselves out of work. The global problem is, that low-skilled workers represent a great number of society, even in a highly educated city like Amsterdam (Appendix P). Educational investments are required to provide a supply of workers for the more skilled jobs that will be created, as can be witnessed in the past. This shift continued into the 20th century as post-secondary education became increasingly common (Economist.com, 2014). With automation and its potential impact receiving more attention over recent years, the question arose; what will people do when they are left without a job? One of the proposed solutions is a Universal Basic Income or UBI, which is an unconditional income, provided by the government, so that the society remains financially solvent.

According to Jacque Fresco, inventor of the Venus project, we should embrace a society where we have abundance and receive a universal basic income (Fresco, J., 1974). This would enable us to create a new innovative incentive system that is focused on solving problems, and distance ourselves from a monetary oriented system. According to Fresco self-redundancy should be supported so that we can thrive; focus on scientific research, make art etc. According to (Veenhoven, R., 2000) freedom of choice is the main enabler for happiness. This is often made possible by economic freedom. According to this statement individuals would potentially be happier when receiving a universal basic income as freedom is created by eliminating the monetary incentive to work and do jobs that many do not find fulfilling (Businessinsider.com, 2010). Instead of waking up to fill our day with monotonous work, we will seek new challenges to take on. We will unburden and liberate ourselves from the monetary system and conduct, in the eyes of society, more meaningful tasks.

4.2.8. A sustainable future

"Moving to a post carbon society"
- Jeremy Rifkin

Our hyper-consumption behaviour is one of the contributors leading to an automated and unemployed future. Yet, our consumption behaviour has also applied pressure to our environment, where we have depleted natural resources and polluted our living environments and nature. To allow a shift to a more sustainable future we have to become less dependent of oil, but the problem is the wide variety of industries and the scale in which it is applied. Oil is currently being used in the development for pharmaceutical products, consumer products and as fuel to power our vehicles, etc. According to M. King Hubbert's theory we would meet peak oil eventually. According to his theory dating from 1953 peak oil would occur in 2000. According to economists we reached and passed peak oil in 2006 (Lerner, M., 2012). This means that the maximum amount of oil won from resources has been achieved. This makes the price of oil increasingly more expensive. The financial crisis that hit the global market in 2008 was, according to Jeremy Rifkin, an after shock of reaching peak oil. He stated that every time we try to regrow the economy at the same rate we were growing before 2008 oil prices will increase, prices of products will follow and the decrease of purchasing power will be an inevitable result. If we would continue to pursue this scenario we would witness this occur every 4 years for the next 25 years. With this in mind, the importance of becoming less dependent on fossil fuels becomes evident.

Two aspects that are characteristic to products that are made out of fossil fuels are their durability and high production capacity at low marginal costs (scientificamerican.com, 2009). The unfortunate result is that a significant amount of these products do not possess an intrinsic value and are therefore easily discarded, resulting in a heavy negative impact for our environment. An alternative for the hyper consumption society that we currently find ourselves in is required; transitioning to a society with a reduced negative environmental impact, starting with our consumption behaviour.

4.2.9. Growing awareness

Globalisation is supported and accelerated by innovations involving the Internet. Due to these developments education and the way that we share knowledge has evolved (Butler-Kisber, L., 2013). This has led for news to spread rapidly and a society that has grown a higher degree of awareness.

We are starting to think more systematically and are creating a biospheric consciousness, where we have come to understand the ecological footprint of personally owned products and the adverse effects of a displacement on the environment (STT, 2013, p.81). We engage with a sharing or collaborative consuming society, meaning that consumers are able to both obtain and provide, also referred to as prosumerism (Botsman, R.). This has led to a change in our behaviour and economic system, as we wish to share products rather than personally owning them. Collaborative consumption is no longer a short-term trend or superficial media hype but a movement that has advanced from a niche topic to an actual change in consumer behaviour (Ehrenhard & Blind 2015, P.73).

4.2.10. Moving to a sharing economy

The first signs of our economic system being in a transitional process became evident around 2008. As a result of the financial crisis the economic system slowly started to transform from a system that fosters private ownership to one of shared development and collaborative consumption (Lerner, M., 2012). Since then initiatives have come to surface that aim at exploiting underutilized assets, enabling the owner to generate an income in a new economic system, called the 'sharing economy' (The economist, 2013). In this new mindset the value of personal ownership has decreased, and financial investments are made in experiences rather than in products. The development of the Internet has become the main enabler of the transition from an economy based on personal ownership and capital, to one of the collaborative commons (Codagnone, C., and Martens, B., 2016).

According to a study conducted by researchers from San Fransisco State University; we value experiences over the ownership of products. The reason why we have not yet made the full transition from investing in experiences and memories only; is because it is hard to estimate the economic value that we place on them. In contrast to experiences, physical items are easier to associate with economic value, explaining why we still acquire expensive products (Huffingtonpost.com, 2014).

Even though it is not evident in every industry yet, the transition has started and an era has been initiated where products of luxury are acquired and used via memberships and contracts: usership over ownership. Today, almost any individual is financially capable of owning a smartphone, yet would possibly not be able to purchase one directly. This is made possible due to contracts between the user and service provider. The service that the product holds or provides has become the exploitable ingredient; in monetary terms but also with regards to collecting data, which has become an economic commodity on itself.

4.2.11. Sharing industries

In a variety of sectors, Internet facilitated platforms have emerged that enable people to share their underutilized assets (Böcker & Meelen, 2016). The potential of moving from an economy based on private ownership to one of sharing becomes evident when looking at what already exists outside the domain of mobility. Restaurants make use of delivery services to unburden the individual at home. One can order Chinese or Italian at a restaurant, which can be interpreted as a multitude of consumers sharing the same kitchen (STT, 2013, p.56). We share clothes and phones are purchased via monthly contracts, paying for the usage rather than the physical product itself. Centralized institutions become decentralized: blogging and spreading news via intangible media made newspaper production redundant (Rifkin, J., 2016). Other examples are what AirBnB did to the hotel industry, Napster to the music industry, Kickstarter to the funding of projects and what Cryptocurrencies could potentially do to our monetary system.

4.2.12. Passing on the baton

The sharing economy is part of a global phenomenon where we are moving from a centralized to a decentralized system, this is also referred to as the collaborative commons. An existing example can be witnessed in Germany, where energy suppliers are not allowed to control the entire distribution network, only provide the resource (Rifkin, J., 2016). This has resulted in a decentralized system, where individuals are now selling their surplus energy back to the grid. Our education system is another example of any industry that becomes subject to the phenomenon of decentralization. The Internet enriches us by making valuable information available that would otherwise have been out of reach (Archer and Woensel, van, 2015, P.7). This results in Massive Open Online Courses (MOOC's). Elite universities like Harvard and Stanford already record their lectures and classes and put them on the Internet for everyone to enjoy (Aldred, J., 2016).

"Software is eating the world" - Marc Andreessen

The development of software driven technology has allowed for new companies to emerge, which turned into giants themselves. Selling intangible high value products, like direct knowledge or social engagement. This has resulted in companies selling physical commodities starting to disappear, an example being the shift from physical to virtual retail environments (Zervas, G., et al., 2016). The shift to a sharing economy has led to a decrease in power and monopoly of leading companies (Meunier, F., 2015). Yet, are we not only witnessing a transfer of power, rather than a decentralization? Google now appears to have a monopoly on distributing and sharing information. Global consumption and sharing will be the next step that will make these large companies lose importance again, as illustrated in the example of energy suppliers in Germany.

4.2.13. Incentive to share

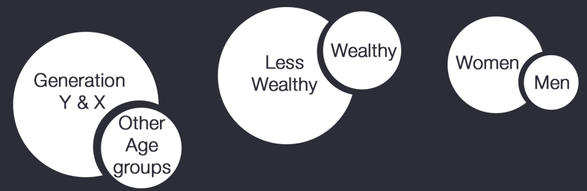
The relationship between physical products, individual ownership and self-identity is undergoing a profound evolution. In other words, we don't want the stuff, but the needs or experience it fulfils (Botsman, 2010). Collaborative consumption describes the growing trend of moving from ownership to joint access of resources (Ehrenhard & Blind 2015, P.2). For this paradigm shift to be successful, it is key to understand the individual's incentives to participate in a shared system in the first place.

According to (Frick et al., 2013, p. 5) consumer motivations in the sharing economy are savings and convenience on the economic and practical side, as well as enjoyment and environmental consciousness on the social and ideological part. It is also referred to be socially strengthening existing ties and engaging in new ones. Self-interest motives lead to reducing levels of consumption while eco-and socio-altruistic motives lead to opting for more environmentally and socially sound products (Marchand et al, 2010). The willingness of the individual and success of the sharing service platform are also dependent on that what is being shared. Sharing tools requires a different approach with regards to the service and holds a lower threshold for the individual than sharing their own car in a peer-to-peer system. Participative motivations for a sharing economy can also differ between different socio-demographic groups (Hellwig et al, 2015). Findings of a qualitative analysis conducted by (Ehrenhard & Blind 2015, P.2) confirm that participants are driven by a triad of economical, ecological and social motivations. The study has found evidence that shared ownership is not only a trend, but an alternative to hyper-consumption as more people intend to participate. The study also showed that the participants that are financially not capable to afford specific goods, share more often. Thus the phenomenon may be especially valued across members of lower income levels. Women share more than men and generations Y & Z do so more frequently than any other age group (Ehrenhard & Blind 2015, P.73).

Sharing incentive

The main driver for people to participate in the sharing industry is the financial aspect. The threshold to participate lowers significantly when the individual recognizes and is convinced by his/her financial gain

Relative sharing



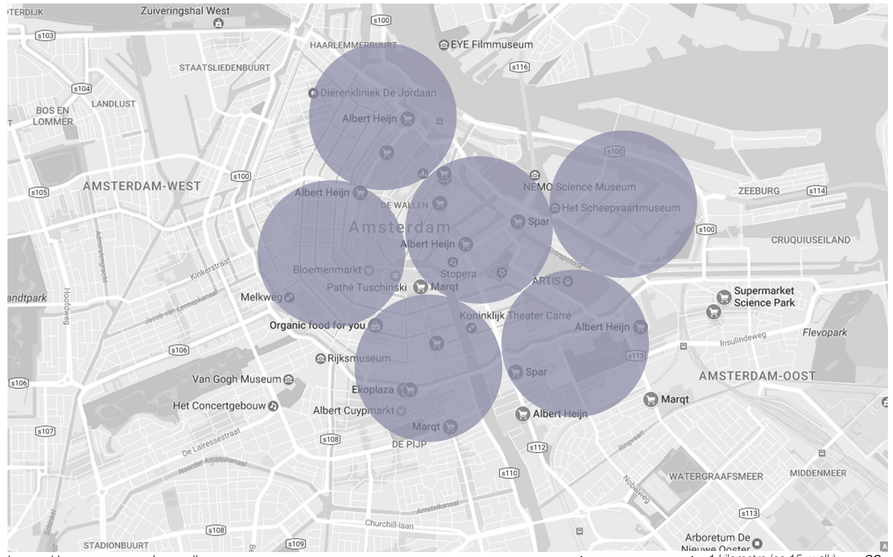
4.2.14. The 5 minute city

Shifting from a centralized system, focusing on private ownership and monetary capital, we have evolved to a collaborative consumption society in 2025. Mono-functionality is lost as everything has become a resource, providing data and any product can be ordered anywhere. The economic system mainly leans on services, yet this has resulted in a centralized mindset. Individuals live in urban cells and are not required to leave their house to get the groceries, as everything can be delivered. This has resulted in a world where travel is almost not needed. Work can be done online, and when we do need to get out; urban cells make sure the required distance to a pharmacy or supermarket is no more than 15 minutes walking, see image on this page. The sameness that we encounter has made our lives convenient yet predictable. Simultaneously, we seek for ways to increase the efficiency of our daily lives. We plan our work and schedule meetings, lunch breaks and leisure time are carefully integrated within this tight schedule. Planning our daily activities, with the objective of taking full control excludes the possibility of flaws and mistakes, but also of surprises.

4.2.15. The purpose of mobility

The meaning of mobility has evolved since the introduction of autonomous electric mobility. External incentives have made us adopt a new way of transport, yet this externally driven morality has also resulted in prudent mobility concepts that do not feed our aspirational spirits. In the past mobility used to trigger our senses, which it now fails to do, in a traditional and emotional way. Mobility was a liberator and has become a pragmatic problem solver that supports collective efficiency, and provides the traveller the opportunity to focus on other activities that are not related to the act of displacement itself.

Due to technological innovation in the field of autonomous mobility, displacement has become available for a larger demographic in 2025. It especially holds great potential for those that are physically limited (STT, 2013, p.106). It was expected that autonomous mobility would result in fewer accidents and less congestion. Yet, especially in the beginning stages that we find ourselves in in 2025, congestion has increased significantly. Not only due to the testing, as it is still in its infancy, but also due to the increased amount of people that have been enabled to become road users.



The combination of a shared economy and autonomous mobility has naturally evolved to a phenomenon known as Mobility as a Service. The relationship between humans and vehicles shifted from ownership to usership. When mobility developed to a service the focus has become on the experienced comfort by the user, and how the time gained can be used efficiently (Daimler.com, 2014).

4.2.16. New way of working

Novel technologies like augmented- and virtual reality will allow for new working scenarios (STT, 2013, p.70). Computers already allow us to work location independently, anytime and anywhere. Coffee shops are filled with people working from behind their laptop taking a sip of their coffee. Because businesses today largely depend on ICT infrastructure, employees have basically become able to work at any location as long as there is an Internet connection available (STT, 2013, p.118). This naturally increases the amount of freelancers, whom are expected to eventually be dominating the labour market. According to (Mondiaal nieuws) it is expected that by 2020 one out of three working individuals will be working on a freelance basis. Smartphones, tablets and laptops have contributed to the level of globalisation as we know it today, and the IoT will increase this even further. We have grown dependent on the devices that connect us to the Internet, and the freedom that they provide us with. New developments in the field of augmented and virtual reality are changing the way we travel and do business, as it will enable us to separate our virtual and physical presence, connecting us on a global level (Bowman, D.). In 2014, as a response to these developments and their potential impact to the way we work and interact; the Dutch politician, and current party leader of the labour party, Lodewijk Asscher informed the government that the economic system as we know it today will proof to be unsustainable in the future due to technological advancements. He stated; that income and our tax system need to be changed completely, to allow citizens to earn a living in the future (Asscher, L., 2014).

4.2.17. Vision conclusion

The Industrial Revolution of the IoT will be unlike the industrial revolutions that we have witnessed in the past, due to the aspect of computational thinking. Expected is that fewer jobs will be generated with the advent of the IoT, and that more will be automated. The jobs that will be created will require a higher level of education than those that have been made redundant as a result of automation. Job redundancy due to automation does not describe a consecutive path, it is based on the level of repetition that can be witnessed. Automation will therefore be able to replace factory workers, but also the work of accountants. The socio-economic phenomena of individualisation and globalisation in combination with technological phenomena like servitization and autonomous mobility, will lead to products providing services that are tailored to the individual's requirements. Data harvesting will allow product service systems to be improved, and will provide companies with valuable information.

For the sharing economy to become globally adopted, the individual incentives should be well understood. The financial incentive has proven to be the dominant driver behind the participation of individuals in a sharing economy. Therefore for it to become truly successful it is key for the individual to recognize the additional financial benefit he or she will gain.

These phenomena introduce a transition of our economic system. We will witness the economic system develop from a centralized system that applauds personal ownership as a characteristic of success, to decentralized system that is less focused on perceived monetary success, but rather focused on solving environmental issues, and using resources intelligently. Alternative concepts are born due to the aversion to our hyperconsumerism behaviour, and the developed understanding of the negative impact of our individual ecological footprint. Urbanization due to an increase in global population will apply pressure and challenge urban transportation solutions. It will require smart planning and allows for new transportation solutions. Autonomous driving and Mobility as a Services are examples of what we will experience. These phenomena will be responsible for changes in the way we interact with vehicles.

“The road to self-redundancy”

Vision

4.3.1. Studying the domain: The Netherlands and Amsterdam

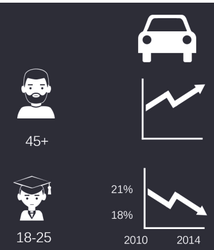
That we are on the verge of a global change in mobility is undeniable and inevitable, due to exponential technological innovation in the field of sustainable transport and the capital being invested. It is expected that by 2050 66% of the global population will be living in an urban environment (United Nations, 2014). Like many cities, Amsterdam will face the difficult task to find ways to cope with the increasing number of inhabitants and annual visitors, in an already crowded space. Yet, Increased globalisation also allows for talent being attracted from all over the world to the Netherlands. The city is keen on attracting highly educated talent, as this improves the country's global competitive position (Gemeente Amsterdam, 2016, P.13). In the process it is important to find a balance between efficiency and comfort for both future inhabitants and existing inhabitants. Even though space is limited, the city will continue to make place to attract new talent.

More inhabitants will result in more daily displacements, which increases traffic congestion. Currently in many streets in Amsterdam the NOx particle count is on average 15% above the European maximum of 40 ug/m3 (luchtmeetnet. nl). The CPB (Centraal Plan Bureau) predicts that the distance travelled in cars in the Netherlands will continue to grow with at least 8% and maximum 23% in 2050. This prediction does not include the potential impact of the autonomous vehicle. As the amount of traffic is expected to increase cleaner modalities will be required in an already polluted environment.

The innovation in the field of autonomous mobility will, especially in the first phase, contribute to the already existing congestion problem. The CPB also predicts that cargo transport, via rail- and waterways, will increase with 14-52% between now and 2050, based on international and national economic developments (Gemeente Amsterdam, 2016, P.11). According to the CPB there is an increase in car ownership in the age group above 45 years and a decrease in the age group below 45 years. The largest decrease is visible under 25 years, from 21% in 2010 to 18% in 2014. With the introduction of a driving license for the scooter in 2010, fewer 16 year olds are now purchasing a scooter. Even though this decrease is visible, the total amount of scooters registered in the Netherlands is increasing (Appendix R). This increase is due to the scooter gaining in popularity among a different demographic. According to the Dutch Branch Organisation for Mobility (BOVAG) the increase in scooter use among an older demographic user-group, is because it has lost its immature image, becoming a serious alternative for commuting (BOVAG, 2015). What is interesting is that a survey, conducted by Goudappel Cofffeng and Youngworks, shows that the youth does still experience the scooter and car as products that contribute to their personal brand image, and are certain of owning a car before turning 30 years old (Goudappel Coffeng & Youngworks, 2016).

To relieve urban environments from heavy congestion, and improve the air quality, municipalities have started to actively decrease the presence of cars in cities. The objective is to decrease the congestion and create more quality public spaces. The introduction of Low Emission Zones should regulate the type of traffic that enters urban environments, as vehicles that are registered as too polluting will be prohibited.

The car will become a less favourable option for urban transport due to legislation that restricts older and more polluting vehicles from entering the city. This legislation also affects the scooter, and in combination with the required driving license it is assumed that the popularity of the scooter will continue to decrease among the youth. When cars are eventually completely prohibited from entering urban environments, and scooters have lost their popularity among a large demographic, what will be the dominating modality in our urban environments?



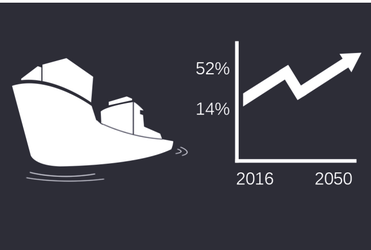


Image: Fine dust in Amsterdam

4.3.2. Creating a well functioning organism

Municipalities, architects and trend forecast/consulting agencies develop ideas and concepts for the future of urban environments. The challenge is that there exist many influential factors, and generally not much attention is paid to the underlying connections between mobility, society and urban planning. This results in a jigsaw with the right pictures but wrong shape, failing to create coherent image (STT, 2013, p.8). For a project revolving around mobility it is therefore important to study the future of its context, as this is also not a static concept. Currently, it appears that the innovation that takes place in the transportation industry is outpacing the innovations on an infrastructural level. This resembles the required infrastructural innovation that the network operators in the telecommunication industry were required to follow (Dr. Ir. A.P. van Deventer. 2011, P.20). The amount of data traffic that the existing mobile infrastructure was capable of handling did not equal the immense service and data sharing capabilities that the smartphones were able to deliver. The traffic was present, yet the infrastructure was not available yet, which happens when the two are not developed parallel to one another. The same now applies to new types of vehicles and the required physical infrastructure for it to succeed. This was confirmed by the municipality of Amsterdam (Appendix O), as the city is forced to work on pilot basis, as long-term projects are outdated on the day that they are finished due to the constant changes and innovation. Transportation should therefore, from the initial ideation phase, be recognized as an integral part of a larger interwoven network in our society. It is dependent on human behaviour, technological-and-social developments, and a function of our society. Infrastructure and mobility therefore should be developed in parallel to lay a strong foundation, and mobility should not suffer or become delayed by a slower developing infrastructure.

4.3.3. Amsterdam - Smart city

By connecting objects in the city to the Internet, the city becomes smarter and more information will become available, this allows for many possibilities and potentially new business (Gemeente Amsterdam, 2016, P.15). TomTom and Google have agreed to cooperate with the municipality, for research and experiments, and to share the accumulated data with the municipality (Gemeente Amsterdam, 2016, P.31). A smarter city is a more efficient city. As devices can communicate with each other, sharing information real-time between different sources like mobile phones, navigation systems and cameras. This will result in lower congestion as vehicles can suggest alternative routes, avoiding being stuck in traffic (Gemeente Amsterdam, 2016, P.16). Appendix M provides an overview of the projects that are currently being developed to solve congestion related challenges. A common characteristic between these projects is the use of smart technology to improve efficiency. In 'living labs' knowledge institutes and industry will work closer together, and will pilot social and new technological innovations. These innovations can potentially improve the cycling safety and result in improved services, like parking facilities. This stimulates the usage of the bicycle and will improve health and quality of life in the city (Gemeente Amsterdam, 2016, P.17). Amsterdam's sustainability program supports and tries to accelerate the transition to cleaner-and in specific electric mobility. In this program there are no requirements for cleaner air, yet it is part of the objective for all projects currently being conducted and those of the future (Gemeente Amsterdam, 2016, P.20). This requires learning by doing, conducting research, connecting, testing and starting collaborations. The city as a Living Lab, should lead to smarter investments for the people of Amsterdam and those visiting, the companies and partners in and outside the city (Gemeente Amsterdam, 2016, P.21).

4.3.4. Traffic in Amsterdam

On the first of April 2016 Amsterdam counted a total of 838.338 inhabitants, of whom 764.000 own at least one bicycle, over 1600 an electric bicycle and 24.000 a scooter (gemeente Amsterdam 2016-2, p.26). Traffic as a whole is expanding and causes an even higher congestion on the already busy roads. More people are moving to Amsterdam, more jobs are created and the city attracts more tourists. Yet there is a smaller budget available for mobility (Wiebes, 2013, P.3). The result is that fewer resources are available, and that in a limited space smart solutions need to find an answer to the growing demand for mobility. This results in prioritizing cost efficient and space saving modes of transport and more efficient usage of the existing capacity.

Amsterdam has the ambition to accelerate the transition of ownership to usership, to solve the increasing level of congestion. As reducing the amount of vehicles leads to more space and efficient usage of the available transport solutions (Gemeente Amsterdam 2016, P.35). Therefore car sharing concepts will continue to receive support, to reduce the amount of otherwise underutilized vehicles. Yet, the amount of cars maintains to grow, while ownership decreases and carsharing has increased with 376% since 2008. Even though the 376% growth appears to be significant, carsharing still only accounts for 1% of all cars present in Amsterdam (Gemeente Amsterdam, 2016, P.10). The most popular modes of transport are walking or cycling. In order to improve and maintain the living quality of the city, the municipality will focus on four programs that are in line with major global phenomena; the Internet of Things, a smarter and more efficient usage of space, Mobility as a service and autonomous vehicles. The municipality aims to achieve these goals by collaborating, monitoring and evaluating on approach, result and impact (Gemeente Amsterdam, 2016, P.24). Due to the rapid innovations in the fields of technology and mobility, and to create an understanding of the potential impact these might have on a city; a program has been created that is required to anticipate on changes in displacement behaviour. This program is called Smart Mobility, and the goal is to connect knowledge institutes with companies, related to urban transport specifically. The potential of this collaboration is for the collected data to be implemented in the city and act to solve pragmatic challenges.

With an increasing amount of displacements taking place in the country, solutions need to be found to cope with these challenges. The CPB predicts a growth of human transport from 23 to 50% in 2050 in the Netherlands, which puts the country under pressure and requires good organizing (Gemeente Amsterdam-3, 2016, P.83). The municipality becomes smarter via data harvesting techniques, and is able to gain insights in displacement- and behavioural patterns. A strict condition remains; to ensure the privacy of the inhabitants. This data has to result in smart mobility solutions for Amsterdam, where a cleaner environment acts as an important side effect, but is not the primary objective (Gemeente Amsterdam, 2016, P.7).

With as objective; improving the city, several Dutch municipalities have accumulated data and conducted research. The acquired data has been made publicly available, for companies to access (STT, 2013, p.113). By doing so the city aims to function as an international example in the field of innovation.

4.3.5. Creating space, quality and efficiency

In order to improve the air quality Amsterdam has decided to introduce a Low Emission Zone (LEZ). The LEZ will prohibit vehicles that have been classified as too polluting from entering the city, with as main objective becoming emission free by 2025 (amsterdam.nl). The city is experiencing a decrease in the amount of cars, but an increase in parking pressure because vehicles are only used incidentally, as cars are parked constantly for prolonged periods of time. In order to optimize the quality of the public space the goal is to have fewer cars and bicycles parked on the streets. The city will create more space by offering inhabitants, whom possess a parking permit, access to parking garages. By doing so the time spent searching for a parking place by visitors will also be reduced, eventually resulting in lowering emissions (Wiebes, 2013, P.22).

Via the Parkeerplan (2012), the Uitvoeringsagenda Mobiliteit (2016) and Visie Openbare Ruimte (2016) more public space will be made available by removing parking places. Visitors will need to park their vehicle in a garage at the border of the city, and enter the city via an alternative mode of transport like public transport. Parking garages will be developed on the Nieuwezijds Voorburgwal and Weteringcircuit. The goal in 2016 was to delete 517 parking places and for 2017 an additional 127 (Gemeente Amsterdam-3, 2016, P.91). It is very important for the city to remain attractive for its inhabitants, companies and tourists. New inhabitants value the quality of shared spaces, and the facilities an area offers appears to be the most important settling condition for new inhabitants (Gemeente Amsterdam, 2013-2). The priority in this environment lies in offering a reasonable amount and attractively furnished open spaces for pedestrians, cyclists and small clean vehicles. Between 1990 and 2010 the following developments in displacement behaviour can be witnessed: within the city a growth of the share of cyclists from 40%-60% at the expense of public transport and mainly the car. Urban traffic travelling to the centre area also shows a growth in the share of the bicycle from 15%-25%, at the expense of the car (Wiebes, 2013, P.18).

The biggest change in local displacement will not be around an increase of volume, yet it will be a shift in the means of transport and the way we use it (Wiebes, 2013, P.20). Yet, this also brings challenges; with the bicycle gaining in popularity; it adds to the already existing parking pressure and safety present in the city (Wiebes, 2013, P.22). The growing popularity of the bicycle is supported by the increasing costs to own a car in the centre; parking costs, insurance and taxes. The 'Amsterdam cycling to sustainability program' has as objective to promote Amsterdam as a sustainable and mobile city with as unique selling point the bicycle (Gemeente Amsterdam, 2008). More frequent use of the bicycle and decrease of cars will result in a healthier population and cleaner environment. The municipality continues to stimulate cycling, and dedicates a lot of attention to regulating safety. The amount of parking places will be increased, in a space efficient manner, to sustain the increasing number of bicycles. In this process busy train and tube stations will receive priority. Trade-offs are required, in order to allow for an efficient flow. Amsterdam will focus on improving the traffic flow, where the bicycle, pedestrian and public transport are planned to be the dominating modalities for the future. To improve the flow of traffic it is decided that not all modalities should be of equal importance in every street. Space has to be used more efficiently, and areas will be developed where specific road users will receive priority. This leads to the birth of so called 'plusnetten', creating a greater distinction between road users, with as goal a higher efficiency output. This also counts for the "red carpet" where the pedestrian will dominate and other road users act as a guest. The Sarphatistraat is a great example of Amsterdam's policy. It started as a pilot where bicycles were the primary users and the car a guest, with a maximum speed of 30 km/h. The pilot resulted to be successful and the Sarphatistraat will act as an example for other streets (Gemeente Amsterdam, 2017). This will hypothetically lead to a quicker and more efficient flow for all road users (Gemeente Amsterdam-3, 2016, P.83). The implementation of Plusnetten does need to be done carefully, to prevent the congestion problem from shifting to another street to favour one type of road user. Currently the city is becoming less wel-

coming to cars, via different initiatives. The cars are being obstructed from entering an increasing number of streets. This leaves visitors of the city confused, and results in a higher amount of search traffic. This initiative appears not to be applicable to every situation, as it might result in one street being relieved from heavy congestion, but the problem is being shifted to another (parool.nl, 2015).

4.3.6. Public transport

In the “Structuurvisie 2040” Amsterdam explains that the underground network is appointed to become the backbone of the entire city. Since 2014 the total amount of inhabitants, commuters and visitors that utilize public transport has been growing. Based on tourism it is expected to continue to grow in the future. One of the examples that will change public transport in Amsterdam is the Noord/Zuidlijn, which is currently being tested, and expected to begin its service in July 2018 (nos.nl, 2018). The underground network will be extended with an additional 9,7 kilometres, becoming the backbone of the public transport network.

The government and public transport regulators are collaborating in the “Hoogfrequent Spoor program” to improve the connection of public transport in the city to that of nationwide transport. This should lead to a higher quantity of trains entering the capital. This might result in an increase of visitors or more visitors travelling by train instead of by car, contributing to a lower congestion in the city. 2017 initiated the start of constructing an additional network of public transport above ground (Gemeente Amsterdam-3, 2016, P.82). This should result in relieving highly congested nodes in the public transport network, and due to the development of other stations the unilateral focus on the Central Station will change. This indirectly also influences other means of transport, and travelling to and from these public transport nodes. The amount of busses will increase and will all receive a terminal station near an underground station at the north- and south side. Tramlines in the centre will be relocated more East-West for a better connection with the underground network. The goal is to create a more efficient and better integrated mobility network, with the underground as main connector.

Due to an increasing amount of inhabitants and visitors new residential areas and public attractions need to be realised. The goal is to create quality housing, and attract visitors to relieve the city centre from its unsustainable congestion. One of the examples is the North of Amsterdam. This district is becoming more popular due to the development of quality housing, facilities an public attractions. The realisation of the Noord/Zuidlijn will contribute to the accessibility (Gemeente Amsterdam-3, 2016, P.85). The North is expected to attract more traffic, and even with the additional underground network the capacity of the ferries that connect the Northern part to the Central Station is required to increase (Gemeente Amsterdam-3, 2016, P.82).

4.3.7. Gentrification

The process of socially upgrading certain urban districts as can be witnessed in the North of Amsterdam, also known as gentrification does bring challenges and negative aspects. Gentrification describes the process of the social and spatial manifestation of the transition from an industrial to a post-industrial economy based on financial, business and creative services, with associated changes in the nature and location of work, in the occupational class structure, earnings and incomes and the structure of the housing market (Hamnett, C., 2003, Gentrification and the Middle-class Remaking of Inner London, 1961–2001).

The first phase of gentrification results in a mixture of different social classes. Yet, the social upgrading continues and eventually eliminates the original social class, that is forced to move due to increased housing prices.

This leads to urban sprawl, and results in those with capital living in or near the city centre and those without living at the borders

4.3.8. Urban districts

Finding a solution to the congestion problem that Amsterdam faces is a challenging task. Yet, finding one that applies to all city districts is impossible. Due to the individual differences between districts, applying the same strategy to the different districts of Amsterdam will not be successful. A different approach per district will be required.

These differences are due to a combination of factors, like demographics and ethnics, but also the spatial distance between the home environment and facilities. For example: the city centre of Amsterdam has been designed around the modality horse and carriage. The streets are narrow and facilities are located on walking distance. The North of Amsterdam has been designed to facilitate harbour activities and has a more industrial character, where residential areas and shopping facilities are separated. These differences have resulted in different modalities being favoured per district, and forms a significant threshold to apply the same strategy to every district.

The share of people that use a car in the Centre and New-West is relatively low, around 9-10%. In the South and North relatively high; 26 and 30% respectively. The share in public transport is high in the South-East. The scooter is most often used in New-West and West, with 4% of all displacements (Gemeente Amsterdam, 2015, P.76). In the North, New-West and South-East housing areas and shopping facilities are divided. This results in a higher usage of vehicles, compared to other districts. The level of education appears to be the main influencer of bicycle usage; income is decisive for car and public transport usage. Individuals that enjoy a higher education appear to use the bicycle more frequently, and individuals with a high income use the car more frequently (Gemeente Amsterdam, 2015, P.76).

Grocery shopping is done by foot or bicycle, yet the district is decisive as in some districts the distances that need to be travelled are greater which results in the usage of different means of transport (Gemeente Amsterdam, 2015, P.76). Even though new regulations concerning the scooter are about to be introduced, the amount of vehicles carrying a scooter numberplate has increased from 48.987 in 2011 to 54.348 in 2014. In 2014 there were 29.722 scooters (limited to 25 km/h) and 23.723 registered (limited to 50 km/h) (CBS, 2014).

4.3.9. Conclusion

According to the Parkeerplan (2012), the Uitvoeringsagenda Mobiliteit (2016) and Visie Openbare Ruimte (2016) more public space will be created in the centre of Amsterdam, with as main goal living, and to generate more space for pedestrians and cyclists. Amsterdam is experiencing a decrease in the amount of cars, but an increase in parking pressure because vehicles are only used incidentally. It is clear that the main modes of transport that Amsterdam wishes to support are the public transport network, bicycle and walking at the expense of larger and personally owned modalities. As a result; the ambition has become to accelerate the transition of ownership to usership, as reducing the amount of vehicles leads to more space and efficient utility of the available transport solutions. The inhabitants of Amsterdam will benefit from a cleaner environment. The municipality aims to solve the transportation challenges by improving the public transport system. As the city attracts more highly educated talent, more space is required to provide housing to these new inhabitants. Due to this increased popularity housing prices start to increase which has a negative effect on the original inhabitant of the gentrifying district. This results in the city becoming unaffordable to live in for those with a lower income and/or educational background.

The urban districts differ from each other and require an individual approach. This results in different modalities being best suited for different districts. Where the bicycle might be favoured in the centre, the car might be a better solution to cover the larger distances in the North of Amsterdam.

4.4.1. Effects on Amsterdam

The generated vision communicates a future where the advent of the IoT will disrupt the lives of many individuals by automating jobs that consist out of repetitive cognitive or physical tasks. Automation in combination with gentrification will specifically affect individuals with a lower educational background and/or income. What professions will be affected first and in what way do these phenomena affect the chosen domain of:

"Mobility for individuals with fewer financial resources, living in urban environments in 2025"

According to (Gemeente Amsterdam, 2013) the Metropolitan Region of Amsterdam (MRA) offers 1.27 million jobs, of which 28% is labelled as low educated. This accounts for 350.600 jobs. For the last 25 years Amsterdam has become more prosperous due to an increase of high-educated inhabitants. This has led to an increase in housing prices making the city nearly unaffordable to live in for the remaining social classes. This has resulted in a geographic miss match between jobs that require a low education and the poorly educated (Gemeente Amsterdam, 2013). Currently the amount of positions that require a low education is higher than there are people that qualify (Gemeente Amsterdam, 2013). Urban sprawl due to gentrification is partly to blame for this, as the areas where housing is more affordable, like Purmerend, the opposite phenomenon occurs. Here it becomes evident that the low educated are simultaneously affected by the automation of production processes and gentrification within urban environments. Another factor that applies pressure to the job security of the lower educated is the fact that the average education level is rising, yet the amount of positions requiring an academic level of education is limited. This results in positions that require a low level of education being taken over by highly educated.

Labour supply among the poorly educated has always been a good indicator for shifts in the economy. As the products or services that they provide are the most vulnerable to economic shifts. Therefore this social class is most interesting to monitor, with the advent of redundancy due to automation. Automation describes a phenomenon that will impact us on a global scale, and one that we all will become acquainted with. For the society as a whole, it is therefore very important to closely monitor how automation will affect those that become its first victims.

Since the 1980's a shift from industrial related jobs to service based jobs is visible in the West of Amsterdam. The highest amount of low educated jobs is to be found in the profit sector; wholesale and retail (25%), hospitality (13%) and distribution and logistics (11%) (Appendix N). In 2001 jobs in the industrial sector were also part of this list, yet due to automation and relocation of production facilities to low-cost countries, many jobs have been lost (Gemeente Amsterdam, 2013). The three sectors consist out of a range of professions, of which some examples are listed below:

- Wholesale and retail: Copy assistant, delivery employee, warehouse and sales representative.
- Hospitality: Host(ess), kitchen worker, coach driver, barkeeper and waiter.
- Distribution and logistics: postman, truck driver, forklift driver and bus driver.

An increase of available jobs in the service industry is also due to the increase of highly educated inhabitants. This group has more capital to spend, which boosts the leisure economy.

4.4.2. Gentrification unique to Amsterdam?

The process of automation is a global phenomenon that we will all experience the consequences of. Will the challenges that occur due to gentrification be unique to Amsterdam, or is this another phenomenon that also effects other urban environments?

Amsterdam is not unique in the social "upgrading" process of urban districts, and pushing out those with fewer financial resources. According to (investopedia.com-2) 15 of the 55 neighbourhoods in New York have been classified as gentrifying. London is also no stranger to the process of gentrification (Hamnett, C., 2003) and the same goes for Berlin, where the government and municipality aim to prevent the capital city becoming estranged by average earners like in London (ft.com). It appears that the combination of a sharing society, automation and gentrification is applicable to many other cities, and requires attention. It is assumed, that even though the domain of this thesis specifically targets Amsterdam in the year 2025, that the outcome will be applicable to other urban environments as well, which increases the value of this study.

5.1. Statement

The future vision, which was the outcome of the clustered context factors, communicated the ingredients for a potential scenario in 2025. The dominating topic is the loss of jobs due to automation, especially affecting the less well educated of our society. The study that has been conducted in the domain clearly communicates two challenges; the introduction of a Low Emission Zone and the phenomenon of gentrification. The following paragraph contains a subjective reaction to the vision, leading to the mission- and context statement. This will lead to an understanding of what challenges the product to be designed is required to solve, and what developments it is required to support.

5.1.1. Position in society

The way in how we approach working is subject to a profound change on a global scale. Employers allow their employees to adopt flexible working hours, and an increase in freelancers has resulted in a 24/7 economy. This impacts urban planning, as mono-functional working areas belong to the past. Borders that used to separate our work, private and social life have slowly started to fade. Individuals can work anywhere and anytime (Wiebes, 2013, P.14). It only appears that not everyone benefits from the new way of working.

If we were to split the social classes into two groups, namely those with a high educational background, and those with a low educational background, one of the fundamental differences is flexibility. In our current society, professions that require a high education focus mainly on tasks for which a computer is required. This has resulted in a certain level of flexibility, where the individual's physical location is only restricted to the fact whether there is an Internet connection available. One can take his/her laptop and work on the go. Those with a lower educational background are limited to a specific physical environment, as their tasks often consist out of physical labour, e.g. working as a waiter in the hospitality industry, see Appendix N. This lack of flexibility also becomes evident with the advent of automation on the horizon. When a solicitor loses his/her job due to automation, the acquired skill set and educational background provides a certain level of flexibility. He or she would be able to start a new career in a wide array of industries, e.g. political, advisory or even in banking. Where as a carpenter has been educated for a very specific profession, and lacks this level of flexibility. The image below communicates the fact that it are the low-schooled that will be affected most by the three recognized phenomena.

5.1.2. A shift in the diffusion of innovation

In the first phase of the road to redundancy we witness automated systems replacing jobs that mainly consist out of physical and/or cognitive repetitive labour. This will affect a large group of mainly low-educated individuals. According to Everett M. Rogers' Diffusion of Innovations (1962): individuals that have a lower educational background, and/or lower income are less involved in the adoption process of the

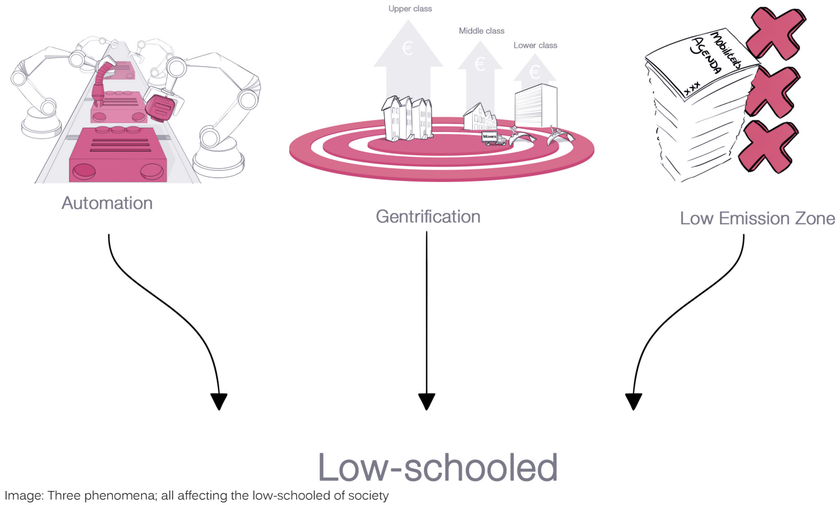


Image: Three phenomena; all affecting the low-schooled of society

innovation life cycle. These individuals often form the late majority, and are therefore traditionally the last to adopt new product innovations. They take a more cautious approach towards new innovations as it requires capital, and involves a high risk. These are often the same individuals that make up the working class with professions requiring repetitive physical labour (Investopedia). In the future vision, self-redundancy results in unburdening ourselves from lifestyles that focus on work, and forcing us to find our purpose elsewhere.

According to this scenario, it can be assumed that a possible outcome is; that financial resources will play a less significant role. Those that are the first to be affected by a change in our economic system belong to the lower social class. As the road to self-redundancy sketches an image that we will eventually all become subject to or affected by, the lower social class becomes in this respect the early adopter of our new economic system. One of the proposed solutions is the introduction of a Universal Basic Income. What I believe is the problem with a UBI, is that is will be issued by a centralized institution like the government. Therefore I feel sceptic towards its introduction, as society would become highly dependent on centralized authorities. This is not in line with the other developments that have been discovered; like the sharing economy, as these share characteristics of a decentralized system where its inhabitants are autonomous and know a high level of flexibility. I am in favour of decentralizing the monetary system as we know it today, but I believe this should come from autonomy rather than by receiving a Universal Basic Income, and I believe mobility has a key role to play in this transition.

The focus of this thesis is on the inhabitants of Amsterdam that have a lower educational background and/or lower income. In its first phase automation will affect jobs that consist of physical or cognitive repetitive tasks. Automation therefore will not only affect the lower classes in the first phase of the road to self-redundancy. The reason why this thesis aims at providing an alternative solely for the lower social classes is because they lack the resources and capital to fund a period of transition where they have to find an alternative. A higher educated accountant knows a greater level of flexibility on the labour market, where as a factory worker does not share this luxury. Even though individuals with a higher educational background will also be subject to the results of automation, it are the lower-schooled that will struggle with the lack of flexibility to find an alternative, and secure a position on the labour market once again. Besides losing their jobs, they are forced to move outside the city due to gentrification and with the introduction of the Low Emission Zone it is expected that many of them will also lose their mode of personal mobility. The product to be designed should therefore aim at providing these inhabitants with flexibility and autonomy, to earn an income on their own terms.

Amsterdam is a good example of a city consisting out of urban cells, to provide convenience for its inhabitants. Yet when we witness cities becoming heterogeneous spreads of homogeneous cells our exploratory character is dimmed down. Individuals can find anything that they need in a 5 minute radius, and are not encouraged to cross borders. I believe that mobility is synonym for exploration, and that it can still be in the future. The city should be approached as an organism or ecosystem; consisting out of different, yet supportive building blocks, embracing diversity and discarding the 5 minute walking city. In the process, mobility should encourage us to explore other parts of the organism, see image below.

The junction where automation, gentrification and policy making meet, is not only of importance for those directly affected by it. It is also highly imported for those whom do not (yet) lose their jobs to automation. In this respect; those that are the first to lose their jobs, and need to adopt a new economic system become the early adopters of which society can learn: finding meaning in a world where human labour has become less significant and an adopting an alternative incentive system.

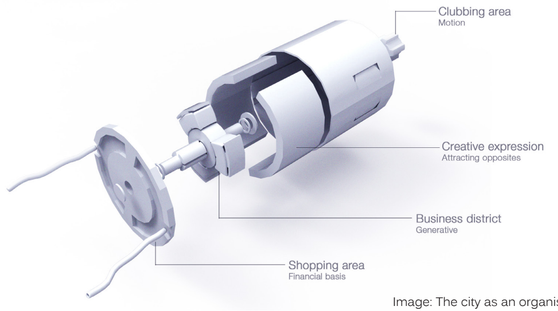


Image: The city as an organism

5.1.3. Alternative offerings of mobility

In the future mobility is expected to lose its exploratory and emotional character via the introduction of autonomous vehicles. It is assumed that mobility can play a role in solving the challenges that have been discovered in the future vision, in other words: mobility will have a pragmatic purpose, besides being a people mover, in conjunction with the unemployment of the lower educated. It is assumed that mobility can offer one of many potential solutions, by providing the individuals with autonomy, enabling them to become prosumers in a decentralized society. The term 'prosumer' was first mentioned first by Alvin Toffler in 1980 in his book: 'The Third Wave'. It describes the merger of consumers and producers, and enables individuals to make decisions on their own terms. The prosumer movement is yet another example of a decentralized system where the individual knows a greater level of autonomy. To create a vehicle that will enable individuals to become prosumers, three challenges need to be overcome; solve the congestion problem that urban areas are facing, mobility has to become part of an holistic network where the individual contributes to the collective and thirdly provide meaning to those that have been made redundant.

According to the created vision our future consists out of a decentralized marketplace, where we value usership over ownership. Urban environments have grown denser, and as a result of gentrification have become unaffordable to live in for the lower social classes of society. The lower educated are forced to live outside the city, and are most often relying on cheaper modes of transport. Specifically these types of modalities will be affected by the introduction of a Low Emission Zone.

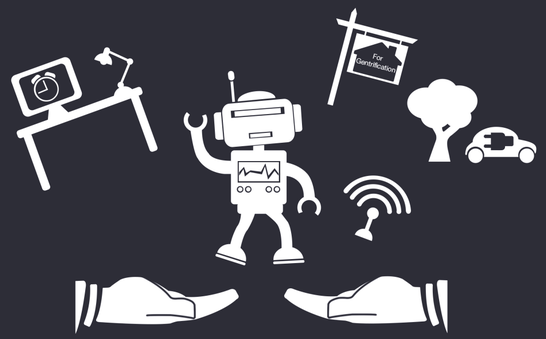
As a response to the vision it is stated that products should be required to contribute to our job prospects and stimulate the transition to a society that is made up out of prosumers. The junction where these phenomena meet has formed the departure for the design phase of this thesis, and can be translated in the mission statement:

'Enable redundant individuals to become prosumers in a service society'

This means that the product should provide autonomy to the individual and the flexibility to shift between being a consumer and producer, thus using the vehicle as a tool to generate an income or to commute from the living environment to the work environment.

The future vision has been based on clusters consisting out of value-free context factors. Creating a mission statement and context statement allows for the formulation of a subjective statement towards the envisioned future, and has resulted in the following context statement:

In the domain of *"Mobility for individuals with fewer financial resources, living in urban environments in 2025, I want to enable redundant individuals to become prosumers in a service society'*



3.3.3. Six factors

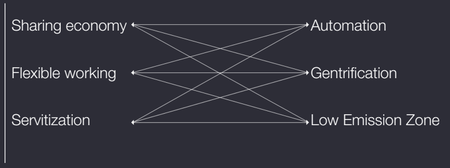
The factors that have been recognized, and marked as being of significant importance in the future domain all share a similar characteristic; a decentralized moral. These phenomena show that we are adopting new characteristics that are part of an economic model that is less focused on financial achievement and materialistic possessions. We are moving towards a society where physical products receive a new virtual dimension. The addition of software will result in service systems, and will not be private property, but part of the collaborative commons. Developments like automation will relieve many humans from their professions whom will need to find new meaning.

“Enable redundant individuals to become prosumers in a service society”

Mission statement

conclusion

Six phenomena have been highlighted, and categorized as being most significant to the chosen domain. It is assumed, based on the conducted research, that these phenomena provide challenges that will significantly influence urban displacement behaviour in the near future. These developments consist out of a mixture of socio-economic, technological phenomena and phenomena that influence urban planning. As mentioned; mobility does not solely depend on the urge of displacing from A to B, yet involves many factors. The challenge is to link these six factors, and create a coherent mobility concept that reacts to these challenges and phenomena.



6.1. Interaction

In 2025 it is assumed that we will still rely on the main driver of our current monetary system: individuals will need to generate an income. As professions that consist out of repetitive tasks will be automated first, former employees in these sectors will need to find alternatives in other sectors that are less susceptible to automation. To support this movement it is assumed that for the individual to hold meaning in an automated future, new products should enable and support the prosumer movement. This means that individuals will be enabled to use a product in the service industry, and by doing so generate an income. Thus, despite the advent of automation, gentrification and local policies these individuals will remain to have a purpose, even in an automated future. In the process of finding a new purpose, these individuals will experience a level of flexibility that they did not have before.

To achieve the goal embedded in the context statement, the desired interaction needs to be specified. In order to understand what interaction is required, the statement has been deconstructed, to understand the qualitative aspects on which the interaction can be built:

- Enabling autonomy and flexibility;
- Creating self-value, and a feeling of pride; I matter;
- The prosumer movement will create a feeling of unity;
- Being in control of the situation in uncertain times;

According to the diffusion of innovation model those with a lower educational background often form the late majority in the acceptance of new product innovations. On the road to self-redundancy these individuals naturally become the early adaptors of a new economic system. Words associated with this can be: 'uncertainty' and 'risk' on one side and 'being first', 'explorer of limits' and 'pushing boundaries' on the other side.

Adopting a new system requires trust from the individual, whom has become sceptical, as he has lost his sense of self-worthiness. Based on the context statement the following combinations of words could be descriptions of the desired interaction to reach the goal embedded in the context statement: Controlled adaptability, Feed individualism, Bring fulfilment, Empowering, Self-government and Stimulate autonomy.

Creating an analogy can mediate in understanding what behaviour and interaction are required to achieve the goal embedded in the context statement. The first analogy that describes this is a team player, as individuals rely on each other for collective success. A mutual trust is required between the players, which depends on their individual flexibility to adapt to different scenarios. The second analogy is that of a Swiss army knife. This is often referred to as a negative quality as it clutters the vision of what the product is, but the analogy should focus of bringing a limited set of possibilities that creates a feeling of freedom for the individual and being in control. The third analogy is that of a safety net. We are willing to take risks when we know that a safety net exists. Combining the three analogies resulted in the following interaction:

'Empowering trust'

We trust the product to meet with the requirements that we share. It is there for us when we need it to be and stimulates us to take risks, as it will support us in the process.

6.1.1. Product qualities

The goal has become; to enable those that have come to feel redundant, as their jobs have been taken over, to feel worthy and needed once again. The required interaction between the product and user is therefore described as empowering trust. In order to stimulate the desired behaviour that leads to this interaction, product qualities need to be specified. The product qualities or characteristics support the desired interaction, and creating these is the final step of the ViP process before the concept development.

Empowered trust is a feeling that can be achieved in many ways. When it is provided by someone or something else a dialogue is required to establish trust in the first place. This does mean not mean always getting what you would like to receive, but knowing that it is always in your best interest.
To materialize the feeling and derive qualitative and quantitative qualities an analogy has been created that explains the intended feeling: The analogy that describes this feeling is listening to your favourite radio station. You trust the station to play your desired genre of music, yet you can still be surprised, like in any type of good relationship. It is not always a positive surprise, but always one that brings the relationship to the next level.

Qualities that fit this analogy are expecting a certain level of *flexibility* and that it will *provide* your set of requirements in the future domain. This asks for *commitment* from the individual user and collective, while being *open* to surprises. The required product characteristics are: *rigid* while being *adaptive* to our desires. The product should be *inviting* and *open* to everyone to aim for a positive impact on both the individual and collective, in the domain of mobility for redundant individuals.

In order to convey the message of the desired interaction, characteristics and qualities a mood board has been created. This mood board will also be used as inspiration during the concept phase.

To summarize:

The product will enable individuals to generate an income by using the product in a shared service system. This is achieved by empowering the individual and creating a trust worthy relationship, based on commitment and flexibility. The qualities that contribute to the establishment and sustain this relationship are rigidity while being able to adapt to different requirements. The main challenges that the product will address are those affecting the lower class of society: automation, the introduction of the Low Emission zone and gentrification.

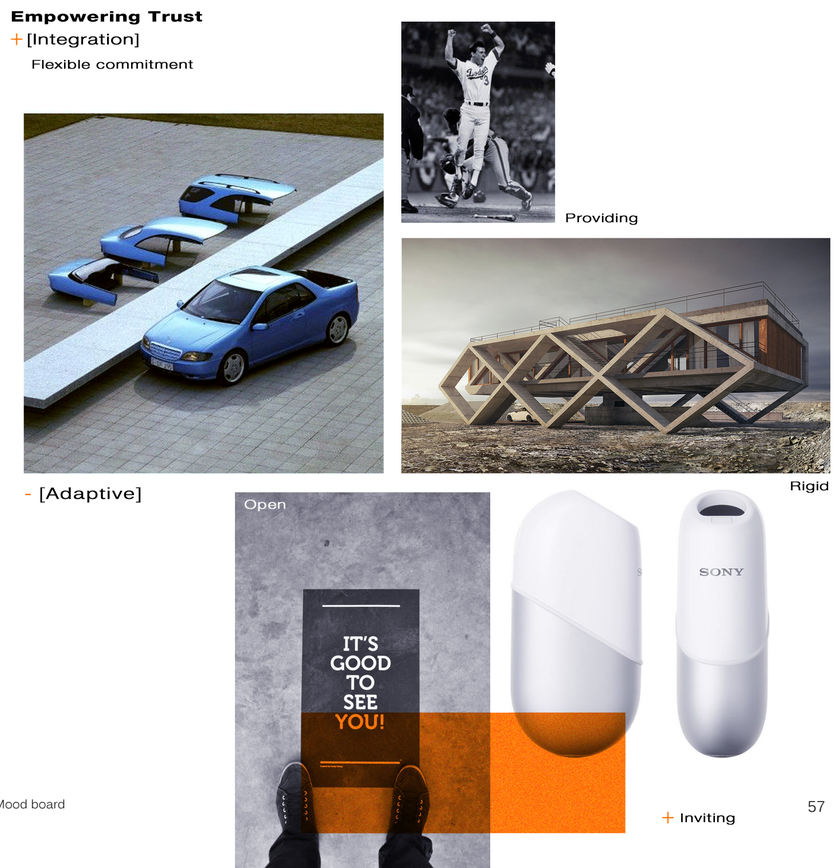


Image: Mood board

“Empowering trust”

Interaction

7.1. Three levels; network, marketplace and product

The objective of this thesis and the challenges the product is required to meet are complex and consist out of multiple layers that address social acceptance, commitment and active participation. In conjunction with the idea that infrastructure and mobility need to be designed hand-in-hand, it is assumed that within an ecosystem all individual components need to complement one another in order to design a well functioning concept. Therefore the outcome of this thesis has not solely become a vehicle concept, as this would only describe one part of the ecosystem, and holds no true value as a single entity. The concept relies on its components and the individual components on the overarching concept. Therefore a product service system has been designed where the interaction between the different layers is descriptive of the novelty of the entire concept.

Based on the literature research and meetings with the municipality of Amsterdam (Appendix g) an understanding has been created of what Amsterdam wishes to become in the future. This has resulted in creating a concept that holds meaning within the physical context it will be placed in, as future architectural and infrastructural plans have been included during the development.

The vehicle concept will share multiple objectives; generating jobs for the poorly educated, providing a means of transportation for those that fell victim to gentrification and urban sprawl, and a solution to the Low Emission Zone that will be introduced in Amsterdam in 2018. The outcome has resulted in a system that exists out of a website or marketplace that supports the phenomenon of collaborative creation, a network with hub stations that has been strategically located over the city of Amsterdam and a modular shared cargo scooter to generate an income for the inhabitants that will lose their jobs as a result of automation.

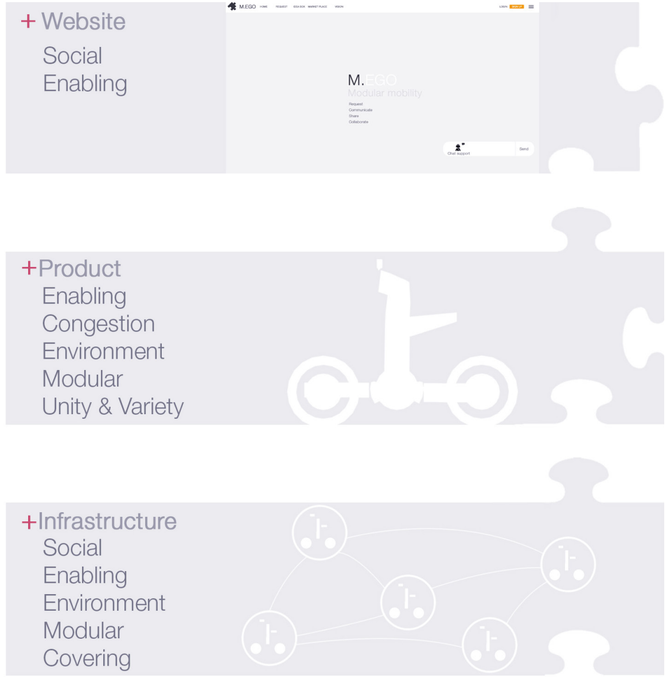


Image: The three layers of Mego

7.1.1. Modular mobility

According to the domain and context statement products should enable individuals to become prosumers. Yet how can mobility facilitate in the transition of becoming prosumers in a service society? Providing an answer to this question has become the objective of the final phase of this thesis: the concept phase. The generated vision, mission statement, interaction and product qualities mark the starting point for the ideation phase. The characteristics have become the ingredients for the detail design, ranging from friendly and flexible to rigid and adaptive.

The mission statement and interaction state that users should be enabled to create a relationship with the product based on trust. In this respect trust should be generated by the believe that the product will provide the means to achieve the individual's goal. In a shared system this will result in the product having to comply with a wide variety of goals, as different users share different goals. To cater to this diverse set of demands the concept of modularity resulted to be the desired means to meet with the diverse set of demands.

Modularity is an abstract principle and can be defined as the "Degree to which an article or system is made up of relatively independent but interlocking components or parts" (businessdictionary.com). As this is a very general description, a more specific description of modularity for this thesis is provided: '*Urban environments are places of diversity, diversity among its inhabitants and diversity in the qualities and characteristics certain areas offer. As it is assumed and argued in this report that we are distancing ourselves from the monetary system with its specified characteristics being: Private property, capital accumulation, wage labour, voluntary exchange, a price system and competitive markets. In combination with self-redundancy as a result of automation individuals are required to find a new purpose. Modularity in this sense means mediating in the process of individuals adopting a new economic system; the collaborative commons. A shared vehicle is offered, that can be modified to a certain degree by adding or taking away cargo modules. The created configuration enables the user to conduct specific tasks and earn an income by doing so*'.

The idea has been interpreted as enabling individuals, by providing a mobility tool that is adaptive to their diverging requirements. This has been translated into modular mobility.

The local policies and introduction of a Low Emission Zone will result in over 30.000 individuals losing the right to enter the city with their scooter. During a meeting on the 14th of November 2017 with the municipality of Amsterdam I was made aware that only a small part of this group can expect a compensation (Appendix g). For both the groups that do receive a compensation, and those that do not, a shared scooter system would provide a good alternative.

7.1.2. The ecosystem

The generated vision developed into a complex concept of layers that need to be addressed in order to provide security for those whose job has been lost as a result of automation. For this ecosystem to succeed, factors as socio-economic phenomena, infrastructural phenomena and city planning are required to be included. The outcome of this study has been treated and described in the literature and strategic phase of this thesis. This has led to an ecosystem that consists out of three layers, namely an online marketplace, a network system and a shared modular cargo scooter named Mego. In the following sections of this report a clear definition of the entire ecosystem will be provided.

7.1.3 Marketplace

In line with the current development of our economic system, it has been decided to implement the aspect of collaborative creation. This manifests itself in the form of an online marketplace, see image on following page. The purpose of Mego is to offer a scooter that hosts various types of cargo modules to transport different types of freight. This will enable users to work for third parties like Deliveroo or DHL. Due to the concept of modularity the cargo modules can be selected based on the type of cargo that is going to be transported. This means that one cargo module will be designed to keep food cool, while the other is designed for parcel delivery.

Mego will be introduced with a limited amount of basic modules. The intended goal is that the market will recognize more potential and think of other more bespoke services. For this reason the online marketplace has been designed. This marketplace can be compared to the e-commerce platform Shopify, where web-developers offer their services to individuals or companies to build a website. Shopify offers basic themes, yet when the client desires additional plug-ins he can ask the online developer community, whom can offer their services for competitive prices. The online marketplace will work in a similar manner. This reveals the second job providing pillar, which is the result of collaborative creation. Mego users will be able to share their specific wishes for a new cargo module on the online marketplace. Freelance designers can react to these requests and offer their services to create a new design. When the designs are made available, they can be downloaded and manufactured. By doing so, Mego becomes a product of collaborative creation, a product of the city.

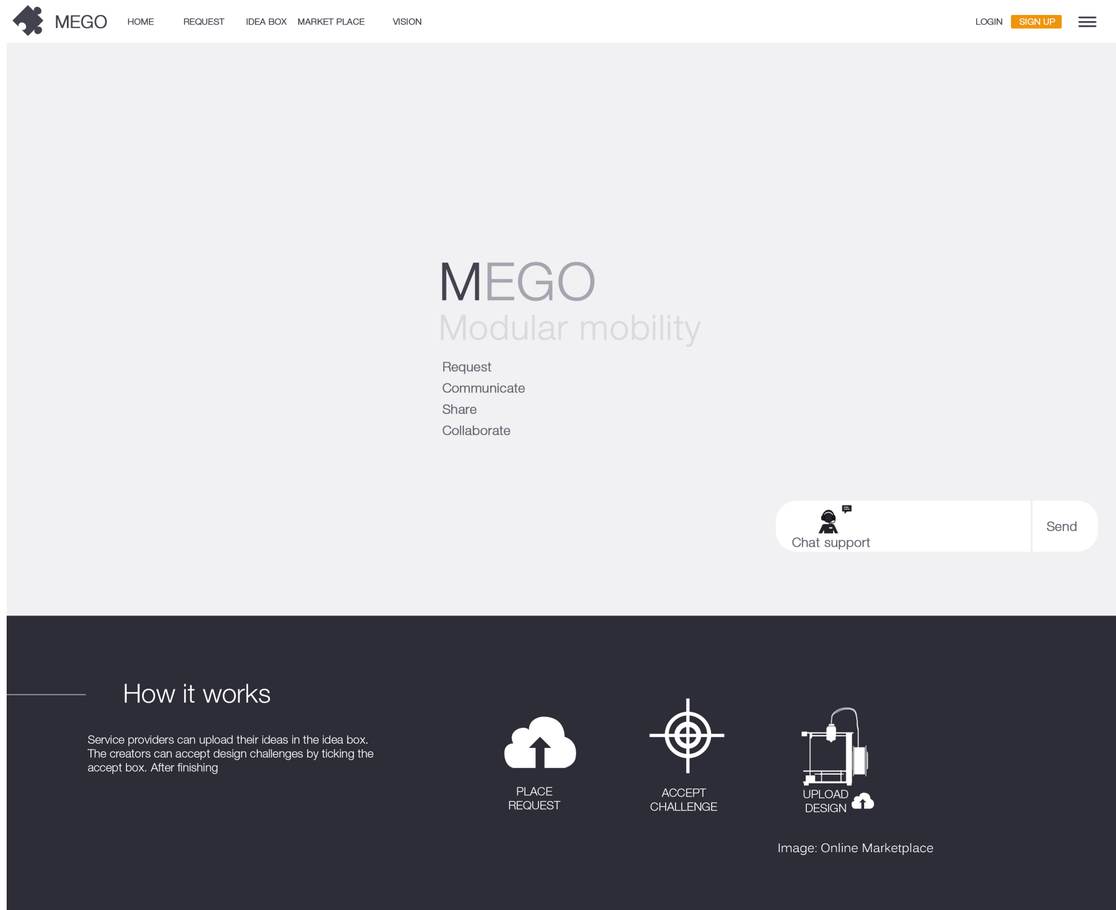


Image: Online Marketplace

Image: China free-floating shared bicycles

7.1.4 Network type

The second layer of the concept consists of a network, where the shared scooters will be placed in. The network can be designed in two ways: a hub-network or a free-floating network. The difference between the two is that within a hub-network the vehicle should be returned to one of the charging stations within the network, where as in a free-floating network; individuals can park the vehicle wherever they desire after usage. According to Luud Schimmelpennink; a hub network is more favourable, as it adds more structure to the system, even though a free-floating network appears to provide more flexibility for the user (Appendix G2). Based on the current experiences with free-floating bicycle sharing programs in Amsterdam, it has been decided to design a hub network, as this proves to be more sustainable, for both the collective and individual, in the long term (van der Linden, S., 2017). The problem associated with a free-floating network is that it can easily result in the opposite what sharing aims for; sharing should result in relieving the city from underutilized vehicles. The effects of this are currently experienced in Amsterdam with both the shared bicycle-and scooter programs. The threat of bicycles and scooters being scattered over the city is not restricted to Amsterdam, as is illustrated by the image on the left. This image shows piles of bicycles that are part of sharing programs in China.

7.1.5. Network design

For those individuals that are affected by gentrification and the introduction of the low emission zone; a better understanding has been created of what professions account for the highest percentage of low level educated individuals. Appendix N provides an overview with the professions that are the largest employers of low-schooled individuals. In the introduction phase, Mego is to be used by low-income/low-schooled individuals. The challenge in designing a hub network that covers the entire city is the positioning of the individual hubs, to meet with the requirements of the users and improve the chances of success. For the design of the network five factors have been taken into consideration, of which the data was retrieved from the Dutch bureau for statistics (CBS). The five factors are relatively; concentrations of low-income individuals, concentrations of individuals receiving social benefit, hospitality concentrations, urban districts that currently have registered most scooters and finally the car free zone.

As discussed in paragraph 2.1.4. inhabitants whom have a CityPass, with a green dot, will be offered a compensation for losing the right to enter the city with their old and polluting scooter. According to the municipality this accounts for 2300 inhabitants (Appendix G). The municipality will offer a variety of compensations to the 2300 scooter owners that comply with the requirements of owning a CityPass with a green dot. The municipality stated that they would consider a Mego membership as a potential addition to the already existing compensations. When all of these 2300 inhabitants would chose to adopt a Mego membership, and based on the fact that a shared vehicle is used up to four times more efficient (Larson, K., 2012), 575 shared Mego scooters will be required. According to the municipality, currently up to 80% has decided to use the provided compensation to invest in an electric scooter, which the municipality admitted was surprising to them. The required quantity of 575 scooters is solely based on the 2300 inhabitants that own a CityPass with a green dot. It does not include the 65.020 inhabitants that receive a social benefit, or the 32.000 inhabitants that are unemployed. The amount of 575 scooters in this respect will be a first milestone, on the road to enable individuals to become prosumers in a service society.

There exists an interesting correlation between the unemployment rate per district (Appendix I) and the modal split (Appendix K). A large share of scooters is registered in New-West, where as according to Appendix I, this urban district also accounts for the highest unemployment level.

Taking these factors into account, an aerial map of Amsterdam has been created that highlights these areas, and indicates the spread of these social classes. These areas naturally overlap, and provides an insight in how an efficient network can be designed that meets with the individual requirements.

As the aerial map shows the initial focus for Mego will be on Amsterdam-ZuidOost, Bos en Lommer, Nieuw-West and Amsterdam-Noord. These urban districts represent areas with the highest percentage of low income and high social welfare inhabitants. Hub stations located in the centre connects the locations to areas with high concentrations of professions requiring a low educational background. This map is based on the current situation and it is likely to change between 2018 and 2025, due to gentrification leading to urban sprawl. When and if the area that illustrates the intended car-free will be implemented is currently uncertain, but the municipality does support the transition to a complete zero-emission city centre by 2025.

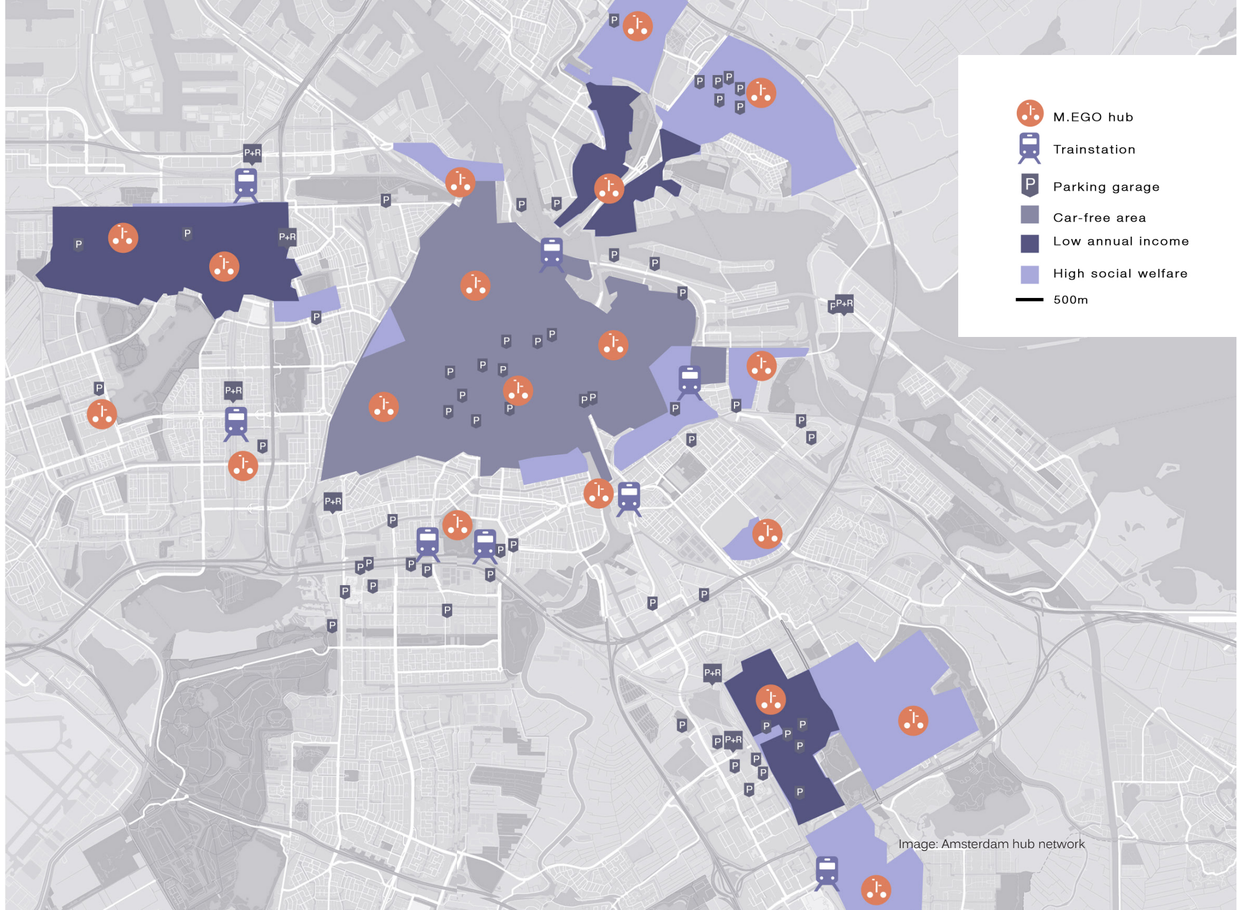


Image: Amsterdam hub network

7.1.6. Difference with existing sharing services

As stated in this report; the primary objective is to enable individuals to become prosumers in a service society. Existing bicycle or scooter sharing programs share different objectives, and Mego would provide a complementary layer. As an example; The London Santander bicycles are part of a public bicycle hire scheme. This means that its objective is also to allow tourists or visitors to use the bicycle to experience the city, in a more flexible, more environmentally friendly and less congesting manner. This significant difference has resulted in a different approach to designing the hub network. The focus for Mego has become to address the challenges that automation poses, and provide an alternative modality to commute between low income housing areas, and concentrations of low educated occupation areas. Therefore the objective is not to eliminate all other scooters, yet to provide this select group with a tool to generate an income and commuter. This results in significantly fewer scooters required to meet with the objective. Where London has a network of 11.000 public bicycles, with over 700 docking stations and in total 19.000 docking points, covering an area of approximately 100km^2, with a cycle docking station situated every 300-500 m. (Duncan, R., 2015). With 575 scooters Mego would only require a fraction of the London network.

7.1.7. Shared system – hypothetical usage

To create a hypothesis on how the scooter will be used on a daily basis, the displacement behaviour in Amsterdam has been studied. During weekdays 118.000 individuals travel from their home to work between 08:00 - 09:00 (Appendix H). This includes door-to-door and first-mile last-mile traffic. This is the first of the two highest intensities in traffic per day. After 09:00 the congestion decreases and the vehicle that was used to get to work is usually becomes static. This results in the opportunity that during the day the vehicle can be used for other purposes, like parcel delivery services. The second highest peak in traffic occurs between 17:00-18:00, and illustrates people commuting from work to home (Appendix H). After 18:00, when people returned home, the frequency of food delivery is highest. Mego will transform from a commuter to a food delivery service due to the modular cargo modules. It is expected that after 23:00 the vehicle can be recharged, or be used by people that work night-shifts, as half of the Dutch working class works in the evening, night or during the weekend (Beckers, I., 2002). The table on this page summarizes the hypothetical usage on a daily basis.

Timeslot	Objective
08:00-09:00	Commuters driving from home to their work (door-to-door and first-mile last-mile)
09:00-17:00	Parcel delivery
17:00-18:00	Commuters driving from work to home
18:00-23:00	Food delivery services
23:00-09:00	Individuals that work during the night
00:00-00:00	*When not in use, the vehicle can be either charging or being used by tourists

Table: Mego hypothetical usage

7.2. Business model

7.2.1. Incentives to use Mego

As can be concluded from the literature study; the incentives for individuals to participate in the sharing economy are mainly of a financial nature. It is assumed that for the introduction of Mego to be successful, usage should pose a serious financial alternative to private ownership of an electrical-and internal combustion engine (ICE) scooter. The reason is that during the introduction phase people with a lower income and capital are targeted. According to the CBS housing costs account for almost 40% of their total expenses, and are therefore more thoughtful on what to spend the remainder on (cbs.nl, 2015). The costs associated with the private ownership of a scooter have been summarized, and compared with the potential costs associated to a shared scooter service (Appendix U). This indicates that with an average speed of 30km/h scooter sharing costs are between €0.34 - €0.80/km. These costs are higher than the costs per km of a personally owned scooter (€0.29/km, scholieren.nibud.nl), excluding the purchase price of the scooter, helmet, lock etc. The aspect and unique selling point, that differentiates Mego from existing shared scooter programs, is the fact that it is designed specifically to generate an income. Therefore the difference is that when you use Mego it does not only cost, but also enables you to generate an income. This additional layer is believed to be a strong financial incentive to convince individuals to use Mego. The case studies that have been conducted during the literature phase indicated that communication with the targeted market to create awareness is a very significant factor to improve the chances of success of a new product innovation.

The challenge is to introduce Mego and create awareness of the additional service layer. Marketing strategies should be applied reaching the implied user, yet (Appendix I) shows that the low-income group consists out of a diverse spread of demographics. Therefore different marketing methods are required to inform and create awareness among the lower educated. Social media is often associated with the youth, but according to (newcome.nl, 2016) elderly were mainly responsible for the registration of new Facebook-accounts between 2013-2014. Facebook advertising allows you to specifically target the intended group with advertisements, based on age, gender, level of education, interests, relationship status and place of residency. Therefore using social media as a platform to introduce Mego, would address the entire targeted user-group. This does not mean that more traditional media like the television and print should not be used to reach the older generation. The municipality has sent out numerous letters to scooter owners living in Amsterdam, to inform them about the new legislation (Appendix S). The same media could be used for Mego to directly address the user group. Another form of printed media is the local newspaper the 'Stadskrant' that contains news and updates per city district. While Facebook has gained in popularity among the older generations, a decrease in popularity is visible among the youth (The Washington post, 2015). At the expense of Facebook, other social media platforms have gained in popularity among the youth over recent years, examples are Instagram and Snapchat. To conclude the following media will be used to target scooter owners directly via newsletters, the 'Stadskrant' and the social media platforms Facebook and Instagram.

7.2.2. Revenue model

In order to create a sustainable business a roadmap and business model are required. As an elaborate roadmap can become a thesis on its own it will not be discussed in-depth. Yet a start will be made, to discuss where the opportunities lie. Per delivery or service conducted by a Mego user a small percentage will go to Mego. The online designers will also be paid via the income generated by the conducted services. The cargo modules can be privately owned, or owned by third parties, with their own branding etc. The marketplace exists for freelance designers and users of Mego to create, in a collaborative fashion, new modules. Mego will adopt a facilitating role, rather than controlling the development of new modules. A style guide will be made available as a source of inspiration for the designers. When a design has successfully been uploaded, the designer will be paid per download.

Similar to the Apple Appstore designers will be able to allow third party advertisements, which will generate an extra revenue stream for the designer, by for example allowing Uber Eats to place their logo on his/her design. Within the Apple Appstore there exist different business models (developer.apple.com):

- Free model (Earn via adds)
- Freemium model (Free product with in-app purchases for upgrades)
- Subscription model (In-app purchases to view content)
- Paid model(single payment)
- Paymium model(pay for the app and additional in-app purchases for upgrades)

The strategy used for Mego is going to be a Paymium model. The modules need to be purchased, and additional revenue can be generated by allowing third party advertisements.

8.1. The product

8.1.1. Conceptualisation

According to the conducted case studies during the fuzzy front end of innovation the following factors have showed to contribute to the success of a new product

- Understanding of domain and future social context
- Core dependent on developments instead of trends
- Sufficient technological research
- Design according to MAYA

The literature study resulted in the domain, and the future vision has been based on a combination of context factors that mainly consist out of future developments rather than current trends. The remaining two factors will be addressed in the conceptualisation and embodiment phase of this thesis.

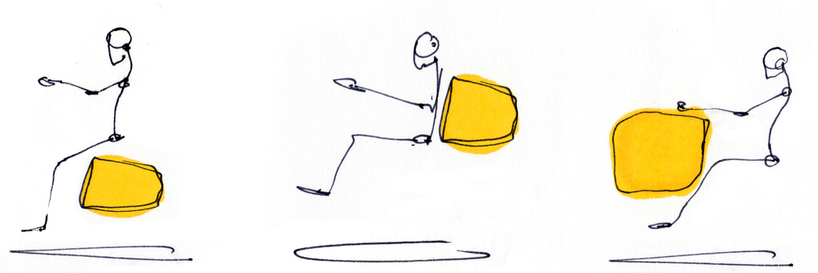
8.1.2. Ideation

The concept of modular mobility describes the outcome of an elaborate literature study and strategic design process. This thesis shares similar values with Stint and Urban Arrow (Appendix T), which are giving the user control over the cargo that they can transport. The objective of this thesis differs in the fact that the cargo modules are to be designed by other individuals. During its life cycle, these modules can constantly be replaced, making it a dynamic design. Unlike the Stint or Urban Arrow, Mego has also been designed to be used in a shared network, rather than being personally owned. This increases user efficiency, but also relieves individuals with fewer financial resources from the required financial investments associated with private ownership.

The objective of the ideation phase therefore resulted to be a search for volumes that enable the concept of a shared vehicle that should enable individuals to generate an income. The challenge is to find a volume that is receptive to the concept of modularity, yet does not appear to be incomplete without the additional modules fitted to it. The form language of the scooter and modules should radiate coherency rather than result in two contrasting volumes. It is assumed that it is important to achieve a balance between the pragmatic aspects that the scooter offers on one side and aesthetics on the other side. In other words; the product should not become a container on wheels.

The ideation phase was therefore started with exploring two factors, the position of the driver and the position of the cargo volume. During this initial ideation three options were found; in front of the driver, underneath him and behind the driver. Each of these different solutions have benefits over each other.

It was decided that pushing the volume, rather than pulling it like a cargo bicycle made more sense. Having the cargo underneath the driver does result in a low centre of gravity, which is desirable for handling, but loading cargo in or on the vehicle was expected to be less favourable. Positioning the cargo module in front of the driver provides a feeling of being in control



Centre of gravity	+	+-	+-
Loading/unloading module	-	+	+
Cargo Overview	+-	-	+

Image: Cargo positioning

The initial ideation phase resulted to be a search between a pragmatic cargo transporter and aesthetic vehicle with coherent lines. This has resulted in a novel archetype, which can be best described as an upside down letter T.

During the sketching phase I sometimes deviated from the search for a volume and tried to render certain details, as can be seen in the sketches on this page. This slowed down the process, as detailing is not the objective during this stage. I sought inspiration in many different areas, yet the interaction of the Star Wars droid on his vehicle (bottom left sketch) provided me with the inspiration to pursue a different interaction between the user and the product.

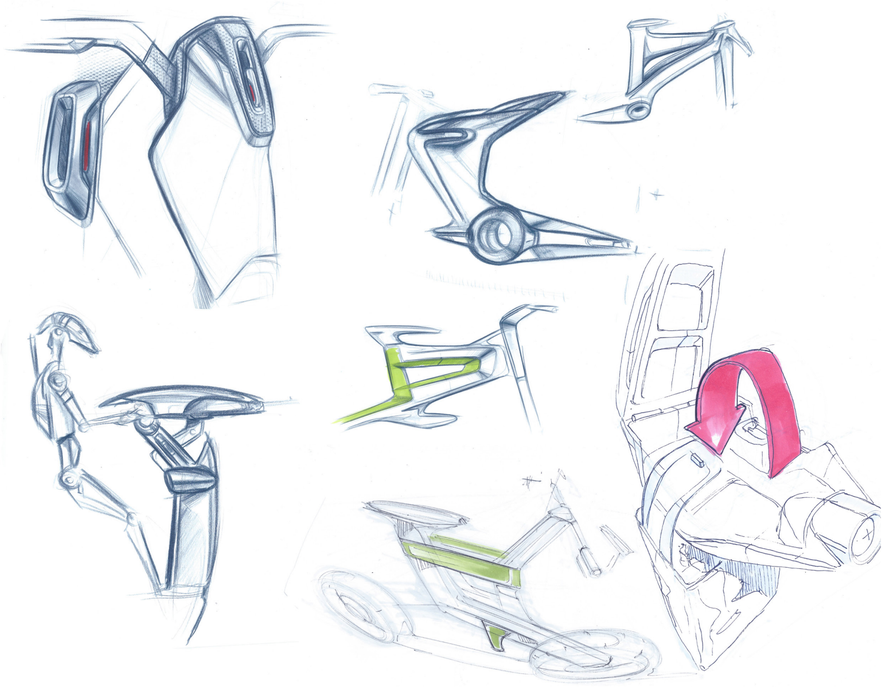


Image: Ideation

The ideation phase resulted in one final concept. The concept of modularity, to accommodate the user to transport different types of cargo, which was the outcome of the ViP process has influenced the scooter on a platform and volume level, and has resulted in a new archetype. During the following steps of this thesis the design will be refined, by implementing the characteristics that have been derived during the ViP process.

As the scooter is based on a new platform, the purpose of the volume and detailing is to support the platform. Due to its novelty I believe detailing should focus on unifying the design. During I found inspiration for the form in a penguin flapping his wings, bottom left image. Curving his/her chest resulted in the feeling of rigidity while maintaining an open character.

Image: Concept direction

8.1.3. Introducing Mego

The sketching face slowly started to materialize and resulted in Mego. Mego is the abbreviation of Mobility LEGO, and emphasizes the modular aspects of the concept. Mego has been designed from the start with the intention of being shared, rather than personally owned. The cargo transport capabilities allow for low-schooled individuals to earn an income by conducting different types of services to third parties. The horizontal base volume consists out of three modules; a front wheel module, centre module and rear wheel module. On top of that a frame is positioned, that is referred to as the tree trunk. The tree trunk is the centre module that connects all modules to each other. The aim to optimize cargo transport capabilities, which resulted in a new archetype that gives Mego its distinctive shape. The open space that has been created at the front of the scooter can be used to connect different kinds of cargo modules to the tree trunk.

8.1.4. Form hierarchy model

The Form Hierarchy Model has been applied as a tool to aid in the design process. This model has been developed by Grondelle and van Dijk, with as specific purpose to analyse company structures. For this thesis it has been used to implement the outcome of the strategic design phase on its different levels. The form hierarchy model distinguishes five physical layers of the concept, from platform to detail. This model can help in the deconstruction of a form analysis, yet can also be used as a tool in concept development. The ViP methodology and the Form Hierarchy Model have been used consecutively. Both models can be deconstructed in order of importance. In the ViP model all layers should support the intended interaction, leading to the goal embedded in the context statement. In the Form Hierarchy Model all layers should support the same intention, as an example; a MPV (Platform & Segment) with racing stripes (Colour & trim) communicates a confusing message where the intended context and interaction are unclear. Thus the layers lower in the hierarchy should be supportive of the platform and segment, similar to the different layers in the ViP model.

Providing autonomy and earning an income via modularity have become the most important characteristics of Mego, and the different layers of the form hierarchy model should communicate this message clearly.

The desired interaction has been formulated as *"Empowering trust"*. The goal of the product system is to bring fulfilment, provide an empowering feeling and stimulate autonomy. These factors require trust, as the user will rely on the system to enable him to become independent. The required qualities that contribute to this interaction have been formulated as *flexibility, provide, commitment* and *open* to surprises. The required product characteristics are: *rigid* while being *adaptive* to our desires. The product should be *inviting* and *open* to everyone to aim for a positive impact on both the individual and collective, in the domain of mobility for redundant individuals.

8.1.5. Platform & segment

For both the platform and packaging, cargo transport has become the dominant factor in the design. The cargo module has been placed on the front of the scooter rather than on the rear, which is more common for a scooter. One of the arguments for placing the module in the front is to enable a more stable driving experience as the centre of mass coincides with the normal force of the front wheel. When the mass is placed behind or above the rear wheel the total mass on the rear wheel increases. This results in a higher normal force, increasing the angle theta of the resultant force in the y direction rather than the x direction; reducing the effective power. This is due to the fact that the rolling resistance Fr1 (see Free Body Diagram on the following page) increases due to a higher load. The increased rolling resistance results in the motor having to conduct more work (W) to achieve a similar result as when there is a lower rolling resistance. To lower the centre of gravity it was decided to incorporate all components related to the drive train and power source in the horizontal base platform. Placed on top of the horizontal volume is the vertical volume, referred to as the tree trunk. The tree trunk has become the centrepiece that connects to all the other modules.

Volume and packaging describes how the volume is placed on the platform. As this project concerns the design of the scooter platform and segment and volume and packaging have been integrated in a single layer in the Form Hierarchy Model. For a Powered Two Wheeler the human interaction aspect does play an important role in the design and interaction with the product. The silhouette is a combination of the vehicle and its driver, and this greatly affects the overall proportions.

8.1.6. Form language

The characteristics that are the result from the ViP methodology determine the form language. This has resulted in a mood board to communicate the intended form language. It is important for the form language and detail design to support the main concept of the Form hierarchy model platform and segment, which are modular and cargo capabilities. The form language should aid in the user understanding the intended purpose and interaction of the vehicle.

8.1.7. Detail design

The objective of the mission statement resulted in a novel platform and segment. For the intended users to understand and accept the concept it has been decided that the design on a detail level should be minimal and not distract. The detail design has to support the character of a modular cargo delivery scooter, yet line continuity connecting the individual details also played an important role to create a product with coherency. Another important aspect is that the product has been designed with the

intention to be used in a shared network. This also contributed to the idea of keeping the design minimalistic and neutral, as it needs to the taste of a diverse multitude of individuals.

8.1.8. Colour & trim

Colour and trim form the final layer of the Form Hierarchy Model. In this stage colour and trim are of lesser importance. Like detail design, the colour should support the concept of cargo transport, have a neutral appearance and fit its surrounding infrastructure.

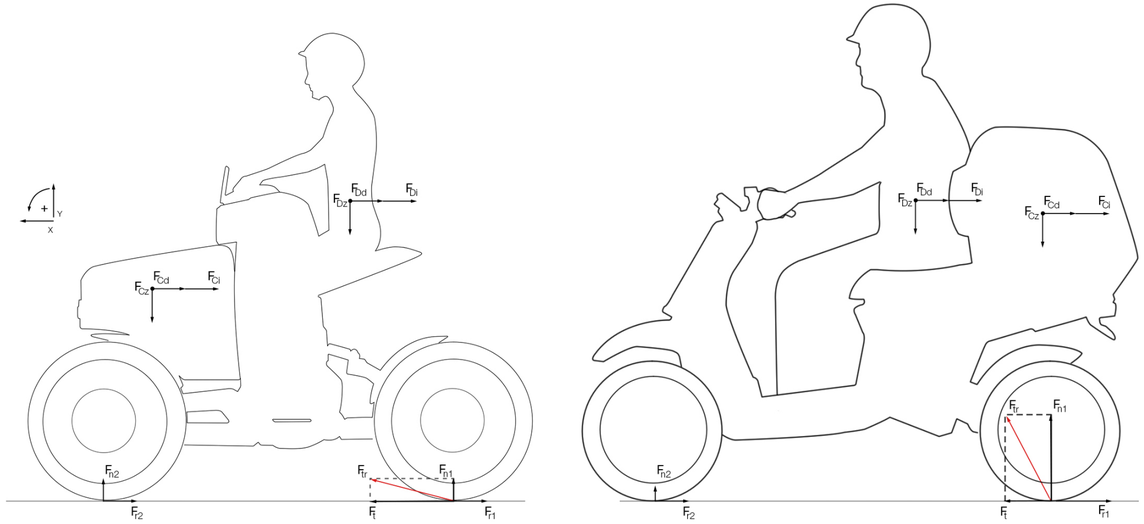


Image: Resultant force

Image: Different cargo moduels

Image: Mego with cargo modules

8.1.9. Design

The final design communicates the concept that evolves around transporting cargo. Even though the chosen body colours of the cargo module and scooter are contrasting the overall volumes are not. Integration of the cargo module and scooter was one of the objectives which is believed to have been achieved.

The generated product qualities and characteristics of the ViP process resulted in keywords like inviting and open. The overall volumes of both the scooter and cargo module are believed to share these qualities, yet the detailing and form language lack in some aspects. The hard geometric lines express a feeling of aggression, which does not contribute to the idea of openness and inviting. The detail design phase that follows will therefore aim at materializing the generated qualities and characteristics on a detail level.

Detail design

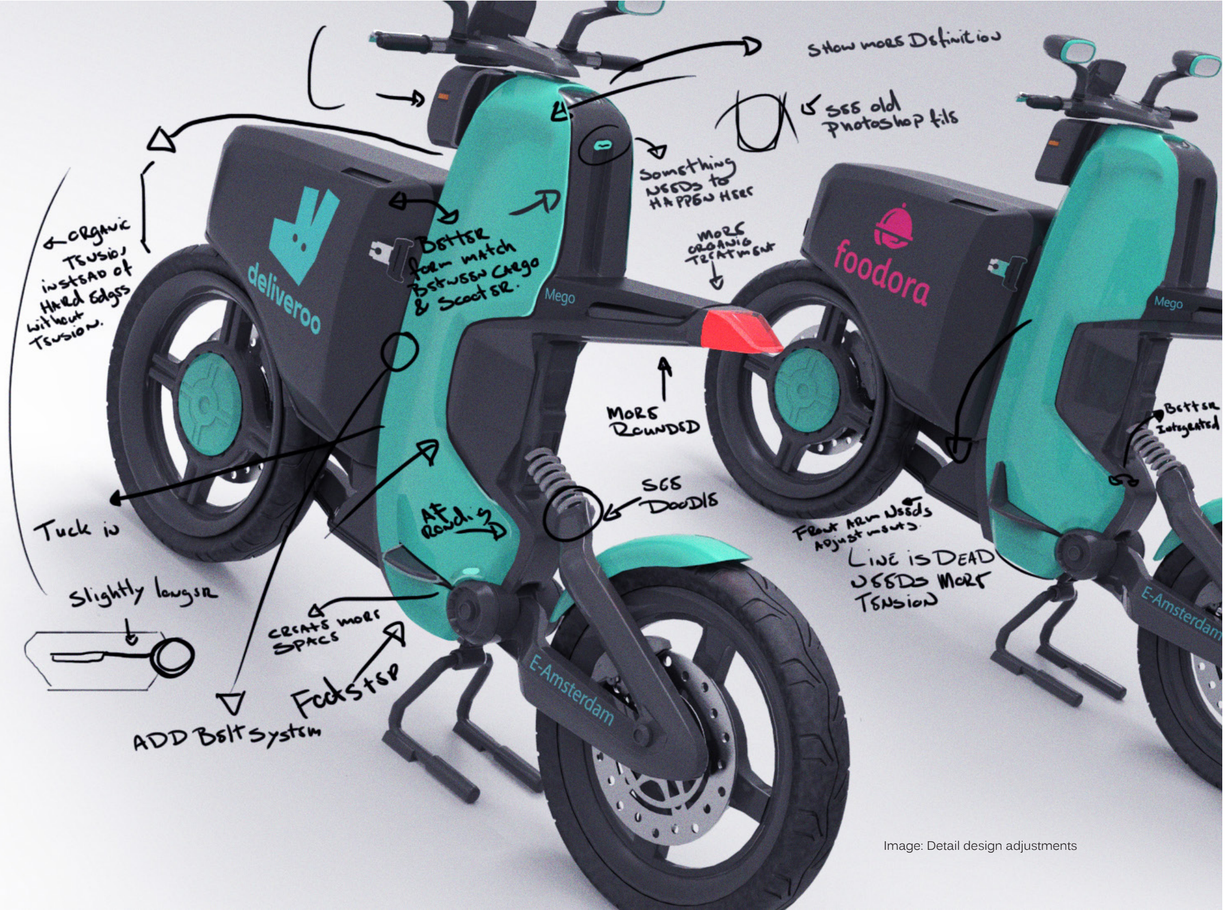


Image: Detail design adjustments

8.2.1. Main adjustments

The image on the left shows two scooters, the one on the far left includes the intended adjustments that need to be made to the design. The scooter on the right shows the old design.

The main challenge has been to create a more dynamic character, and materialize the outcome of the product qualities.

In order to accommodate the cargo module the vertical volume, or tree-trunk needs to be vertical, so that the module can be placed as close as possible to the front of the scooter. Yet, this resulted in the character line that starts at the top and continues to the foot steps to lack tension. This resulted in adjusting the vertical character line and graphically adding more tension to the design, with the front of the scooter remaining vertical. The housing of the headlight also conveyed a static image and needed to be adjusted to comply with the intended design.

The seat and tail light also had a very straight character which needed to be adjusted as this did not fit to the open and welcoming qualities that were the result of the ViP process.

Line continuity played an important role during the detail design process to create a unified design. This has been important as Mego already has a novel shape the detailing needed to be minimal to achieve the desired interaction.

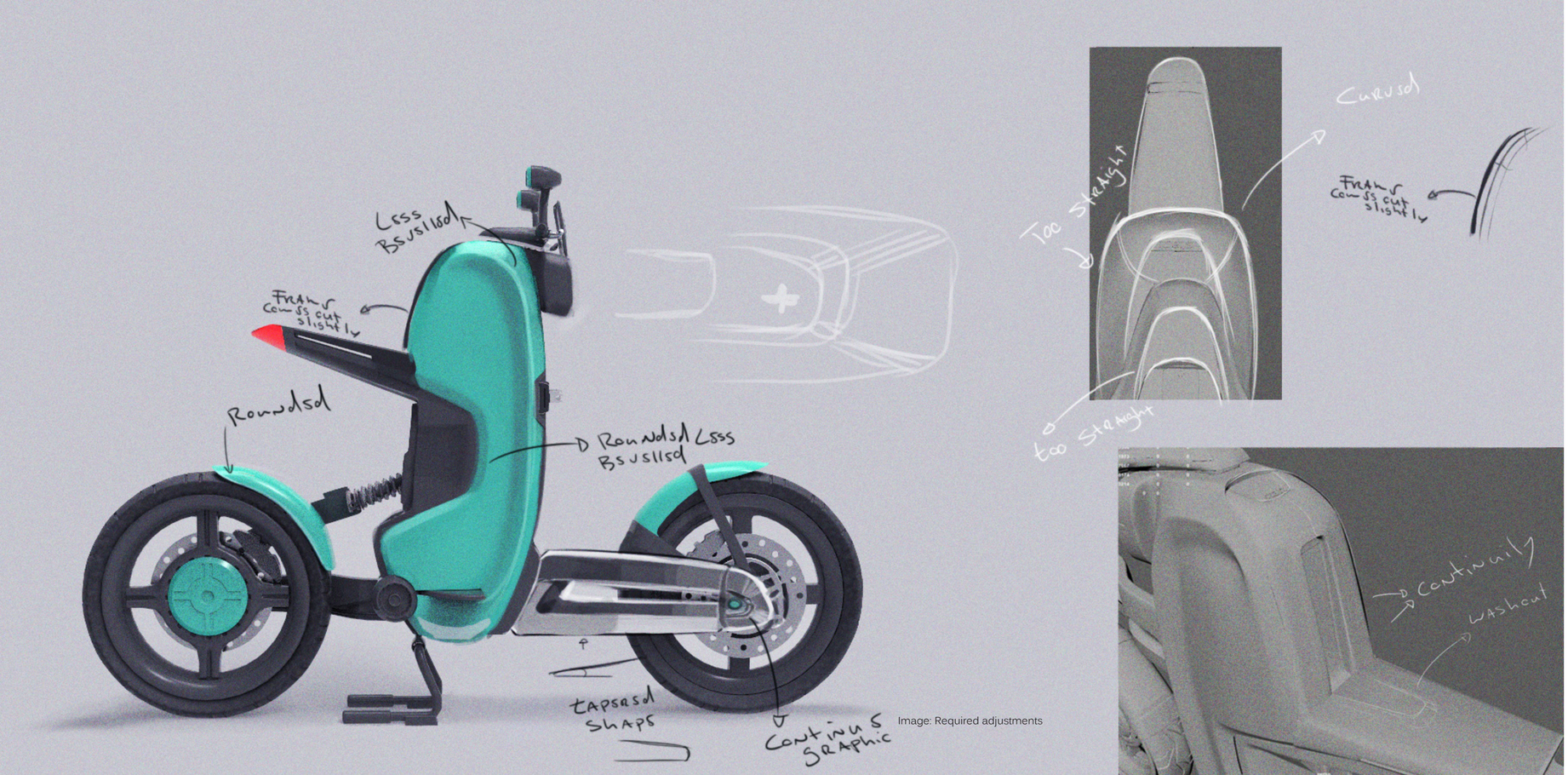


Image: Required adjustments

The general remark on the design is that it consisted out of harsch and straight lines. In some cases the straight lines appeared to create negative surfaces, which was an undesired result.

Both the front arm needed to be adjusted. Especially the front arm had to visually contribute to the forward motion of the scooter, resulting in a more dynamic character.

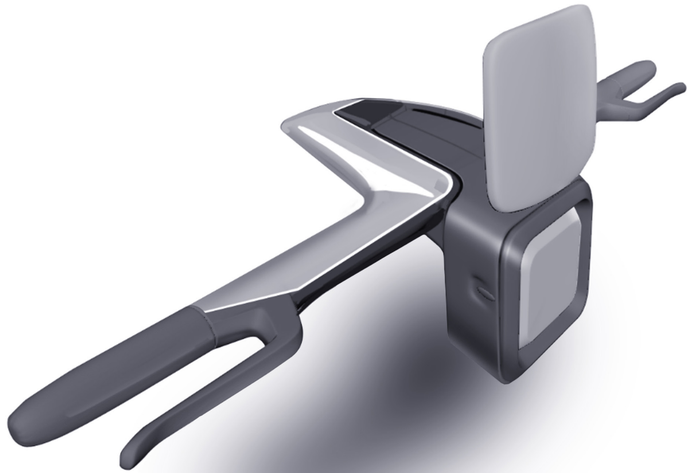


Image: Integrated handlebar detail design

8.2.2. Handlebar

During the design of the handlebar I tried to integrate it into a single unit with the headlight. In the sketches and Photoshop renderings this integration appeared promising. Yet, when positioning the volume on the main body the dimensions were off and the coherency in the design was lost, as the headlight unit appeared to be positioned too high on top of the main body. Therefore it was decided to stay closer to the original design, yet make the overall volumes more rounded.

Image: Handlebar detail design

8.2.3. Headlight

The headlight contributes to the character of the vehicle, as it plays an important role in the physiognomy, giving expression to the vehicle; an aggressive expression can potentially turn down certain users. As Mego is intended to be used by a wide variety of individuals I aimed for a neutral and approachable expression. This resulted in making the housing that holds the headlight more rounded, with a LED strip acting as a daytime running light. The Headlamp consists out of two half strips and one located in the centre. The central graphic of the headlight continues on both sides of the housing and introduces the indicator lights, resulting in a coherent design.

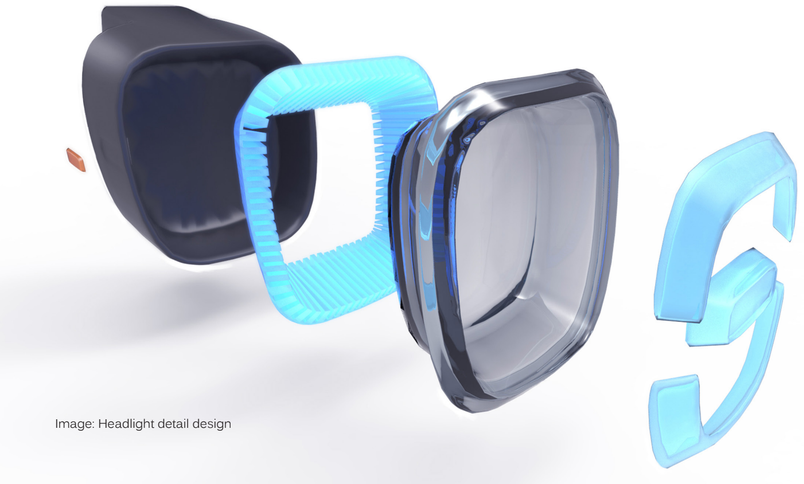


Image: Headlight detail design

8.2.4. Side mirror

Side mirriors are mandatory to have on a scooter since 2006 (snelslagen.nl). Also for this detail I searched for a shape that would not distract from the overall design, yet is not boring and contributes to the character the detials are required to express

The eventual keysketch on which the design has been based was inspired by a person wearing a helmet or a cap.

Image: Mirror detail design

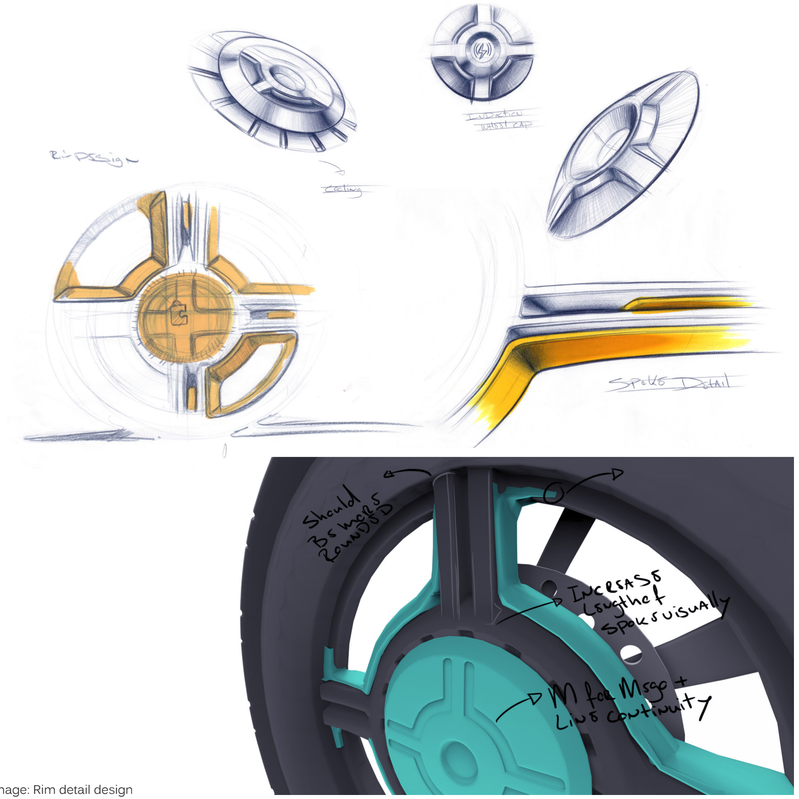


Image: Rim detail design

8.2.5. Rim design

Mego aims to convince the inhabitants of Amsterdam to participate in the sharing economy. As the research indicated the financial incentive outweighs all other arguments. As there is currently no charging standard for powered two wheelers I decided that the process of recharging the battery should not add additional steps for the user to conduct. Therefore it has been decided that the front wheel incorporates the receiving coil of an electromagnetic coupling pair. Charging via induction therefore became the dominant factor in the design of the rim. The wheel cap that lies on top of the rim acts as the housing for both the ferrite plate and secondary coil. I decided to design a rim with four spokes, and not make the design too complicated as this would be in contrast with the desired interaction. The lines of the spokes continue in the wheel cap, where an abstract letter M, for Mego, contributes to the continuity of the lines. The wheel diameter lies between 16-17 inches, which is relatively large for a scooter. The size for the wheel is also the result of the concept of charging via induction, as a larger diameter of the coils increases the maximum power transfer.

The actuator is located in the rear wheel. Therefore the rear wheel shares the same design aesthetics as the front wheel.

8.2.6. Footstep

Unlike a conventional scooter the feet of the driver are positioned on both sides of the scooter. For the design of the footstep I aimed for visually connecting the pivot point of the rear arm to the footstep extrapolating in the character line, which covers the side of the body panel. The footstep consists out of a metal frame and anti-slip to guarantee a safe ride.

At this point Mego has not been designed to be used by a driver and additional passenger, as the focus has been on transporting cargo. Mego therefore has no additional steps for a potential passenger.

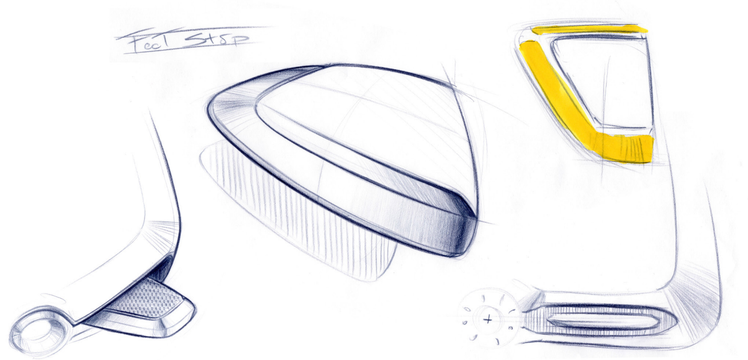


Image: Footstep detail design

Image: Final design with cargo module

8.2.7. Conclusion Detail Design

The main objective of the detail design phase was to create a coherent design. According to the form hierarchy model that has been applied during this thesis the detailing should support the intended interaction of “empowering trust”. This means that the vehicle should communicate the capability of transporting cargo. Yet, as the user will also rely on Mego to earn an income the relationship should also be based on trust and openness. This resulted in adjusting the initial design to a form language with more rounded details. I believe this gave expression to the desired product quality of expressing rigidity, while being open and welcoming to people.

8.2.8. Colour scheme

The objective of Mego is to generate an income by working on a flexible basis for different service providers. The idea that the product will be used for various third parties resulted in a neutral colour scheme of a grey frame, white fairing and turquoise detailing. The reasoning for this decision is that it will not create an unpleasant contrast when branding of third parties is applied to the cargo module.

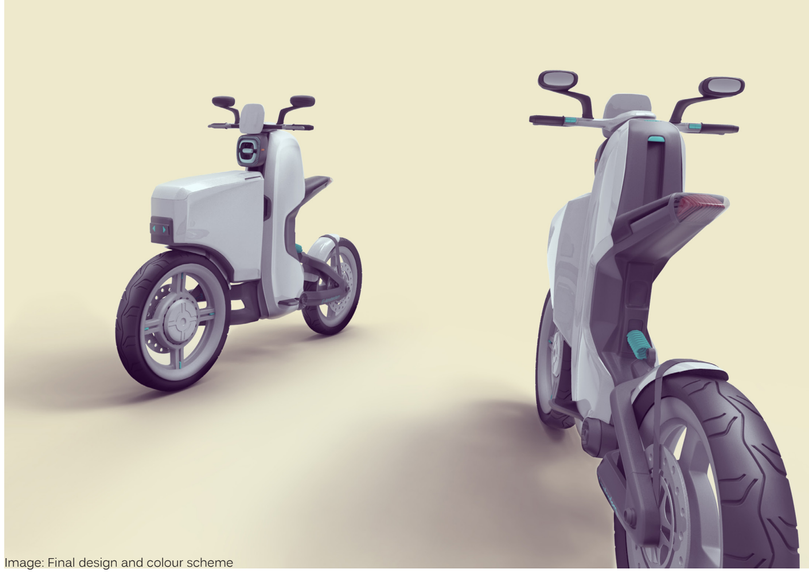


Image: Final design and colour scheme

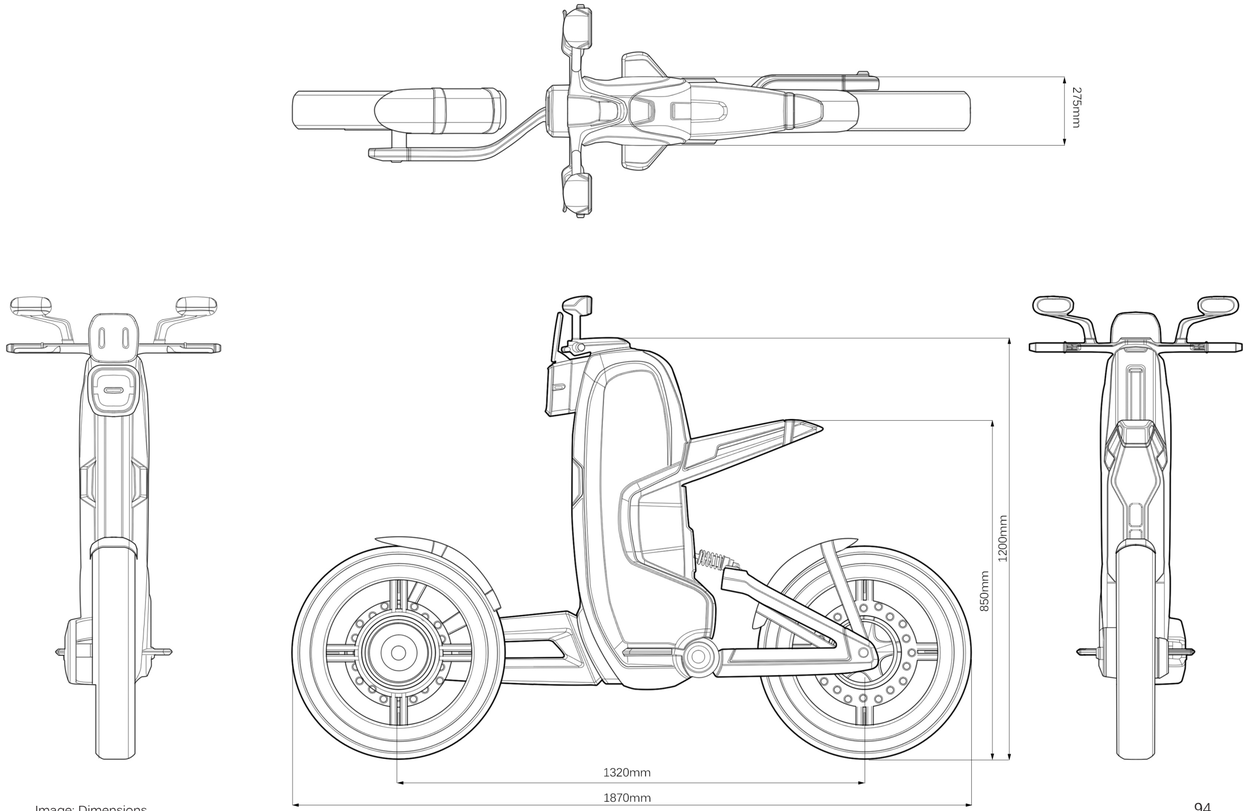


Image: Dimensions

8.2.9. Dimensions

The images on this page illustrate the intended posture of the driver and interaction between the driver and the scooter.

The previous page shows the orthographic technical drawings and main dimensions. The sitting height of Mego is with 850mm slightly higher than a conventional scooter (approximately 790mm). This results in a more upright and active posture, and good overview over the cargo that is being transported.

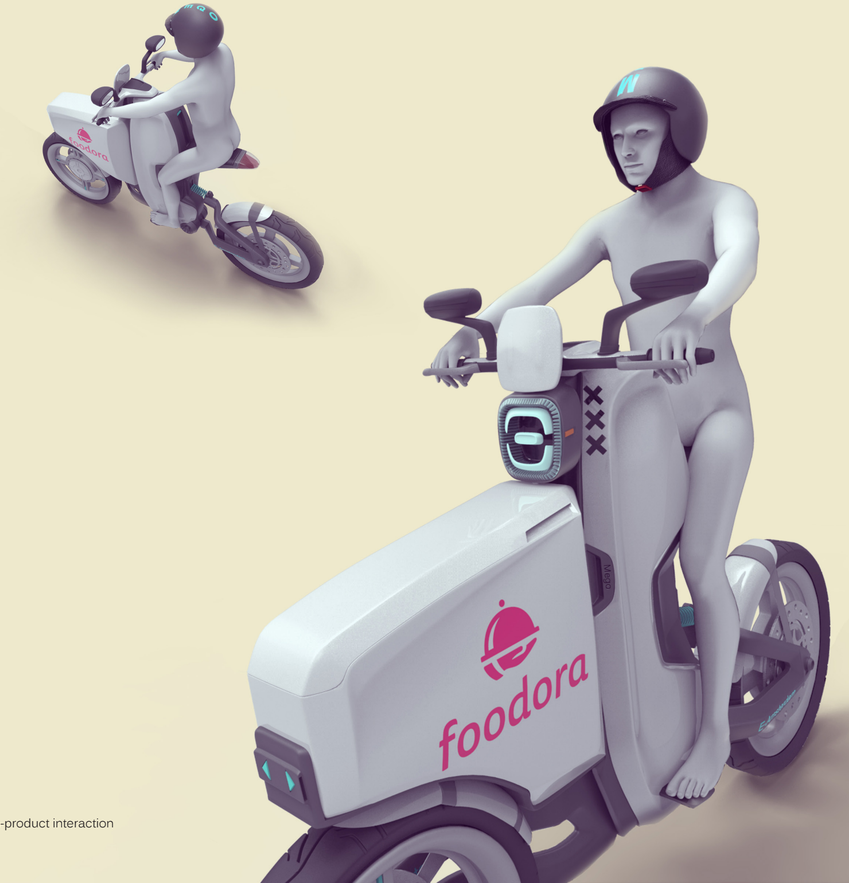


Image: Human-product interaction

8.2.10. Embodiment design

The ideation phase has resulted in a concept that describes the intended interactions, overall proportions and main concept. The next step is to address the required components, i.e. the individual components need to be specified.

8.2.11. Battery pack

The dimensions of the battery pack have been based on the hypothetical daily user scenario, where it is assumed that the scooter is actively used during the day by different users, and can charge during the night. The complete argumentation for the dimensions can be found in Appendix J. Mego will have a 14S14P battery pack, meaning that it consists out of 14 cells being connected in series and 14 in parallel.

Based on the expected cargo and range the power of the motor has also been calculated, including a safety factor see Appendix J. The calculated power output of the rear wheel motor, including a safety factor, p95 male with cargo, resulted in 5000W.

This only describes a theoretical number, and it is expected that the final motor output will be in lower in practice.

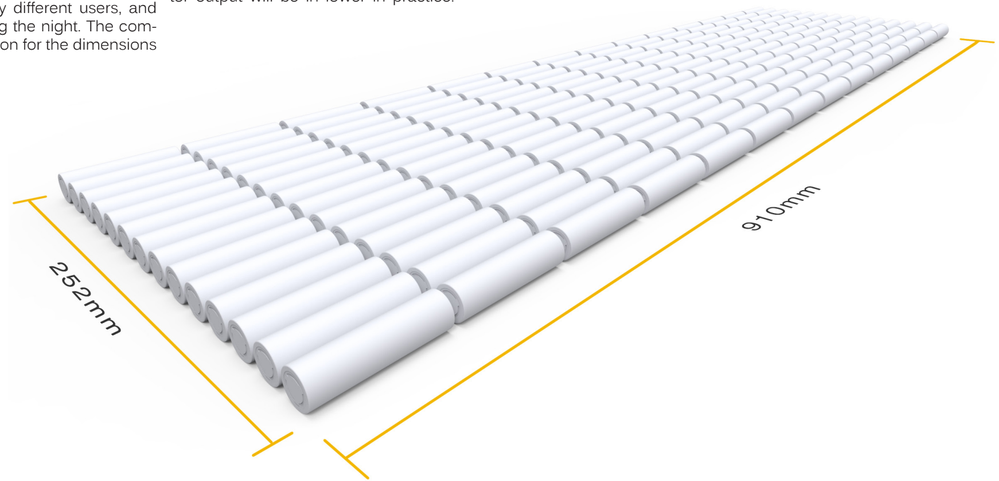


Image: Required amount of battery cells

8.2.12. Cargo module

In the field of cargo transport; dimensions and volume are the most important aspects. For Mego the intention has been to find a balance between the ability to transport cargo, yet not create a container on wheels.

The intention for the cargo modules is that they will eventually become a product of collaborative creation, yet to inspire and communicate the intention and possibilities one module has already been designed. The main goal was to not create two separate and contrasting volumes. The module should share the same form language as the scooter and when connected create a unified design. In my approach I restricted the maximum amount of cargo that one could transport with this particular module. In order to enable individuals to also transport deviating volumes two fasteners have been integrated in the front of the scooter. By doing so the user is enabled to transport boxes and other volumes without the necessity of using the cargo module.

During the introduction phase Mego is meant to be used by a wide variety of people that are part of the lower social class. These people can be divided into two groups, namely those that will use Mego to earn an income and those that will use Mego for their daily commute.

The first group consists out of inhabitants of Amsterdam whom will use Mego to earn an income on their own terms, in an automated future, where their former professions have been made redundant.

The other group that will make use of Mego consists out of inhabitants that have been forced to move away from the city centre, yet still need transportation for their daily commute.

With respect to generating employment opportunities Mego will target two groups. The first groups consists out of individuals that have lost the right to enter the city with their own vehicle, as it is regarded as too old and polluting. Yet these individuals still require their tools to perform their job, examples of this group are gardeners, plumbers, electricians and handyman. These individuals will acquire their own Mego cargo module, which can be designed specific to their requirements and wishes. The images on the right shows an interpretation of what this could be for a freelance handyman, The module itself can completely be redesigned, yet this will be the challenge for the Mego community. The designed module can also be adjusted to comply with bespoke requirements. This means that the interior of the module can be changed to the requirements of a plumber or gardener.

The second group will be enabled to use the modules, but does not personally own them. This group is enabled to use a shared Mego to work in the service industry. Examples are DHL, Uber eats and PostNL. These companies will become Mego partners and will have specific modules made for their specific requirements. As we are moving towards a freelance society, this means that inhabitants of Amsterdam can de-

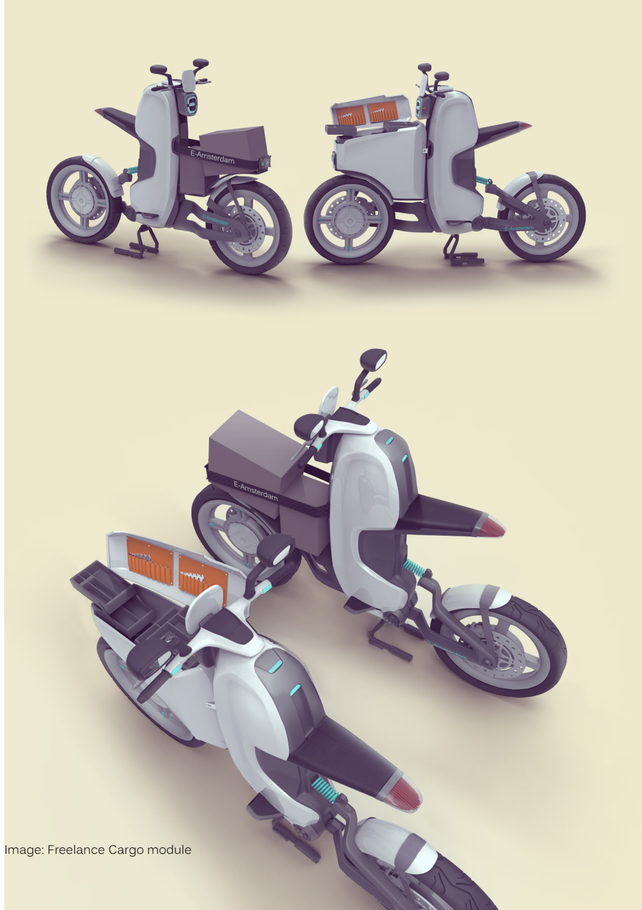


Image: Freelance Cargo module

cide to use Mego and work on Monday for DHL and on Tuesday for Uber eats. This will provide the lower social class with security, but also with a level of flexibility and autonomy that they did not have before.

8.2.13. Cargo module design

The form language of the cargo module has been based on the outcome of the ViP process, and therefore shares a similar design aesthetic as the scooter. The main objective of the design of the cargo module is to convey a feeling of being integrated in the design of the entire vehicle, rather than being a separate and contrasting volume, while maximizing the cargo volume.

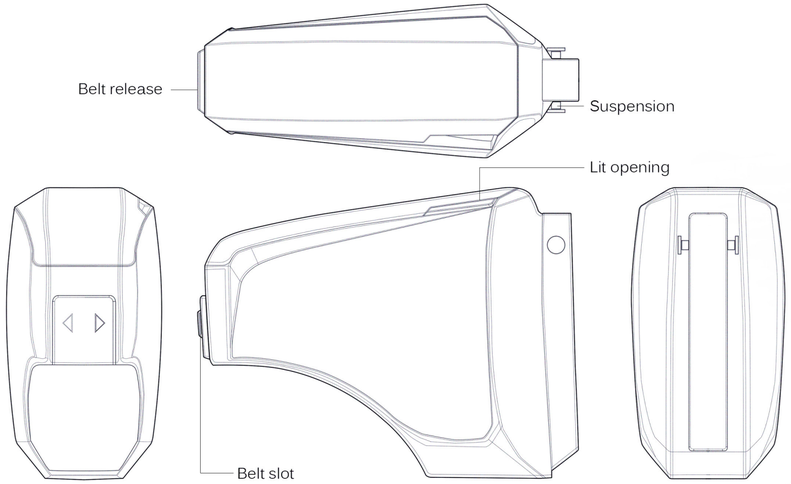


Image: Cargo module design

8.2.14. Helmet

At the time of writing this report the bill that states that all scooters should drive on the road and the mandatory wearing of a helmet has been submitted and approved by the Dutch House of Representatives on the fourteenth of December 2017, but has not yet been approved by the Council of State (amsterdam.nl). According to (scooterenmilieu.nl) the chance exists that the bill will not pass, and that wearing a helmet will not become compulsory. Based on the contextual phenomena occurring in Amsterdam it has been decided that Mego will be used on the road, with or without the bill being passed. The main arguments are safety as cycling lanes have become overcrowded, and the speed difference between a scooter and cyclist is too large. Amsterdam is planning to slowly transition in to a car-free city, and it is therefore assumed that this will create room for alternative modes of transport on the road.

This does mean that wearing a helmet will become mandatory for Mego. Designing a helmet lies not in the scope of this thesis, yet the concept of wearing a helmet in a shared system has been explored. Three existing scooter sharing platforms have been studied, and specifically the way helmets are handled. In most cases a helmet is provided that is located underneath the seat in the storage compartment. According to the German sharing program Coup hygiene caps are also provided. The website states that these helmets are checked and cleaned on a regular basis (joincoup.com-1). The same goes for the Paris based Cityscoot, but users are also allowed to bring their own helmet (cityscoot.eu). The third scooter sharing initiative, called Yugo, also provides two helmets that are stored inside the scooter with hygienic caps (getyugo.com). Coup is available in both Paris and Berlin, and according to French legislation it is mandatory to wear gloves while driving a scooter. Yet, Coup does not provide these to their users, due to the risk of theft and hygiene issues (joincoup.com-2). Even though these services have chosen for the helmets being shared as well it is assumed that this will result in hygiene issues, which is unfavourable. Therefore it has been decided that Mego users will need to bring their own helmet or purchase one from Mego. The image on this page shows a basic helmet with a branding example.

Image: Helmet design

8.2.15. Steering concept

The concept of modularity has influenced the design of the package significantly. In order to accommodate the option of transporting cargo, a different type of steering transmission is required to what is commonly used on scooters. This has resulted in a front fork with a central hub steering unit, similar to what is used on the Austrian motorbike the Johammer J1 (johammer.com). This type of steering dates back to the Ner-A-Car, which was designed in 1918 (neracar.com). The embodiment of the front arm will receive attention after this thesis, and has therefore not been fully materialized during this thesis.

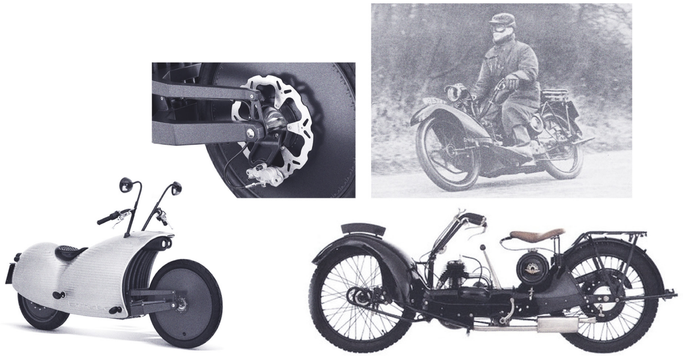


Image: 1919 Ner-a-Car and modern Johammer J1

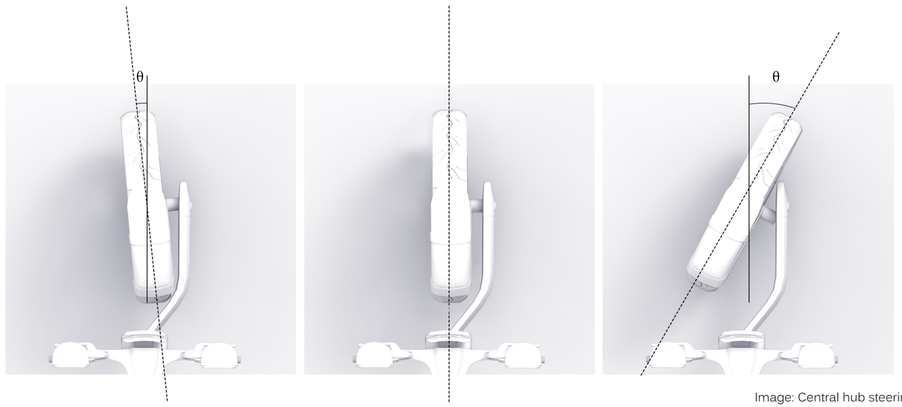


Image: Central hub steering

8.2.16. Charging hub

The following paragraph will discuss the design of the charger with integrated locking system.

The design of the hub network received significant attention as it is assumed that the quality of the network contributes to the potential success of the entire concept. To motivate the target group to make use of the shared system, it is important that it is offered close to their living environment. One of the facts that acted as a motivator to start this thesis is the absence of a charging infrastructure for the electric two-wheeler in Amsterdam. Ease of use, and unburdening the user from additional actions like plugging in a charging cable were the main requirements for the design of the charging station. Different alternatives to charging by wire exist; an example being battery swapping. Although this can provide a time efficient solution, I believe it is an additional action that complicates the process of using the scooter, and not everyone will be physically capable of taking out a battery pack. I believe locking and unlocking the scooter should be a convenient as recharging an electric toothbrush, and this also inspired me to research the technology of wireless energy transfer. This technology and its practical applications currently receive a lot of attention (todayonline.com, 2017). With the absence of a convenient charging standard, it was decided that charging via induction would provide the best solution to provide the user a safe and pleasant experience.

The principle of inductive charging or electromagnetic coupling is based on the electromagnetic field (EMF) that is created when a current flow appears in conductive materials. The EMF can be increased by winding the conductive materials as a coil. The primary coil acts as a sender. A second coil that is attached to the battery of the device, acts as the receiving coil and is referred to as the secondary coil. Due to the electromagnetic field a current is induced in the second coil. This technology allows to wireless transfer power, and can be used to recharge a battery. A disadvantage is that the efficiency of this technology decreases significantly when the gap between the primary and secondary coils increases. Yet, the efficiency can be increased and the advantages seem to outweigh the challenges. According to (Lui, N, 2016) there are three reasons to charge via induction:

- The galvanic isolation between the charger and EV, meaning better security.
- Requiring less maintenance, because most of the components of the system are protected by the proper encapsulation, which decreases the deterioration.
- Safer and more practical applications in harsh environments.

Image: Induction charging hub

8.2.17. Wireless charging applied to Mego

An unburdened interaction, without the necessity of cables, between user and hub station has become the primary objective in the design of the charger, which resulted in charging via induction.

The receiving coil of the induction system has been installed in the front wheel. The reason for this is that the length, and thus diameter of the wire, in both the receiving and sending coil, acts proportional to the power transfer. The primary reason for installing the receiving coil in the front wheel is because it is assumed, that when other manufacturers adopt the same charging technique it could lead to a universal standard for charging Powered Two Wheelers.

The package of the charger has been designed with the intention of becoming a universal standard. Wheel diameter and primary coil size have become the main factors to limit the dimensions of the charger. The dimensions of the primary and secondary coil can be found in appendix Q.

The charging station has been designed with a similar objective as the scooter, as it should stimulate an easy interaction and provide the user with. The characteristics and qualities that have been the result of the ViP process have been applied during the ideation phase of the charger, as it should convey the image of ease in usage. With regards to the design and styling of the charger, the same approach as with the scooter has been taken.

The charging station visually communicates the state of charge via a LED strip. The Strip radiates a blue hue when fully charged, and a red hue when charging. An orange hue tells that the scooter has been reserved, and is therefore not accessible to others.

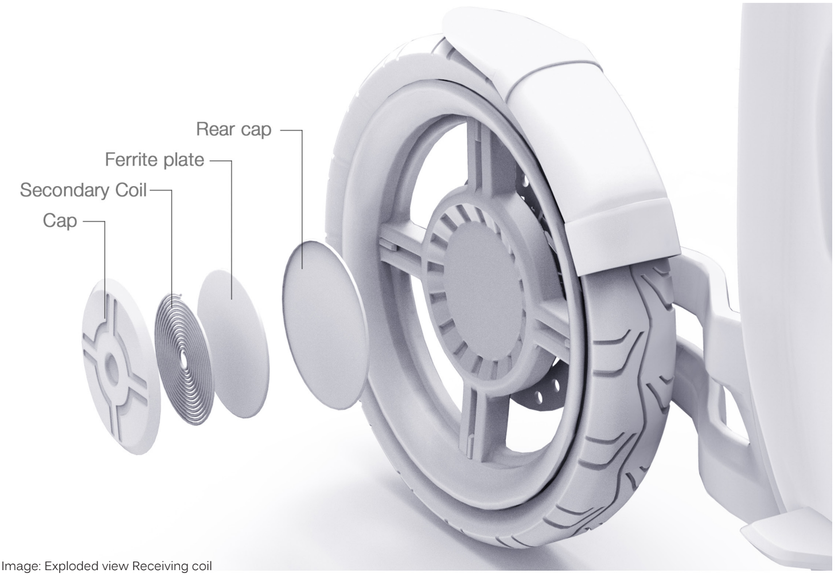


Image: Exploded view Receiving coil

Image: Mego charging

9.1. Individual and collective benefits

Amsterdam has to cope with increasing levels of congestion due to an increasing amount of inhabitants and visitors. With a shared mobility service like Mego the user efficiency is increased by four times, relieving the city from vehicles that are parked for prolonged periods of time. For this to occur the user needs to be convinced to participate in the sharing economy. As the literature study indicated that the main driver for individuals to participate in a sharing program is of financial nature, the aspect of generating an income with Mego should be clearly communicated.

For the individual the financial incentive of sharing a vehicle is supported by the fact that users are enabled to generate an income when using Mego. This benefits the user, but is also beneficial to the socio-economic position of Amsterdam, as a tool is created that enables its inhabitants to earn an income.

9.1.1. Scenario

Mego will be introduced in combination with a mobile application. People that have an account and want to use Mego can use their mobile application or the website to find and reserve a Mego scooter. Reserving a vehicle can be done up to 30 minutes in advance, similar to the car sharing service Car2go (car2go.com). The application will inform the user where the hub station is located and what the fastest route is to get there.

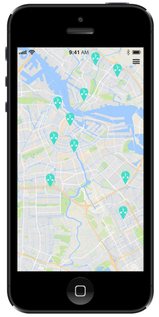
The user interacts with the charging station via a screen and a led strip. The Led strip acts as a use-cue and can change its hue; green indicates that the scooter is fully charged and ready to be used, a red hue communicates that it is still charging and an orange hue means that the scooter has been reserved in advance by another Mego user. Upon arrival the user can use his/her smartphone to unlock the vehicle, and rate the state of the vehicle. The mobile phone of the user can be placed on the handlebar and acts as an interface while driving.

After usage a Mego needs to be returned to a hub station to terminate the rental time. After detaching his/her mobile phone the vehicle will be locked and starts charging for the following rental period. The previous describes the scenario when the user only intends to use Mego for commuting, yet Mego has been designed to earn an income. The second scenario describes the process of reserving a Mego scooter to earn an income, see scenario 2 on page 107.

Image: Phone acts as interface

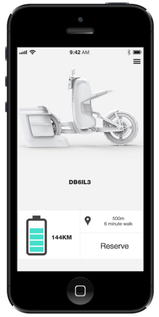
9.1.2. Scenario 1

To start the application the user needs to select the Mego icon.



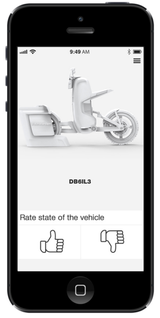
The application shows an aerial map of Amsterdam with the individual hub stations.

After selecting one of the hubs the amount of available scooters is communicated.

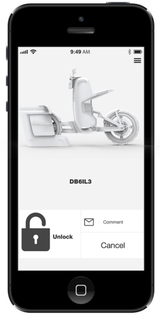


Selecting one of the available scooters brings the user to the reservation menu. The scooter remains reserved for 30 minutes.

The app shows the shortest route to arrive at the hub station.



After arriving at the hub station the user is asked to rate the state of the vehicle.

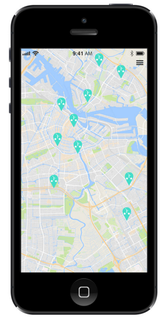


When the vehicle is in the desired condition the user can unlock the scooter via his/her smartphone.

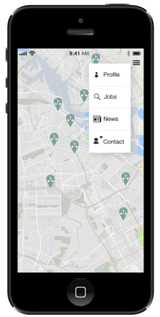
The phone is placed on top of the handlebar and now acts as the interface for the navigation.

9.1.3. Scenario 2

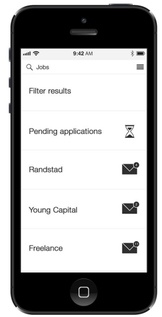
To start the application the user needs to select the Mego icon.



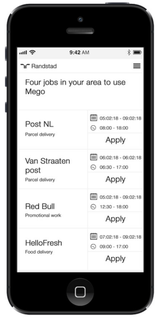
The application shows an aerial map of Amsterdam with the individual hub stations.



By selecting the bar menu on the top right a drop down menu occurs. This allows the Mego user to search for jobs.

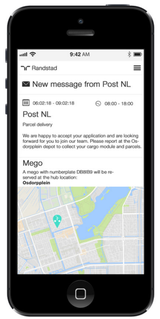


The application shows the employment agencies at which the user is registered and the amount of available jobs.



Selecting the employment agency Randstad will open a menu with available vacancies. The user applies to Post NL parcel delivery.

The Mego application indicates that a new message has been received.



Opening the menu shows that the application has been approved by Post NL and provides the required additional information.

Evaluation

For this thesis I used the Vision In Product design (VIP) to help generate a future vision in the domain of: “Mobility for individuals with fewer financial resources, living in urban environments in 2025”.

Prior to formulating the domain I studied the chosen context of Amsterdam in 2025. I was aware of the new legislations that is expected to be introduced, and soon realised that this would pose a negative effect on the lower social class.

Formulating the vision resulted in three phenomena that would significantly influence the chosen domain, namely gentrification, the introduction of the Low Emission Zone and the automation of jobs.

In contrast with the previous Industrial Revolutions jobs will be lost due to automation. Where globalisation before meant more trading opportunities and generating jobs, this time it will mainly eliminate jobs, due to the additional layer of computational thinking.

The phenomena that became the ingredients for the storyline of the future vision all shared a decentralized quality, e.g. the collaborative commons. Combining the three phenomena; automation, LEZ and gentrification naturally resulted in the idea that products should support the prosumer movement, and that products should provide the opportunity to generate an income.

The context statement naturally occurred from the created vision. As we are moving to a service society I believe products should be hybrids; enabling individuals to become consumers or producers whenever they desire. Creating the interaction was more difficult, as it is based on qualitative aspects, and I feared excluding certain aspects in the decision making process. Coming up with an appropriate analogy to describe the product characteristics was another challenging step. But I believe that “Empowering trust” clearly describes the desired interaction. Like any relationship humans are involved in, trust is created from a mutual giving and taking which builds a strong bond and empowered feeling.

Mego became the result in the search for the interaction between a cargo volume and driver. The modular aspects have become the result of Mego being designed to be used in a sharing system, and therefore having to meet a diverse set of requirements.

Even though many mobility sharing initiatives are started, the global success remains out. I believe this is partly due to the way this is communicated, as the focus lies on the what and how, rather than on the why, which might be the most important aspect.

The literature study indicated that sharing to reduce our environmental impact appears aspirational yet is not the incentive for individuals to participate. Research shows that the financial incentive remains the dominant factor for individuals to use a shared service. When using Mego the objective is to earn an income, rather than the fact that you are sharing a product. I believe sharing should focus less on sharing, but rather on the additional benefits. When we use public transport the space is also shared, but this is not the way it is communicated. In the train one is enabled to work or watch a movie, which is not yet possible when commuting by car. I believe that the benefits of using Mego should be communicated in a similar manner; a tool to earn an income on a flexible basis.

The process of linking the physical design to the generated characteristics and qualities also proved to be a challenging task, yet this was also due to my lack in experience modelling in Maya.

The final result is a new archetype of scooter that has been designed to accommodate the concept of transporting cargo. The cargo modules can be removed and adjusted to the user’s requirements.

Cities all over the world aim to reduce emissions, and the sharing economy communicates a global phenomenon. Gentrification is also not limited to Amsterdam and gentrification plays a significant role in many cities. What is unique is the combination of the three phenomena, and the understanding how this will affect the low-schooled of society. Scooters that transport cargo also already exist and so do scooter sharing services. Yet what is key to Mego is that it provides a response to the recognized phenomena and combines them to provide one single solution.

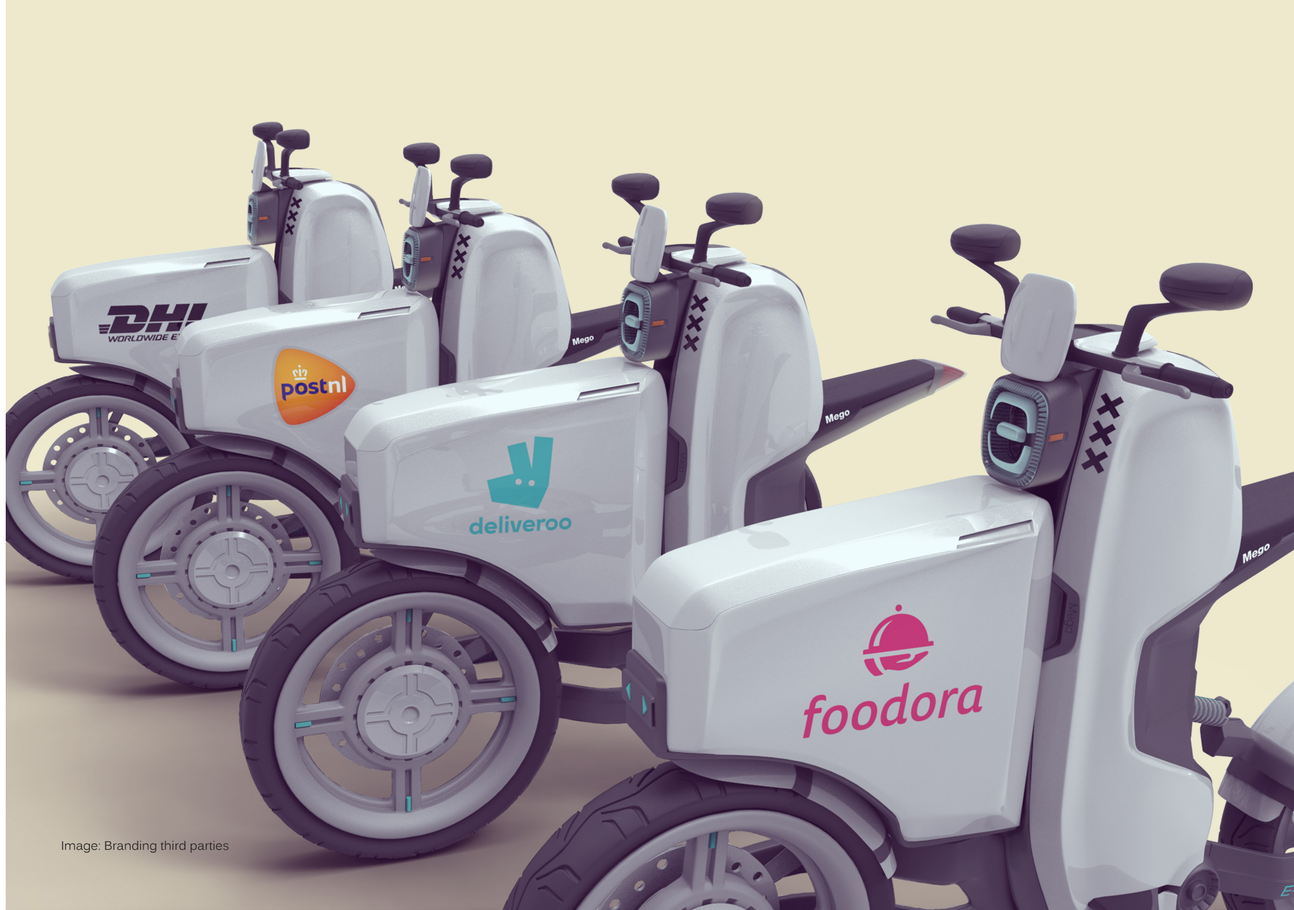


Image: Branding third parties

Reflection

The following will provide a description of my work ethics and attitude during this graduation project, and aims at discovering fields that can be optimized.

It was stated in the beginning of this report that I decided to utilize this thesis as a springboard to start my own company. In hindsight it resulted to become a lot more than that. I gained many new skills and forced myself to take a more open position in contacting people. During this thesis I visited many presentations in Pakhuis de Zwijger in Amsterdam. The topics that were covered during these presentations all had a relation with urban mobility, but covered different subjects. Via these presentations I got in contact with Luud Schimmelpennink and the in Delft located incubator Connekt. I met with Stichting Doet and presented multiple times for the municipality of Amsterdam.

I have also been able to improve my presentation skills due to the Valorisation team of the faculty of Industrial Design. This resulted in a more streamlined way of presenting, and leaving out the unimportant noise. In the introduction of this report one of the objectives stated the accumulation of the required network to continue to work on this project. Even though the municipality of Amsterdam has not granted me with an investment (yet), the reaction and feedback have been very positive so far. Another meeting has been scheduled on the 13th of February 2018 to present the process that has been made since November 2017. Based on the comments of both my supervisory team and the valorisation department of the Faculty of Industrial design, I have decided to apply for a feasibility study at the NWO, applied science and technology. The next step will be to start developing the physical concept, for which the battery pack controllers and electric motor have already been ordered.

I still need to work on prioritizing what is important and what is not, as gaining new knowledge and insights are positive, yet I noticed that I sometimes tried to design every detail before finishing the basic concept.

But this was also intentional, as before I started this thesis I came up with a list of personal objectives, of which I believe would make this thesis worthy of a master degree at the Technical University of Delft.

I did deviate from the track sometimes, which resulted in studying the concept of induction charging and creating a simulation in Matlab. Prior to this thesis I had no exact knowledge of this process, and it has been a great learning experience.

During my internships I became acquainted with the CAD program Maya from Autodesk, yet never modelled an entire vehicle or product. This also resulted in a steep learning curve and sometimes frustrated moments. Yet, it has been a valuable personal investment, as I am certain to remain using this software package.

Methodology

Prior to this thesis I worked with the ViP methodology four times. Yet, I experienced that this is not sufficient to feel fully comfortable and only use the method as a guide. For the VIP methodology to be most effective I had to follow all of its steps. VIP starts with the deconstruction of existing products that solve challenges today, similar to what you are trying to tackle. This phase ranges from product to interaction and context level, and includes quantitative descriptions and qualitative descriptions of interaction. Yet for this project understanding why today's product is designed the way that it is, and understanding the context the designer faced appeared to be of lesser importance. The reason for this is that from an early stage it became clear that the product would be part of a product-service system. For this project the focus is on the entire concept, rather than on the physical product alone. Therefore I found the deconstruction phase of the ViP methodology of less value during this thesis.

Recommendations

Before developing a physical prototype several design decisions are still required. During this thesis the goal of the detail design phase was to generate a coherent design, and the working principles received less attention.

One of the areas that still requires a lot of work is the front arm and central hub steering mechanism. Even though this is a proven technology for motorcycles it has not been applied to scooters very often. The main difference between a scooter and a motorcycle is that a scooter has been designed to fit the urban environment better, and therefore requires a certain degree of agility. It needs to be studied what degrees of steering can be achieved, and whether this is applicable to urban environments.

As the cargo transport capabilities received the most attention other aspects like physical ergonomics received less attention This should also be included in the following phase to optimize the dimensions of the scooter.

From an aesthetics perspective I believe the rear arm lacks the quality that the rest of the design does have. The point where the rear arm is connected with the spring-damper feels cramped, and a potential solution would be to slightly increase the wheelbase.

All these aspects will become the subject of the following steps after my graduation.

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Glossary

Autonomous vehicle - Also known as a driverless car or self-driving car, is a vehicle that is capable of sensing its environment and navigating without human input.

CBS - Centraal Bureau voor Statistieken

Collaborative commons - A sharing economy that is emerging from the old paradigm of capitalism

E-bike - Bicycle that is equipped with an electric powered actuator.

First-mile last-mile - Describes the phenomena of getting from a transportation hub to the home environment.

Gentrification - is best explained as the social and spatial manifestation of the transition from an industrial to a post-industrial economy based on financial, business and creative services, with associated changes in the nature and location of work, in the occupational class structure, earnings and incomes and the structure of the housing market.

Hyperloop - Transportation concept: Capsule travelling through a near fractionless vacuum pipe, transporting freight and/or passengers

LEZ - Low Emission Zone

No2 - Nitrogen dioxide

Physiognomy - Facial expression

Urban Sprawl - The spread of an urban area into what used to be countryside

ViP - Vision in Product Design: Context driven design methodology