MEGO

Modular mobility

Master thesis - Appendices

Integrated Product Design

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Appendix A - History of the scooter

First generation 1915-1930

Before it is possible to view the scooter on a product level more information is required concerning its origin. According to historical data, the first scooter was created by C.N. Nelk in 1912 in California. Like the Nelk the Motoped, which was first produced in 1915, it was based around the very same concept as kids's push scooters.(Shattuck, C. & Peterson, E., 2005, P.13) Around the same time Autoped was founded and started producing its first scooters with a 155cc engine mounted next to the front wheel. The Autoped was used by traffic cops, postmen, men and women. It was marketed as the most unique and widely useful motor vehicle that has ever been produced, for business and pleasure. The price was so low that almost everybody could afford one. In 1917 the Autoped was introduced to the European market for the first time. Three manufactures started to produce the Autoped, of which one located in Czechoslovakia improved the design by placing the motor between the footboards and complementing it with a seat, resulting in a higher sense of comfort and better weight distribution. After WW1 the Aircraft manufacturer Cloustershire Aircraft Company of Cheltenham manufactured the Unibus in 1922. It was marketed as the car on two wheels, being as comfortable as a chair and the ideal runabout alike for country walks or town shopping. At £99 the Unibus was too expensive and said to be ahead of its time to be appreciated fully.

The reputation of first-generation scooters was damaged by a glut of unstable machines with unrigid frames, and more substantial examples like the Reynolds Runabout and the Unibus were too expensive to be competitive (Webster, M., 2008).

Brand image & identity

The first generation of the scooter was marketed as a safe, cheap and comfortable alternative to a car. In real life they were not very safe and were too expensive. In Appendix A2 an overview can be found of advertisements. It was marketed as something new in transportation, and many of the adds pictured women riding the scooter, which the manufactures also tried to target, being lightweight and easy to handle

Second generation 1936-1968

During the Second World War the scooter received a make-over. The English Lieutenant Colonel J.R.V Dolphin invented a construction that allowed for the handlebars and fork to be folded, and retractable saddle reducing it to a compact volume. This was the birth of the Brockhouse Welbike. The reason for the design was that it could be dropped out of a plane in a container on a parachute, and acted as a primary means of transport for paratroopers. During wartimes a compete to win atmosphere exists. Winning a war means outperforming the competition. During WW2 this resulted in a rapid technology development These wartime inventions were later used after the war. Corgi Motor Cycle started producing a foldable scooter based on the Welbike. They produced the compact vehicle and marketed it as the perfect solution to do the groceries and offered a cheap solution to a car. A number of companies were producing the foldable bikes, which could easily be fitted in the boot of a car and was to be used to avoid traffic. After the second world war the focus was on reestablishing the economy. In order to allow trading less expensive mobility solutions were required. This was one of the drivers behind individuals accepting novel technology. The purchasing costs of scooters and alternative vehicles were significantly lower than that of a car. Did people stand behind their economy and actively support economic growth, or was it a more self-centric cause that surrounded this movement? People wanted cheap mobility solutions as that was all that they could afford, independent of their physical shape, as long as it provided the required physical freedom (Lachance, D., 2006). Therefore individuals were willing to accept microcars as it was all that they could financially afford after the Second World War. The Isetta, Mescherschmitt etc. were unusual even for their time. Now methodologies like designing according to the MAYA principle exist to help guarrantee a positive market acceptance. In times of financial insecurity the individual and society appear to be more aware and cautious in their spendings. With less to spend new low budget products are required.

Brand image & identity

Focus was on compact, efficient and economical transport. When economies grew and individuals became more wealthy the vehicle became a tool to communicate one's social status again and the microcars and scooters became less popular.

Third generation 1946-1964 and beyond

The Italian company Piaggio started as an aircraft manufacturer. During WW2 they collaborated with Germany and were therefore not allowed to produce aircrafts after the war anymore, this initiated the birth of the Vespa. It was seductive, cheap and reliable. The step-through frame allowed women to wear skirts, and the concealed engine, placed under the seat kept oil, grease and dirt from chic Italian clothes. The 1953 movie Roman Holiday featuring Audrey Hepburn also contains scenes of Miss Hepburn riding a Vespa. This, in combination with the movie posters of the actress on the scooter contributed to the success and acceptance of the Vespa worldwide

The Mods

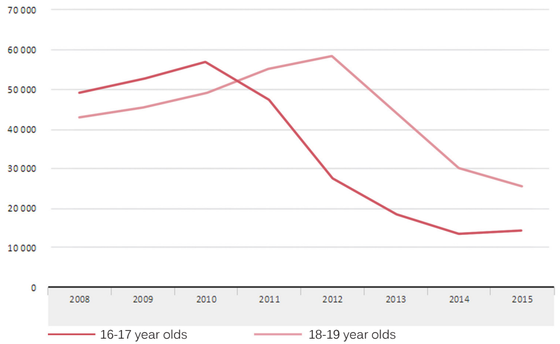
The Vespa as a cultural icon took off in the 1960's in Great Britain, where the youth group called the Mods treated the Vespa as a fashion accessory, customizing it to their own personal taste and as a signal of being part of this cultural movement.(Sarti, D., 2004) The scooter received a more rebelious image; it became a vehicle for independent women and rebelious youth.

Brand image & identity

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 advertisements. This does not only go for the Vespa brand itself. In 2007 Yamaha launched a campaign which said: Euro style meets Yamaha engineering. The style of the 60's and 70's is desirable and a marketing tool.

Modern era 2017 - and beyond

Since the introduction of the scooter license in 2013 the amount of scooter owners under 20 has dropped significantly in the Netherlands, yet the total amount of scooters in the Netherlands continues to grow. This is mainly due to the 50< age group, as the scooter ownership among the youth continues to drop, see image below.



Source: cbs.nl, 2015b, Nederlandse jongere is uitgebromd

Appendix B - Scooter Historical timeline

Autoped

The Autoped was invented in 1915. It was produced in Europe under license in Germany, France, Britain and Cczechoslovakia.

ABC Skootamota

The ABC Skootamota was an improved Autoped. Featuring a seat, motor actuating the rear wheel providing more comfort and safety. It was noted to be practical, popular, and economical.

Unibus

First scooter with modern full bodywork

Brockhouse Welbike

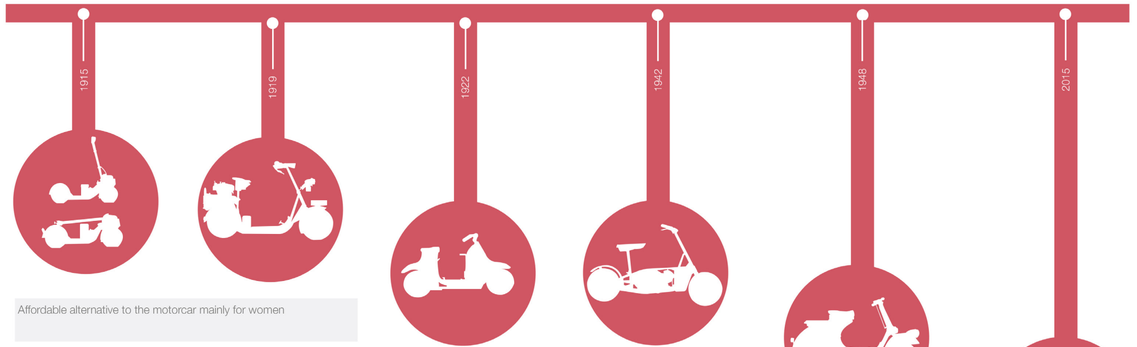
Developed in WW2 the Skootmota was developed to be folded to a compact volume to be dropped with a parachute and function as primary vehicle for paratroopers.

Vespa 125

After WW2 there industries had to be reastablished and there was a need for cheap personal transport. Piaggio was not allowed to produce aircrafts, and started producing the Vespa

Vespa 50

The modern day scooter serves our short distance transport.



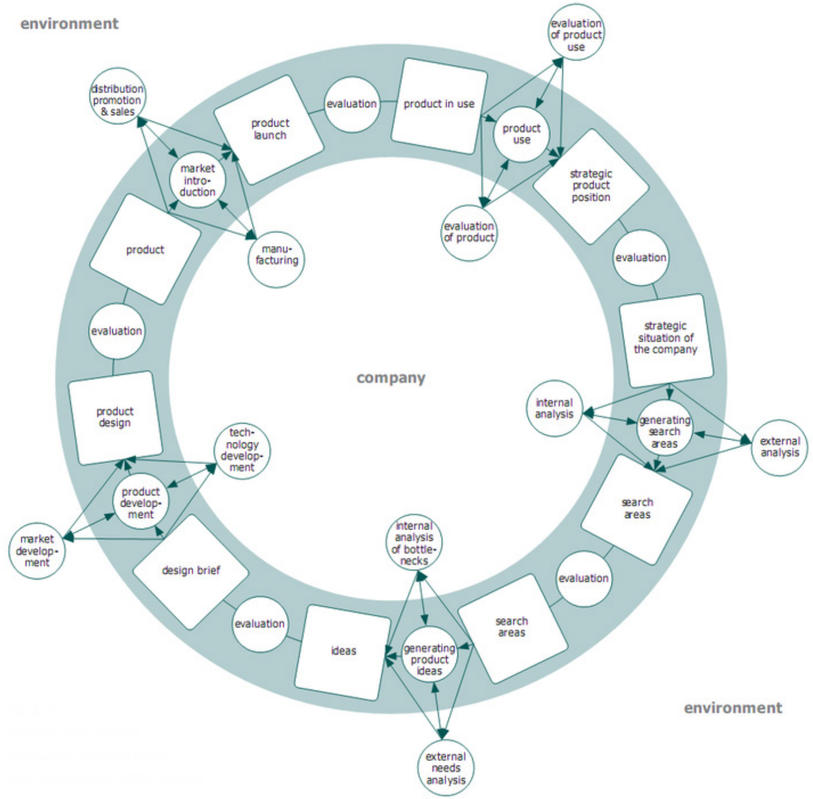
Affordable alternative to the motorcar mainly for women

Affordable alternative to the motorcar to be used by anyone

Rebellious youth

Youth & 55+, slowly losing youth image

Appendix C - Delft Product Innovation Method



Appendix D - Case studies

Sinclair C5

The Sinclair C5 is an electrically assisted tricycle, and was first introduced to the market in 1985 for 399 pounds. The man behind the C5 is Sir Clive Sinclair. Sir Clive Sinclair once stated that you should prepare people before introducing something radical. And they missed to do that with the C5, and therefore not achieving the intended success. It has been stated that it was too far ahead of its time. But what does this mean? In some era's consumers seem to share a higher level of acceptance towards novel technology. Yet success and acceptance appears to be dependent on context and interaction. These concepts are not static, they are changing variables. Were these two variables not fit for the C5 at the time it was introduced? Production started and finished in 1985. It has been stated that it was ahead of its time. As it was such a low vehicle, concerns around the C5 were road safety. The driver was not required to wear a crash helmet, and with a top speed of 15 mph it was difficult to keep up with the other traffic. UK press labelled the C5 from the start as unsafe. According to the press the low ground clearance made visibility an issue and could potentially lead to dangerous situations.(C5owners.com, 2011) This was in fact not the case as it had a hi-vis mast for other road users to notice it and the H-point was similar to that of a Mini Cooper. According to Transport expert Professor Stuart Cole the reason for the failure was also due to other road users not being used to alternative and slow moving vehicles. The infrastructure forced the C5 user to drive between cars instead of a cycling lane. The C5 was launched on January the tenth 1985, which didn't help as it was not suited at all for bad weather conditions. The performance, or the lack of it also did not contribute to the success. The C5 had a 0.25KW motor, and due to the law for electrically assisted tricycles allowed for a maximum speed of 15mph, which also made it unfit for its intended position in the traffic.

Conclusion

The Sinclair C5 failed because people thought of it being unsafe. Even though reports stated the opposite the C5 did not visually communicate safety. Combined with the press' opinion the whole concept was viewed by the public being unsafe. Both the public and infrastructure were not ready for the C5 and legislation made it unfit to the current context. A lack in market communication resulted in confusion among potential customers. It has even been said that no market research was conducted and that the development was only based on Sir Sinclair's gut feeling.

BMW C1

The C1 was introduced to the market in 2000 and was marketed as a motorcycle that would keep you dry. The headliner was not only for weather protection, but was part of a safety cell that would protect the driver in a collission. It could be used by one driver whom was not required to wear a crash helmet and passenger sitting on the rear outside the safety cell wearing a crash helmet. The C1 was not aimed at motorcyclists. It was designed to tempt car drivers away from their little boxes and into a brave new world of shorter journey times, inside what is undoubtedly the safest scooter ever made.(Carolenash, 2008) Individuals riding the C1 enjoyed it, as it allowed you to drive in bad weather while wearing a suit and shiny shoes. It shared the advantages of a scooter overtaking long queues of traffic in bad weather, with a windscreen, roof and windscreen wipers, without having to wear any waterproof clothes. It was so brilliant you felt you were cheating all the rules that everyone else has to live by. According to (Urban75 Forum, 2010) the reason for its failure is because of its high purchase price. It only had a 125 or 176cc 18 bhp engine, which performance wise makes it compete with a scooter and not a motorcycle. Then € 7.350 is a lot to pay for a scooter. For people new to driving a scooter or motorcycle it was difficult to manouvre or park. The width of the floor made it difficult to place your foot down when reaching a traffic light. Due to its high mass of 185kg, a high centre of gravity due to the roof construction in combination with the small wheels was not a recipe for perfect handling. (Motorcyclenews, 2006) For experienced drivers it was not exciting enough due to its bad performance, and the press reviews were also negative. As it was segmented as a conventional scooter individuals rated it based on the perspective of a scooter. The styling also did not contribute to its success, and when driving it you had to be thick-skinned as you would receive odd looks. Finally the marketing from BMW or their dealers was not conducted very well. As the dealers also couldn't make up what it was that they were selling.

Conclusion

The C1 was too expensive, and because of unclear communication from BMW and the dealers the public was not able to understand it. It was a heavy and clumsy scooter or slow motorcycle. Association is important as consumers will compare novel products with those that they are already familiar with.

Witte Fiets

The white bicycle plan was introduced in 1965 by Luud Schimmelpennink in the Netherlands, it did not succeed, yet in other capitals the market did accept it as a shared service. The white bicycle was introduced 20 years after WW2. Between 1965-1970 the car gained in popularity at the expense of the bicycle. The amount of daily bicycle rides dropped with 60.000, where the amount of cars in the city increased with 74.000. In 1968 a protest group was created called 'De lastige Amsterdammer' . This group demonstrated against the car being used for commuting within the city. It was being used inefficiently, polluting and considered being dangerous. (Jordan, P.,2013) In 1971 the Dutch journalist Pieter Niehorster was given the task to experience the position of the bicycle in the city by cycling to work instead of using the car. His conclusion stated that the whole urban infrastructure was built in favor of motorized transport. Cycling therefore was not a pleasant experience, which resulted in more individuals using the car for their daily commute. In 1997 the first modern bicycle sharing system was introduced in Rennes. Using smart bicycle racks and dumb bicycles. An important factor for the success of bicycle sharing inititatives, like those in New York or Paris, is the exploitation of outdoor advertising. It appears that bicycle sharing programmes do succeed in other cities, like Paris, Antwerp, Barcelona, New York and London. Bicycle sharing systems never really succeeded in Amsterdam, the alleged reason is that because on average we already own 1.5 bicycles per inhabitant (Broer, 2016) The only time when one does not have his/her own bicycle and requires one is when visiting a different city by public transport. This explains the success of the "OV fiets". Therefore the failure lies not in a refusal or unwillingness to share, but the market is already satisfied as almost every individual already owns a bicycle. (Houweling, M., 2007) Companies are still experimenting with bicycle sharing innitiatives: In Utrecht on the Lage Weide there is a pilot with white e-bikes with a tablet mounted to the handlebar called Gobikes, in Amsterdam Urbee will start with 300 electric bicycles with sharing purposes with an objective that over the years to come they can expand to a total of 1500 bicycles. In Rotterdam the aim is to have 450 Gobikes by the end of 2017. (OV, 2016) The potential success of the e-bike remains questionnable, as it is viewed by the youth being corny and for people coping with a physical disability.(Goudappel Coffeng & Youngworks, 2016)

Conclusion

The Dutch market was already saturated with privately owned bicycles. At the time of introduction the trend was to use the car instead of the bicycle, and the infrastructure at the time was in favor for this type of transport. With cycling being less popular in general a sharing program was likely to fail. Interesting to see is that currently the municipality is changing the infrastructure in favor of the bicycle, and almost fifty years after the first demonstrations against the car being used for daily commuting in the city, an understanding of its impact has been created. In some cities inhabitants are unfamiliar with the concept of cycling, and therefore municipalities introduce bicycle sharing concepts. The Dutch inhabitants did not need to get acquainted with the bicycle, thus the market was already saturated. In contrary the Dutch OV-fiets is successful as it mainly targets individuals travelling to other cities whom require a bicycle as they do not bring their own.

SMS

Initial growth of the short messaging service was slow, with customers in 1995 sending on average only 0.4 messages per GSM customer per month. One factor in the slow takeup of SMS was that operators were slow in setting up charging systems, especially for prepaid subscribers, and eliminate billing fraud which was possible by changing SMS settings on individual handsets to use the SMS's of other operators. Initially, networks only allowed customers to send messages to other users on the same network, limiting the usefulness of the service. This restriction was lifted in 1999. By the end of 2000, the average number of messages reached only 35 per user per month. When the network providers figured out a proper charging system the popularity of SMS went up. In the UK, in 2001, 12.2bn text messages were sent (Crystal, D., 2008) In contrary to SMS MMS and mobile video calling never picked up. The new MMS standard were anticipated to enhance the SMS mobile messaging experience beyond all recognition, allowing users to add colour images, animations, audio samples, and video clips to their personal and business messages. (Novak, L., & Svensson, M., 2001) According to (Quora.com, 2011) the low quality, high costs in bits and privacy concerns were to blame. The required technology was not mature enough; the quality of the camera was too low and the connectivy was not great. The concept made sense, yet the network did not support the data transfer in a desirable fashion. Now that the infrastructure has caught up, the applications for video sharing have become hugely popular. Currently mobile applications like Snapchat and Whatsapp allow individuals to share video's via Wifi networks which is a lot cheaper. Facebook live allows users to broadcast their video's live. Which now starts to challenge the 'old fashioned' SMS. This is especially the case in Western countries where these services are growing in popularity. (Michael, H., 2011)

Conclusion

The market is required to respond when the user understands the potential of a product or service and desires to use it. The network and infrastructure that support the product then need to be developed rapidly. In the case of mms and mobile video calling the negative aspects like low quality and high costs influenced the success. When the context developed overtime the same concept became hugely popular.

Mini disc

In 1983, just a year after the introduction of the Compact Disc, Immink and Braat presented the first experiments with erasable magneto-optical Compact Discs during the 73rd AES Convention in Eindhoven. (Immink, K., & Braat, J., 1984) It took, however, almost 10 years before their idea was commercialized. Sony's MiniDisc was one of two rival digital systems, both introduced in 1992, that were targeted as replacements for the Philips Compact Cassette analog audio tape system: the other was Digital Compact Cassette (DCC), created by Philips and Matsushita. Sony had originally intended Digital Audio Tape (DAT) to be the dominant home digital audio recording format, replacing the analog cassette. (Immink, K., & Braat, J., 1984) By the time Sony came up with MiniDisc in late 1992, Philips had introduced a competing system, DCC. This created marketing confusion very similar to the Betamax versus VHS battle of the late 1970s and early 1980s. Despite having a loyal customer base largely of musicians and audio enthusiasts, MiniDisc met with only limited success. The initial low uptake of MiniDisc was attributed to the small number of pre-recorded albums available on MD as relatively few record labels embraced the format. The initial high cost of equipment and blank media was also a factor. Mains-powered hi-fi MiniDisc player/recorders never got into the lower price ranges, and most consumers had to connect a portable machine to the hi-fi in order to record. This inconvenience contrasted with the earlier common use of cassette decks as a standard part of an ordinary hi-fi set-up.

Conclusion

A lack in standardization resulted in confusion among customers. The music player and were developed the music industry did also not embrace the new format which resulted in relatively few albums being available to purchase and listen to via the Minidisc. The Mini disc was not destined to be the successor of the Walkman. As the music industry did not support the format, but also because music was being treated differently. With Mp3 gaining in popularity in the late 1990's, the birth of the peer-topeer file sharing Internet service Napster also took place. As individuals became able to download and share music files there was also the need for a commercially available portable device capable of carying and playing Mp3 file formats. This resulted in the Mp3 player and is also what the Apple Ipad and Itunes have to thank their succes for.

The mini disc player did not comply with developments in the music and sharing industry.

Conclusion Case studies

I believe that the biggest contributer to the success or failure of a product innovation is understanding the context and 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 Mini disc example standardization contributes to market acceptance. Currently there exist multiple EV charging standards. There are two or three pin charging plugs, which results in that EV-owners can not recharge their vehicle at all available charging stations. The fragmentation of charging standards complicates the landscape.(Field, K., 2016) Designing according to the MAYA principle, with regards to the market understanding the product, and being able to relate it to that what they already know contributes to market acceptance. In the case of the Sinclair C5 and BMW C1 individuals could not categorize the product. If there exists a product that comes remotely close to the new product we will judge it based from that perspective, and if it opperates or handles inferior to that what we already know than 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. Electric cars look like ICE cars and therefore it will be judged from the same perspective, resulting in to questions about the limited range.

The 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, to add credit, 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 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.

Appendix E - Strategies

Commercialization of innovation

Strategies for commercialization of a new product innovation are critical for gaining a sustainable level of customer acceptance and financial performance. It is essential for technology development that marketing leaders achieve a deeper understanding of the strategies that might influence commercial success and failure (Mooney, R., 2016, Abstract) The Commercialization of Innovation (CoI) framework, was later extended by (Chiesa & Frattini, 2011; Datta, 2011; Frattini et al., 2012). The objective is to demonstrate how technological innovation can become profitable, and how a successful market introduction can be achieved (Mooney, R., 2016, P.7). Key constructs underlying the theory include three substrategies through which new product technology innovation moves: Early adoption strategy, Adoption network configuration strategy, and Mainstream adoption strategy (Frattini et al., 2012). Two categories comprise a launch strategy: strategic and tactical (Frattini et al., 2012; Hultink, Griffin, Hart, & Robben, 1997).

Within the strategic and tactical categories, there are eight dimensions of CoI: timing, targeting, positioning, distribution, pricing, communication, product, partnerships and alliances (Frattini et al., 2012). Each of these conceptual dimensions could indicate customer acceptance and financial performance achieved by the innovation (Frattini et al., 2012). According to the economist and political scientist J. Schumpeter, the essential feature of innovation, requires a new combination which disturbs the existing static equilibrium (Takeuchi, H., 2013, P.69). This is difficult as individuals are more keen on that that they are already familiar with (Buijs, J., 2012).

Knowledge Based Strategy (KBS) recognizes that an essential feature of strategy is to interpret the particular situation at hand and continuously create the future within the social context (Takeuchi, H., 2013, P.70). In order to understand the market, an emotional connection with customers through the products is a key enabler for success (Takeuchi, H., 2013, P.76. Judgements have to be made based on knowing that everything is contextual and decisions made knowing that everything is changing. When this happens actions have to be taken knowing that success depends on doing so in a timely fashion (Takeuchi, H., 2013, P.74).

According to (Takeuchi, H., 2013, P.70) humans should be in the centre of strategy, strategy should be viewed as a dynamic process and a company should have a social agenda and not be afraid to ask the question; 'What is our reason of existence?'. The most prominent feature of knowledge, compared with physical resources and information, is that it is born out of human interaction. Knowledge is created by people in their interactions with each other and the environment. Hence, to understand knowledge, we must first understand the interactive process from which knowledge emerges among human beings. Toshifumi Suzuki believed that there was no sense in trying to create a long-term plan under conditions of short-term change. (Takeuchi, H., 2013, P.75) During more turbulent times, more contradictions exist, which makes sustainable product innovation more difficult. This makes corporate success more fragile. Only a few companies have proven themselves capable of changing as fast as the environment around them and dealing with complexities surrounding them. One of the main reasons why companies fail today is their tendency to kill contradictions, opposites, and paradoxes by sticking to old routines created by their past success. (Takeuchi, H., 2013, P.75) For companies to remain succesful in the future, they have to develop a strategy that allows them to adapt to contextual developments. Not being afraid to discard old routines. If a strategy has lost it's reason of existence due to changing factors. In less succesful periods the company should have the ability to harness the negatives as a wake-up call to energize itself (Takeuchi, H., 2013, P.76).

According to the KBS view, the firm has to have its own future-building vision on how it would like to be in the future and how it would like to change society. This vision should not simply be an extension of the present, but closer to a leap towards fulfilling a dream or an ideal. This vision holds meaning when it is transparant. and unique to the firm; also, this vision should be constantly communicated with employees of all levels as well as with the external environment (Takeuchi, H., 2013, P.76). On a daily basis the firm should ask and answer the question, "What is good?" By doing so it can create value to society. By adopting a communicative position and a rational way of thinking the firm will understand and know what should be done for the common good. (Takeuchi, H., 2013, P.77) Failure will occur if a company does not communicate and listen to their customer. And is too stubborn to adapt to a developing market (Parry, M. E. and Kawakami, T., 2017) Approaching a problem or opportunity in this way; focussing on the future vision and understanding what actions need to be taken corresponds to the Vip method that will be consulted in the following phase. According to Jeremy Rifkin the only way for a collaborative consumption society to succeed is via open and transperant communication.

According to (Mooney, R., 2016, P.98) three phases of the introduction process allow for using strategies that can be of influence to the succes of the product; prelaunch phase, pilot customer phase, broader market phase.

During the prelaunch phase the following strategies are of importance: include first-mover timing strategies, market segmentation targeting strategies and co-creation product strategies (Mooney, R., 2016, P.98)

According to (Mooney, R., 2016, P.98) during the pilot customer phase the following strategies can be implemented:

- Mix of positioning the innovation as a real technological breakthrough and something more commonly known or incrementally innovative,
- A mix of parent and sub-brand branding strategies,
- A skimming pricing strategy,
- A mix of messages highlighting the sophisticated and technical product features and then communicating the innovation as something more commonly known in the market,
- A thought leadership communication strategy,
- A distribution strategy that utilized the pilot customer's existing customer base to field trial the product on patients,
- A partnership and alliance strategy of selecting an early adopter pilot customer who funded redeployment of technology for the market.

Strategies implemented during the broader market launch phase include:

- A penetration pricing strategy
- A targeting strategy of identifying new sectors and opportunities that might benefit from the innovation. (Mooney, R., 2016, P.98)

Organizational leaders must make their own assessment and select the strategies that make the most sense based on market research and the type of innovation. Is the company launching a radical or incremental innovation since different types of innovation require a different set of commercialization strategies. The challenges associated with being a first mover are: having an unclear positioning strategy and not having the right partnerships or alliances in place to stimulate diffusion of the innovation.

Another factor that can lead to a delayed market acceptance or failure of a product is because producers can adopt a myopia. This can be the result of three sources: (1) organizational factors, (2) technology factors, and (3) environmental factors. Important elements within these categories include the interpretation of the market performance of earlier generations of the technology, the interdependence of partners within the value network.

Managers need to move away from focusing on a single knowledge asset in favor of combining demand aligning supportive knowledge assets with dominant knowledge assets. There are important synergistic effects from developing organizational capital and human capital together. (Parry, M. E. and Kawakami, T., 2017) Managers who rely too much on organizational capital and ignore its human capital are likely to miss an important channel to explore and acquire new knowledge. Conversely, if managers rely too much on human capital and ignore organizational capital then they may be unable to provide a platform to communicate and share knowledge with others. Managers also need to take advantage of social capital to enhance the willingness of organizational members to share knowledge with each other.

During the pilot customer phase, the targeted audience has to be introduced to and educated on the novel technology. Set the price high and afterwards lower it, the same goes for the novelty of the technology used. First introduce it as something new and later as something known to the market. Conducting Understanding of the underlying connections.

Horizon 2020 - Valley of Death

What might be more applicable to the situation of a starting business is the strategy sketched in the Horizon 2020 program. One of the key aspects of the KETs strategy is addressing Europe's major weakness: the translation of its knowledge base into goods and services. (M. Butter et al, 2014, P.16) The "Valley of Death" is one of the central elements of the EU KETs strategy: to reduce the "Valley of Death". The strategy combines the two issues of deployment and reindustrialisation into an approach that differentiates three fundamental stages in the innovation chain of KETs and KET-based products: technological research, product development, and competitive manufacturing. (M. Butter et al, 2014, P.8)

According to (Jenkins & Mansur, 2011) there exist two valleys of death, a technological and commercialisation. The fundamental difference between both lies in their activities. Where, in the technological Valley of Death, it is about the research, development, and innovation of the product:

- Technological research, transforming fundamental research into technologies.
- Product development, transforming technologies into product prototypes.

The commercialisation Valley of Death is about the development of a commercial production system. This includes testing and validation of the manufacturing, as well as demonstrating manufacturing to customers: Competitive manufacturing, creating production systems to commercially produce the products.

This second valley integrates product technologies, manufacturing technologies, the establishment of the market network, and the restructuring of the organisation in order to establish a production system (Butter et al. 2013). The conclusion is that to cross the Valley of Death succes is not only about technology (product/manufacturing), but it should also address organisational and market issues. (M. Butter et al, 2014, P.17) This is in line with the four phases of the Delft Innovation Method of product innovation.

MAYA

'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

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 in-

troduced 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 potentially lead to a failed product. (Dam, R., 2016)

Conclusion

According to the consulted literature it can be stated that the following factors influence the success of a product innovation:

- Core dependent on developments instead of trends
- Understanding of domain and future social context
- Sufficient technological research
- Design according to MAYA
- Strategic timing
- Market research and communication
- Partnerships/aliances
- Standardization
- Positioning
- Distribution
- Competitive pricing
- Competitive manufacturing
- Interaction with customer
- Customer acceptance

These factors will be ordered according to their place in one of the four phases of the Delft Innovation Method. The framework created will be used to review five products that were novel at their time of introduction, and will indicate whether or not the factors can say something about how they performed.

Appendix F - ViP process

Appendix G - Transcript of records

On the 14th of November 2017 I presented my thesis to the municipality of Amsterdam, at the Weesperplein 8 in Amsterdam.

On the first of January 2018 the Low Emission Zone will be introduced: all scooters with a date of first admission before 2010 will not be allowed to enter Amsterdam anymore. The municipality subsidizes those whom have a CityPass with a green dot. These people can receive a voucher to purchase a newer and cleaner vehicle. The municipality offers De gemeente heeft subsidies voor mensen met een stadspas met groene stip.

- 400 euro for a bicycle
- 400 for a public transport membership
- 1000 for an electric bicycle
- 1200 or an electrical scooter

According to the municipality there are 2300 individuals that have a green dot. So far only 60 individuals have registered to make use of this arrangement. 80% appears to choose to use the vehicle to purchase an electrical scooter. Old scooter owners will not receive sum of money in their bank account. They will receive a voucher, which can be handed in at a dealer..

Vera de Kort of the LEZ communication team sees Mega as a serious addition to the list of compensations to the loss of their scooter.

Projectteams SNOR (snorfiets naar de rijbaan):
Marc van Gemert, project lead SNOR
Sylvester van der Horst (alternative routes)
Remy Niekus (Design public space)
Saskia Steenbergen, communication

Projectteam Low Emission Zone scooter:
Peter Vlugt, communication
Vera de Kort, communication

Appendix G2 - Transcript of interview Luud Schimmelpennink, 2017, De Witte Stad.

Car company Pon has recently acquired the Accell group, becoming the largest bicycle manufacturer in the world. It is clear that this company is also changing its course. In an urban environment individuals should distance themselves from private ownership, but there should be a good alternatives to make such a transition possible. You should therefore provide equivalent alternatives. Currently Schimmelpennink is working on the idea of the “Witte Stad”. Bicycle sharing initiatives like Urbee focus, according to Schimmelpennink on the long distance travel. Within his concept of the “Witte stad” he aims at providing mobility for short distance travel at low cost and high frequency usage.

Schimmelpennink believes that the car today is ready for radical changes. What he envisions is a product that can be shipped in parts, and that individuals “built” the vehicle themselves like a building kit. This generates a feeling of involvement and pride. This enables the individual to also conduct maintenance, as they know the product very well. Schimmelpennink’s background lies in the reinforced plastic industry, and is currently discussing posibilities with Pon. He believes that building a concept is not the difficult part, but what he would like to see is a vision for the future. This should provide an answer to what the future relationship will be between mobility and its surrounding infrastructure and the people. An example would be a hub located outside the city where individuals can park their vehicle, yet an equivalent alternative should be provided to accomodate displacement behaviour within the city itself. He believes that there exists a vacuum that can be filled in, in the sense that a vision of the future should help to understand what the city can become and what modalities are required. This should be supported by multiple groups and should lead to a presentation in “Pakhuis de Zwijger” to create awareness.

To relieve the city from its congestion problems, quality should be spread instead of centralized. This can be achieved by adding the aspect of adventure. A network is required of existing initiatives like Urbee to achieve this goal and stimulate a behavioural change among individuals. Change is required as the density in urban environments will increase in the future and the modality car is not workable anymore. The car is not used frequently on average, and becomes therefore a static volume consuming valuable space that we basically don’t have. Utilizing the old “Witkar” network can become a driving force and pressure on the municipality which will result in change. The challenge of introducing a new system lies in the acceptance of people. Humans naturally review a product based on the knowledge that they have. Therefore it is key that the individuals recognize the benefits of a new system, and give up on personal car ownership. The essential aspect is that you provide a network of modalities, so that individuals have free choice on what to use. Small initiatives like the Biro should not be used in a private environment, but should be part of a collective system. What is key is to develop a plan with a clear objective. The change that we will see in public transport, is that we will have pods that are waiting for you, instead of you waiting for the train to arrive. The three pillars that will shape our future are autonomous driving, electric motors and the sharing aspect of mobility. When the concept embraces these three pillars you have a strong foundation on which you can continue.

With regards to Car2go, Schimmelpennink believes that the concept itself is executed well, except for the freefloating part. He believes that such a system should have centralized charging stations where you can collect and return a vehicle. The concept of free-floating adds a lot of extra costs, even though it sounds very tempting in the first place. He believes that you should place the centralized stations in equal city environments, in order to support an equal amount of traffic between the individual stations and that it would not result in one empty station and one full station.

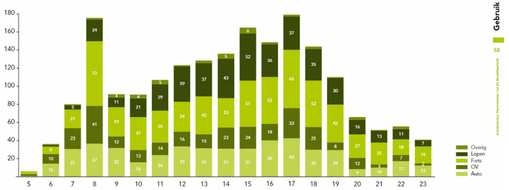
Schimmelpennink also finds the developments around the fun aspects of mobility an interesting phenomenon. New modalities like the Segway or Hoverboard also mean to make mobility more fun and agile.

With regards to the road to self-redundancy Schimmelpennink says that todat our income is the distributor of our wealth. Automation will result in individuals losing their jobs, but the city should become a place where those people can find meaning again. In the sixties Schimmelpennink was already a great proponent of abolishing our economic system that is based on consumption. He believes that in the future we will require less products and start to understand that life itself is more valuable than purchasing one product after the other.

Appendix H - Amsterdam
Thermometer van bereikbaarheid 2016

Nieuwe pagina

Tussen 8 en 9 uur worden er 72.000 verplaatsingen per fiets gemaakt door Amsterdammers



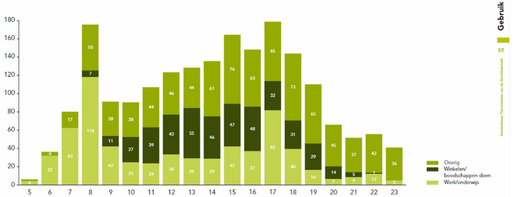
[1] Aantal verplaatsingen (x 1.000) per uur van de dag door Amsterdammers op een gemiddelde werkdag, 2015

Bron: CBS, 2015

Het aantal verplaatsingen dat Amsterdammers maken verschilt per uur van de dag. De meeste verplaatsingen worden gemaakt tussen 17:00 en 18:00 (179.000). In dat uur worden ook de meeste autoverplaatsingen gemaakt (42.000).Tussen 8:00 en 9:00 ‘s morgens worden de meeste fietsverplaatsingen (72.000) en OV-verplaatsingen (41.000) gemaakt. Tussen 15:00 en 16:00 wordt er het meest gelopen.

Nieuwe pagina

Tussen 8 en 9 uur gaan 118.000 Amsterdammers naar werk of onderwijs



[1] Aantal verplaatsingen (x 1.000) per uur van de dag door Amsterdammers op een gemiddelde werkdag, 2015

Bron: CBS, 2015

Het aantal verplaatsingen per uur van de dag is sterk afhankelijk van het motief. Tussen 8:00 en 9:00 ‘s morgens worden de meeste verplaatsingen (118.000) gemaakt met het motief werk/onderwijs. In de middag is het motief van verplaatsingen veel vaker winkelen/boodschappen doen, dit piekt tussen 13:00 en 14:00.

Appendix i - Uitkeringen
p.187 - Amsterdam in cijfers 2016

5

5.3.20 Geregistreerde werkloosheid [1] naar stadsdelen en leeftijdsgroepen, 1 januari 2016 (procenten)

stadsdeel	leeftijdsgroep in jaren 15-24	25-34	35-44	45-54	55-65	totaal
A Centrum	1,2	4,0	8,1	12,9	18,1	8,5
B Westpoort	x	x	x	x	x	x
E West	2,9	6,8	12,8	21,7	26,8	12,5
F Nieuw-West	2,8	9,4	14,4	18,1	21,6	12,5
K Zuid	1,2	3,9	8,2	13,9	19,5	8,3
M Oost	2,1	6,7	10,6	16,2	21,7	10,6
N Noord	3,5	11,0	16,2	19,4	21,8	14,4
T Zuidoost	3,1	13,9	20,2	23,8	26,7	17,1
Amsterdam	2,4	7,2	12,4	17,9	22,3	11,7

[1] De geregistreerde werkloosheid is het aandeel 15-64 jarigen dat gebruik maakt van een van de volgende regelingen:
- Bijstand (WWB levensonderhoud, WWB Bbz, IOAW, IOAZ)
- Gedeeltelijke arbeidsongeschiktheid (<80%)
- WW

bron: afd. Inkomen/CBS/bewerking OIS

5.3.21 Uitkeringen AOW, 2015-2016

	2015 1e kwartaal	2e kwartaal	3e kwartaal	4e kwartaal	2016 1e kwartaal [1]
leeftijdsgroep					
AOW-leeftijd tot 70 jaar	33190	33600	33940	34940	33290
70-74 jaar	23240	23460	23360	23130	23500
75-79 jaar	16500	16650	16950	17120	17150
80-84 jaar	11460	11440	11510	11530	11520
85-89 jaar	7180	7120	7120	7130	7090
90-94 jaar	3400	3390	3360	3360	3310
95-99 jaar	770	770	780	780	790
100 jaar of ouder	90	100	90	90	90
geslacht					
mannen	43140	43580	43960	44490	43880
vrouwen	52690	52930	53170	53610	52850
hoogte uitkering					
volledig	69310	69500	69830	70110	68990
gekort	26520	27010	27300	27990	27740
totaal uitkeringen	95830	96510	97130	98090	96730

[1] Voorlopige cijfers.

bron: CBS

5.3.15 Uitkeringen naar stadsdelen en soort regeling, 1 januari 2016

stadsdeel		WIA	WAO	WAZ	Wajong	WW	totaal
A	Centrum	870	1380	90	630	1940	4910
B	Westpoort	x	x	x	x	x	x
E	West	1970	2710	50	1400	3590	9730
F	Nieuw-West	2460	3210	80	1790	3270	10810
K	Zuid	1370	2280	90	1110	2940	7780
M	Oost	1600	2460	70	1530	2930	8600
N	Noord	1480	2350	60	1340	2170	7400
T	Zuidoost	1470	1690	20	1150	2680	7010
X	onbekend	x	x	x	x	x	x
Amsterdam		11220	16090	460	8950	19530	56250

bron: CBS/bewerking OIS

5.3.16 Uitkeringen WIA naar stadsdelen en leeftijdsgroepen, 1 januari 2016

		leeftijdsgroep in jaren						waarvan	
stadsdeel		15-24	25-34	35-44	45-54	55-AOW	totaal	WGA	IVA
A	Centrum	x	60	190	270	350	870	720	150
B	Westpoort	x	x	x	x	x	x	x	x
E	West	x	200	490	640	630	1970	1630	330
F	Nieuw-West	10	320	600	760	780	2460	2050	410
K	Zuid	x	100	330	400	530	1370	1130	240
M	Oost	x	160	400	500	540	1600	1310	290
N	Noord	x	130	300	480	560	1480	1190	290
T	Zuidoost	x	110	250	450	660	1470	1140	330
X	onbekend	x	x	x	x	x	x	x	x
Amsterdam		20	1080	2550	3510	4060	11220	9160	2060

bron: CBS/bewerking OIS

5.4.1 Kernelijfers inkomen, 2009 2013 (x 1.000 euro)

	2009	2010	2011	2012	2013
gemiddeld persoonlijk inkomen (x 1.000 euro)					
per inwoner	22,9	23,0	23,5	23,7	24,1
per persoon met een heel jaar inkomen	31,6	31,9	32,5	33,1	33,8
totaal actief	39,6	40,1	41,1	41,9	42,8
totaal niet-actief	17,9	18,1	18,3	18,3	18,7
werkloosheids- en bijstandsuitkering	15,1	15,6	15,7	16,0	16,7
arbeidsongeschikt	21,3	21,4	21,6	21,7	22,1
pensioenontvanger	20,3	21,9	22,3	22,5	22,9
gemiddeld besteedbaar inkomen (x 1.000 euro)					
per huishouden	30,7	30,7	30,8	31,4	31,8
eenpersoonshuishouden	21,3	21,1	21,2	21,4	21,6
paar zonder kinderen	41,3	41,3	41,3	42,1	42,4
paar met kinderen	47,8	48,0	48,8	49,8	50,5
eenoudergezin	26,1	26,4	26,7	26,7	26,9
overig huishouden	41,6	41,7	41,6	42,4	42,8
gestandaardiseerd huishoudensinkomen per huishouden	23,5	23,5	23,6	24,0	24,2

bron: CBS

5.4a Gemiddeld persoonlijk inkomen van personen met een heel jaar inkomen per wijk, 2013

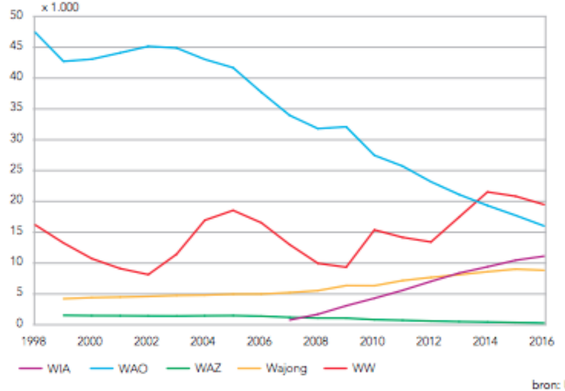
bron: CBS/RIO 2013

5.3.19 Uitkeringen WW naar stadsdelen en leeftijdsgroepen, 1 januari 2016

stadsdeel	leeftijdsgroep in jaren 15-24	25-34	35-44	45-54	55-65	totaal
A Centrum	30	370	370	560	620	1940
B Westpoort	x	x	x	x	x	x
E West	100	920	950	890	730	3590
F Nieuw-West	180	760	690	850	800	3270
K Zuid	60	600	690	800	800	2940
M Oost	90	630	670	840	700	2930
N Noord	80	400	470	630	590	2170
T Zuidoost	100	460	560	780	790	2680
X onbekend	x	x	x	x	x	x
Amsterdam	630	4120	4410	5340	5030	19530

bron: CBS/bewerking OIS

5.3b Uitkeringen, 1 januari 1998-2016



bron: UWV/CBS

5.4.2 Kerncijfers inkomen stadsdelen, 2013

stadsdeel	inwoners (x 1.000)	gemidd. persoonlijk inkomen (x 1.000 euro)	personen met een heel jaar inkomen (x 1.000)	gemidd. pers. ink. per persoon met een heel jaar inkomen (x 1.000 euro)	huis-houdens (x 1.000)	gemidd. besteedbaar inkomen per huish. (x 1.000 euro)	inde gestand. inkomen huishoudens (Ned.=100)
A Centrum	86,0	30,7	63,0	40,6	47,4	34,4	113,5
B Westpoort	0,4	13,2	0,2	22,3	0,2	17,9	62,3
E West	140,9	23,7	101,4	31,9	73,6	28,8	93,4
F Nieuw-West	143,8	19,4	93,2	28,8	60,9	30,3	89,2
K Zuid	139,5	32,0	101,6	42,8	73,5	37,2	118,0
M Oost	126,1	24,4	85,2	35,2	57,7	33,6	102,0
N Noord	89,9	19,0	60,7	27,2	40,3	29,0	86,1
T Zuidoost	84,0	17,9	54,9	26,3	38,8	26,5	80,7
Amsterdam	810,9	24,1	560,4	33,8	392,6	31,8	99,2

bron: CBS/RIO 2013

5.4.3 Personen met een heel jaar inkomen (incl. studenten) en gemiddeld persoonlijk inkomen naar stadsdelen en geslacht, 2013

stadsdeel	personen met een heel jaar inkomen (x 1.000) mannen	vrouwen	totaal	gemiddeld persoonlijk inkomen (x 1.000 euro) mannen	vrouwen	totaal
A Centrum	33,2	29,9	63,0	47,4	33,1	40,6
B Westpoort	0,2	0,1	0,2	25,3	x	22,3
E West	50,9	50,5	101,4	34,9	28,9	31,9
F Nieuw-West	47,7	45,5	93,2	33,0	24,4	28,8
K Zuid	48,5	53,1	101,6	52,1	34,3	42,8
M Oost	42,8	42,4	85,2	39,8	30,6	35,2
N Noord	29,9	30,9	60,7	31,3	23,3	27,2
T Zuidoost	26,6	28,3	54,9	28,9	23,9	26,3
Amsterdam	279,8	280,7	560,4	38,8	28,8	33,8

bron: CBS/RIO 2013

5.4.4 Personen met een heel jaar inkomen (incl. studenten) en gemiddeld persoonlijk inkomen naar stadsdelen en leeftijdsgroepen, 2013

stadsdeel	personen met een heel jaar inkomen (x 1.000) <25 jaar	25-44 jaar	45-64 jaar	65 jaar e.o.	gemiddeld persoonlijk inkomen (x 1.000 euro) <25 jaar	25-44 jaar	45-64 jaar	65 jaar e.o.
A Centrum	5,0	26,5	21,6	9,9	11,0	43,8	47,5	32,1
B Westpoort	0,0	0,1	0,1	0,0	x	x	x	x
E West	9,4	53,1	27,9	11,1	11,4	37,8	32,4	20,2
F Nieuw-West	10,4	35,7	29,9	17,3	11,4	32,5	35,2	20,9
K Zuid	7,9	45,6	28,6	19,4	11,6	49,3	50,2	29,4
M Oost	7,9	38,9	27,9	10,5	10,6	40,8	39,3	22,0
N Noord	5,4	21,0	21,2	13,2	11,6	29,8	32,5	21,1
T Zuidoost	5,7	19,8	21,3	8,1	10,8	27,9	30,8	21,3
Amsterdam	51,7	240,7	178,5	89,6	11,2	38,8	38,4	24,1

bron: CBS/RIO 2013

Appendix j - Battery pack argumentation and calculation

As the main objective of the vehicle is to provide different type of services, a better understanding of the food delivery market is required. The food delivery market is one of the more dominant markets where two wheelers are used is that of food delivery. This is an increasing market and according to (Driessen, S., 2016 , Maaltijdbezorging: een groeimarkt vol kansen, https://insights.abnamro.nl/2016/04/maaltijdbezorging-een-groeimarkt-vol-kansen/) the market has grown with 3% compared to the year before.

The peak in food delivery is after 18:00, and the most popular days of the week to order food is Saturday and Sunday. Dinner is still the most popular meal to order, yet lunch and breakfast are gaining in popularity among individuals.

As the literature study indicated the freelancer market is growing. According to (Driessen, S., 2016 , Maaltijdbezorging: een groeimarkt vol kansen, https://insights.abnamro.nl/2016/04/ maaltijdbezorging-een-groeimarkt-vol-kansen/) this is also one of the groups that orders food online more often than others. According to (http://scooterforum.net/threads/wat-verdient-een-pizzabezorger-wie-is-het-hier.164376/)

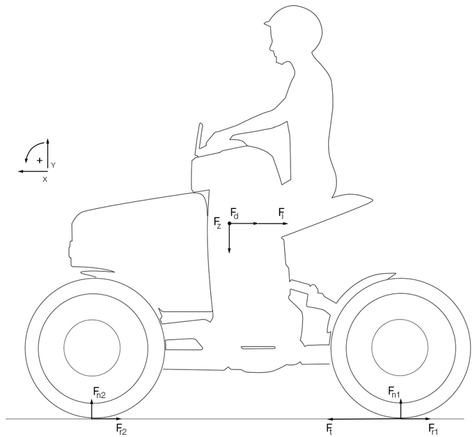
The longest distance to be travelled in Amsterdam, is from the Tafelbergweg in South-East to the Westpoortweg in West. To complete this distance with a bicycle it is about 25,5 km according to Google maps..

With the Transvaalbuurt as starting point Google maps was used to calculate how much time a 2,5km radius would take to travel by both a car and bicycle. The result is around 9-10 minutes. This means an average speed of 15-16.5km/h is achieved. Decided is to take the worse case scenario that for every delivery the courier needs to go back to the restaurant to pick up the food. One delivery then takes in total 20 minutes and the total distance is 5km. Per hour this is 15km travelled without stopping/charging. If this would continue from 18:00-23:00 = 5 hours= 75km. This would be the expected theoretical maximum without charging the product needs to be able to achieve. To guarantee a long lifespan the batteries should not be depleted over 80% of their capacity and with a heavy load batteries are expected to deplete twice as fast. (75/0.8).2=187.5km

According to the Dutch scooter startup Bolt mobility, their scooter's efficiency requires it to have three battery modules to achieve a desired range of 200km at 25km/h. This is 2568Wh (856Wh per module) (total of 210 18650 cells) Theoretically 197 cells are required to achieve the maximum of 187km at a single charge. One battery produces 12.395Wh. 197 will produce 2441.815Wh. The system nominal voltage is said to be 50V. This would mean a required amperage of 2441.815Wh/50=48.83A. 50/3.7V= 13.5 battery cells in series. Rounded is 14 cells. The total of required cells was 197. This means that 197/14=14, it would require 14 modules connected in parallel, consisting of 14 cells connected in series. 14p14s

Battery specifications: Panasonic NCR18650B Li-ion 3,7V 3350 mAh battery.

According to the website of Bolt their modules of 70 18650 cell are rated at 856Wh. It should be stated that Bolt uses a KERS, in the form of a regenerative braking system. These numbers are likely to be theoretical.



restart;

Force formula's

$$\sum F := Ft - Fd - 2 \cdot Fr - Fi = 0$$

$$Fr := m \cdot g \cdot Cr$$

$$Fr := 8.82900$$

(1.1)

$$Fd := \frac{1}{2} \cdot Cd \cdot A \cdot \rho \cdot v^2$$

$$Fd := 69.55703125$$

(1.2)

$$Fi := m \cdot a$$

$$Fi := 324.0$$

(1.3)

$$Ft := Fd + Fr + Fi$$

$$Ft := 402.3860312$$

(1.4)

$$Mt := Ft \cdot r$$

$$Mt := 102.2060519$$

(1.5)

$$Pt := Mt \cdot \omega$$

$$Pt := 5029.825389$$

(1.6)

$$Pt := \left(\left(\frac{1}{2} \cdot Cd \cdot A \, \rho \cdot v^2 \right) + (m \cdot g \cdot Cr) + (m \cdot a) \right) \cdot v$$

$$Pt := 5029.825390$$

(1.7)

Motor

$$\omega := \frac{v}{r}$$

$$\omega := 49.21259843$$

(1.1.1)

$$Rpm := \frac{\omega \cdot 60}{2 \cdot \pi}$$

$$Rpm := 469.9456980$$

(1.1.2)

Nomenclature

Pt= Mechanical Power required for delivering traction
F= Resultant Force
Ft= Traction Force (Tire on suface)
Fd= Drag Force generated by the wind
Fr= Rolling resistance
Fi= Intertia Force
m= Total mass of the FBD
g= Gravitational force
Cr= Rolling resistance coefficient
Cw= Wind resistance coefficient
Cd= drag coefficient

A= Frontal area of the FBD m
ρ= Airdensity kg/m3
a= acceleration (From 0-45 in 7 seconds)
v= linear max velocity for a scooter is 45km/h = 12.5 $\frac{m}{s}$
r = Wheel radius
ω= Angular velocity
Fz=Consists out of driver (Dined 20-30 years, P95 male=103kg), Battery = 45g per 18650 cell, extra load and vehicle

$$\rho \tag{1.2.1}$$

Variables

> $A := 0.632$

$$A := 0.632 \tag{1.3.1}$$

> $v := 12.5$

$$v := 12.5 \tag{1.3.2}$$

> $Cd := 1.15$

$$Cd := 1.15 \tag{1.3.3}$$

> $\rho := 1.225$

$$\rho := 1.225 \tag{1.3.4}$$

> $Cr := 0.005$

$$Cr := 0.005 \tag{1.3.5}$$

> $g := 9.81$

$$g := 9.81 \tag{1.3.6}$$

> $m := 180$

$$m := 180 \tag{1.3.7}$$

> $a := 1.8$

$$a := 1.8 \tag{1.3.8}$$

> $r := 0.254$

$$r := 0.254 \tag{1.3.9}$$

Battery

Formula's

> $Pbattery := Ubc \cdot Qp$

$$Pbattery := Ubc\,Qp \tag{2.1.1}$$

Nomenclature

mcell=maximum mass of 1 18650 cell
Qp= Battery cell capacity in Ah
Pbattery=Battery capacity in Wh
Vbc=Nominal voltage of one battery cell

Sr=Wh/km
Vn= Nominal voltage entire system
Ib=Current per battery cell
Is= Current draw entire system
s= desired range in km at 45km/h
Qps=Battery capacity in Ah entire system
W= Required capacity in Watt hours entire system
Qs= Quantity in series
Qp=Quantity in parallel

Variables

> $mcell := 0.045$

$$mcell := 0.045 \tag{2.3.1}$$

> $Qp := 3.35$

$$Qp := 3.35 \tag{2.3.2}$$

> $Ubc := 3.7$

$$Ubc := 3.7 \tag{2.3.3}$$

> $Ib := 20$

$$Ib := 20 \tag{2.3.4}$$

> $Sr := 12.84$

$$Sr := 12.84 \tag{2.3.5}$$

> $s := 187500$

$$s := 187500 \tag{2.3.6}$$

> $Vn := 50$

$$Vn := 50 \tag{2.3.7}$$

Range

> $Qps := \left(\frac{Sr}{Vn}\right) \cdot \left(\frac{s}{1000}\right)$

$$Qps := 48.15000000 \tag{2.4.1}$$

> $W := (Qps \cdot Vn)$

$$W := 2407.500000 \tag{2.4.2}$$

Physical layout

> $Quantity := \frac{W}{(Ubc \cdot Qp)}$

$$Quantity := 194.2315450 \tag{2.5.1}$$

> $Qs := \frac{Vn}{Ubc}$

$$Qs := 13.51351351 \tag{2.5.2}$$

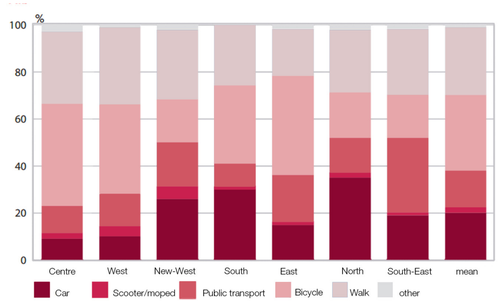
> $Qp := \frac{Quantity}{Qs}$

$$Qp := 14.37313433 \tag{2.5.3}$$

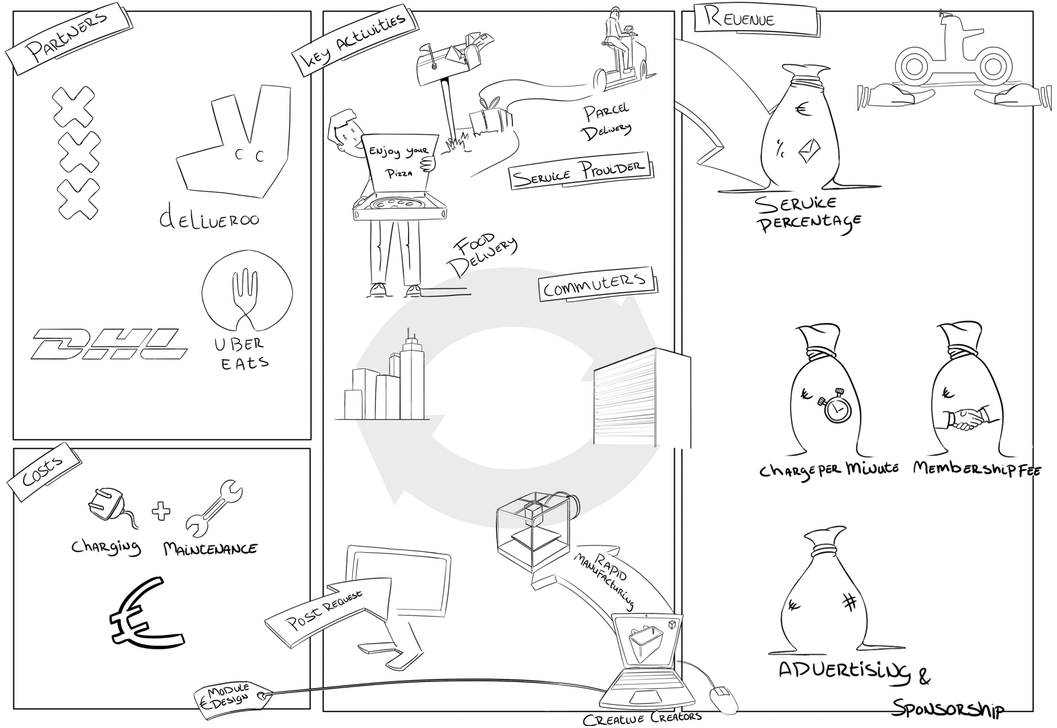
> $mp := mcell \cdot Quantity$

$$mp := 8.740419525 \tag{2.5.4}$$

Appendix k - Modal split - gemeente Amsterdam 2013



Appendix L - Business model



Appendix M - Amsterdam developments

1. A project is currently under development to make traffic lights smarter and connecting them to vehicles. This allows for smarter, more dynamic and more efficienct traffic flows (Gemeente Amsterdam, 2016, P.15).

2. Amsterdam is currently developing a publically accessible network of beacons. These beacons will be placed on different locations in the city and will be constantly broadcasting signals. Developers can use this for the development of applications. Pedestrians passing by a beacon will receive a notice on their phone, and can receive information on a statue located near the beacon, or receive real-time traffic updates to increase mobility efficiency (Gemeente Amsterdam, 2016, P.16).

3. Another project currently being developed is "the things network". This is an open and crowd sourced Internet of Things data network (LoraWan) which allows devices to communicate with each other(Gemeente Amsterdam, 2016, P.16).

4. The SCRIPTS project initiated by the AMS Institute is a study with the focus on the future of public transport use. It is expected that people will order their transport as a combined service of a bicycle or pedelec and public transport. The research will focus on how sustainable transport services can be developed with the preferences of inhabitants in mind (Gemeente Amsterdam, 2016, P.19). These developments result in services initiated by the GVB and NS. The focus is on providing a complete travel solution, of which the Mobility-mixx card is an example. This card allows the user to pay for all products and services related to public transport (Gemeente Amsterdam, 2016, P.19). Project STAD, which is conducted by the Vrije Universiteit and AMS Institute, conducts research on the effect of autonomous vehicles and destination, location and choice of transport. The objective is to create an indication of how autonomous mobility will affect the urban planning. It is important to gather this information before the introduction of the selfdriving car so that urban and architectural planning can anticipate and involve these developments in the planning. Questions with regards to safety of other road users, and the required amount of parking facilities need to be answered (Gemeente Amsterdam, 2016, P.20).

The Image below shows the causality effect of the development that autonomous mobility potentially initiates. It will influence our driving behaviour and combined with developments in the field of telepresence will make us less physically attached to an environment. Yet this is concluded from the perspective that autonomous mobility will become successful. According to the survey conducted by (Goudappel Coffeng & Youngworks, 2016) the youth still holds many questions when it comes to autonomous mobility. According to the same survey the youth is also not very thrilled about the idea of vehicle sharing and its efficiency increasing potential. (Autotrader, 2013) confirms that current owners of a car hold a special relationships with their car.

5. Another initiative called Allegro has the objective of monitoring the behaviour of cyclists and pedestrians in the city. This program is conducted by the Technical University of Delft and the Amsterdam Institute for Amsterdam Metropolitan Solutions (AMS institute). By combining and using big data, cycling and walking should become saver and more pleasant (Gemeente Amsterdam, 2016, P.17).

6. The Smart Cycling Futures program that is initiated by the University of Amsterdam focuses on cycling in the city.

Appendix N - Most popular professions that require a low education

	stadsdeel								
	A Centrum	B Westpoort	E West	F Nieuw-West	K Zuid	M Oost	N Noord	T Zuidoost	Amsterdam
G1 groothandel	666	224	564	788	776	407	357	363	4145
G2 detailhandel	2307	93	1291	1170	1796	1032	753	686	9128
H transport en logistiek	235	175	536	1483	290	542	697	376	4334
I horeca	2048	25	892	390	933	530	282	250	5350

Appendix O - Transcript of records Municipality of Amsterdam Joyce Zwaan & Lizann Tjon 20-02-2017

On the 20th of February 2017 I presented my thesis to the municipality of Amsterdam, at the Weesperplein 8 in Amsterdam.

According to Joyce Zwaan the policy with regards to influencing/manipulating mobility in Amsterdam is very pragmatic. The situation changes too fast to do an elaborate study on the situation, due to the congestion. As when this study would be conducted the situation would be completely different already. Today the municipality aims to use the means available to adjust the current situation, on pilot basis. When this appears to be effective a more permanent solution can be considered. In this way the municipality is able to realize changes much quicker than before. This has been done at the Munt square in Amsterdam as well as the Sarphatistraat. After this pilot an evaluation is conducted on the inhabitants how they experienced these changes. This results in adjusting the situation real-time to achieve the desired experience for all road users.

This has resulted in the Municipality reevaluating plans to understand whether they are still applicable to a changing environment.

This way of working is not applicable to all projects, but where it is possible to apply this way of working the municipality aims at doing so. This way of working is the result of the "Uitvoeringsagenda Methodiek".

It is easy to manipulate the behaviour of car drivers, by increasing parking prices etc. When it comes to bicycles it already becomes a lot more difficult as the vehicle itself is a lot smaller and more difficult to fine. Trying to influence the behaviour of scooter drivers is even more difficult. Joyce Zwaan holds her breath when it comes to forcing 25km/h scooter drivers to the road, due to the dangerous situations this might result in. According to Zwaan the reason why the 25km/h scooter has become increasingly popular is due to the increase in parking costs for the car. This resulted in estate agents using a scooter to drive in between meethings rather than a car.

Zwaan believes that the introduction of the Low Emission Zone will result in many inhabitants applying for an exemption, which also occurred with the introduction of the Low Emission Zone for lorries.

She believes the municipality will face a difficult time in responding to the affected individuals. But also fears that these scooter owners will be unaware of their rights and how to get in contact with the municipality.

Zwaan recognizes the problem that these changes in legislation will affect inhabitants with a lower income, but also argues that these individuals should contact their employer when the modality is used for commuting.

Amsterdam does support the idea of achieving a higher user efficiency by introducing a shared system, but Zwaan believes, when introducing a sharing concept, that this should work complementary to the cityscape, rather than adding additional volumes and visually polluting the streets. A shared system should therefore effectively address a large group of individuals, and Zwaan personally believes it would be beneficial to Amsterdam if you immediately introduce these users to the new legislation in Amsterdam. It should communicate the benefits over using a car, as when the car is more efficient to the individual they will remain to use the car. This is also the problem when it comes to microcars, as these are currently purchased complementary to a car. According to Zwaan new concepts should therefore relief the city from its high congestion and influence the behaviour of people. The car is not the only modality to blame for the congestion challenges that we face in the city. Overcrowded bicycle lanes are also receiving significant attention. An example is the popular shopping area the "Nine Streets", where cars have been prohibited from entering. The only road users that were allowed were cyclists and pedestrians, yet the situation has become more problematic, than when cars were still allowed.

Appendix P - Highest completed level of educational

6.10.4 Bevolking van 15-74 jaar naar hoogst afgerond opleidingsniveau, 2014 (procenten)

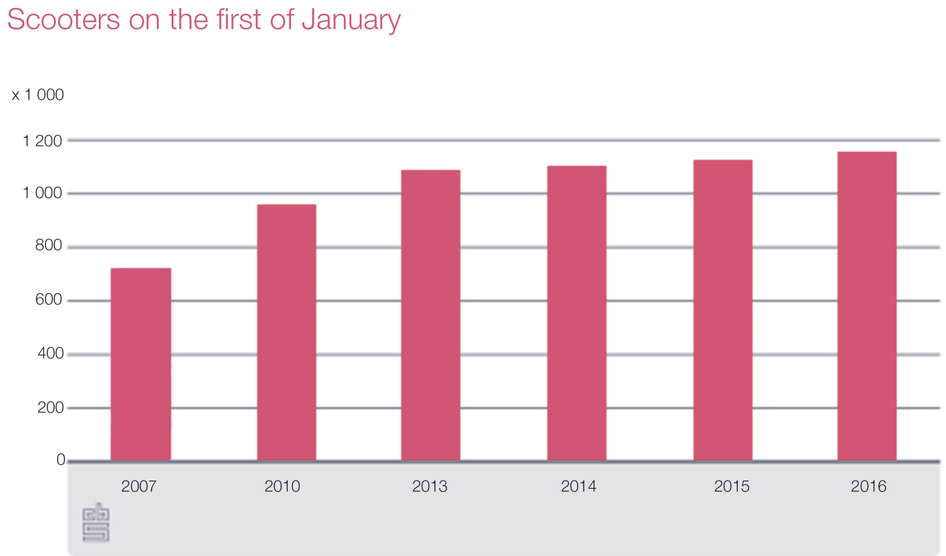
	laag		midden	hoog
geslacht				
mannen	26	35		39
vrouwen	26	33		41
leeftijdsgroep				
15-24 jaar	36	49		14
25-34 jaar	13	29		57
35-44 jaar	19	32		49
45-54 jaar	27	35		38
55-64 jaar	33	31		36
65-74 jaar	41	28		31
migratieachtergrond				
Surinaams	40	44		16
Antilliaans	32	44		25
Turks	56	33		11
Marokkaans	56	34		10
overig niet-westers	38	35		27
westers	17	33		50
Nederlands	16	33		51
generatie				
Nederlanders	16	33		51
1e generatie migranten	40	33		27
2e generatie migranten	30	41		30
totaal	26	33,9638284521		40

- Bron: CBS/bewerking OIS
- Publicatie: Amsterdam in cijfers 2017
- Download: 2017_jaarboek_6104.xlsx

Appendix Q - Dimensions Primary and Secondary coil

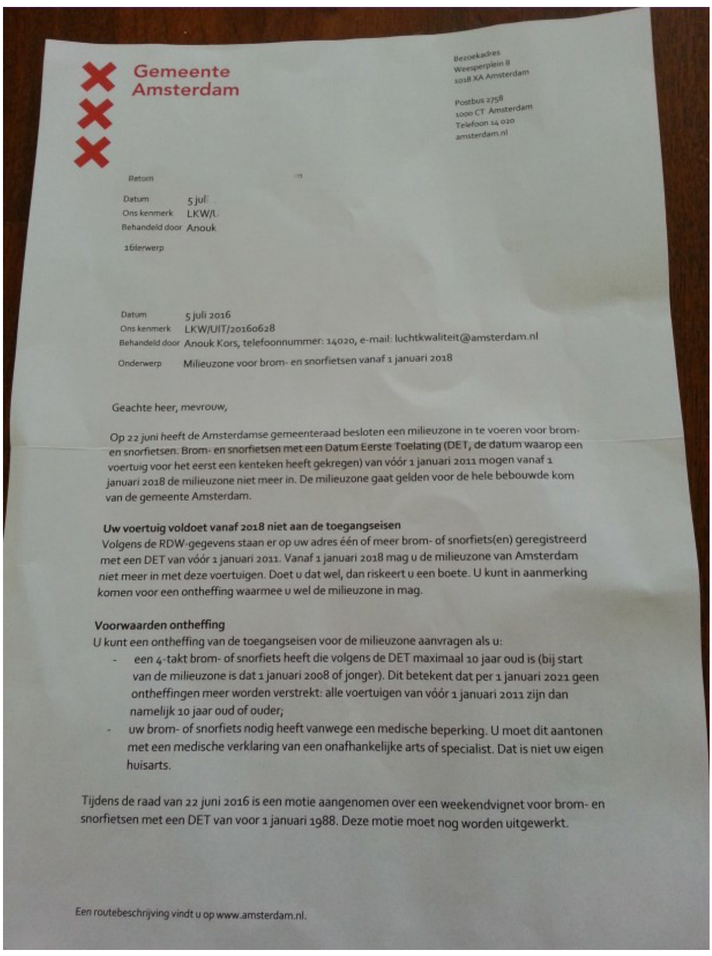
Primary coil	**Copper wire**	**Litz wire**
Outer diameter (mm)	180	
Inner diameter (mm)	20	
Wire diameter (mm)	5.64	0.177 (including insulation)
Spacing between windings (mm)	0.05	
Wire length (mm)	4383	139662
Width ferrite plate (mm)	10	10
Number of windings	14	32
Secondary coil		
Outer diameter (mm)	180	
Inner diameter (mm)	20	
Wire diameter (mm)	5.64	
Spacing between windings (mm)	0.05	
Wire length (mm)	4383	139662
Width ferrite plate (mm)	15	15
Number of windings	14	32

Appendix R - Increase in registered scooters



Source: CBS,2015b;RDW.

Appendix S - Letter sent to scooter owners in Amsterdam by municipality



Gemeente Amsterdam

Bezoekadres
Weesperplein 8
1018 XA Amsterdam

Postbus 2758
1000 CT Amsterdam
Telefoon 14 020
amsterdam.nl

Retour

Datum 5 juli
Ons kenmerk LKW/L
Behandeld door Anouk

16lerwerp

Datum 5 juli 2016
Ons kenmerk LKW/UIT/20160628
Behandeld door Anouk Kors, telefoonnummer: 14020, e-mail: luchtkwaliteit@amsterdam.nl

Onderwerp Milieuzone voor brom- en snorfietsen vanaf 1 januari 2018

Geachte heer, mevrouw,

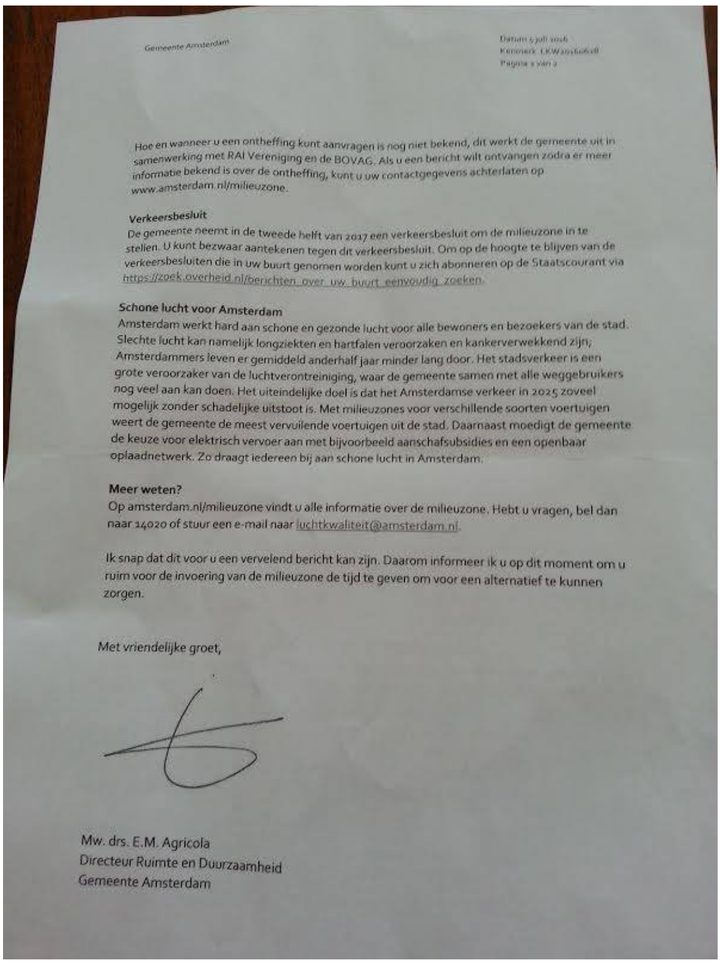
Op 22 juni heeft de Amsterdamse gemeenteraad besloten een milieuzone in te voeren voor brom- en snorfietsen. Brom- en snorfietsen met een Datum Eerste Toelating (DET, de datum waarop een voertuig voor het eerst een kenteken heeft gekregen) van vóór 1 januari 2011 mogen vanaf 1 januari 2018 de milieuzone niet meer in. De milieuzone gaat gelden voor de hele bebouwde kom van de gemeente Amsterdam.

Uw voertuig voldoet vanaf 2018 niet aan de toegangseisen
Volgens de RDW-gegevens staan er op uw adres één of meer brom- of snorfiets(en) geregistreerd met een DET van vóór 1 januari 2011. Vanaf 1 januari 2018 mag u de milieuzone van Amsterdam niet meer in met deze voertuigen. Doet u dat wel, dan riskeert u een boete. U kunt in aanmerking komen voor een ontheffing waarmee u wel de milieuzone in mag.

Voorwaarden ontheffing
U kunt een ontheffing van de toegangseisen voor de milieuzone aanvragen als u:
- een 4-takt brom- of snorfiets heeft die volgens de DET maximaal 10 jaar oud is (bij start van de milieuzone is dat 1 januari 2008 of jonger). Dit betekent dat per 1 januari 2021 geen ontheffingen meer worden verstrekt: alle voertuigen van vóór 1 januari 2011 zijn dan namelijk 10 jaar oud of ouder;
- uw brom- of snorfiets nodig heeft vanwege een medische beperking. U moet dit aantonen met een medische verklaring van een onafhankelijke arts of specialist. Dat is niet uw eigen huisarts.

Tijdens de raad van 22 juni 2016 is een motie aangenomen over een weekendvignet voor brom- en snorfietsen met een DET van voor 1 januari 1988. Deze motie moet nog worden uitgewerkt.

Een routebeschrijving vindt u op www.amsterdam.nl.



Gemeente Amsterdam

Datum 5 juli 2016
Kenmerk LKW/20160628
Pagina 2 van 2

Hoe en wanneer u een ontheffing kunt aanvragen is nog niet bekend, dit werkt de gemeente uit in samenwerking met RAI Vereniging en de BOVAG. Als u een bericht wilt ontvangen zodra er meer informatie bekend is over de ontheffing, kunt u uw contactgegevens achterlaten op www.amsterdam.nl/milieuzone.

Verkeersbesluit
De gemeente neemt in de tweede helft van 2017 een verkeersbesluit om de milieuzone in te stellen. U kunt bezwaar aantekenen tegen dit verkeersbesluit. Om op de hoogte te blijven van de verkeersbesluiten die in uw buurt genomen worden kunt u zich abonneren op de Staatscourant via https://zoek.overheid.nl/berichten_over_uw_buurt_eenvoudig_zoeken.

Schone lucht voor Amsterdam
Amsterdam werkt hard aan schone en gezonde lucht voor alle bewoners en bezoekers van de stad. Slechte lucht kan namelijk longziekten en hartfalen veroorzaken en kankerverwekkend zijn; Amsterdammers leven er gemiddeld anderhalf jaar minder lang door. Het stadsverkeer is een grote veroorzaker van de luchtverontreiniging, waar de gemeente samen met alle weggebruikers nog veel aan kan doen. Het uiteindelijke doel is dat het Amsterdamse verkeer in 2025 zoveel mogelijk zonder schadelijke uitstoot is. Met milieuzones voor verschillende soorten voertuigen weert de gemeente de meest vervuilende voertuigen uit de stad. Daarnaast moedigt de gemeente de keuze voor elektrisch vervoer aan met bijvoorbeeld aanschafsubsidies en een openbaar oplaadnetwerk. Zo draagt iedereen bij aan schone lucht in Amsterdam.

Meer weten?
Op amsterdam.nl/milieuzone vindt u alle informatie over de milieuzone. Hebt u vragen, bel dan naar 14020 of stuur een e-mail naar luchtkwaliteit@amsterdam.nl.

Ik snap dat dit voor u een vervelend bericht kan zijn. Daarom informeer ik u op dit moment om u ruim voor de invoering van de milieuzone de tijd te geven om voor een alternatief te kunnen zorgen.

Met vriendelijke groet,

Mw. drs. E.M. Agricola
Directeur Ruimte en Duurzaamheid
Gemeente Amsterdam

Stint Pick-up
Max mass: 300kg

Stint BSO
Max mass: 300kg

Stint Special Edition
Max volume: 1.6 m3
Max mass: 500kg

Stint Cargo
Max volume: 1.6 m3
Max mass: 500kg

Appendix U - Comparison: scooter ownership vs shared use

	Type			
	Personally owned scooter with ICE	Personally owned electric scooter	Mego	Personally owned electric bicycle
Costs				
Fuel	€0,051/km	Full charge €0.40	€0.00	Full charge 0.10
membership	€0.00	€0.00	€0-8	€0.00
Purchase price	€1400.00	€2999.00	€0.00	€1800.00
Repair & maintenance	€0,026/km	600 2-3 years new battery	€0.00	€500 3-5 years new battery
Insurance	€25/month	€25/month	€0.00	€0 - €25/month e-bike vs pedelec
Lock	€50.00	€50.00	€0.00	€50.00
Price per minute	€0.00	€0.00	Yugo = € 0.17*, Cityscoot=€ 0.20*, Felyx=€ 0.30*	€0.00
When driving an ICE scooter one pays 0,28 euro per kilometer. If the average annual mileage lies around 3000km, then the annual costs are 843euro				
*https://www.getyugo.com/faq -				
https://www.cityscoot.eu/en-savoir-plus/?lang=en				
https://felyx.nl/faq				
http://scholieren.nibud.nl/uitgaven/wat-kostt/wat-betaal-je-echt/de-kosten-van-een-scooter.html				
https://radar.avrotros.nl/nieuws/detail/e-bike-kopers-houden-te-weinig-rekening-met-extra-kosten/				
http://www.scooterprijs.nl/elektrische-scooter.html				
https://www.anwb.nl/binaries/content/assets/kampioen/pdf/k5-2013-test-e-scooters-tabel-meetgegevens-internet-2.pdf				
http://www.scooternews.nl/elektrische-scooter/				
https://elektrischefietsenkiezen.nl/hoeveel-kost-opladen-accu				