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Transport with e-cargo bikes in Switzerland

GEO 511 Master's Thesis

Author
Felix Poelsma
17-734-872

Supervised by
Dr. Simon Noori

Faculty representative
Prof. Dr. Christian Berndt

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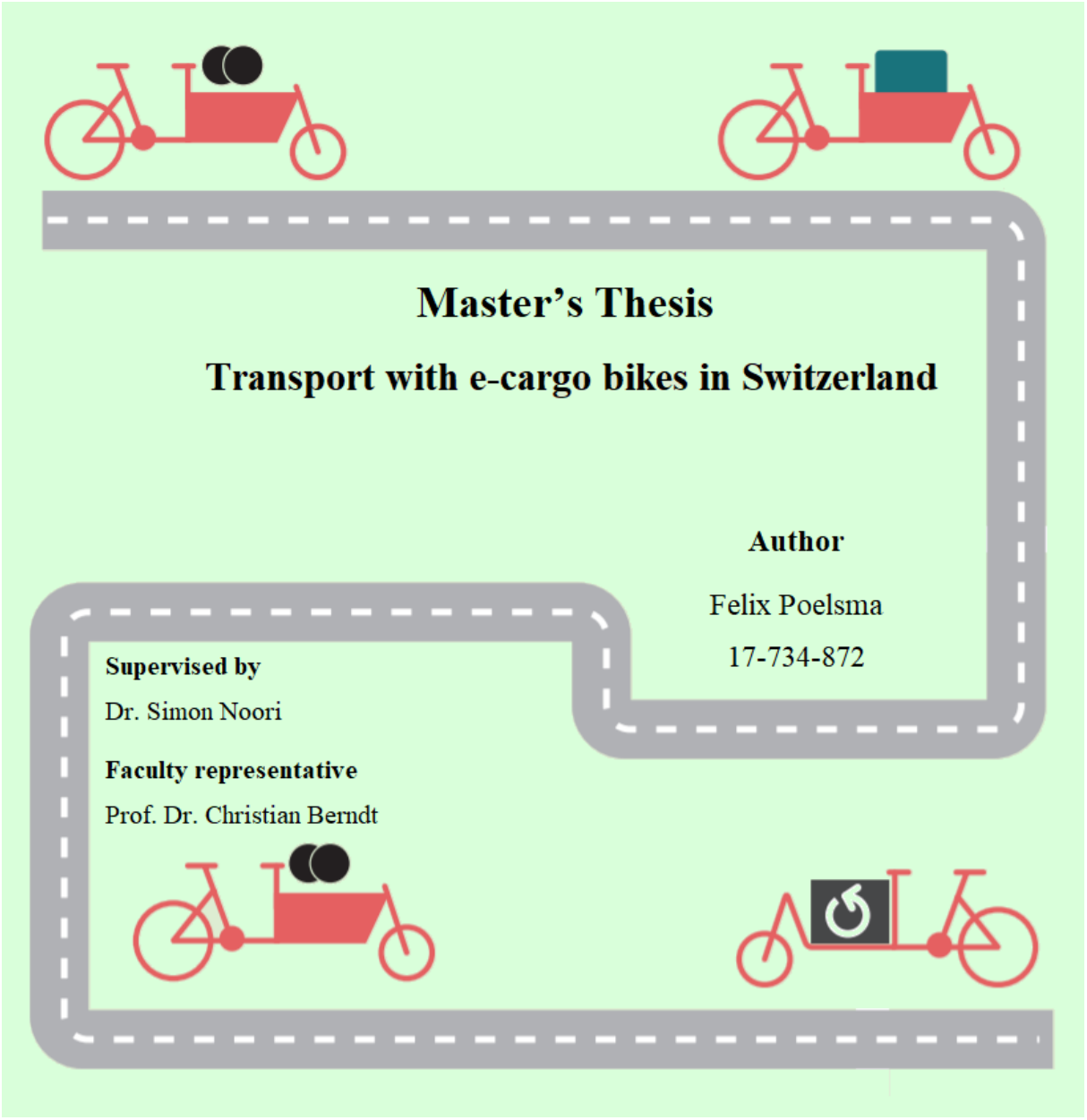
Department of Geography, University of Zurich

University of Zurich[UZH]



Cover picture: Transport with e-cargo bikes in Switzerland (author representation, inspired by: Beckmann et al., 2016, p. 15).

Foreword and acknowledgments

Before you lies the Master thesis ‘Transport with e-cargo bikes in Switzerland’. This thesis, done at the Economic Geography Group, has been written as completion of the Consecutive Master program Human Geography, at the University of Zurich. I was engaged in researching and writing this thesis from the 19th of May 2019 till the 30th of April 2020. The project proved to be a challenging but all the more valuable contribution to the development of my academic skills. I would like to thank my supervisor Simon Noori for his valuable, constructive and critical guidance throughout this process. Furthermore, I would like to sincerely thank all the interview participants for their time and interesting contributions, which made this research project possible. I also benefitted from debating issues with my friends and family, which allowed for a continuous critical reflection on my research.

I hope you enjoy your reading.

Felix Poelsma

Summary

Rising greenhouse gas emissions, congestion and noise disturbance puts current transport systems under pressure. Especially in urban areas, innovative solutions are needed to make current transport systems more sustainable. This research project explores one such solution, namely electric-powered cargo bicycles or ‘e-cargo bikes’. E-cargo bikes can be used to transport children or goods and can replace motorised transport on short distances between 10 and 15 km, with loads up to 300 kg. This research project explores which factors are driving or hindering e-cargo bike usage in Swiss urban areas. Building on theory from transition literature, the rise of e-cargo bikes is analysed with the support of the Multi-Level Perspective from Geels (2002). Hereby acknowledging that transitions are socio-technical processes and are influenced by actors from various sectors in society. Through interviewing actors from diverse sectors ranging from retail, policy, science and manufacturing, various factors could be identified. It is shown that e-cargo bikes are believed to be a promising alternative for motorised transport, but still is a niche-product in Switzerland. Important factors driving e-cargo bike use are environmental considerations, time efficiency, growing awareness and costs. However, costs can also be a hindering factor as it depends with what other transport modes e-cargo bikes are compared to, to assess whether or not e-cargo bikes are cost-saving or expensive. Other hindering factors are the Swiss transportation infrastructure, a political climate which put cycling low on the agenda, restrictive regulations on weight and the number passengers, safety perceptions, transportation culture and the fact that e-cargo bikes are produced outside of Switzerland. Nevertheless, the demand for e-cargo bikes seems to be growing. How e-cargo bike usage will develop in the future is uncertain, however measurements such as easing regulations or banning cars from city centres, could lead to an increase in e-cargo bike usage.

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1. Introduction

Cities all over the world struggle to become more environmentally sustainable (Banister, 2005). Pollution arising from the transport sector has negative effects on air quality, which can lead to health problems for city residents. Furthermore, noise arising from road traffic negatively affects the health of city residents (EEA, 2019). On a global scale, greenhouse gas emissions needs to be reduced to moderate the detrimental impacts of climate change. Achieving this poses a large societal challenge, as big structural changes in current transport systems are necessary (Geels, 2012). The transportation sector accounts for a quarter of the EU's greenhouse gas emissions and while other sectors have seen reductions in emissions, those arising from transport have risen (EEA, 2019). In Switzerland, transport accounts for a large part of the energy consumption (38%) and greenhouse gas emissions from transport have risen between 1990 and 2017 (BFS, 2020). Consequently, the dominance of motorized transport is viewed as untenable (Banister, 2005; Steg and Gifford, 2005), therefore scholars and policymakers believe that a transition towards more sustainable transport systems is necessary (Schwanen et al., 2011; Geels, 2012).

This research project explores one solution that supports a transition towards more sustainable transport systems. This solution is the transportation of goods and/or children by electric-powered cargo bicycles (e-cargo bikes) instead of cars. As e-cargo bikes use significantly less space and omit far less greenhouse gas emissions compared to cars, e-cargo bikes can be an effective solution to reduce congestion and improve air quality (Wrighton and Reiter, 2016). Especially for short distances e-cargo bikes can be an efficient alternative to current transport systems (Hess and Schubert, 2019). Therefore, this mode of transportation suits urban areas well. Urban areas are characterized by high population densities and close proximity of different locations. This means that most trips are less affected by slower modes of transportation compared to rural areas where distances tend to be larger (Schwanen et al., 2004; Wrighton and Reiter, 2016). Moreover, e-cargo bikes are easier to manoeuvre through heavenly congested areas and are often able to access areas that are closed to motorized transport, such as car-free city centres (Leonardi et al., 2012). Furthermore, people driving an e-cargo bike do not need to have a driver's license[1], providing people without a driving licence access to an electrical supported vehicle which can be used to transport goods.

[1] In Switzerland, drivers of 'fast e-bikes', meaning e-bikes which provide support up to 45 km/h, do need to have a driver's license (minimal category M - motor) (CH, 2019). However, the majority of e-cargo bikes on the market today do not provide electrical support to such speeds and are classified as 'slow e-bikes'.

Wrighton and Reiter (2016, p. 951) see a lot of potential in replacing motorized transport with (cargo) bicycles in urban areas.

> *In urban areas on average 51% of all motorised trips - associated with the transport of goods - could be shifted from car to the bicycle or cargo bicycle. About 1/3 of these motorised trips that could be shifted can be attributed to commercial transport, whereas private logistics (e.g. shopping and/or leisure transport) accounts for 2/3.*

In addition to the transport of goods, e-cargo bikes can also be used to transport children or pets (Lieswyn and Wilke, 2016). A study in the United States found that a cargo bike[2] could be a viable alternative of a car for young families living in urban areas (Riggs, 2016). Additionally, 68.9% of the respondents in this study changed their travel behaviour after they purchased a cargo bike and 66% stated to use their cargo bike as their primary mode of transportation. Thus, cargo bikes have the potential to change people's transport behaviour for the transport of goods, children or both. According to Beckmann et al. (2016), an e-cargo bike can function as an alternative to cars on routes till 10-15km, with loads up to 300 kg as can be seen in Figure 1.

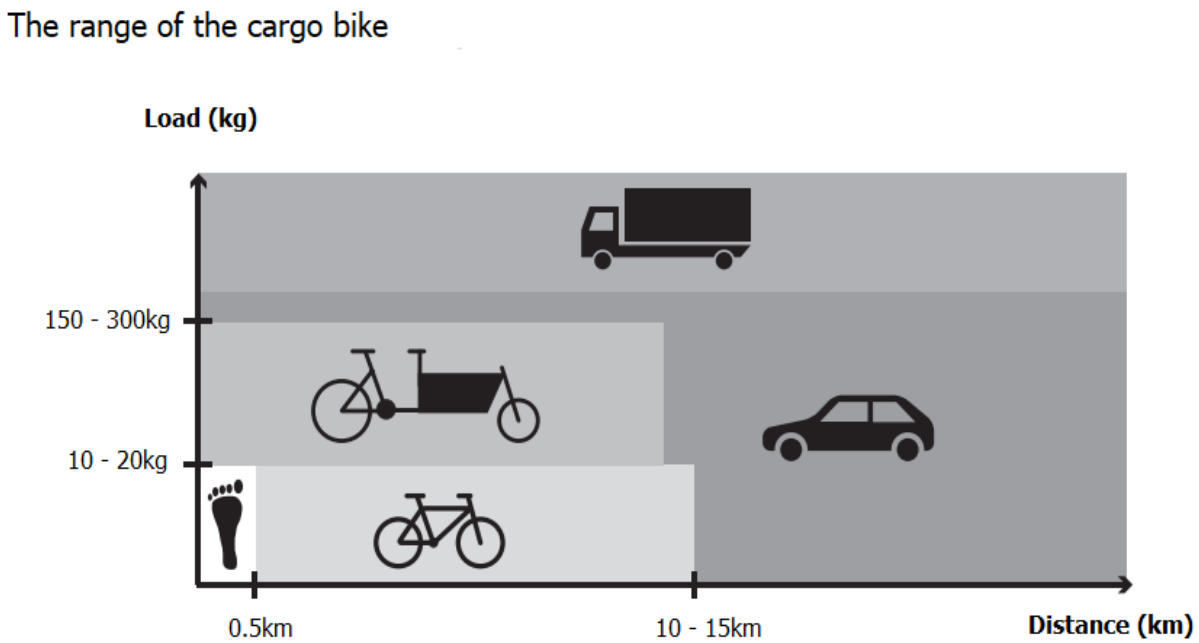


Figure 1: Range of cargo bikes compared to other transport modes (Modified from source: Beckmann et al., 2016, p. 13).

[2] In this study, no distinction was made between e-cargo bikes and cargo bikes (i.e. bikes without electric support).

In Swiss urban areas, many short distance trips are conducted with motorized traffic as can be seen in Table 1. In 2015, the length of 41% to 52% of the motorized journeys in six major Swiss cities was less than 5 km. This indicates a large potential for e-cargo bikes in Swiss cities as e-cargo bikes could are particularly suited for short-distances.

To date, e-cargo bikes are still a niche mode of transportation in Switzerland and there is little research on this mode of transportation (Hess and Schubert, 2019). Furthermore, in Switzerland e-cargo bikes are not counted separately in bicycle statistics but are added to the category of e-bikes (Siegenthaler, 2017). Therefore, there is little data on the actual number of e-cargo bikes on the roads. This poses a challenge for researchers as well as policy-makers. Thus, while e-cargo bikes can make transport in urban areas more efficient and sustainable (Riggs, 2016; Wrighton and Reiter, 2016; Hess and Schubert, 2019), low data availability (Siegenthaler, 2017) can discourage researchers and policy makers from analysing how this potential can be exploited in Switzerland.

Table 1: Different distance ranges conducted by motorised transport in various Swiss cities in 2015 (Source: Basel-Stadt et al., 2017, p. 10).

Distance	Basel	Bern	Luzern	St. Gallen	Winterthur	Zürich
Till 1km	8%	7%	6%	6%	6%	5%
1-3 km	22%	22%	19%	26%	24%	19%
3-5 km	22%	14%	23%	17%	19%	18%
> 5 km	48%	58%	52%	52%	51%	59%

This research project aims to fill this gap and generate insights on the usage of e-cargo bikes in Switzerland. To do so, it explores who in today's transport system uses e-cargo bikes and for which purposes. This project collects insights from actors with various links to the e-cargo bike sector. Interviews with bicycle shop owners, manufacturers, researchers, managers of transportation businesses and governmental employees sketch a picture about the state of e-cargo bike usage in Switzerland. With this information this research projects answers the research question:

Which factors drive or hinder the rise of e-cargo bikes in Switzerland?

This thesis is structured as follows: The next chapter presents a historical background, which sets the stage of how the relatively new technology of e-cargo bikes arrived in Switzerland. Subsequently current e-cargo bike models and their characteristics are shown. Chapter three presents the theoretical approach of this research project. This explains from which scientific angle the usage of e-cargo bikes will be analysed. Moreover, it discusses the research question and related sub-questions in more detail. In chapter four the research methodology will be explained. More specifically, it describes the data collection and the data analysis. Subsequently, chapter five shows the results of the data analysis and chapter six discusses these results. Finally, chapter seven provides the conclusions and discusses the limitations and future outlook.

2. Background

E-cargo bikes are a relatively new mode of transport (Basterfield, 2014), therefore the emergence of e-cargo bikes is discussed from a historical perspective. Looking into the rise of cycling and different types of bicycles puts the rapid current developments regarding e-cargo bike into perspective. Further, it shows how the usage and meaning of 'the bicycle' has changed over time. After this historical overview, current e-cargo bike models and how they are employed in Switzerland will be presented.

2.1. Historical overview

Whereas e-cargo bikes are quite novel, transporting loads by bicycle occurred already in the late 19th century (Basterfield, 2014). Today's e-cargo bikes are a combination of many different technological innovations, most notably e-bikes and cargo bikes. Through time, the usage and meaning of the 'bicycle' has changed multiple times. At first the bicycle was only used by a select group of individuals, but with time it became a vehicle which gave many social groups more freedom and mobility (Kaschuba, 2004). Such developments influence the way transport systems are used and designed. Looking at the history of bicycles and e-cargo bikes provides insight into possible usage purposes for present-day Switzerland.

2.1.1 The first bicycle and the 'bicycle-boom' – 1870-1950

The first bicycle or 'draisenne' is attributed to Baron Karl von Drais and was presented to the public in Paris in 1818 (Herlihy, 2004). This first model had to be pushed forward by the driver's feet. More specifically, the bicycle consisted of a seat with two wheels and a steer, but without pedals. Many innovations to this first bicycle followed, such as the pedals, the chain-drive, and the pneumatic tires and at the end of the 19th century different types of bicycles were driven all across Europe (Herlihy, 2004). At first, bicycles were mainly used for sports and competitions by men of the upper class of society. Riding these early bicycles was not easy, especially the popular penny-farthing bicycles, as shown in Figure 2, required training. However, the so-called 'safety bike', depicted right in Figure 2, would change this, as riding such bikes was much more comfortable.

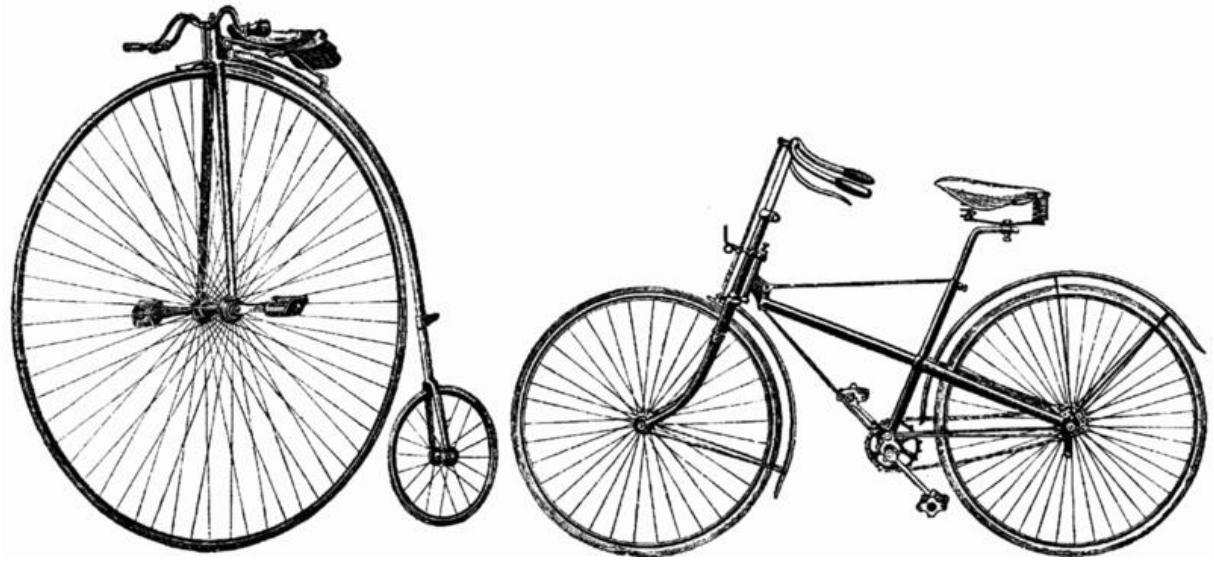


Figure 2: The penny-farthing bicycle (left) and the safety bike (right) (Modified from source: Lueger, 1904, p. 119).

Around the 1900s the image of the bicycle as an 'elitist sports vehicle', started to change towards that of 'a method of transportation for the mass' (Oldenziel and de la Bruhèze, 2011). This 'bicycle-boom' at the start of the 20th century brought far-reaching developments in society. This new mode of transportation changed the spatial mobility[3] of many individuals and sometimes also influenced their social mobility[4]. The bicycle was an important tool in social emancipation, especially for women and the working class, as bicycles offered them a level of freedom and flexibility that was until that moment only available for the elite (Kaschuba, 2004). According to ViaStoria and ASTRA (2014, p. 25, author translation) 'Women cyclists publicly embodied the new, mobile and independent woman. The bike helped women to question the prevailing notions of femininity'.

2.1.1.1. First cargo-bikes

During the bicycle-boom, lots of experimentation with various bicycle models was conducted. Because the classic penny-farthing bicycle aimed only at young, athletic men, other models for different social groups emerged. Among these are the first tricycles, which were developed in the 1880s. Tricycles were seen as less dangerous, because with three wheels the chance of tipping over is very small (Basterfield, 2014). Initially, tricycles were aimed at women and elderly as these groups were seen as needing more protection. However, these

[3] Spatial mobility refers to the movement of people between different places such as movements within different areas of a city, region or states, more on this in section 3.1.
[4] Social mobility refers to the movement of individuals or groups between various positions within society, more on this in section 3.1.

models also offered extra space, which allowed for the transport of for example a box or a basket. Many small shop owners recognized the potential of transporting their goods with tricycles and the first cargo-bikes, such as shown in Figure 3, were developed. Some tricycles were also used to transport persons, or even both. Also mail services made use of some of these models (Basterfield, 2014).

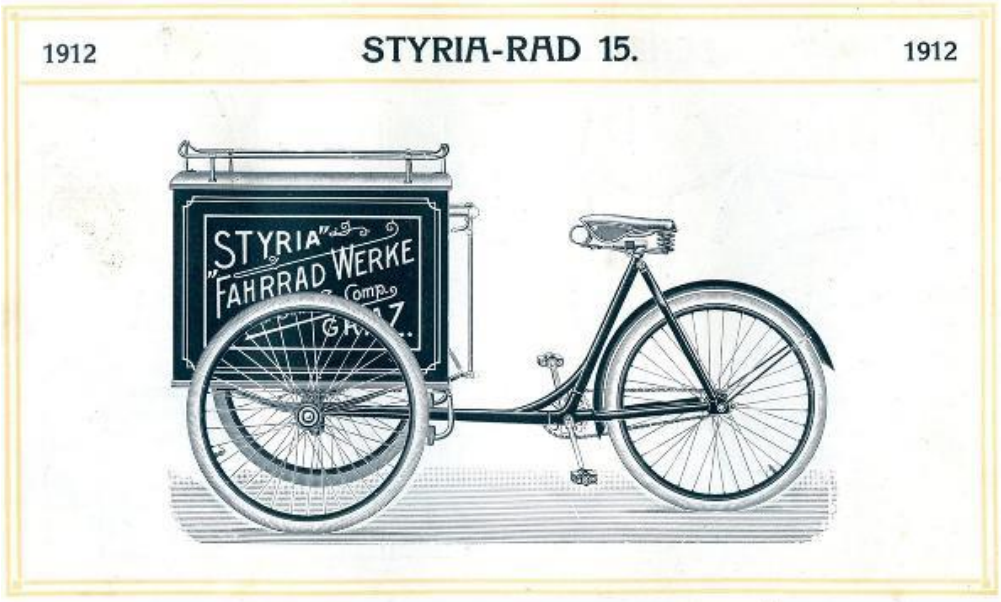


Figure 3: Early cargo bike, model Styria 1912 (Source: Argus, 2019).

2.1.1.2. First e-bikes

Around the 1900s, the first electric powered bicycle emerged. It was developed by the Singer Motors Company. However, these early e-bikes did not get popular and Singer Motors decided to focus on developing models powered by gasoline instead of electricity (Rose, 2012). Singer Motors would not be alone in their focus on internal combustions engines, as this would eventually lead to the emergence of 'motorcycles' (Basterfield, 2014).

2.1.1.3. Switzerland during the bicycle-boom

Just as in other European countries, bicycle manufacturing companies were founded in Switzerland at the end of the 19th century (ViaStoria and ASTRA, 2014). The increasing number of bicycles also changed the way roads and infrastructure was being used, yet large amounts of separate bicycle infrastructure was not common. The rise of automobiles, although they were few in number, caused changes in road infrastructure. In Switzerland, the

slower bicycle was often seen as dangerous for faster moving cars, which meant that the bicycles needed to be removed from infrastructure used by cars. Consequently, little roads for cyclist were realised (ViaStoria and ASTRA, 2014). Compared with other countries, Switzerland appears to have an average number of cyclist during this period, Switzerland might have had even more bicycles per inhabitant than countries such as the Netherlands or Denmark (ViaStoria and ASTRA, 2014, p. 20)[5], which are seen as 'bicycle nations' nowadays (Pucher and Buehler, 2008).

2.1.2. Mass motorization – 1950-1980

Across the western world the number of bicycles quickly dwindled in the second half of the 20th century. After the world wars a new era of prosperity emerged and automobiles powered by fossil fuels became the dominant mode of transportation (McNeill, 2001). Not just the amount of bicycles was reduced, also the reputation of the bicycle changed. Whereas the bicycle at first stood for freedom, the bicycle was now seen as an inferior mode of transport (Oldenziel and de la Bruhèze, 2011). If people could not afford a car, they should at least be able to afford a motor-scooter. Of course this dynamic was stronger in some countries than others, however even nations which were traditionally bicycle focused (such as the Netherlands and Denmark), showed a reduction in bicycles in this period (ViaStoria and ASTRA, 2014).

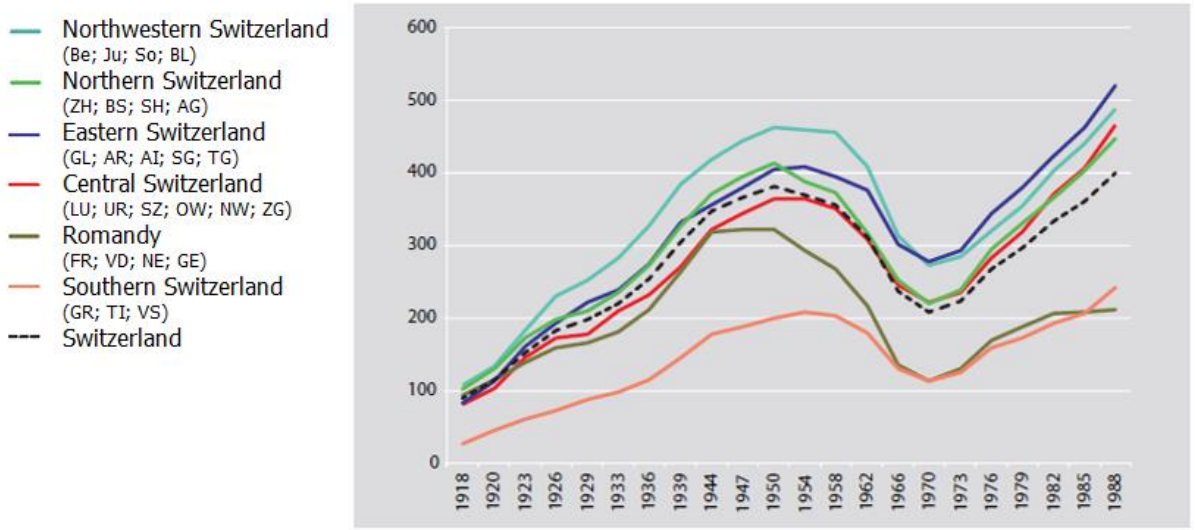
Urbanization, population growth and increasing wealth all contributed to an increase in car use in cities. Gradually, roads became more and more a space solely reserved for transportation with the car as dominant mode of transport. This 'automobile regime' has shaped cities' spatial planning and their infrastructure became geared towards facilitating automobiles (Oldenziel and de la Bruhèze, 2011). Traditionally, streets were not just places to go from A to B, but also places where people would meet and they were used as children's playgrounds. However, this usage and meaning of streets now changed (McNeill, 2001). This mass-motorisation had far-reaching consequences. City centres lost population, while living in the peaceful suburbs and countryside became the new ideal. The car made a spatial separation between living and working possible. Cities and transportation infrastructure were

[5] ViaStoria and ASTRA (2014) who rely on a dissertation by Schacht (1933) state that this is the case. Yet, a table provided in the same source (Schacht, 1933 in ViaStoria and ASTRA, 2014, p. 20) seems questionable as some numbers appear improbable. As the original Table by Schacht (1933) could not be accessed, this statement has to be interpreted with care.

tailored to allow for this new form of mobility, which means that motorized transport was given priority over other modes of transport (Oldenziel and de la Bruhèze, 2011).

2.1.2.1. Switzerland during the mass motorization

Just as in other European countries, the number of bicycles dropped sharply around the 1950s, which is shown in Figure 4. The ideal of owning a car while living in the suburbs was also visible in Switzerland (Kahsai and Schaeffer, 2010). Gradually, cars became a necessity for taking part in society (Meyer, 2008). In the Swiss traffic policy, road infrastructure for bicycles and also pedestrians often had to make way for roads for motorized vehicles (Oldenziel and de la Bruhèze, 2011). By ignoring space for cyclist and pedestrians, city planners typically designated relatively narrow spaces for roads, which would make inclusion of such cycling infrastructure in Swiss urban areas very difficult in the future (ViaStoria and



ASTRA, 2014).

Figure 4: Number of bicycles per 1000 inhabitants in regions in Switzerland (Modified from source: ViaStoria and ASTRA, 2014, p. 20).

2.1.3. Cycling renaissance – 1970-Present

Around the 1970s the political climate changed, environmental concerns and events such as the oil crisis raised doubts on the reliance on motorized transport. Especially in cities resistance against the dominance of cars grew (McNeill, 2001). Over time, cities had become more and more crowded and congestion and air pollution became important issues in cities

throughout the world. Public transport was expanded and also bicycles rose in significance again. This time however, the reputation of the bicycle partly rose because it was perceived as a more sustainable mode of transport (Oldenziel and de la Bruhèze, 2011).

2.1.3.1. Comeback of e-bikes

This new period of cycling interest also brought about new innovations. The e-bike made a comeback and in the 1980s and various e-bikes models hit the market in the Japan (Rose, 2012). However, these e-bikes did not receive much traction in other markets due to technical limitations, such as battery life and high costs (Fishman and Cherry, 2015). Technological improvements led to models which were faster, could ride longer distances and could be produced at more attractive prices. Around the 2000s e-bikes were sold throughout the world, with China, the Netherlands and Germany as leading markets (Fishman and Cherry, 2015).

The potential of e-bikes to reduce emissions arising from transport is widely recognized, however it remains hard to quantify (Fishman and Cherry, 2015). Various estimations on to what extent an e-bike is more sustainable compared to a car exists (Cherry et al., 2009; Buffat et al., 2014). However, in practice, the environmental impact of an e-bike depends on multiple factors. Factors to take into consideration are the production of the e-bike itself and the type of battery, which can differ between manufactures. Further, the extent to which electricity is generated by sustainable energy sources has to be considered. In Switzerland around 60% of the electricity is generated by hydropower (BFS, 2019) which is perceived to be a sustainable energy source. However, other European countries the reliance to a much greater extent on fossil fuels to generate electricity, which makes electricity powering e-bikes less sustainable. Nevertheless, it is evident that individuals conducting journeys with an e-bike instead of a car cause far less CO2 emissions. The sheer weight of a car versus an e-bike means that, regardless of how sustainable the energy source is, there is much less energy needed to power an e-bike. Furthermore, an e-bike takes less space on the road, which reduces congestion. Finally, it is also very silent mode of transportation and thus reduces noise disturbance. Nevertheless, this silence might on the other hand be a safety concern. Papoutsi et al. (2014) note that silence is an important factor in e-bike related accidents because people fail to notice the e-bike in time.

E-bikes have the potential to transform the transport sector, however this is not a given. To give an example, if a person decides to use an e-bike instead of a car powered by gasoline,

one can speak of a radical change. However, when someone replaces a regular bicycle with an e-bike, the change is only incremental (Hofmann and Bruppacher, 2008). It is unclear where and when the technologies of e-bikes and cargo bikes were combined to form the first e-cargo bikes models. However, it is estimated that this development happened during the 1980s and 1990s (Kirkels, 2016).

2.1.3.2. Switzerland during the cycling renaissance

As shown Figure 4, also in Switzerland the amount of bicycles started to increase again around the 1970s. It is also during this period that new associations regarding sustainable mobility were being founded. Most notably 'Pro Velo Schweiz' in 1975 and 'VCS Schweiz' in 1979. Pro Velo aims to improve the conditions for everyday and recreational cyclists (Pro Velo, 2019), whereas VCS aims to promote more sustainable transport modes, one of which is cycling (VCS, 2019). However, also in Switzerland it had become common to live and work in different places, which implied longer travel distances. Therefore, the bicycle was predominantly for recreation vehicle, instead of commuting (ViaStoria and ASTRA, 2014). Additionally, road infrastructure planners payed little attention to the inclusion of cyclist the past decades, which made cycling often unattractive and unsafe (ViaStoria and ASTRA, 2014). Oldenziel and de la Bruhèze (2011, p. 40) explain that cycling infrastructure was improved, yet it would not reach the same level as during the bicycle boom:

> *During the 1990s, Swiss policymakers adopted grass-roots initiatives often in an ad-hoc fashion and focused on designing bicycle lanes, but everyday cycling remained just a fraction of the old levels.*

In the early 2000s the sale of e-bikes in Switzerland started to grow and increased rapidly recent years (Buffat et al., 2014; Scaramuzza et al., 2015). The environmental impact of this development has been studied by Buffat et al. (2014). They investigated whether or not e-bikes are used as an alternative or additional mode in Switzerland. It was found that many participants use their cars 'much less often' and 'less often' since they acquired an e-bike. However, the authors also mention that people do not view a normal e-bike as a full replacement of the car because the car is still seen as necessary to conduct trips which require more space to transport more persons or goods. Here, e-cargo bikes could potentially play a role a reduce the need for cars even more. When exactly e-cargo bikes arrived in Switzerland remains unclear from the literature.

2.1.4. Summary

Over time, the meaning and usage of bicycles has changed. Whereas the first bicycles were used by the male upper class for sport competitions, later bicycles models played a role in the social emancipation of women and the working class by giving these groups more freedom. The first cargo bikes were used by small business while early experiments with electric powered bicycles fizzled out as a result of the rise of internal combustion engines. Cars became the dominant mode of transport and across the world, the importance of cycling waned. Around the 1970s the bicycle made a comeback, partly because environmental concerns showed the disadvantages of a car-dominant transport system. The first e-cargo bikes were developed in the late 20th century and are believed to be potentially an efficient and more sustainable alternative in urban areas.

2.2. Current situation

As of now, many different e-cargo bike models exist. They can be used to transport goods, children and pets and it is not uncommon that bicycle manufactures are surprised by the various usage purposes people find for the bikes. Regular cargo-bikes, i.e. without electric support have been in use since already in the 19th century (Kirkels, 2016). The electric support however, enables user to transport goods or persons much more comfortably, over longer distances and faster. Because of this, e-cargo bikes are believed to have the potential to compete with cars, especially in urban areas (Hess and Schubert, 2019). Before presenting the various e-cargo bikes models currently available, the term e-cargo bikes will be defined.

2.2.1. What is an e-cargo bike?

In this research project an e-cargo bike will be defined as follows:

> *An e-cargo bike is a bicycle with an electric motor, which support the driver to propulse the bicycle forward. It is specifically designed to transport loads.*[6]

[6] It was decided to develop an own definition, as in the literature the terms of cargo bike, e-cargo bike, freight bicycle, freight tricycle, box bicycle are often used interchangeably. This definition fits the e-cargo bikes which are used in Switzerland best, because it includes two- and three- track vehicles and excludes non-electric bikes and bicycle trailers.

This definition is quite broad, thereby including the large variety of different e-cargo bike models. It does however, not include trailers which can attached to a bicycle. Trailers will be treated as a separate technology which, in some cases, competes with e-cargo bikes as a transport option. Furthermore, a trailer could also be attached to an e-cargo bike, to increase its capacity to transport loads even further, as can been seen in Figure 5.

Figure 5: An e-cargo bike with combined with a trailer (Source: Carla Cargo, 2020).

Figure 6: A single track e-cargo bike (Source: Urban Arrow, 2020).

Figure 7: A two-track e-cargo bike (Source: Babboe, 2020).

2.2.2. Different e-cargo bike models

There is a large variety of different e-cargo bike models on the market. A distinction can be made between single-track and two-track models, which each can be particularly suitable for either passenger or freight transport. Single-track refers to two-wheeled vehicles, were the wheels are located in sequence of one another. An example of a single-track e-cargo bike is seen in Figure 6. In contrast, two-track models often come with 3 (or more) wheels, were two wheels are located adjacent from one another. In this way the wheels create two separate tracks on which the vehicle will move through traffic. An example of an two-track e-cargo bike is provided in Figure 7. Generally single track vehicles are more manoeuvrable, while two-track vehicles provide more stability. Figure 8 shows the different types of e-cargo bikes which are on the market. This wide array of models is categorized by the load they can carry, 2-wheeled or three-wheeled and their suitability to transport goods or persons.

Figure 8: Overview of the different types of cargo bikes (Modified from source: Beckmann et al., 2016, p. 10-11).

2.2.3. E-cargo bike usage in Switzerland

E-cargo bikes might serve as an alternative for people who want to transport multiple persons and/or goods. To date, little data of the relation of e-cargo bike use and car use exist. In Switzerland one example is Carvelo2go, via this e-cargo bike sharing platform, private customers can rent e-cargo bikes. According to a user survey by Carvelo2go (Stawicki and Schmid, 2019), participants stated that in 2018, around 42,3% of the conducted trips replaced trips that otherwise would have been conducted by car. This shows that e-cargo bikes can be used as an alternative for cars. The most important usage purposes of these trips were transporting children (42,1%) and groceries (41,5%). Another study by Hess and Schubert (2019), analysed what barriers Carvelo2go users and inhabitants of Basel who did not use Carvelo2go, perceived for using this e-cargo bike sharing platform. This survey showed that most active users of Carvelo2go, also often ride bicycles themselves. Furthermore, they tend to have some experience with other sharing schemes, such as car-sharing. An important reason to not make use of Carvelo2go was access to a similar mode of transport, this could mean they had access to or bought an e-cargo bike of their own. It could also imply that they used similar transportation options such as bike trailers, suggesting that bike trailers could compete with e-cargo bike usage. Further, respondents which could not imagine using e-cargo bike sharing appeared to be afraid of using e-cargo bikes. This was due to the speed of e-cargo bikes or they deemed cycling to be unsafe, as stated by Schubert (2019, para. 7) ‘These individuals are afraid to cycle because of the many cars in the city and believe that bike paths are too unsafe’.

Besides families, businesses and especially in the delivery sector are using e-cargo bikes too, no data in Switzerland has been yet collected, to give insight into what extent this is happening. Various courier companies offer to transport goods by means of e-cargo bikes, these are mainly relatively small and young companies which are hired by larger delivery companies like DPD, DHL or Die Post. For instance, Die Post bought a majority of the bicycle courier company Notime AG in order to outsource a part of the Die Post deliveries to be done on e-cargo bikes (Die Post, 2018).

2.2.4. Summary

As of now, many different e-cargo bike models are on the market which can be used for different purposes. E-cargo bikes can be classified by their suitability to transport either goods or persons and whether it is a 2- or 3-wheeled vehicle. In Switzerland, little information on the number and usage of e-cargo bikes exist. Nevertheless, a user survey by e-cargo bike sharing platform Carvelo2go suggest that e-cargo bikes are mostly used to transport children and for doing groceries. Users state that sometimes they would have conducted these trips by car. Also the delivery sector seems to make use of e-cargo bikes, however little is known about the scale of these operations. Before exploring the usage of e-cargo bikes in Switzerland in more detail, the theoretical approach will be presented in the next chapter.

3. Theoretical framework and research questions

This chapter describes the analytical perspective of this research project and presents its research questions. E-cargo bikes can potentially transform our mobility behaviour, especially in urban areas, thus theory guiding this research is rooted in the field of mobility and urban transportation. Moreover, to capture this transformation, this research builds on a theoretical framework from transition studies.

3.1. Mobility

This research project focuses on spatial mobility in urban contexts, as using an e-cargo bike seems to be mostly related to the spatial mobility of the user. Yet, mobility is a broad concept that includes both spatial and social mobility. Spatial mobility entails the movement between different places, such as movements within and between different areas of a city, region or state. On the other hand, social mobility refers to the movement of individuals or groups between various positions within society. These positions or so-called 'social strata' are different categories based on socioeconomic factors such as wealth, race, gender, social status and power (Gebhart et al., 2011). Spatial and social mobility often influence one another. This is most evident with the topic of migration as the movement of people between states (spatial mobility) logically influences the socioeconomic position they hold within society (social mobility) (Gebhart et al., 2011). The use of an e-cargo bike obviously changes the spatial mobility options of the user. Less obvious is that it can also change a user's social mobility. For example, using an e-cargo bike might also be linked to a sustainable and healthy lifestyle and place the user in a social strata which values sustainability.

3.2. Urban transportation

Populations across the globe are becoming more urbanized and in Switzerland, 73.8% of the population lives in urban areas (Plecher, 2020). This means that urban transportation systems are of utmost importance for the majority of Swiss residents and plays a large role in their spatial mobility. Transportation in urban areas is typically a complex matter because of the high number of travel modes, origins, destinations and a high amount of traffic (Rodrique et al., 2016). Urban transportation has traditionally been perceived as a matter of individuals travelling to certain specific destinations such as commuting to work, shopping areas and

leisure activities. Nevertheless besides urban residents, businesses and organizations also make use of the urban transportation networks. Thus, freight transport is also an important part of the urban transportation (Rodrique et al., 2016). Because of this, this research project focuses on e-cargo bike usage by private households as well as businesses.

3.3. Transitions

It is often mentioned that e-cargo bicycles can potentially transform the transport sector (Wrighton and Reiter, 2016; Hess and Schubert, 2019; Beckmann et al., 2016), however, to what extent such a transformation or transition is actually occurring remains unclear. In order to situate the developments surrounding e-cargo bikes into a theoretical framework, a conceptual approach from the field of transition studies will be used. A transition can bring far-reaching structural change in societies. Socio-economic factors influence the adoption of a new and promising technology, making a transition more than just a technical process. Rotmans et al. (2001, p. 16) explain that transitions occur through the interaction between different actors in society:

> *A transition is the result of developments in different domains. In other words, a transition can be described as a set of connected changes, which reinforce each other but take place in several different areas, such as technology, the economy, institutions, behaviour, culture, ecology and belief systems. A transition can be seen as a spiral that reinforces itself; there is multiple causality and co-evolution caused by independent developments.*

Due to this interaction between various actors in society, transitions can also be called 'socio-technical transitions'. Because of the many different influences from different areas, transitions tend to be complex in nature, span a long time-period and include multiple actors (Geels, 2011).

There are multiple theories on transitions and how they unfold. According to Coenen et al. (2012) the Technological Innovation Systems (TIS) and the Multi-Level Perspective (MLP) are most dominant perspectives in the transition literature. Both theories are concerned with technological change and innovation, yet their analytical focus is slightly different. This research project uses the MLP perspective developed by Geels (2002) because, in contrast to the TIS, the MLP aims to explain the rise of a technology in a more broad perspective. Here, an innovation or technology is situated in a historical and sectoral landscape. In this way the MLP allows for the inclusion of a wide range of influences from various fields. This makes

the MLP strong in providing an overarching view of how a technology is picked up by different actors from different sectors in society. On top of that, also the way society influences the development of a technology e.g. through the political climate or certain cultural preferences is accounted for in the MLP. Thus, the MLP seems to be most suitable for this explorative research project as it allows for the inclusion of a wide variety of actors that might have or had an impact on the transport of loads by e-cargo bikes in Switzerland.

In contrast, the TIS approach mainly focuses on the emergence of new technologies and the role of 'driving actors' such as entrepreneurs. A TIS can be defined as:

> *A dynamic network of agents interacting in a specific economic/industrial area under a particular institutional infrastructure and involved in the generation, diffusion, and utilization of technology (Carlsson and Stankiewicz, 1991, p. 94).*

Although the TIS approach is a useful theoretical lens to analyse the emergence of new technologies, it is not optimally suited to place technologies into a wider context and therefore not optimally suited for the broader approach of this research project.

3.3.1. The Multi-Level Perspective

The basic premise of the MLP is that transitions are complex co-evolutionary processes, which are the result of multiple developments by a variety of actors at different levels. The MLP consist of three analytical levels as can be seen in Figure 9, namely niches, the socio-technical regime and the socio-technical landscape. A technology or innovation can cause a transition if it is able to move from the level of a niche-innovation to the socio-technical regime. The socio-technical landscape can influence both niches and the socio-technical regime.

- **Niches**: here, innovations are developed. These can for example be research centres, demonstration projects or start-ups. According to Geels (2002, p.365) niches are 'protected spaces in which actors learn about novel technologies and their uses'. On this level, individuals or small groups of actors deviate from the status quo and come up with radical new technologies and/or practices. Niches can be supported by actors or institutions with very specific demands. For example, governments or businesses can give grants or loans to promising start-ups or provide them with know-how.

- **Socio-technical regime**: the socio-technical regime refers to the status quo. More specifically, the socio-technical regime stabilizes and reinforces the usage of a particular innovation. Rip et al. (1998, p. 338) describe the concept as follows: 'the coherent complex of scientific knowledge, engineering practices, production process technologies, product characteristics, skills and procedures, established user needs, regulatory requirements, institutions and infrastructures'.
  More specifically, a technology can be reinforced in various ways. Policies, infrastructures, industries and market actors, as well as cultural and social practices can have a stabilizing effect on the technology, while at the same time inhibiting the development of other technologies. For example, the technology of 'the automobile' is supported by infrastructure aimed to optimize car use. Regulations on how to use cars and cultural practices are examples of stabilizing factors supporting car usage. It has to be noted that within a socio-technical regime, innovation can take place. The cars which are driven today are vastly different than those a few decades ago. However, this kind of innovation is only incremental and will not lead to a transition.
- **Socio-technical landscape**: refers to the wider context in which niches and regimes operate. These are external influences such as the political climate or cultural values. The landscape can put pressure on regimes and niches. For instance, the need to act against climate change puts pressure on motorized transport systems and favours more sustainable alternatives. Changes in the socio-technical landscape can 'break open' a socio-technical regime and give way for innovations from niches. However, innovations can also move from the niche to the regime level without supporting influences from the socio-technical landscape.

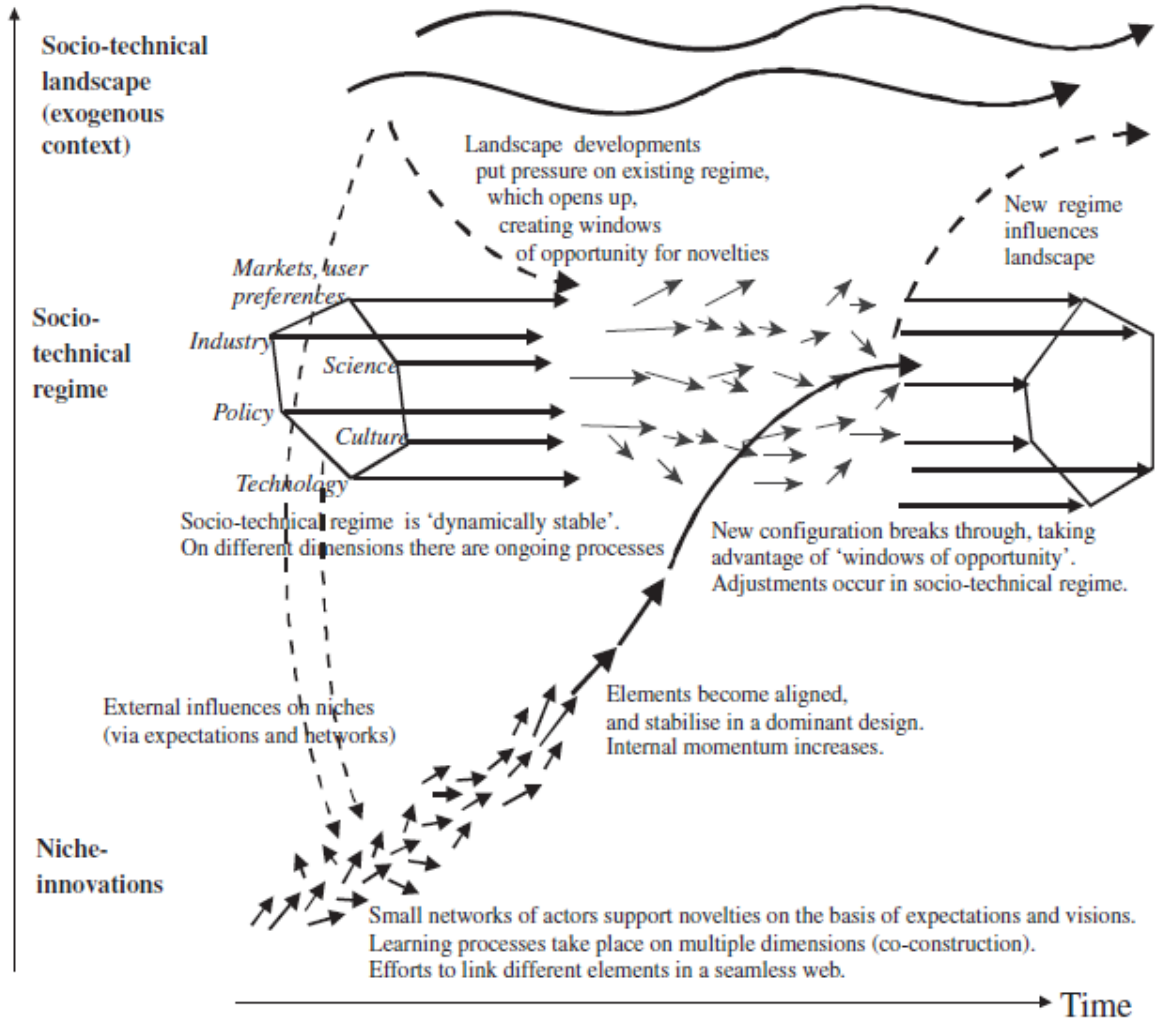


Figure 9: Multi-level perspective on transitions (Source: Geels, 2002, p. 1263).

Figure 10 illustrates how a technology can move between and is influenced by these three different levels in a hypothetical illustration of the 'innovation' of e-cargo bikes. It shows that e-cargo bikes are a combination of the technology of 'cargo bikes' and 'e-bikes'. Both of these technologies originate in niches around the beginning of the 20th century (Basterfield, 2014; Cox and Rweznicki, 2015), but did not move to the regime level. In other words, these technologies existed and were used by a small group of actors but did not become common practice in society. After the Second World War, not much innovation was seen with regard to e-bikes or cargo bikes as bicycle usage declined because of the rise of motorized transport (McNeill, 2001). However, changes on the landscape level, most notably the increasing concerns about the environmental sustainability of motorised transport, prompted research in other modes of transport. This gave new opportunities for bicycles and one could argue that regular e-bikes are now common practice, as there is a large industry producing and selling e-

bikes and regulations on their use and assemblage are in place (Hofmann and Bruppacher, 2008). This bicycle renaissance also led to the combination of cargo-bikes and e-bikes, leading to the emergence of the first e-cargo bikes in the 1980s (Kirkels, 2016).

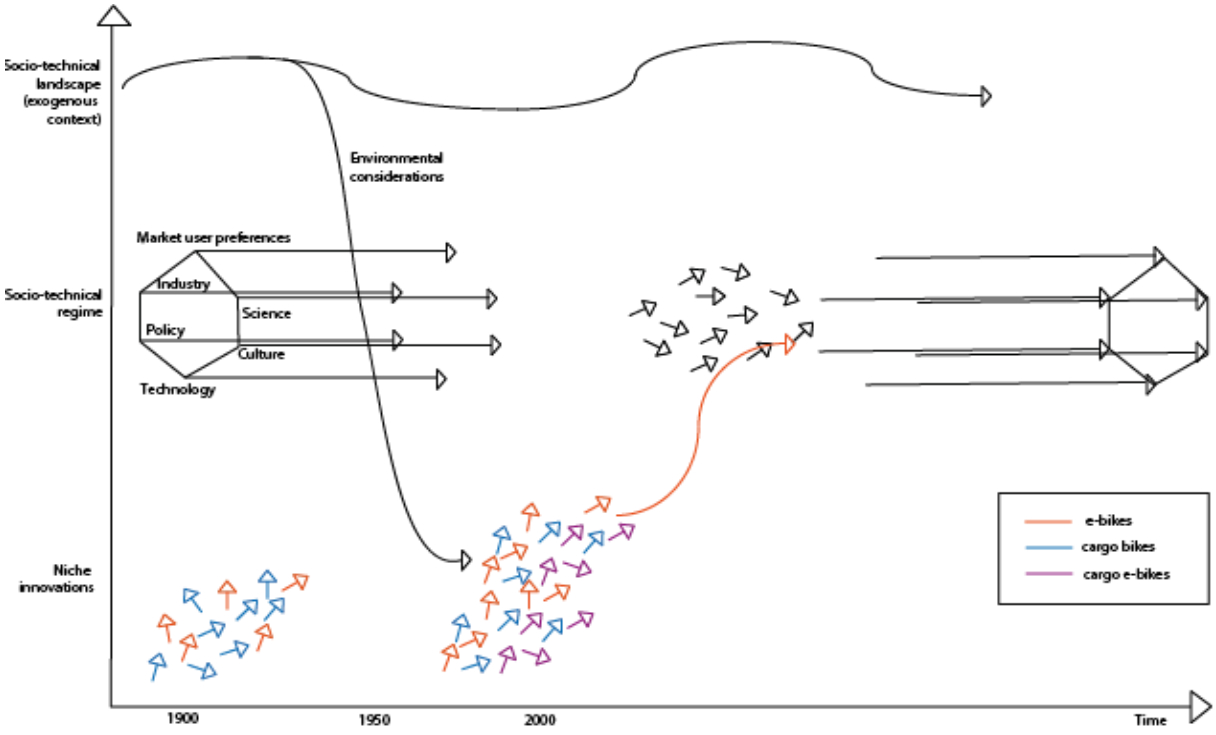


Figure 10: Hypothetical trajectory of e-cargo bikes in the MLP framework (author representation).

3.4 Research questions

Although it appears that various kinds of cargo is increasingly transported by e-bikes, there is little scientific data on which actors are using e-cargo bikes and for which purposes. Further, the factors that make actors choose to use e-cargo bikes remain unclear. This leads to the following research question of this research project:

Research question:

- Which factors drive or hinder the rise of transport of loads with e-cargo bikes in Switzerland?

Several sub-questions have been developed to collect sufficient and complete insights to answer this research question.

Sub-questions:

- To what extent are e-cargo bikes used as an alternative or additional mode of transport?
- Since when do actors choose to use e-cargo bikes?
- What makes actors choose to transport loads with e-cargo bikes?
- What do actors see as limiting for the use of e-cargo bikes?

4. Methods

At the time of writing, little information on the usage of e-cargo bikes in Switzerland is available (Hess and Schubert, 2019). This calls for an inductive research approach and therefore this research project will build on the knowledge of various experts. The research questions of this research project are thus explorative in nature and a qualitative approach is taken. This allows to delve deep into the data and make sense of the rich but complex information. According to Creswell (2014, p. 4):

> *Those who engage in this form of inquiry support a way of looking at research that honours an inductive style, focus on individual meaning, and the importance of rendering the complexity of a situation.*

The experiences, perceptions and evaluations of experts are used to build an accurate understanding on the usage e-cargo bikes in Switzerland. Subjectivity and contextuality of the respondents, as well as of the researcher is taken into account.

4.1. Data collection – Interviews

This research project relies on 'expert interviews' to collect data. Interviews are an efficient way of data collection in qualitative research (Scheepers et al., 2016). More specifically, this research project deploys 'Semi-structured theory generating expert interviews'. In this section, I elaborate on this term by discussing two individual parts of it. I start with introducing a 'semi-structured' interview, followed by 'the theory generating expert interview'. Finally, some interviews had, for practical reasons, to be conducted by telephone, so the final section explains the 'Semi-structured theory generating telephone expert interviews'.

4.1.1. Semi-structured interview

One can distinguish between structured, semi-structured and unstructured interviews (Scheepers et al. 2016). Structured interviews consist of a list of predetermined questions. Here, there is little room for variation or follow-up questions. In essence, structured interviews are questionnaires done verbally. On the other end of the spectrum lie the unstructured interviews. These interviews are conducted in an open manner. Unstructured interviews consist of open-ended questions only and have little organization. In this case, the

interviewer gives the interviewee all the space to elaborate and steer the direction of the interview. Between these two one finds the semi-structured interview. Such interviews often work with a list of topics, which could be followed chronologically, but this is not a prerequisite. Semi-structured interviews can vary in the space for follow-up questions and opportunity to expand or include new topics during the interview. By working with a 'topic list', the data of the different respondents can be compared. At the same time, there is room to dive into specific topics a little further, as some respondents have more knowledge about a specific topics than others. It is because of this reason semi-structured interviews underlie this research project, as the selected experts come from different sectors and likely have different knowledge on different topics.

4.1.2. The theory generating expert interview

Expert interviews are typically used to collect 'specialist knowledge', which cannot be obtained from other sources (Mieg and Näf, 2006). Moreover, an 'expert' can potentially provide valuable insights into complex matters, which is difficult or impossible to obtain otherwise.

Bogner et al. (2009, p. 46-48) distinguish three different types of expert interviews. Firstly, the 'exploratory expert interview' focusses on 'getting a feel' of the subject under investigation. It is best used as a first orientation and to give structure to a particular problem. Therefore, exploratory expert interviews often function as a starting point of a research project and should be conducted as openly as possible. Insights from expert interviews can be used to build hypotheses, to prepare topic lists and/or to develop other types of interview guides. Secondly, 'systematizing expert interviews' are used with the goal to obtain complete information about the topic at hand. The expert functions as a guide, who shows the interviewer the information he needs to be aware of to test his hypotheses. Compared exploratory interview, this interview type is more structured and individual interviews need to roughly follow the same trajectory. In this way, the data of the different interviews can be compared. Thirdly, the 'theory generating expert interview' aims to build theory. By reconstructing the knowledge of various experts, overall patterns or typologies can be distinguished. In this form of interview, the interviewee is more than an information source. The subjectivity of the interviewee is also vital to understanding the issue at hand. Motives, routines or implicit beliefs can be just as valuable as the objective information the interviewee

provides. Just like the systematizing expert interview, interviews need to roughly follow the same trajectory for the sake of comparability of the data. Another element of the theory generating interview is that the interviewee can be both a 'guide' to the desired information and the object of investigation at the same time. This is important because the beliefs and experiences of the diverse group of interviewees can provide valuable insights in itself. According to Bogner et al. (2009, p. 48) theory generating expert interviews have the goal to 'communicative opening up and analytical reconstruction of the subjective dimension of expert knowledge'. This implies that the implicit decisions and actions of the expert are a valuable source of information. The knowledge the expert possess is just as valuable for this research project as their own conceptions and routines they might have developed. As explained by Bogner et al. (2009, p. 48):

> *The researcher seeks to formulate a theoretically rich conceptualization of (implicit) stores of knowledge, conceptions of the world and routines, which expert develop in their activities and which are constitutive for the functioning of social systems.*

Although this is an explorative research project, which might give the impression that the exploratory expert interviews should be used, the theory generating interview is best suited for this research project. Because Bogner et al. (2009) explain that explorative interviews are more useful as a starting point and can support the formulation of topics for the interview guide. In this research project this is not necessary, as the MLP-perspective from Geels (2002) (see also section 3.3.1.), provides an analytical lens to look at the usage of e-cargo bikes. So, as the MLP-perspective, already provides an excellent starting point for the development of the topic lists, conducting exploratory expert interviews is not necessary. Compared to the systematizing interview, the theory generating interview are better suited to deal with the subjectivity of the interviewer, making this the most suitable type of interview for this research.

4.1.3. Telephone interviews

Although this research project intended to conduct all interviews face-to-face, some interviews had, for practical reasons, to be done by telephone. There are several reasons for this, sometimes the interviewee was located at geographically distant places. For example, manufacturers of e-cargo bikes appeared to be located in different countries, such as Germany. Another reason for conducting a telephone interview, was that some interviewees

requested this. Several interviewees expressed a preference for a telephone interview, mainly as this was perceived as less time-intensive.

However, a telephone interview is not the same as a face-to-face interview and some precautions have to be taken. Most notably, with telephone interviews, non-verbal communication is limited and social cues such as body language cannot be picked up (Opdenakker, 2006). In addition, social cues can ease the atmosphere and influence the flow of the interview (Christman, 2009). Nevertheless, also with telephone interviews, social cues can still be expressed. For example, by changing intonation and taking the time to ensure that the interviewee and interviewer understand each other. Christman (2009) suggests that by taking short brakes during a telephone interview, both sides have the opportunity to process the information and understand each other better.

4.2 Sampling

For this research project various experts from different fields had to be identified, before presenting the sampling strategy and the interview participants, the term 'expert' will be described.

4.2.1. Who is an expert?

The question of what constitutes an expert has been debated over time in social research. Traditionally, an expert was seen as a scientist who possesses lots of knowledge on a particular topic (Schütz, 1964). However, not only scientists can be viewed as experts. According to Mayring (1996, p. 49), everyone is an expert, namely an expert on their own meanings. Also Bogner et al. (2009, p. 49) argue for a broader understanding of an expert and warn that an expert cannot solely be defined by their 'knowledge dimension'. Besides the expert's factual knowledge, subjective orientation and routines also have to be taken into account. Therefore, Bogner et al. (2009, p. 54) define an expert as follows:

> *An expert has technical, process and interpretative knowledge that refer to a specific field of action, by virtue of the fact that the expert acts in a relevant way (for example, in a particular organizational field or the expert's own professional area).*

So, in this research project, any actor who might hold valuable information about e-cargo bike usage in Switzerland is considered an expert. Not just because of their technical knowledge

(for example on different e-cargo bikes models) but also because of their subjective orientations (such as why they decided to sell these particular models).

4.2.2. Sampling strategy

When selecting potential interview participants, a 'purposeful sampling' approach was combined with a 'snowball sampling' strategy. According to Patton (1990, p. 169):

> *The logic and power of purposeful sampling lies in selecting information-rich cases for study in depth. Information-rich cases are those from which one can learn a great deal about issues of central importance to the purpose of the research, thus the term purposeful sampling.*

Potentially information rich cases were selected by the researcher, however at the end of each interview, interviewee's were asked if they knew other actors that might be of interest for the research project. In this way, also actors unknown to the researcher could be identified. On top of that, interview partners could, in some cases, provide additional information on why certain actors could also be of interest. Thanks to this snowball method, so-called 'critical cases' (Patton, 1990) could be identified.

4.2.3. Interview participants

To gather data on the wide variety of factors which influence the usage of e-cargo bikes in Switzerland, the study aims to include actors from a variety of fields. Table 2 shows an overview of the interview participants.

All interviews were anonymized and each interview partner was given an pseudonym. These pseudonyms are used when quoting or referring to their respective interview transcripts. With these pseudonyms the anonymity of the interview partners is being respected.

Table 2: Interview participants

Sector	Description of participant	Pseudonym	Abbreviation[7]
Delivery	Logistics company	Joop	Joo-D
	Bicycle logistics company	Jaap	Jaa-D
Bike sharing	Company which provides e-cargo bike sharing	Dirk	Dir-SH
Bicycle retailer	Regular bicycle shop	Huib	Hui-R
	E-cargo bike shop[8]	Gijsbert	Gij-R/M
Manufacturing	Manufactures of trailers for bicycles and e-cargo bikes.	Loes	Loe-M
Government	Office on cycling coordination	Diederik	Die-G
Science	Scientist in the field of Mobility	Truus[9]	Tru-S
	Scientist in the field Sustainability	Jet	Jet-S
Company	Small business which use e-cargo bikes to deliver their products	Ada	Ada-C
Cycling advocacy associations	Cantonal level association	Ingrid	Ing-CA
	Swiss-wide association	Wilhelmina	Wil-CA

[7] The abbreviation is a combination of the participant's pseudonym and the sector they are active in.
[8] Besides selling e-cargo bikes, this participant also constructs specialized e-cargo bikes, making this participant both a retailer and manufacturer of e-cargo bikes.
[9] This individual already gave an online interview on the topic of e-cargo bikes in Switzerland, as this interview covered most of the topics central for this research project, it was decided to use this online interview as an interview transcript.

4.2.4. Positionality

During the different interviews, different relations between the interviewer and the interview participants existed. Bogner et al. (2009) offer some insights on how to handle various relations between the interviewer and the interviewee.

In most instances of this research project, the interviewer is a 'lay-person' compared to the expertise of the interviewer. The interviewee might therefore try to simplify issues in order for the lay-person to understand the information. Although the interviewee might do this with the intention to help the interviewer, it can lead to oversimplification or incomplete information. Therefore, the interviewer needs to be wary of this dynamic and ask sufficient follow-up questions to discover all the relevant information (Bogner et al., 2009).

The other relationship which occurred during this research project is what Bogner et al. 2009 call the relation of 'interviewer as accomplice'. Here, there is a shared background between the interview partners. As the researcher has experience with bicycle logistics, this relationship occurred when interviewing actors from the delivery sector. Because of this, the interviewer possess more knowledge on certain fields than on other topics covered in this research project. According to Bogner et al. (2009), this relationship might lead to the discovery of lots of information because the interviewee and interviewer have a similar understanding of the issue. On the other hand, some issues might not receive enough attention as it is assumed by the interviewee that the interviewer is already aware of the information. To counter this, the interviewee has to be wary of this dynamic and ask sufficient and detailed (follow-up) questions.

4.3. Interview guides

Every interview was conducted with the support of an interview guide. An interview guide is a document which is created prior to the interview. It contains a topic list to be discussed and is constructed in such a way to allow for flexibility and fluidity during the interview. This means that the way the topics are approached and the order in which they are discussed can be influenced by the interviewee (Mason, 2004).

4.3.1. Interview elements

Each interview guide has been tailored to each specific interview partner. Although all interview partners have a link to mobility and e-cargo bikes, they are experts in quite different fields. For instance, the interview guide prepared for bicycle retailers focused naturally more on market dynamics, while the interview guide with a cycling association focused more on policies regarding cycling. To give some guidance to the development of the interview guides, the MLP perspective of Geels (2002) was used. The different elements that make up a socio-technical regime, as can be seen Figure 11, were used as inspiration.

This means that the core of each interview consisted of questions on the different elements, which make up a socio-technical regime, namely:

- Markets, user preferences
- Industry
- Policy
- Technology
- Culture
- Science

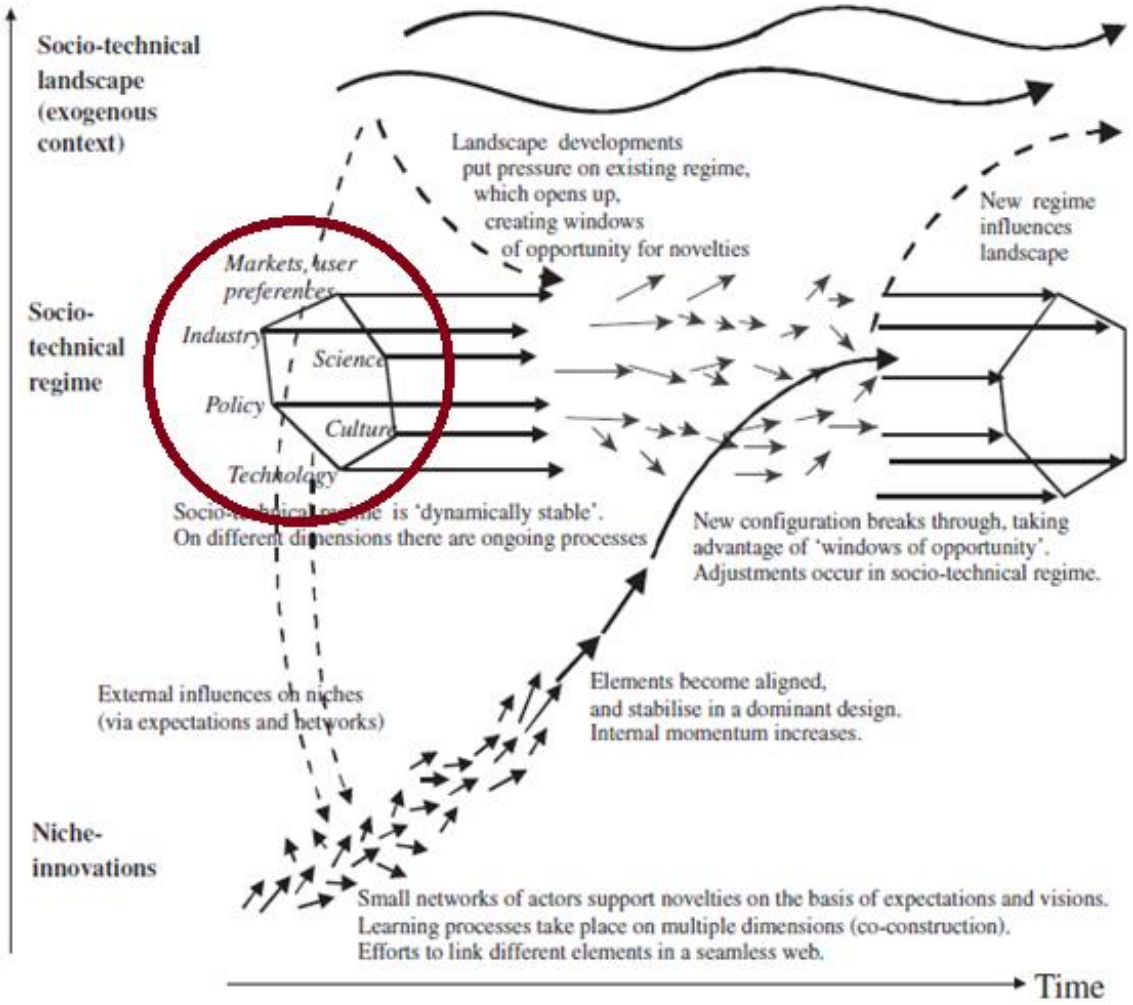


Figure 11: Elements from the MLP perspective which formed the starting point for the interview guides (Modified from source: Geels, 2002, p. 1263).

While it is expected that e-cargo bikes are located at the level of a niche innovations, the interviews are centred on elements of the socio-technical regime level. By discussing these different influences, insights in where to situated e-cargo bikes in this framework will be obtained. Furthermore, in order to explain which possible difficulties e-cargo bikes might face when trying to move from the niche to the socio-technical regime level, the stabilizing effects of a socio-technical regime need to be understood. Besides these elements questions on the experiences, motivations and temporal change where also included to situate this information into a wider context.

Naturally, each interview participant possesses more knowledge on some elements (such as 'science' or 'policy') than others. Therefore, each interview guide focused more on some particular elements respectively. In addition, the time required to touch on all the elements of

the socio-technical regime in detail would not have matched the availability of the interview partners. However, as a semi-structured interview approach was chosen, interview partners had the opportunity to elaborate when it appeared they knew much about a particular topic. With this approach the interview guide is used as guidance, instead as a strict protocol.

The interviews guides are provided in Appendix 1. To give a brief insight to how such interview guide looks like, some example questions are shown here:

A question on topic 'policy' could be:

> *Are you aware of any regulations for e-cargo bikes?*

An example of a question referring to 'market preferences' is:

> *Do you know which e-cargo bikes models are popular?*

After such broad questions, more detailed follow-up questions were asked. Sometimes some questions or answers did not solely refer to one specific element.

4.3.2. Language

The language of the interviews depended on the capabilities of the interview participant. The interviews in this research have been conducted in English, German, Swiss-German and Dutch. To be even more precise, one interview was spontaneously done with two interview participants of the same organization at once, where each interviewee preferred to speak in a different language. So, the language during the interviews was sometimes flexible to enable the interviewee to feel comfortable and phrase their answers in any way they preferred.

4.4. Transcription

In order to analyse the data from the interviews, each interview was converted into text. Following Poland (1995), an interview transcript should reflect what was said by the interview participant as closely as possible:

> *Despite the inherent limitations of written and aural records, an attempt should be made to ensure that transcripts capture the utterances as closely as possible as they were audiotaped (Poland, 1995, p. 295).*

This implies that transcripts are written out word-by-word, which resulted in texts that are almost the exact reproduction of the spoken interview. The transcripts were corrected for

eventual grammar mistakes, but preserve the way the interview participant choose to express his or herself. Nevertheless, to prevent that the written text would not capture the essence of what the interview participant was trying to say, for example through non-verbal communication, the transcript was slightly adjusted in some cases (Poland, 1995). Each interview has been transcribed in the language the interview was conducted in. However, when quotations are used in the results section (Chapter 5), they are translated to English.

4.5 Qualitative data analysis - Coding

An approach rooted in Grounded Theory (Corbin and Strauss, 1990) was used to analyse the data. Grounded Theory seeks to construct theory through a methodological gathering and analysis of the data. This implies an inductive coding process. Typically, such a coding process consists of three stages (Corbin and Strauss, 1990, p. 13-15):

1. Open coding: Here, different categories to organize the data are developed directly from the text.
2. Axial coding: In this stage, the different categories are connected with each other to explore how these categories might be linked and might influence each other.
3. Selective coding: In the final stage, the codes central to the theoretical concepts and insights are selected.

During this research project, the coding process was an ongoing and non-linear process. Such open coding allows for the creation of a large variety of codes and avoids possible exclusion of unexpected results. The coding process was conducted with the computer software 'MAXQDA'. The analysis was done on various levels, as coded segments consisted of 'sentences', 'paragraphs' or sections of the data (i.e. the interview transcripts). Already in the early stage of the coding process, categories could be established. This occurred mainly when the data showed strong similarities. For example, different interview participants mentioned several regulations regarding the usage of e-cargo bikes. The most notable are the allowed 'load' (in kg) and the 'number of persons' that one is legally allowed to transport. This resulted in the category of 'regulations'.

When all interviews were conducted and had gone to this first stage of open coding, the stage of axial coding started. Here, the different coded segments and the first categories were critically revisited and their links between these coded segments or categories were investigated (see also Chapter 5. Results).

Eventually, the selective coding stage consisted of organizing the code system in a way most relevant for this research project. Not all coded segments or categories are vital for answering the research questions of this particular research project. To give an example, some coded segments focus on how some actors use cargo bikes in their own everyday lives. However, for this research project, the experts own experience of driving e-cargo bikes, although interesting information, did not always prove central in providing insights in which factors drive or hinder the usage of e-cargo bikes. Therefore, this category was given less importance than other categories such as ‘regulations’ or ‘transportation infrastructure’.

5. Results

The following chapter covers the results of the data analysis. Important categories which originated from the qualitative data analysis are presented and explained, often through direct quotes from the interview participants[10]. First different e-cargo bike user groups are presented, namely private households and businesses. During the data analysis it became clear that these two user groups typically had different motives on why to use e-cargo bikes. After this differentiation on e-cargo bike users, the emergence of e-cargo bikes in Switzerland is shown. Then, a series of categories which could influence the decision of using e-cargo bikes as a mode of transport are presented namely: competing transport modes, costs, and environmental considerations. These will be followed by a series of categories which influence e-cargo bike usage in a more indirect way. These are the political climate, transportation infrastructure, safety perceptions, transportation culture, regulations and the fact that e-cargo bikes are produced outside of Switzerland.

5.1. E-cargo bike users

Participants mention that there are various kinds of e-cargo bikes users, which use e-cargo bikes for different usage purposes. These users can be broadly distinguished into private households and businesses. Private households use e-cargo bikes mostly to transport their children (Hui-R: 11; Dir-SH: 3). However, there are various ways people can use e-cargo bikes and more specialized models for specialized purposes are developed. Businesses use e-cargo bikes primarily for deliveries, however this is still a niche activity done by several small businesses and enterprises (Ing-CA: 91-92; Joo-D: 56; Dir-SH: 39). Larger companies seem to be interested and experimenting with e-cargo bike delivery (Joo-D: 5).

> *I think that those companies are waiting for the right start-up to be 'the one solution'. We were the right start-up for the Swiss post. DPD, DHL are of course also looking for, and partnering or taking over start-ups (Jaa-D: 60).*

[10] Quotes of the interview participants are shown by their abbreviation as presented in Table 2, followed by the number corresponding to the paragraph of their interview transcript. Quotes from non-English speakers were translated by the researcher into English.

5.1.1. Private households

Participants mention that transporting children often is the main usage purpose for private households (Hui-R: 11; Dir-SH: 3). These typically young families who decided to acquire an e-cargo bike, often have a background or connection with people from Northern European countries, where e-cargo bikes are more established.

> *It' s mainly people from northern countries, or the Swiss who are friends with people from northern countries. Or people, young families who often take summer holidays in the north. And then they come back after the summer holidays, and we often see a peak in orders. This also shows that people experience, feel the benefits of those bikes in northern countries, mainly the Netherlands. And then they want to have one of those too. So that's a bit how sales are going (Gij-R/M: 15, author translation).*

These customers can function as 'ambassadors' and increase the awareness of e-cargo bikes among their network (Gij-R/M: 13). Additionally, e-cargo bike users appear to be quite positive about their experiences with these vehicles.

> *Yes, most of them are very enthusiastic and when they it bring back for service, it has to be finished as soon as possible, because they drive every day. Incredible how dependent the people have become, just like with a car (Hui-R: 21, author translation).*

Also, various participants mention that they often hear from e-cargo bike users that driving e-cargo bike is fun (Gij-R/M: 9, 118; Ing-CA: 53; Ada-C: 63) and especially children seem to enjoy this mode of transport. Sometimes it are the children themselves who can get their parents interested in e-cargo bikes (Gij-R/M: 13).

> *Well the main thing is that we receive lots of positive feedback, especially children, people use it driven their kids to somewhere. They enjoy sitting in the cargo bike, they are sitting in the front, and not in the back as for example in things like a trailer. The kids can see what is going on and talk with their mom or dad that drives (Dir-SH: 3).*

Besides buying their own e-cargo bike, one can also use e-cargo bikes in other ways. For example, it is possible to rent e-cargo bikes, this can be a great way for people to try it out and get accustomed to such vehicles (Gij-R/M: 106). However, not all bicycle shops offer e-cargo bike renting services (Hui-R: 17). Another way of using e-cargo bikes is through sharing. Carvelo2go is the only e-cargo bike sharing platform in Switzerland (Dir-SH: 31). Carvelo2go is expanding rapidly and is present in most cities in Switzerland, offering e-cargo bikes to be used for specific time periods. This

project allows many people to try out these vehicles and also leads to an increased awareness of e-cargo bikes.

> *The sharing project creates visibility and may inspire some to buy their own cargo bike (Tru-S: 15).*

5.1.1.1. Popular e-cargo bike models

The participants explain that there are many models currently available on the Swiss market. These models vary greatly in size and usage purposes. It is unclear which models are the most popular or most frequently used (Dir-SH: 33).

> *That is very broad, I cannot say that, one likes more this and another likes more that (Hui-R: 13, author translation).*
>
> *Who exactly uses which kind of e-cargo bike, that's something I do not know (Wil-CA: 6, author translation).*

This wide variety of models allows people to choose from various and specialized models, which fits their usage purposes best.

> *I think there is a solution for everybody now (Ing-CA: 59).*

5.1.1.2. Wheelchair transportation

One specialized kind of e-cargo bikes are models which allow for the transport of people in a wheelchair, an example of which can be seen in Figure 12. Such an e-cargo bike enables families to transport their child in their wheelchair, and can give them more opportunities to reach certain places.

> *interesting for young families who may not need to rely on the bus or their large car anymore (Gij-R/M: 22, author translation).*

Such specialized configurations appear to be in their infancy and organizations which support individuals with a disability are not always sure what to make of these vehicles. It is often unclear if, to what extent and by which organization families can receive financial support for such vehicles (Gij-R/M: 22). Furthermore, it seems to be uncertain if and how this situation could change. For instance, there are safety labels where manufacturers could apply to increase the likelihood of receiving support, especially from organizations such as care centres or schools (Gij-R/M: 45). However, it seems to vary case by case, which make

manufacturers unsure whether or not investing in acquiring such a safety label would really make an impact.

> *I wonder, is the percentage of foundations paying then substantially higher and higher amounts? Or is it just a smack of money that we throw out the door for something we don't really need? (Gij-R/M: 28, author translation).*

Figure 12: Wheelchair bike (Source: DoubleDutch GmbH, 2020).

5.1.2. Businesses

Besides private households, e-cargo bikes are also used by various businesses. These can be either small businesses who use it to deliver their own products (Dir-SH: 39), or businesses in the delivery sector (Joo-D: 56). Small businesses typically use e-cargo bikes to deliver their own manufactured products, lots of these small businesses are involved in food industry (Dir-SH: 39). For example, an ice cream shop (Dir-SH: 39), a cheese maker (Dir-SH: 9) or soup and juices producers (Ada-C: 3). However, these examples are far from exclusive and another participant mentions that users also find various usage purposes themselves.

> *I could not even imagine what all people do, but they do a lot of crazy shit today (Loe-M: 18).*

As a delivery vehicle, e-cargo bikes are believed to have a large potential, especially because of their ability to avoid traffic jams (Loe-M: 36).

> *We deliver during the evening, so we start at 6, 7 p.m. and the city is just crowded. That's why we decided to find a vehicle that goes through traffic quicker. And the only vehicle that was there, that was cheap enough. Was a bicycle (Jaa-D: 15).*

Also the financial aspect of employing e-cargo bikes was mentioned.

> *even a company like Amazon, which is maybe not known for working climate friendly, figures out that it is a cost reduction (Loe-M: 28).*

However, it appears to be quite context dependent when comparing e-cargo bikes with other delivery vehicles. There are many different parameters to include when comparing the cost between vehicles (Joo-D: 36). For instance, if a company already has a certain logistical infrastructure in place to distribute packages, the question is how much changes have to be made to this infrastructure to allow for delivery with e-cargo bikes (Jaa-D: 31). Important parameters in logistical infrastructure will be presented next.

5.1.2.1. Micro hubs

Multiple participants mention that e-cargo bikes are particularly suitable for relatively short trips and last-mile deliveries (Jaa-D: 16; Ing-CA: 31; Joo-D: 12). This implies that a delivery company needs several warehouses within an urban area, from which e-cargo bikes can deliver goods throughout the city. In contrast to delivering with a delivery van, which can be loaded from a location outside the city and spend the whole day delivering the packages, e-cargo bike must, because of their smaller capacity, drive back and forth to these nearby warehouses or 'micro hubs'.

> *Then you need the necessary infrastructure, the necessary system that you can also work with cargo bikes. We are stationed in Zurich Altstetten and if you have to ride a bicycle, to the city centre from there, that's not so efficient, because the route is simply too far. A bike has to load packages several times a day. That's a little bit different than with a truck, which you load in the morning and then can deliver the whole city during the rest of the day (Joo-D: 12, author translation).*

With such micro-hubs, which allow short delivery trips, delivery with e-cargo bikes can be efficient.

> *it's pretty efficient and it fits well to our logic that we do mini-tours. So that you go to pick up point A to pick up point B, you do it for 1 hour. You do your tour with 15-30 stops and then come back and do another one (Jaa-D: 16).*
>
> *Now it showed that we are as efficient as a Mercedes Sprinter in the city (Jaa-D: 19).*

However, setting up an delivery system with micro hubs is easier said than done. Especially in busy urban areas, finding space to build or rent such a place can be challenging.

> *this is relatively difficult. In the city of Zurich, we tried for 3 years to find such a place to rent. And also in dialogue with the city of Zurich and the city has supported us with the search. But unfortunately we haven't been able to find anything (Joo-D: 12, author translation).*

Nevertheless, such problems might vary as possibilities on the real estate market differ per city.

> *there [Sion] the whole situation of space is completely different than in the city of Zurich. In Sion one does not have such issues with parking. There we solve it with a trailer of a delivery van, so the delivery van driver loads up his trailer and drives to Sion. There he leaves the trailer and the cargo bike driver drives up and down to the trailer to deliver the packages (Joo-D: 16-17, author translation).*

So, it appears that the opportunity to efficiently deliver packages with e-cargo bikes varies between urban areas. Whenever it is possible to set up micro-hubs, e-cargo bikes deliveries can be just as efficient as delivery with vans.

5.1.2.2. IT systems

Another point of concern are the IT-systems used by delivery companies, when employing e-cargo bikes such systems might need to be changed. For example, the same system which is used to plan routes for vans, might not be suitable for e-cargo bikes.

> *regarding the planning, the map needs to include the steepness, so the height differences. It will be quite different when you have to drive over a hill, this is an essential difference from a planning point of view (Joo-D: 11, author translation).*

Even though an e-cargo bike comes with electric support for the driver, maintaining the same speed when driving uphill is not possible. This makes planning routes for e-cargo bikes different compared to delivery vans.

5.1.2.3. Cooling

Another issue related to delivery is the ability to cool temperature-sensitive goods. In contrast to a cooling truck, an e-cargo bike might not be able to keep goods at desired temperatures. According to the participants, cooling with e-cargo bikes is possible, partly because most trips tend to be relatively short.

> *We have for example a cheese maker in Bern. Who delivers everything with a cargo bike. For short distances that works fine, in cities. However for longer distances that might be difficult because you cannot cool things for a long time, so 2 hours max. (Dir-SH: 9).*

A simple cool box with cooling elements, enables products such as food and also medicines to be transported by e-cargo bikes (Jaa-D: 99).

> *One question, which often came up, is the cold chain. Because the cold chain must of course be respected. This means that we have to prove to certain customers that we take the soup from here at 5 degrees Celsius and deliver it to the shops at 5 degrees, or less than 5 degrees. For this we have measured with a little temperature meter during our delivery tours. We work most of the time in winter, then the temperature is usually no question. But we have confirmed that our Thermobox works and that we can also deliver cold in summer (Ada-C: 22, author translation).*

5.1.2.4. Employees

For delivery companies, employing e-cargo bikes also depends on the willingness of their (potential) employees to use them. Especially employees with experience with other vehicles such as delivery vans might not be willing to change to cycling.

> *If we searched for, I don't know 200-300 maybe, we'll probably find them. But to find 300-400 people that want to ride bikes, but then want to ride an electric cargo-bicycle, I am not so sure. I think it's easier to just go for people that just want to sit and ride and just not pedal (Jaa-D: 69).*

Yes it depends, there are of course persons who prefer to be a bit more sporty on the road and who also like this. It should also be something fun when travelling with an e-cargo bike and as a side-effect also improve their fitness. But it depends what kind of people they are and if they also really are interested in doing something like this (Joo-D: 52, author translation).

5.1.2.5. Popular e-cargo bike models

Companies that need multiple e-cargo bikes seem to prefer suppliers who allow for a certain level of customization and deliver them a tailor made model.

They offered us a good level of cooperation. We had the possibility to develop some new ideas with them and then these were also implemented for our bikes here in Switzerland (Dir-SH: 33).

So, they were they only ones who answered for our configuration who were tailor made (Jaa-D: 8).

Another participant mentioned the possibility to build special designs from scratch. For example by building a bike for a small hotdog business, from which hotdogs can be prepared and sold. Another example would the wheelchair bike as shown Figure 12 (Gij-R/M: 125).

Additionally, some also state that it is not always clear which type of e-cargo bike model suits their usage purposes best.

The field of bicycles is of course new for us as we come from the trucking business and we have little experience of transporting with bicycles. And like with every beginning, we first have to collect some experience, work a bit with it, before we can truly say something about a specific bicycle (Joo-D: 46).

5.2. Emergence of e-cargo bikes in Switzerland

The participants give various insights into when e-cargo bikes arrived in Switzerland. However, it remains hard pinpoint to a specific point time or to generalize for entire Switzerland. It seems that the first e-cargo bikes where used by private households in the late 2000s, which could be bought in specialized shops (Gij-R/M: 86) and regular bicycle shops started offering e-cargo bikes models a few years later (Hui-R: 7). However, these early models did not prove to be well-suited for the hilly terrain in Switzerland and later models resulted in higher satisfaction (Ing-CA: 97). These improved models became available around 2013 in Switzerland (Gij-R/M: 86).

Regarding businesses it is unclear when the first pilot projects with e-cargo bikes started. However various small businesses often did this when municipalities offered subvention programs, for example in Basel and Bern (Gij-R/M: 100; Dir-SH: 39). In the delivery sector, a young delivery company has started with e-cargo bikes in 2016 (Jaa-D: 3). Larger delivery companies seem to be still testing if and how they could integrate e-cargo bikes in their delivery systems (Joo-D: 46).

Nevertheless, several participants mention that the demand for e-cargo bikes seems to be growing.

> *Yes. I believe there is more demand, there are also a lot more competitors (Gij-R/M: 88, author translation).*

> *Yes, I bought my first cargo bike about ten years ago. I bought it online when my daughter was born. It was a Babboe, that's a Dutch, or no a Danish company. We bought a Babboe family with 2 seats and then our second one was born. And then everyone in the city looked at you like what is this, we could have been with maybe ten cargo bikes in the city. And now you see them at every corner (Ada-C: 61, author translation).*

Other participants are convinced that e-cargo bike usage will continue to grow in the future (Hui-R: 48)

> *I think so, it will grow I am sure, I am sure it will grow. More and more people realise that you can transport almost everything with a cargo-bike. I think companies as well. (Ing-CA: 91)*

5.3. Competing transport modes

The participants mentioned various vehicles to which e-cargo bikes can be compared to. Bicycle trailers and electric vehicles can in some cases be a viable alternative for e-cargo bikes (Hui-R: 50; Jaa-D: 28), while cargo bikes without electrical support seem to be of little significance (Hui-R: 5). Compared to cars, e-cargo bikes are seen as a more sustainable alternative (Ing-CA: 31), however when exactly it makes sense to use e-cargo bikes depends on a lot of factors and might vary per case (Joo-D: 36). Public transport is not believed to be an competing mode of transport, rather a complementary one (Dir-SH: 21).

5.3.1. Bicycle trailers

Bicycle trailers are seen as a technology competing with e-cargo bikes. In some instances people stated that they do not need an e-cargo bike because they own a bicycle trailer (Jet-S: 65). Especially when it comes to transporting children, bicycle trailers are often used for the same purpose.

> *One already has an e-bike and gets children, then they want to transport their children, but they do not want to pay 6 to 7 thousands francs. And for 1000 francs they can buy a trailer and then it is also possibly to transport the children, just not as comfortable (Hui-R: 50, author translation).*

With an e-cargo bike, the passengers are seated in front, with trailers they are behind the driver. Having them in front allows for more interaction and the driver is able to check on them more easily, this is why e-cargo bikes are considered to be more safe by several participants (Hui-R: 54; Jet-S: 59; Dir-SH: 4; Gij-R/M: 117). More information on safety will be provided in section 5.8.4.

In contrast to an e-cargo bike, one can always disassemble the trailer, which is therefore more flexible to use (Wil-CA: 20).

Another difference is that an e-bike with a trailer transform a single track vehicle into a two track vehicle, this will increase its stability.

> *Generally, it is very robust and because of the three wheels, it stands all time on the same position. So it is always balanced. Not flipping over. (Loe-M: 35)*

On the other hand, two tracks can also have disadvantages.

> *In Switzerland, travelling with three wheels is not optimal. You have no cycling paths, you have pits and bumps were you drive over, you cannot get past poles and fences, you just bump into everything (Gij-R/M: 47, author translation).*
>
> *Trailers also give problems, because you are wider with two tracks. With this you cannot really move easily and quickly through traffic, then you are almost a van. Bicycles with a single track are better, then you maybe make more delivery runs, but you make quick delivery runs (Ada-C: 43, author translation).*

5.3.2. Cargo bikes without electrical support

In Switzerland it is also possible to purchase cargo bikes without electrical support (Hui-R: 3; Gij-R/M: 86), however this is believed to make up a only minor share of the market (Hui-R: 5). Because these cargo bikes can only comfortably be used in flat areas, their range in such a

hilly country like Switzerland is limited. Often, cargo bikes without electrical support are second-hand e-cargo bike models which experienced engine failures (Gij-R/M: 86). It has to be noted however, that drivers can also disable the electrical support while driving an e-cargo bikes. This is an option for individuals wishing to improve their fitness (Jet-S: 65). In this case however, they still have the opportunity to switch the support back on when faced with a steep road or unusual heavy loads.

5.3.3. Electric vehicles

One participant mentions that in some instances other electric vehicles might be a viable alternative for e-cargo bikes. In this case these other electric vehicles were so-called DXP's, as shown in Figure 13. DXP's have roughly the same dimensions as e-cargo bikes however one or multiple trailers can be attached, which increases its capacity.

> *the capacity is bigger. One problem that we had with the cargo-bikes, is that they are just too small (Jaa-D: 33).*
>
> *And the DXP is one of the vehicles which is available, which is not in use. Which is sufficiently charged in the evenings. So we're testing this now, if it is something that we should go for on a regular basis (Jaa-D: 28).*

In this instance there is a collaboration between the Swiss Post, who uses these DXP's for mail delivery and a young delivery company Notime AG. As the Swiss Post delivers mail between specific times slots, this delivery company can use the DXP's at times Swiss Post does not use these vehicles.

> *Mail delivery is done in the morning until twelve o'clock, or 14.00. And from 14:00 in the afternoon until 19:00 or 18:00 when we deliver, there's enough time to charge them. So then after we used them, at 8 or 9 o'clock, the next morning they're charged again. So we're giving them a second life. We use it basically as a second shift. This is usage of the vehicles which are already there, so you don't need to have another bicycle or another vehicle that you need to buy. And also you do not need to store them somewhere, charge them somewhere. So you have just one infrastructure for everything, which is already there (Jaa-D: 30-31).*

Figure 13: An electric vehicle, type DXP 5.0 with trailer (Source: Emobay, 2020).

In this particular case, using DXP's saves lots of resources as the infrastructure from Swiss Post can be used. Making these vehicles more attractive for this particular delivery company. As of now, more experience need to be gathered to gain insight to what extent DXP's and e-cargo bikes differ in performance.

> *Efficient, I'm not so sure. I think in areas like in Seefeld or the inner city of Lausanne or Geneva, Bern, cargo-bikes might be more efficient and easier to use. But we're not 100 percent sure yet. They are plus minus the same at the moment (Jaa-D: 39).*

5.3.4. Cars

E-cargo bikes can be a more efficient on short distances and a environmentally sustainable alternative for cars and this potential was mentioned by several participants.

> *It is a huge chance to transform the way of transporting things in the city. In my opinion it should be possible to move all those DHL and UPS vans out of the city (Ing-CA: 31).*

> *Cargo bikes are currently a niche product, but they can make a whole family change their mobility behaviour and renounce their own car. At least for a certain time and phase in life. For many people, their weekly shopping or trip to the garden and DIY centre at the edge of town is the main reason for owning a car. A cargo bicycle can be a good solution in precisely such cases (Tru-S: 14).*

Compared to a delivery van, an e-cargo bike is deemed cheaper, not just because of the purchase price of such a vehicle, but also when it comes to additional costs such as maintenance and insurance (Gij-R/M: 11). However, for larger companies comparing costs is not that straightforward. As described in section 5.1.2 several factors have to be accounted for. The number of required employees, amount of cargo they can transport and also possible changes to current logistical infrastructure all play a role in such analysis (Joo-D: 36).

Nevertheless, one participants explains that reducing costs can be an important factor for companies to use e-cargo bikes.

> *And they are much cheaper than a car, and you get them electric. Or without any. So that the cleanest, the fastest and the best solution, the bicycle (Jaa-D: 17).*

Also regarding time efficiency, several factors needs to be considered (Joo-D: 36). However, for some businesses e-cargo bikes prove to be a more efficient option.

> *Out of laziness, one of our employees tried once, to drive our route with a delivery van and he needed twice as much time. In the city centre, you constantly have to look if someone comes, whether it fits and so on. We have not calculated it exactly, but we know from our experience that bicycles are much quicker. (Ada-C: 9, author translation).*

Another difference is that with an e-cargo bike, one does not need a driver's license.

> *I think there are advantages, for example in Baden where a colleague lives, who does not have a driver's license, now uses a cargo bike to transport his things. I haven't thought about it before, but that would be an example that more young people, who do not have a driver license, can transport stuff, even without a car (Jet-S: 54).*

5.3.5. Public transport

Participants perceived public transport not as a mode of transport which competes with e-cargo bike usage (Dir-SH: 21). They rather envision a transport system where e-cargo bikes

are used efficiently in tandem with other sustainable modes of transport, such as public transport.

> *Often, not always, but often, it makes sense to combine transport modes, for example with the train, public transport, private car or shared car. So it is actually always a question which mode of transport is actually the most ideal? So we work to make this entire process efficient, when does someone take a car or when does someone take their e-bike. So for example for me, it is clear that when I go somewhere by train, I use my bicycle to cycle to the train station (Wil-CA: 8, author translation).*

One participant explained how they use different transport modes to deliver their goods, by combining the train and e-cargo bikes.

> *For example to Winterthur, we do that also with the bicycle. We load our cargo bike here and go to the station, then we take the train to Winterthur with the bike and then we deliver with our bicycle in Winterthur and head back (Ada-C: 17, author translation).*

In such examples public transport is not a competing mode of transport but rather a complementary one. However, when it comes to spatial planning, public transport can sometimes compete with cycling infrastructure for space.

> *And in Zurich also the public transport, so if the VBZ [Public transport company in Zurich] says we need those space for ourselves, then that is more or less a law here. That's a struggle as well. Of course public transport is important, but we don't think it should always be first priority, then all the time, until something else. Because not everyone wants to take public transport. It costs a lot, it costs really a lot and cycling is cheap. And it is healthy and it is productive and its good for the people. That's what we believe. That's what we struggle for (Ing-CA: 8).*

5.4. Costs

E-cargo bikes are viewed by some participants as expensive vehicles, with prices ranging from 5000 to 7000 CHF (Tru-S: 15; Die-G: 77; Ing-CA: 55). Specialized models can be even more expensive (Gij-R/M: 126).

> *it's cheaper to buy a vespa, or a small car, not a new one. It is cheaper than buying a cargo-bike (Die-G: 79).*
>
> *And a cargo-bike is very interesting, but from my point of view they are way too expensive for the average family (Die-G: 84).*

Thus, e-cargo bikes are seen as quite expensive and for the same amount of money, also other vehicles such as a motor-scooter or even a second-hand car can be bought. However, other participants mention that it is also a matter of perspective.

> *In general, we in mobility have the problem that people cannot and do not want to do the math. Otherwise they would notice how expensive their car really is, with insurance and maintenance costs as well as taxes (Tru-S: 23).*
>
> *Also the additional costs, like insurance or power, that is nothing with a cargo bike compared to a normal company van (Gij-R/M: 11).*

Another participant added that Switzerland, compared to other countries, has relatively high salaries and argues that price might not be the most important factor limiting e-cargo bike usage. Instead realising the possibilities of e-cargo bikes might be more important than the purchase price.

> *And when I look outside and see how many people are riding e-bikes, really expensive-e-bikes. Just normal e-bikes, then I think if there is a country in the world where people have enough money to buy an e-cargo bike it has to be Switzerland (Ing-CA: 59).*
>
> *I think they might become a bit cheaper, I don't know if they can produce more it might get a little bit cheaper. Or they might get better for the same price, so we had a first generation motor, and I was really not happy with it. But we have the second generation now and it works perfect, we bought a bit too early. We were a bit unlucky there. And I think it is like with computer, like you get more computer for the same money then you did 2 years before. And it might be the same with bikes and e-bikes and cargo-bikes. I think people should realise what the chance it is. And that's the biggest obstacle (Ing-CA: 97).*

5.4.1. Subsidies and financial support

Some participants believe subsidies are necessary to grow the amount of sales of e-cargo bikes in Switzerland (Gij-R/M: 96). Some subvention programs have been conducted in Switzerland, mostly on the municipal level. Some programs where aimed at private households, while others were aimed at businesses.

> *It's always organized by municipalities and not nationally. For example, in Bern and also in Basel and some more cities. There are programs that subsidized especially companies to use cargo-bikes for professional reasons. So for example the city Bern decided, ok we have 30.000 francs that we can give to companies. So the subvention for buying a cargo bike, the company I think received 2000 francs maximum each. And this program was finished in 2*

> *or 3 days because, the companies were so, ehm it lasted 2 or 3 days until the max. amount of 20 or 30 companies was reached (Dir-SH: 39).*

Other programs were also open for private households.

> *in Basel, the city of Basel payed 2500 CHF per bike, so the families came running to the store (Gij-R/M: 98, author translation).*

However other participants mention that they are not in favour of subsidies, (Ing-CA: 71; Die-G: 86) believing that this is not the way to support e-cargo bikes.

Besides subvention programs which support the acquisition of e-cargo bikes, financial support is sometimes also provided to young companies in the mobility sector.

> *With regard to mobility, the market is distorted because, in particular, motorised private transport results in high external costs that must be borne not by the polluter but by the general public. At the same time, the state supports public transport. Tax-financed road construction is supplemented by mandatory parking spaces for construction projects. 200 new spaces are made available in Switzerland every day. That's unbelievable. Within this subsidised competition, asserting yourself with new, innovative offerings is a challenge. Start-ups therefore need help (Tru-S: 25).*

Several participants reiterates that financial support was vital to grow their business.

> *of course in the beginning there were some funding from several programs which we benefitted of. Like there was 'Gardanova', it is a local energy supplier and there was a funding project that helped me a lot (Loe-M: 12).*
>
> *we did have funding and there is a co-working space in Freiburg, with supports start-ups, and we did win a local prize and for half a year, we got some money and we got coaching support and also a work space. That helped of course very much (Loe-M: 16).*
>
> *Of course it was also financial. But they did offer us a lot of help with for example our business model development. Also to develop new solutions to new problems as you are expanding. Normally the scaling of such a project is difficult. If you begin in a very little environment and then you scale it up to the whole of Switzerland, normally that comes with some problems. And they helped us with that a lot. But the main support for us was financial support which allowed us to grow this fast (Dir-SH: 29).*

Here, the participants mention that besides financial support also other forms, such as coaching or a workspace helped them growing their business. However, financial support appears to be the most important for their growth. Especially because other transport modes such as motorised transport and public transport are supported by the government in direct and indirect ways.

5.5. Environmental considerations

E-cargo bikes are perceived as a more environmentally sustainable mode of transport compared to motorised transport and the participants mention that e-cargo bikes could potentially replace lots of cars trips.

> *they can make a whole family change their mobility behaviour and renounce their own car. At least for a certain time and phase in life. For many people, their weekly shopping or trip to the garden and DIY centre at the edge of town is the main reason for owning a car. A cargo bicycle can be a good solution in precisely such cases (Tru-S: 14).*
>
> *If we as a society want to achieve the goals of the Paris Agreement on climate change by 2030, we have to considerably change our daily mobility behaviour. This means that in cities, we clearly need to prioritise public transport and bicycles, and ban cars from the core zone – unless they are shared. Cargo bikes can make a contribution here (Tru-S: 17).*

Replacing cars with more sustainable e-cargo bikes was often mentioned as important for the participants.

> *Of course we do not want to replace other bike rides as having people go by bike is a good thing, they don't have to go by cargo-bike instead of a normal bike. But if you have to transport something, normally in Switzerland most of the people go by car and there of course the big goal is to replace cars trips. So for us it makes sense in the cities. We have, it's not only traffic issues but also the environmental issues. Yeah and therefore I would say yes it's one goal to replace car trips (Dir-SH: 19).*
>
> *Yes, well I would not say replace. I would say it is a better alternative. Because replace sounds a bit negative, I mean there is still maybe a use for cars. But inside urban areas we definitely we have to rethink and transporting with cars is maybe not the most efficient. Especially in times of climate crisis, we definitely have to think of new ways and also efficiency or transport is getting more and more relevant (Loe-M: 30).*

However, another participant mentions that it is unclear to what extent e-cargo bikes are truly used an replacement for car trips.

> *Nevertheless I still think it has to be looked at, like what is the effect, is it a positive thing? If you use it instead of bike trailer then of course you are less exhausted but you are using more energy, than if you would ride a regular bike. And then switching to a cargo bike, in terms of energy consumption it is more energy instead of saving. So the energy consumption is something we have to carefully look at, what it substitutes and what is going on. I think it is too early to do a real impact analysis (Jet-S: 55).*

Several participants also state that they want to be an example and function as ambassadors of this new mode of transport. They try to increase the awareness of e-cargo bikes and show that other ways of urban mobility exist.

> *I sold my car and bought a cargo bike. Mostly to show, it can be done differently. And you can see, in many places, the cargo-bikes are coming. Once someone has started, suddenly more and more appear. You travel much faster through the traffic chaos, everything is filled with cars, just chaos. But you can pass easily on a bike and these are moments that every single one of us can actually exemplify that things can be done differently (Die-G: 73).*
>
> *also when I'm riding my bike, riding in the city. Even if I don't have anything in the box, you know. Always ride with the cargo bike to show it's just normal, nothing out of the ordinary (Gij-R/M: 11)*
>
> *And it was great for me to be a part of this change, with my company as well as with my family (Ada-C: 62).*

5.6. Political climate

Several participants mention that they believe that sometimes the political support for measures which promote cycling and e-cargo bikes is lacking.

> *we see certain problems regarding e-bike mobility. Not because of us, we are happy that this technology and its innovations are coming, but other sections of the public government, see big problems coming. In case of accidents and such kind of things, which means the cantonal police, certain people from the Civil Engineering Office, these are the guys which are doing the roadworks, they don't like it actually (Die-G: 22).*
>
> *And also from the federal government, the Federal Road Office for example, there is no sense of supporting bicycles. The Federal Road Office is more car-focused, we need more highways to facilitate more traffic in cities. Such kind of statements are difficult for us to understand (Die-G: 43).*

Political support can be crucial for the success of projects focused on promoting cycling.

> *Yes, often it takes someone from the top who says, we need more bicycles (Die-G: 41).*

5.6.1. Long time span of planning projects

Switzerland is characterized by its decentralized style of government, which implies that when it comes to infrastructure planning, many organizations are involved. This can make it difficult to get everyone on the same page and can be a very time-consuming process.

> *there are too many people involved actually. You have the Canton of Zurich, Office of Transport, Civil Engineering Office, which is another direction, with different people, with a different mindset. And furthermore you have the cantonal police. Then you have the same at the city of Zurich, they have as well, different plans, different ideas. And then you have all the politicians, who had people voting for them and you have the people who live there. And this is quite a planning story, to realize a project, it normally takes between 6 and 8 years, until you have figured out all issues (Die-G: 38).*

Here, the participant describes the many different actors which can be involved in infrastructure planning projects in canton Zurich. In other cantons, such large amount of actors involved is not rare. Furthermore, in Switzerland many projects fail to cross the borders of different governmental territories.

> *While national cycle routes are being established abroad, in Switzerland this usually fails at municipal borders (Tru-S: 10).*
>
> *municipalities, which we have 165 of in canton Zurich and all of them are doing things in a slightly different way (Die-G: 18).*

An example of where political support is vital for supporting cycling is the ‘Masterplan Velo’ which includes several measurements to support cycling in Zurich and was developed in 2008. However, one participant states that the implementation of these measurements is not going well.

> *I mean we work together with the green-party and the socialist party, well and they also say we don’t understand why it does not, why it shouldn’t be possible to build good infrastructure. It is just always a question of priorities (Ing-CA: 14).*
>
> *And really important projects, like there is a tunnel planned beneath the main station, you have heard? Should be finished 3 years ago, should have been, maybe it is 2024 now, maybe. Or another project is ehm, a cycle path along the lake, from Wollishofen until Tiefenbrunnen. That’s delayed as well, nobody knows what’s happening. So, it’s difficult everywhere, the only thing from all the proposals of Masterplan Velo, there is a part on schooling, schooling the children, that is the only part that really works. Everything else is, yeah you can make toilet paper out of that plan (Ing-CA: 29).*

Another issue is that road infrastructure projects are typically planned years in advance and it appears to be difficult to make changes to ongoing planning projects.

> *And the cantonal cycle network plan we realized, was decided in 2016 and since then it like, it's like a planning guideline, which means that all projects which were started before. They are not taking care of the requirements of bicycle infrastructure. It just out of scope because these projects were started before. So it will take 10 years to see results according to the cantonal cycle-network plan (Die-G: 38).*
>
> *Additionally, Swiss roads are built relatively well, they last 20 years without problem, which means that what is constructed today and was planned before 2016, partly is with very bad cycling infrastructure. People are also surprised, because they want to cycle, but it then it will take of course 20 years, before something new will be made there. One tries to get in touch with the cantonal police, to get some improvements done short-term, but this is very difficult (Die-G: 39).*

Here the participant explains that because infrastructure projects are planned well in advance, they do not always suits the needs of current traffic users, especially cyclists. Sometimes the police can make short-term amendments to such projects, mainly from the perspective of safety. In practice however, this appears to be difficult. This lack of involvement of cycling advocates in infrastructure planning varies per canton. One participants explains that is some cantons, some cycling lobby groups are being more actively involved than in other cantons.

> *Pro-velo is integrated in some regions, and here in the Canton of Zurich Pro-velo is absolutely not integrated (Ing-CA: 12).*
>
> *In Bern they had a new city council, who said we start a new bicycle-initiative, they call themselves the bicycle-capital and they are about to get to that place. Winterthur is pretty bicycle friendly, Basel as well. And we could to the same, it is not really wizardry, the solutions are known. I mean if you don't know them there are lots of best practices examples all over the world. So it is easy to do it. Only, and I can only repeat it, it is always only a question of priorities (Ing-CA: 24).*

When cycling lobbyist are not involved, the only way to influence projects is often by taking legal action. However, this step is often quite late in the planning process and can be very complex and time-consuming.

> *Because the law says, organizations like ours can only make or file a complaint if a large part of our members are involved, or are using this part of the road and that they are affected. So we always have to find someone who use that part of the road almost every day and make, together with this person, a complaint. Before that, some years ago, if we made a complaint they invited us*

> *and we talked about it, and we often found a solution. And that they just don't do that anymore, I don't know why, I really don't know why (Ing-CA: 22).*

So in these instances, organizations need to collaborate with local residents to file a complaint, this makes it quite complex to influence infrastructure planning projects. Logically cycling advocates prefer to be involved in a much earlier stage and give advice instead of taking such formal steps.

5.7. Transportation infrastructure

Because e-cargo bikes (must) drive on the cycling infrastructure, the state of cycling infrastructure influences e-cargo bike users and regular cyclists alike. Participants note that although e-cargo bikes might be bigger than regular bicycles, e-cargo bikes should be able to make use of cycling infrastructure (Die-G: 27-28). This is seen as an important benefit, as by using cycling infrastructure e-cargo bike users can avoid congestion (Loe-M: 36; Jaa-D: 15). Generally, multiple participants state that they do not perceive the current bicycle infrastructure as overly bicycle friendly.

> *We need for example a better bicycle infrastructure in Switzerland (Wil-CA: 10, author translation).*

> *and if we want to have more people as all-day cyclist, the infrastructure needs to change and it needs to change dramatically, because currently the infrastructure is only for addicted people or people who are very used to it (Die-G: 48).*

The participants perceive cycling infrastructure in Switzerland sometimes as unsafe, which can prevent individuals from choose cycling as their mode of transport (Wil-CA: 10, 50; Die-G: 48; Ada-C: 57). Especially for groups such as young kids or elderly a more safe cycling infrastructure is needed (Wil-CA: 10). The participants offer various insights on how improvements can be made, in order to facilitate cycling better (Ada-C: 57; Die-G: 89; Wil-CA: 40). First, improvements for cycling infrastructure in general will be shown, before presenting issues which apply solely to e-cargo bikes.

5.7.1. Cycling infrastructure

5.7.1.1. Shared spaces

In Switzerland many roads are designated to be used by for both pedestrians and cyclists. These type of roads are called ‘mischflächen’ or ‘shared spaces’. Shared spaces are often viewed as problematic because of the large speed differences between cyclists and pedestrians. This speed difference only increased with the emergence of e-bikes and can result in dangerous situations.

> *To a certain point it works, to a certain point yeah. But if you have someone going outside with his dog, on a long leash and you have a mother driving her cargo-bike, with in front 2 children, it won’t work anymore (Die-G: 31).*
>
> *and we are as well working on the, ‘entflechtung’ [disentanglement]. Which means we try to have a separate bike lane for cyclist, a separate space for pedestrians and a separate space as well for cars. Otherwise nobody is happy (Die-G: 29).*
>
> *One sees that when these mixed-areas are ‘disentangled’ from one another and you really have a infrastructure for the bicycle and one for the pedestrian, then the pedestrian will feel safe on the sidewalk and the cyclist and e-cyclist are then mostly travelling on their own infrastructure (Wil-CA: 50, author translation).*

As of now, on shared spaces pedestrians must be careful of fast-moving cyclist (including e-bikes) while cyclists must drive slower or manoeuvre between groups of pedestrians. The participants mention that this can lead to frustration for both travel groups.

5.7.1.2. Removing parking spaces for cars

Space in cities is limited and cycling infrastructure competes with infrastructure of other transport modes. This is perceived to be mostly a question of prioritization and cycling appears to be quite low on the prioritization list (Wil-CA: 10; Ing-CA: 8).

> *and at the moment, the mindset is, or the prioritization is: public transport first, cars and motorized traffic second, third pedestrians, fourth position bicycles. This is the actual setting (Die-G: 38).*

Participants mention that the removal of public parking spaces will offer lots of possibilities to improve cycling infrastructure (Die-G: 34). Especially in crowded urban spaces,

respondents believe that transport modes which take up less space and which are more sustainable, should receive more support (Wil-CA: 50).

> *sorry but parking lots in the public space is really thinking of the 20th century (Ing-CA: 38).*
>
> *so in the end you have a push-pull situation to move people away from cars. We have about 60.000 public car parking spaces in Zurich and I mean a majority of the people don't have a car here anymore and the car availabilities are decreasing in cities, so I think taking away 10.000 of these 60.000 parking spaces is not such a big deal (Ing-CA: 40).*

5.7.1.3. Wider lanes

Another issue is the width of the current cycling lanes. As of now, cycling lanes are 1.20 meters till 1.50 meters wide, however this is not always sufficient (Die-G: 29). Especially when taking the hilly terrain into account. When cyclists go uphill they usually need more space as cyclists naturally tend to swing a bit to the left and right. This is why a new standard of 1.80 meters is being proposed (Die-G: 29).

5.7.1.4. Priority

Sometimes cycling infrastructure improvements can be made without actually using additional space. In some instances it is more a matter of prioritization. By prioritizing one transport mode on a particular road, certain traffic users can be incentivized to take this road more often. For example, on roads which are not used most frequently used by motorist, cyclist can be given priority. In this way cyclist are incentivized to make use of this road, instead of a road busy with cars. Such a strategy can prevent potential conflicts between different transport modes (Die-G: 34, 45). Another solution in this category would be the reduction of the speed limit. By reducing the speed on roads in urban areas from 50 km/h to 30 km/h, cars and cyclist are much less likely to come in conflict (Die-G: 35).

5.7.2. E-cargo bikes and road infrastructure

5.7.2.1. Parking space for e-cargo bikes

Because e-cargo bikes are much larger than regular bicycles, finding a suitable parking place can be challenging. Because of a lack of a better alternative, e-cargo bike users often have to

park on the sidewalk, which can be of hinderance for pedestrians. As of now, none to a very few parking spaces are available which fit the dimensions of e-cargo bikes (Jet-S: 52; Dirk: 37).

> *It are large things, so yeah one must always look that one can park it somewhere (Wil-CA: 6, author translation).*

On the other hand, participants acknowledge parking e-cargo bikes can be much easier to park compared to cars, as it are much smaller vehicles (Dir-SH: 3; Gij-R/M: 12).

5.7.2.2. Pedestrian refuges

Many crossings in Switzerland have one or more pedestrian refuges. A pedestrian refuge allows, beside pedestrians, also cyclist to stop in the middle of a crossing and finish a crossing when traffic and/or traffic lights allow. These are typically small sections of pavement which only provide space for a limited number of cyclist and pedestrians. However, these pedestrian refuges are, as the name implies, not designed for e-cargo bikes and e-cargo bike drivers appear to have trouble fitting their bikes on these areas, an example of such a situation is shown in Figure 14.

> *I often have problems on an island or pedestrian refuge. You know, the island between traffic lights, and sometimes you have either the front or the back wheel on the road or the tram track. For example Bellevue is such a place and it is really not comfortable. So you have the stand there side-ways. But it does not fit (Ing-CA: 36).*

Figure 14: E-cargo bike which does not fit on a pedestrian refuge (Source: Lieb, 2019).

5.8. Safety

The topic of safety appeared to be an important category, which also includes the perception of safety. Just as with the previous section on transportation infrastructure, safety perceptions relate to both cycling in general and e-cargo bikes specifically. The participants mention that cycling is not always perceived as a safe mode of transport compared to other transport modes (Wil-CA: 24). At the same time, learning how to cycle is seen as very important, especially for children (Ing-CA: 29; Die-G: 70). Another issue is the safety perception of bicycle trailers compared to e-cargo bikes and the brakes of e-cargo bikes.

5.8.1. Safety perceptions on bicycles vs cars

Some parents prefer to transport their children by car, as they deem cycling infrastructure to be unsafe.

> *What also is mentioned frequently, is that it is safer to transport a child by car, we hear this a lot (Wil-CA: 24, author translation).*

However, even though it might be safer to transport children by car instead of by bicycle, in the long run this can have serious disadvantages:

> *At the moment that they are in the car, they are of course relatively safe, but when these kids are also transported by car and at a certain point, around 10-12 years old, move around in traffic by themselves, well then they have learnt nothing right? When they then get a bicycle and ride it, when they suddenly travel independently, what is than more dangerous, when they never learned it? (Wil-CA: 26, author translation).*

In this instance, safety relates not only to the moment of travelling itself, but also to the long-term consequences of choosing a particular mode of transport. When sitting in the back of a car children might experience much less of the traffic around them, compared to when cycling or as a passenger in an e-cargo bike.

5.8.2. Training

The amount and type of cycling training people have influences how safe they travel when cycling but also how safe they feel, in Switzerland, cycling training comes in different forms. Participants argued that children need training in order to travel comfortable with any kind of bicycle throughout the course of their lives (Wil-CA: 11).

> *Yeah and this is worthful as well. We have created a campaign which helped children, second till 6th class, how to learn cycling. Because this is an another big issue in Switzerland. Many, many families they don't even have bicycles for their children. Because of mom or dad is not cycling, how should their kids do it? So we need to change as well the behaviour here (Die-G: 70).*

There are various programs in place which train children how to ride a bicycle (Ing-CA: 29; Die-G: 70; Jet-S: 52). Usually these programs take place in primary school, however every canton organizes this differently (Wil-CA: 34). In general, training courses aimed at children are judged to be successful programs (Ing-CA: 29).

Besides training courses aimed at children, courses aimed at other social groups exists as well, again this differs between cantons (Wil-CA: 38). Governmental bodies offer courses for adults or specific groups which can benefits from cycling skills, for example the Canton of Zurich offers cycling courses for immigrants (Die-G: 70). Some courses are aimed at specific kind of bicycles, for example courses on how to ride e-bikes (Jet-S: 52). Offering courses specifically on e-cargo bikes might encourage people to try out this novel type of bicycle. However, it is unclear to what extent such specific training would be taken up and lead to an increase of e-cargo bike usage (Jet-S: 52).

An e-cargo bike is, compared to regular bicycles or e-bikes quite large and one has to be able to manoeuvre such a vehicle safely around traffic (Wil-CA: 20).

> *cargo bikes are different, people can feel a bit unsure driving them, they are also wider and longer. And they need more space, so that is not always that easy, for example if you are riding on the same space of the tram for example (Jet-S: 28).*

Cycling courses do not only help when driving a bicycle, one participant mentions that in Switzerland many people have little cycling experience. This means that when these individuals are using another mode of transport such as a car, they do not always understand how bicyclist move and behave in traffic.

> *You are always misjudged by car drivers, as in the Netherlands every car driver also cycles, so he reacts differently on cyclists. Here a lot of cars drivers do not cycle. That is a whole other system and you notice it with the car driver. They misjudge you, truly wrongly, cutting you off and if you are going too fast that is fatal (Gij-R/M: 56, author translation).*

5.8.3. Government agencies

One participant notes that within different governmental bodies, different perceptions on the safety of cycling and e-bikes exist. For example, the Swiss Council for Accident Prevention, views e-bikes as an potential danger and investigate how to reduce the number of accidents with e-bikes. However, these the figures on e-bike accidents appear to not always reflect reality well.

> *For example, if you look at questionnaires, for example from 'Velokonferenz' here you find independent studies and questionnaires. For example, they asked, would the accidents with your e-bike also occur with a regular bike? For example when landing into a tram tracks, such things can happen to any bicycle and this perspective on e-bikes and also e-cargo bikes is therefore not always right (Die-G: 46-47).*

5.8.4. Safety perceptions on e-cargo bikes vs bicycle trailers

As described in section 5.3.1 bicycle trailers are a competing mode of transport of e-cargo bikes. Bicycle trailers have a longer history in Switzerland and one participant mentions that because of this, some are more accustomed to this vehicle and therefore perceive it as a safer mode of transport (Gij-R/M: 13). However, when it comes to safety, various participants argue that e-cargo bikes might be a safer, especially when transporting children (Hui-R: 54; Jet-S: 59; Dir-SH: 4; Gij-R/M: 117). The most notable difference between e-cargo bikes and bicycle trailers is that with e-cargo bikes, children are seated in front of the driver, while with a bicycle trailer they are seated behind the driver. This means that when using an e-cargo bike, the driver can interact with the children more easily and act quickly in case something happens.

> *Security wise, having children in the front is safer, you can see what is going on. Trailers are behind the bike (Dir-SH: 4).*

Another difference is that with e-cargo bikes, children can see what is going on and are less likely to be surprised by sudden curves, manoeuvres or bumps in the road. However, this perspective on safety is not always shared by the general public. One participant argues, that because e-cargo bikes are new they are seen as more dangerous.

> *But isn't it dangerous, moving your kids in front of you? Is what they ask me, what else should I do? Drag them behind my vehicle, like a trailer. I do not get it, it is always, always shown that this is less safe. It is imprinted in their minds, I think it will take another generation or two before they grow out of it. Before*

their 'blinders' are opening just a little bit and look what else exists in the world. It is striking that they really have these blinders, which are totally closed, even after years (Gij-R/M: 118, author translation).

Another participant argues that it depends on the situation and that both vehicles can have their advantages and disadvantages.

With regard to danger, it is of course a bit dependent on the children, how they behave. When they are in front, you can interact with them more easily, but when they are calm and sit behind without issues, then this is of course not that necessary. Therefore we do not say which vehicle is best, we give people advice so they can decide themselves what is the most practical for them (Wil-CA: 20 author translation).

5.8.5. E-cargo bikes brakes

A more technical aspect of the safety of e-cargo bikes are the brakes. As of now, the motors powering e-cargo bikes allow for fast and powerful bikes. Technology wise, it is relatively easy to build a quick e-cargo bike, the issue is with slowing these fast and heavy vehicles down effectively (Gij-R/M: 58; Jaa-D: 13). The brakes tend to wear out quickly and bicycle manufacturers do, at the moment, not offer effective and durable breaking systems in the eyes of the participants:

I think the market is not there yet, Riese Müller has for example e-cargo bikes with e-support up to 45 km/h. Which make me think, how will you brake with these things? We have, there simply do not exist such strong brakes to slow that down. So many bikes are so crazy fast but with bad brakes. We also have many requests of people who want to go fast, but I say, you should be able to really brake effectively, especially when you are heavenly loaded and going 45 km/h (Gij-R/M: 55-56, author translation).

Especially in Switzerland, the hilly terrain makes good brakes even more necessary (Gij-R/M: 62). One participant argues that the braking systems should not come from the field of bicycle manufacturers, but from the field of motor scooters.

The brakes should be motor scooter brakes. I think bicycle brakes are just shit on a bike that, goes that fast and they are also so heavy (Jaa-D: 107).

For such kind of technological improvements, the e-cargo bike industry depends on what kind of parts are available on the market.

All these businesses coming from cargo bike industries face similar issues. Because it is a question of what parts are available on the market. Like the wheels for example, a lot of development goes into that, to make it stronger and

have a longer lifetime. And now manufacturers and sub-manufacturers starts to develop parts needed, or especially for cargo-bikes. Because cargo bikes I see all the time, it is yeah something that's been produced for either a regular bicycle, a car or a moped (scooter) and somewhere in between are cargo-bikes. So there is actually a gap of products and now we start to close this (Loe-M: 42).

5.9. Transportation culture

Transportation culture refers to the way people feel about cycling and e-cargo bikes. Participants argue that cycling needs to become more embedded in Swiss transportation culture, in order to increase the amount of cyclists and e-cargo bike users (Gij-R/M: 107).

> *Getting used to it is very important the 'Gewöhnungseffekt' [getting-used-to-effect]. That kids growing up have the feeling that it is fun to cycle. Of course sometimes it rains, but then you simply have a rain screen. So the goal is to show the public that there are also different options than the car (Wil-CA: 13, author translation).*

This closely relates to safety perceptions and the amount of training people have, especially in crowded cities people sometimes do not perceive cycling as safe and therefore do not choose to cycle (Jet-S: 50). For instance, potential e-cargo bike buyers often mention that they are worried about tram tracks (Gij-R/M: 75). However, one participant mentions that most e-cargo bikes have quite wide tires, which makes it virtually impossible to get stuck in trams tracks (Gij-R/M: 73), however with a regular bicycle such trams tracks can be tricky, therefore any kind of bicycle can be perceived as dangerous because of tram tracks.

Another issue which specifically concerns e-cargo bikes is the speed e-cargo bikes can have (Jet-S: 65).

> *They could not imagine try out cargo-bike sharing because they were afraid of the speed the electric motor. Often in relation to cycling in the city 'it is unsafe to cycle here', to many cars and the additional eclectic motor makes the bikes even faster, with more safety issues (Jet-S: 65).*

One respondent mentions that drivers from e-bikes and e-cargo bikes can also be more mindful of other users of cycling infrastructure.

> *It really is a mindset, where one thinks okay it is a privilege for me to cycle on the cycling infrastructure. Because it is actually a fast vehicle and it should also not be a problem, to follow a women with a basket behind her bicycle with*

> *15 km/h, until the road is wide enough to overtake her. Instead of being annoyed instantly and ring and so on, it is a mindset (Die-G: 25).*

Another issue is the weather, as rain appeared to be an important determinant for individuals when deciding which transport mode to use (Die-G: 94; Ing-CA: 95; Jaa-D: 62).

> *The weather is an issue, when it is cold or rainy, or snowy or icy on the roads, then people do not like the cargo bike (Dir-SH: 5).*

However, one respondent notes that most of the time the weather does need to prevent people to get on a bicycle.

> *being honest, around 200 or 220 days a year, are easily possible for bicycles because there is no rain, no snow and no nothing. If you have the equipment you are able cycle to whole year. But it needs to be, ehm, a specific mindset (Die-G: 94).*

Several participants mentioned the need to raise awareness about e-cargo bikes and their potential (Die-G: 68; Tru-S: 15). This applied for both awareness among private households, businesses as well as government agencies (Die-G: 19). One participant believed that getting people to realise the potential of e-cargo bikes might be the most important factor hampering their adoption (Ing-CA: 97). In order to raise awareness about e-cargo bikes, several participants engage in various activities.

> *We just launched a series on Facebook using portraits of companies using cargo-bikes. Because we think as well that in big or smaller cities, the distribution of parcels and packages can be done perfectly by cargo-bikes. We also plan to bring out a small business plan, like a factsheet where you can see how you can save resources financially. Because people in Switzerland, yeah probably most of the world, are money driven. If they can see a business case, where they can save money and probably also can do something good for the environment and also for the people living in cities, that could be a game-changer (Die-G: 61).*

> *With this brochure we try to bring the topic nearer to the people. As well as to enable them to choose the right model and to stimulate their thoughts (Wil-CA: 13, author translation).*

5.10. Regulations

There are several laws in place which regulate what one can and cannot do when driving an e-cargo bike. Some of these regulations apply to cycling in general, however more specific regulations on e-cargo bikes also exists. For example on the width, number of passengers, weight, speed and new cargo bike models.

Regarding the rules and regulations on cycling, one participant is quite positive.

> *I think, in general, in Switzerland we have enough legislation regarding cycling. For example that we have slow and fast e-bikes and that with the fast e-bikes, one must carry a helmet. I think that makes sense. But the cyclist are not really restricted when travelling in Switzerland (Wil-CA: 40, author translation).*

However, not all participants share this view.

> *Unfortunately the Swiss law is not so bicycle-friendly (Hui-R: 42, author translation).*

In some cases the novelty of e-cargo bikes in Switzerland seems to be of hindrance because regulations are not adapted to this innovation.

> *Because of the development of new cargo-bikes and that's going so fast, we are lagging behind with our, we are lagging behind with our law-making (Ing-CA: 82).*
>
> *Definitely this is a problem and especially our product is really innovative so the laws are not written yet (Loe-M: 61).*

Nevertheless one participant mentions that regulators are also aware of these dynamics and actively seek out information on how they might change specific regulations.

> *They called us and, because the Swiss are changing their city laws. For example in Biel you cannot enter the city centre by car. So they need innovative solutions like us and they don't want to disturb innovation by an old law for bicycle trailers. So they told us that they want to change it. So we hopefully have a change beginning next year so we will see. Then it's going to be much easier and generally if you're in EU it's much easier. Because then the laws are very similar, also street laws, sometimes some minor differences. But in terms of exporting it is a bit more work for Switzerland (Loe-M: 61).*

5.10.1. Width

One regulation is regarding the width of an e-cargo bike, which cannot be over 1 meter. This rule is seen as appropriate by the participants as wider vehicles can become impractical to handle (Hui-R: 39; Jaa-D: 72; Gij-R/M: 70). One respondent notes that although there is a restriction on the width, there are none regarding the length (Gij-R/M: 70). At the moment, e-cargo bike models of over 3 metres in length are available.

5.10.2. Number of passengers

In Switzerland, a maximum of 2 persons can be transported by an e-cargo bike or behind a bicycle with a trailer. This regulation is viewed as limiting and out of date by several participants (Wil-CA: 40; Gij-R/M: 112; Ing-CA: 79).

> *In Switzerland maximal 2 children can be transported, while often 3 or 4 could be transported. In the EU there is no such limit, or only for 4 or 5 children I believe. But In Switzerland you are only allowed to transport 2. While often the cargo-bikes are designed for 3 or 4 children (Hui-R: 40-42, author translation).*

The participant mentions that e-cargo bikes are often designed to transport more than 2 children, however legally, one can only transport 2 children. This can be confusing for e-cargo bike users and some bicycle retailers feel obliged to let their customers sign a document stating that they are aware of this rule when they purchase a cargo bicycle with more than 2 seats (Gij-R/M: 112).

5.10.3. Weight

Another issue is the maximum load one is allowed to transport with an e-cargo bike (or any kind of bicycle). A total of 200 kg can be transported with an e-cargo bike in Switzerland, however this viewed as very little by various participants (Ada-C: 34; Die-G: 65), partly because it includes the weight of the driver and the bike itself.

> *I think that the most important thing is that you get rid of those 200 kilograms of limitation, because a box and a bike weigh together 60, 70 kg, a person weighs 90 kg. So then you have around 40 kilos left, which is not much (Jaa-D: 47).*

Also with regard to weight, Swiss legislation differs from EU legislation.

> *one of the main issues is that these big cargo bikes have a limitation of weight, to 200 kg, in Switzerland, in the EU the exact same bike can have till 380 kg (Die-G: 65).*

E-cargo bikes are developed and manufactured outside of Switzerland (Hui-R: 37) and often e-cargo bikes are designed to transport heavy loads, however Swiss law prevents this.

5.10.4. Speed limit

One participant argues that the speed of 25 km/h does not really makes sense. As of now slow e-bikes provide support up to 25 km/h and fast e-bike up to 45 km/h. By supporting up to 25 km/h, e-cargo bikes can drives almost as fast as cars (in 30 km/h zones), but not entirely. Therefore, the participant argues that allowing support up to 30 km/h might make more sense, to avoid speed differences between different transport modes that often share the same road (Gij-R/M: 56).

5.10.5. New e-cargo bike models

Another participant explains that it can be challenging for a new e-cargo bike models to be approved on Swiss roads because new models have to be approved by Swiss legislators.

> *and the three-wheeled cargo bikes, like the 'Musketeer' or 'Armadillo'. You can't use those in Switzerland, because of regulation. We are trying to get an armadillo on the road this year. Terribly expensive and extremely complicated. Stupid rules. The lights have to be a certain distance from each other for example (Jaa-D: 34).*

5.11. No Swiss e-cargo bike manufacturers

There are no Swiss companies which manufacturer e-cargo bikes (Hui-R: 37), apart from a few highly specialized models (Gij-R/M: 125). Most e-cargo bikes which are being used in Switzerland come from other European countries such as the Netherlands, Germany, Denmark and France (Ada-C: 61; Gij-R/M: 86; Jaa-D: 5; Dir-SH: 33). This has several implications, as it appears that not all models developed by manufacturers outside of Switzerland, are suitable for the Swiss environment. The hilly topography which characterizes Switzerland, can make using e-cargo bikes more challenging.

5.11.1. Motors

> *With the front motors, in the front wheel, with full power, so 'on' or 'off', that worked in the Netherlands. But here, if you sold those with even 15 different stances, they still burn out going uphill. So the motors really broke, they became too hot, they shut down, overcapacity (Gij-R/M: 86, author translation).*

The participant explains that the first e-cargo bike models, which had their motors directly powering the front wheel, where not well suited for the Swiss landscape. At the moment, better motors are available and instead of these 'front motors' the so-called 'mid-drive motors' are now common (Hui-R: 27). Such motors transfer the motor's power to the rear wheel via the bicycle's chain drive and have proven to be more reliable. Around 2013 such kind of e-cargo bikes were available for sale in Switzerland (Gij-R/M: 86).

5.11.2. Sun protection

When it rains, most e-cargo bike models can be covered with a rain screen, however there is no such a thing which protects against the sun.

> *often what the Dutch don't realize, is protection from the sun. Guys at Urban Arrow say sunscreen? You're happy when the sun shines, aren't you? But that's simply outdated, the sun is so dangerous and people want to have a sunscreen for their bikes (Gij-R/M: 67, author translation).*

Here the participant explains that in the Netherlands, where several e-cargo bikes brands (like Urban Arrow) produce there models, sun protection has not received much attention. However, this appears to be an issue on the minds of potential Swiss e-cargo bike users.

5.11.3. Import taxes

Lastly, bicycle shops have to pay the import taxes when ordering e-cargo bikes to their stores.

> *In terms of imports, all very expensive. Transporting a bike to my storage in Constance [Germany] costs 125 euros. Bringing the bike here to Winterthur [Switzerland], costs 300 euros. Who profits from that? Just a few extra kilometres for the truck. And those extra expenses, you can't charge those to the Swiss, who also are aware of the prices in Europe and otherwise they buy it there, in Freiburg or Konstanz (Gij-R/M: 79, author translation).*

However, despite these additional expenses for Swiss retailers compared to retailers from the EU, Swiss retailers do not pass these extra costs on to their customers out of fear of shopping tourism. These customers could also buy their e-cargo bikes in other countries, such as Germany or France, which gives Swiss retailers a disadvantage compared to retailers outside of Switzerland.

6. Discussion

This chapter discusses the results presented in the previous chapter. The four sub-questions (see section 3.4.) will be critically analysed first, before answering the main research question of this research project:

> *Which factors drive or hinder the rise of transport of loads with e-cargo bikes in Switzerland?*

The first sub-question deals with how e-cargo bikes are used, the second treats the temporal aspect of e-cargo bike usage in Switzerland. Question three focuses on reasons actors can have to use e-cargo bikes while the fourth question explores factors limiting e-cargo bike usage. The first two questions help to put the developments of e-cargo bike usage into a broad perspective. The latter two sub-questions focus on driving (question 3) and hindering (question four) factors of e-cargo bike usage and provide more direct insights into addressing the main research question.

6.1. To what extent are e-cargo bikes used as an alternative or additional mode of transport?

The potential of e-cargo bikes to replace other modes of transport is often mentioned, especially when it comes to replacing motorized transport (Wrighton and Reiter, 2016; Beckmann et al., 2016; Loe-M: 36; Ing-CA: 31; Tru-S: 14). In this instance, e-cargo bikes can contribute to more environmentally sustainable urban transport systems and to reducing congestion (Wrighton and Reiter, 2016). Besides replacing other transport modes, e-cargo bikes might also encourage individuals to undertake new kind of journeys, which they would not have considered otherwise. For example, one could use e-cargo bikes for a recreational cycling tour and discover areas, which were not considered for visits before. In this case, e-cargo bikes are used as an additional mode of transport. It remains unclear to what extent e-cargo bike are used as an additional mode of transport, this does however not appear to be an important issue for the participants. Nevertheless, very specialized e-cargo bike models could encourage people to conduct new kind trips, such as wheelchair transport.

In the remainder of this chapter, e-cargo bikes will be discussed as an alternative mode of transport followed by a discussion on the usage of e-cargo bikes as an additional mode of transport.

6.1.1. Alternative mode of transport

To what extent e-cargo bikes replace other transport modes appears to be hard to quantify, which was mainly due to the novelty of e-cargo bikes. Not all participants knew how people decide to use their e-cargo-bikes (Loe-M: 18). Especially when it comes to private households in urban areas, there seems to be a lot of potential for e-cargo bikes to replace other modes of transport (Wrighton and Reiter, 2016), yet to what extent this is happening is unclear from the data of this research project. However, a user survey of the e-cargo bike sharing platform Carvelo2go suggests that Carvelo2go users replace motorized transport with e-cargo bikes in 42,3% of their trips (Stawicki and Schmid, 2019). Yet, Carvelo2go users likely use e-cargo bikes differently from households that own an e-cargo bike. Individuals who own an e-cargo bike experience less barriers to use it, compared those that use e-cargo bike sharing. For example, they do not need to bother with the distance to nearest e-cargo bike sharing station, opening hours and do not have to pay-per-ride. Therefore, it is likely that individuals who own their own e-cargo bike might choose this transport mode more often compared to individuals using e-cargo bike sharing. The fact that little information is available on how private households use e-cargo bikes shows how new this mode of transport actually is. One participants argues that it might be too early to do a more in-depth analysis on e-cargo bike usage (Jet-S: 55). Several participants mention that it is very important to grow the awareness of the existence and possibilities of e-cargo bikes (Die-G: 68; Tru-S: 15; Ing 97). So, analysing how e-cargo bikes are used exactly might be premature as various actors focus their efforts on getting individuals to use e-cargo bikes in the first place (Ing-CA: 97; Wil-CA: 13; Die-G: 61). Not only raising the awareness on the existence of e-cargo bikes is important, but also showing how one can actually use e-cargo bikes and integrating it within people's mobility behaviour is vital (Ing-CA: 97). Various organizations provide materials that both mention the existence of e-cargo bikes and explain how one can actually use it (Wil-CA: 13; Steinmann and Geiser, 2018; Beckmann et al., 2016).

Regarding businesses, the usage purposes are more evident. Companies typically have conducted some kind of analysis to find out which vehicle suits their business best (Jaa-D: 17; Joo-D: 36), the use of e-cargo bikes in business contexts is more clearly defined and e-cargo bikes are often more clearly compared with motorised delivery vehicles. It has to be noted that it is also possible that businesses want to use e-cargo bike simply because they prefer bicycle delivery, without conducting an in-depth analysis (Ada-C: 9). The extent to which e-cargo bikes can replace motorized transport for businesses seems to be dependent on a variety

of factors. More exactly, the most important factors are the ability to fit e-cargo bikes in the existing logistical infrastructure, the availability of micro-hubs, planning systems and employees' willingness to use e-cargo bikes. As these factors vary per company, the extent to which e-cargo bikes can be used can vary strongly between different businesses. Yet, smaller companies with less complex logistics systems can switch easier from one transport mode to another. Some smaller businesses are for example able to completely rely on e-cargo bikes (Schmid and Stawicki, 2017; Ada-C: 3). These are typically local business in the food sector that deliver to a customer base that is located relatively nearby. Large delivery companies also express interest, but appear to be mostly exploring how to use e-cargo bikes by means of pilot projects (Joo-D: 5; Jaa-D: 60). Larger companies might take more time to evaluate e-cargo bikes because they have might have more complex logistics systems in place. Depending on the results of such pilot projects, also larger companies could start using e-cargo bikes. However, also external factors could give incentives for the uptake of e-cargo bikes. As mentioned by Geels (2002), external factors or influences from the socio-technical landscape could 'break open' current practices. For example, political measures such as subvention programs (Gij-R/M: 96; Dir-SH: 39) or restrictions for cars to access city centres could amplify the use of e-cargo bikes (Loe-M: 61; Leonardi et al., 2012).

6.1.2. Additional mode of transport

The focus and advantages of e-cargo bikes are often linked to their potential to replace other, most notably motorised transport modes (Wrighton and Reiter, 2016; Beckmann et al., 2016; Loe-M: 36; Ing-CA: 31; Tru-S: 14). Yet, in this research project, few insights could be obtained on the issue whether or not e-cargo bikes are used as an additional mode of transport. Thus, the exact extent to which e-cargo bikes could encourage users to conduct trips they would not have conducted before, remains unclear. More specialized models can encourage people to see new possibilities. An example of this can be transporting people in a wheelchair per e-cargo bike (Gij-R/M: 22). Such a vehicle could give people in a wheelchair and their families more mobility options. As this is a relatively easy to use vehicle, eventual barriers to go on trips can be reduced. Other examples of more specialized e-cargo bikes exist, such as a large food bike to reach different places for small business (van Rooijen, 2019). According to the user survey of Carvel2go, 12,7% of the trips conducted with the e-cargo bike sharing platform, were trips the user would otherwise not have conducted. So, when it comes to e-cargo bike sharing, some trips can be classified as additional transport.

6.2. Since when do actors choose to use e-cargo bikes?

Regarding the temporal aspect of e-cargo bike usage in Switzerland, it appears that e-cargo bikes were introduced in the early 2000s (Ada-C: 61, Gij-R/M: 86). Technological improvements made e-cargo bikes models more suitable for the Swiss terrain (Gij-R/M: 86; Hui-R: 27). It is common that niche innovations come in many different forms and many early models or configurations fail, before a certain model becomes more popular (Geels, 2002). Because the meaning and usage of 'the bicycle' has changed throughout time (Oldenziel and de la Bruhèze, 2011; ViaStoria and ASTRA, 2014), it is very well possible that e-cargo bikes influence current views on cycling. The e-cargo bike allows for transport of much larger loads by bicycle and could normalize the transportation of loads by bicycle (Dir-SH: 19). Such cultural changes are vital for niche technologies to become more commonplace, i.e. break through to the level of socio-technical regimes (Geels, 2002).

In the following section, the initial use of e-cargo bikes by private households will be discussed first, before moving on to businesses.

6.2.1. Private households

The first e-cargo bikes were sold in Switzerland around the 2000s and their demand has been growing ever since (Gij-R/M: 88). This growth of demand is expected to continue (Hui-R: 48: Ing-CA: 91). The rise of e-cargo bikes usage by private households might be due to three reasons: technological improvements, increased awareness and subsidies. Firstly, technological improvements have made e-cargo bikes better suited for the Swiss landscape. Early models proved not to be optimally suited to cope with the typical hilly terrain in Switzerland (Gij-R/M: 86). Because e-cargo bikes are produced outside Switzerland (Hui-R: 37), e-cargo bike manufacturers might have developed vehicles for their domestic markets first, before taking special requirements for foreign markets into account. This might explain why motors of early models imported to Switzerland did not perform well on steep roads. Over time, technological improvements have been made and current e-cargo models are believed to be better suited to the Swiss terrain (Gij-R/M: 86). Secondly, although awareness is still limited, increasing awareness about e-cargo bikes seems to have supported their distribution. As e-cargo bikes are quite novel, potential users might not realize that and how they could integrate e-cargo bikes in their lives (Ing-CA: 97). Often, e-cargo bike buyers have relatives who already use e-cargo bike or are themselves from regions where e-cargo bikes are

more established (Gij-R/M: 15). Additionally, the sharing project by Carvelo2go creates a lot of visibility of e-cargo bikes in urban areas (Tru-S: 15) and contributes to increasing awareness. Another factor is that many e-cargo bike users are satisfied with their e-cargo bike and function as positive ambassadors (Hui-R: 21, Gij-R/M: 13). This implies that both connections to people with e-cargo bikes as well as seeing e-cargo bike riding around in the neighbourhood, can encourage private households to start using e-cargo bikes. Thirdly, subvention programs did also cause more private households to purchase e-cargo bikes, for example in Basel (Gij-R/M: 98; AUE-BS, 2016).

6.2.2. Businesses

When it comes for e-cargo bike usage by businesses, it is hard to pinpoint when exactly e-cargo bikes started to be used. Small businesses can be incentive to adopt e-cargo bikes through various support programs, such as the 'Mir sattlä um!' campaign in 2016 in Bern (Stadt Bern, 2016) or a campaign in Basel in 2018 (SRF, 2018). These programs aimed at small businesses proved to be very popular (Dir-SH: 39). Which indicates that with financial support, small businesses might start using e-cargo bikes. However, such programs are always organized at municipal level, which means that it is likely that within Switzerland differences exist into when e-cargo bikes might have increased in number. When it comes to larger delivery companies, e-cargo bikes appear to be used sporadically, mostly in the form of pilot projects (Joo-D: 58) or smaller start-ups which are taken over. How this will play out in the future remains uncertain. Larger delivery companies such as DHL, UPS or DPD employ various motorized vehicles such as trucks and delivery vans. However, experience shows that for short distances, e-cargo bikes can be just as efficient (Jaa-D: 16), or even more time-efficient (Ada, 9). However, there are many factors influencing the viability for a delivery company to employ e-cargo bikes (Joo-D: 12). An example of this dynamic is Notime AG, a young bicycle delivery company of which the Swiss mail delivery (Die Post) took over a majority share. Now, Die Post's logistical infrastructure can be used, which caused Notime AG to experiment with different electrical vehicles, called DXP's (Jaa-D: 28). Here, the possibility to experiment with DXP's emerged from the circumstance that Die Post is not using these vehicles during the time Notime AG delivers. Because of this, Notime AG can use these DXP's, giving these electric vehicles a second life. Such an example shows that there is a lot of experimentation going on and that at this moment there is no clear pathway how things might develop.

6.3. What makes actors choose to transport loads with e-cargo bikes?

Actors can have various reasons for using e-cargo bikes. The most important considerations for both private households and businesses will be discussed in this section. For both user groups, environmental considerations (Dir-SH: 19: Loe-M: 30) and costs (Loe-M: 28) appear to be important factors. Other reasons can be time efficiency and awareness. E-cargo bikes can be more time-efficient by avoiding congestion, this is especially an important driver for businesses in the delivery sector (Loe-M: 36; Jaa-D: 15). Having relatives or seeing e-cargo bikes on the road could inspire people to starts using e-cargo bikes as well (Tru-S: 15).

6.3.1. Private households

Little information is available when it comes to the usage of e-cargo bikes by private households. Sometimes manufacturers themselves are surprised how their products are used by their customers (Loe-M: 18). However, for private households it appears that people use it mainly to transport their children (Hui-R: 11; Dir-SH: 3). These findings are in line with the results of the user survey by Carvelo2go (Stawicki and Schmid, 2019), as transporting children made up the largest share of trips by Carvelo2go users, namely 42,1%. This was closely followed by 41,5% for doing groceries. Other usage purposes were transporting large materials, business related, bringing away garbage and pet transport. Although, these usage purposes might seem insignificant for Carvelo2go users, they could be important to other e-cargo bike users. The usage purposes from someone who owns an e-cargo bike is likely to differ from someone who uses e-cargo bike sharing because when one owns an e-cargo bike there are much less usage barriers. Moreover, when one owns an e-cargo bike, one can choose a particular model, it might be possible that the model offered by Carvelo2go is not optimally suitable for these less popular usage purposes from the survey.

6.3.1.1.Costs

With prices ranging from 5000 to 7000 Swiss Francs (Tru-S: 15; Die-G: 77; Ing-CA: 55), some participants argue that e-cargo bikes are too expensive for the average family (Die-G: 84). For this price, one can also buy a motor-scooter or even a small second hand car (Die-G: 79). Some municipalities have featured subvention programs for households which wanted to buy an e-cargo bike (Beck, 2016; Dir-SH: 39), these programs were very popular (Gij-R/M:

98), which suggest that the costs are an important factor for households considering e-cargo bikes.

However, the question whether or not an e-cargo bike is expensive, comes down to what such a vehicle is compared with. For example, if a family has two cars, but can replace one of their cars with an e-cargo bike, this would be cheaper. Especially because the additional expenses of e-cargo bikes, such as insurance, power and maintenance are much less compared to a car (Gij-R/M: 11). To add to that, people typically tend not to do an extensive cost-benefit analysis when comparing different transport modes. Especially cars come with a lot of additional costs regarding gas, maintenance, taxes and insurance and might appear cheaper than they really are (Tru-S: 23). On the other hand, compared to bicycle trailers, e-cargo bikes are quite expensive. For instance, when a household already has an e-bike at the moment they get children a bicycle trailer can be a logical option. This is because one can easily mount or dismount a trailer behind their e-bike and therefore they only need to invest in the trailer (Hui-R: 50). The investment into a trailer is mostly around the 1000 Swiss Francs, which is much less than buying a whole new e-cargo bike.

In sum, whether or not e-cargo bikes are expensive really depends on where e-cargo bikes are compared to. Compared to bicycle trailers it can be expensive while compared to cars it can be a cost reduction. Therefore raising awareness of the diverse usage purposes of e-cargo bikes and how to integrate them into mobility patterns, might be more important (Ing-CA: 97).

6.3.1.2. Environmental considerations

In order to reach the goals of the Paris Climate Agreement, changes to current mobility behaviour is necessary (Tru-S: 17). E-cargo bikes could be part of the solution to create more sustainable transport systems in Switzerland. However, it is unclear from the interviews to what extent environmental considerations are important for households who choose to use e-cargo bikes. Nevertheless, it is reasonable to assume that environmental sustainability might be an important factor. A study on regular e-bike users in Switzerland by Buffat et al. (2014) showed that environmental awareness is one of the most important values for e-bike owners. According to this study, the majority of e-bike owners could be classified as consumers who pursue a healthy and sustainable lifestyle. Further, ‘a commitment to a more sustainable mobility that respects the environment’ was mentioned as an important factor to buy an e-bike

(Buffat et al., 2014, p. 62). Although one cannot be certain to what extent the values of e-bike users and e-cargo bike users are similar, it is likely that they share a commitment towards more environmentally sustainable transport[11].

6.3.1.3. Awareness

Another reason which might support private households choosing to use e-cargo bikes are the positive experiences of current e-cargo bike users. It appears that e-cargo bike users are often very satisfied (Gij-R/M: 9, 118; Ing-CA: 53; Ada-C: 63) and that such users function as positive ambassadors of e-cargo bikes (Hui-R: 21, Gij-R/M: 13). Especially children appear to enjoy this mode of transport (Gij-R/M: 13). Moreover, when it comes to sales, private households often have social contacts who use e-cargo bikes (Gij-R/M: 15). This implies that awareness and word of mouth is an important driver for private households to start using e-cargo bikes. Additionally e-cargo bike sharing by Carvelo2go increases the visibility of e-cargo bikes and might inspire others to use e-cargo bikes as well (Tru-S: 15).

6.3.2. Businesses

For business, three reasons seems to be the most important to adopt e-cargo bikes. Namely to be more environmentally sustainable, deliver goods more efficiently and to reduce costs. The importance of these three variables can vary between regions and companies.

6.3.2.1. Costs

When it comes to costs, one e-cargo bike is of course much cheaper than a single car or delivery van, however it depends on the situation how many e-cargo bikes are needed. In Switzerland, subvention programs aimed at businesses led to increase in e-cargo bike usage, especially for small business (Dir-SH: 39). This might suggest that the costs e-cargo bikes are an important determinant. When it comes to larger business little information is known about

[11] It has to be noted that in Switzerland there is no distinction between e-bike and e-cargo bike owners (Siegenthaler, 2017), it might very well be possible that some of the respondents in the study of Buffat et al. (2014) are in fact e-cargo bike owners.

the costs of employing large amounts of e-cargo bikes. Through testing and pilot projects companies are gathering more experience on this matter (Joo-D: 46). A larger company might have a more extensive logistics system in place, which can make it harder to integrate e-cargo bikes into their activities. Another approach is taking over younger companies with more experience with e-cargo bike deliveries. One example of this is the Swiss mail service, Die Post, who bought a majority share in the bicycle delivery company Notime AG (Jaa-D: 60). However, also for larger companies delivering with bicycles can be a cheaper option (Loe-M: 28).

6.3.2.2. Environmental considerations

For actors involved in the e-cargo bike businesses, be it either selling, providing, or manufacturing e-cargo bikes. Providing a more sustainable mode of transport was an important reason they got involved in the business (Loe-M: 30; Dir-SH: 19; Die-G: 73). Furthermore, looking for cleaner ways to transport goods is also important for actors in the delivery sector (Jaa-D: 17; Loe-M: 30).

It is reasonable to assume that when businesses use e-cargo bikes instead of delivery vans they will omit much less greenhouse gas emissions. To what extent this will be the case in Switzerland is unclear, however examples from other countries show that the reduction in emission is huge:

> *Trials by DHL, where two vans are replaced by a 'City Hub' and four e-cargo bikes, are estimated to reduce CO2 emissions by 16 tonnes p.a.. In Maastricht, four companies that replaced a conventional van with an e-cargo bike saved more than a tonne of CO2 in six months. In London, a butcher that began using an e-cargo bike instead of a van whenever possible was able to reduce CO2 emissions by 75%. (Cairns and Sloman, 2019, p. 5-6)*

The notion that e-cargo bikes are more environmentally sustainable is widespread by the participants and this notion alone appeared to be was sufficient to choose e-cargo bikes over other modes of transport (Jaa-D: 17, Tru-S: 17; Dir-SH: 19). Nevertheless, exacts figures to what extent such businesses will be more environmentally sustainable in Switzerland will vary per case. Factors such as, the amount of e-cargo bikes needed to replace a delivery van, the type of goods and the distance which needs to be covered, will vary per company.

6.3.2.3. Efficiency

When it comes to efficiency of delivery, e-cargo bikes can be quicker than vans in urban areas (Ada-C: 9; Jaa-D: 19). However, the efficiency of an e-cargo bike compared to a delivery van depends on the location of the warehouse or micro hub from which the e-cargo bike can operate. When this warehouse is located relatively far from the delivery area, it might not be viable to use e-cargo bikes because of their smaller capacity. Such a warehouse can be hard to organize as space in city centres can be limited (Joo-D: 12).By making use of cycling infrastructure e-cargo bikes can be faster vehicles on short distances, avoiding traffic jams and parking issues (Loe-M: 36). Further, e-cargo bikes can access areas which are closed off for cars such as car-free city centres (Leonardi et al., 2012). Because of this, e-cargo bikes can potentially be a more efficient transport option in urban areas.

6.4. What do actors see as limiting for the use of e-cargo bikes?

Various aspects were mentioned to limit the usage of e-cargo bikes in Switzerland. These can be categorised in the following factors, namely transportation infrastructure, the political climate, safety concerns, regulations, costs, transportation culture and the absence of Swiss e-cargo bike manufacturers. These factors are linked together and should not be viewed as sperate influences. For example, the safety perceptions of e-cargo bike users is of course also influenced by the transportation infrastructure. Together this set of factors hinder the usage of e-cargo bikes for both private households and businesses.

6.4.1. Transportation infrastructure

Regarding transportation infrastructure, many participants argue that Swiss road infrastructure is not always well-suited for cycling (Wil-CA: 10, 50; Die-G: 48; Ada-C: 57). Because e-cargo bikes are obliged to make use of cycling infrastructure, cycling infrastructure also influences e-cargo bike usage. Sometimes, people can be afraid of using e-cargo bikes because they view cycling infrastructure to be unsafe (Jet-S: 65). However, this does not mean that e-cargo bikes are better off on other parts of the road. Although speed differences with other cyclist (especially those not riding an e-bike) might occur, this difference would be even greater when e-cargo bikes were to be placed in the same category as motor-scooters.

Further, using cycling infrastructure allows e-cargo bike users to avoid traffic jams (Die-G: 27-28; Jaa-D: 15). Thus, improvements in current cycling infrastructure is necessary.

Several measurements were mentioned by the participants. Most notably, disentangling shared spaces, removing parking spaces for cars to make room for cycling infrastructure, giving priority to certain roads users and wider bicycle lanes. These kind of measures are not ground-breaking and many examples of creating safe and efficient road infrastructure exist (Ing-CA: 24). Implementing such measures seems to be more a matter of prioritization (Ing-CA: 14). Even in busy urban areas were space seems to be limited, restructuring transportation infrastructure is first and foremost a question of political will (Die-G: 38; Ing-CA: 24). The same applies for measures concerning e-cargo bikes specifically, such as creating parking spaces and pedestrian refuges which fit the dimensions of e-cargo bikes. In areas where pedestrian refuges cannot be changed, e-cargo bikes should be allowed to use a different route.

6.4.2. Political climate

The political support to implement cycling measures is vital, it appears that between different cantons or municipalities, differences exist into the extent cycling is being prioritized. For instance, the cities of Bern, Basel and Winterthur are mentioned as relatively positive towards cycling (Ing-CA: 24, Dir-SH: 39, Gij, 100), other cities such as Zurich are often judged as lacking the political will to support cycling (Ing-CA: 8, 22, 29, Die-G: 38). For example, the Canton of Zurich developed a program in 2009 which includes several measurements to support cycling, which had to be realized in 2018. However, only 4 out of the 26 measures were implemented (Fassbind, 2018). This might (partly) be due to the sheer amount of actors involved, which adds a lot of complexity to the implementation of planning projects. It can take up to 6 to 8 years to get all involved actors on the same page (Die-G: 38). Figure 15 shows the large number of actors which can be involved in the realization of planning projects in canton Zurich. Although not all actors shown in Figure 15 also possess decision-making power, each actor could file a complaint in case they are unhappy about a particular project. Within different governmental bodies, different opinions on cycling and e-bike mobility exist (Die-G: 22). This means that the various actors as can be seen as in Figure 15, often have different goals and priorities and that it is challenging to get everyone one the same page (Die-G: 38).

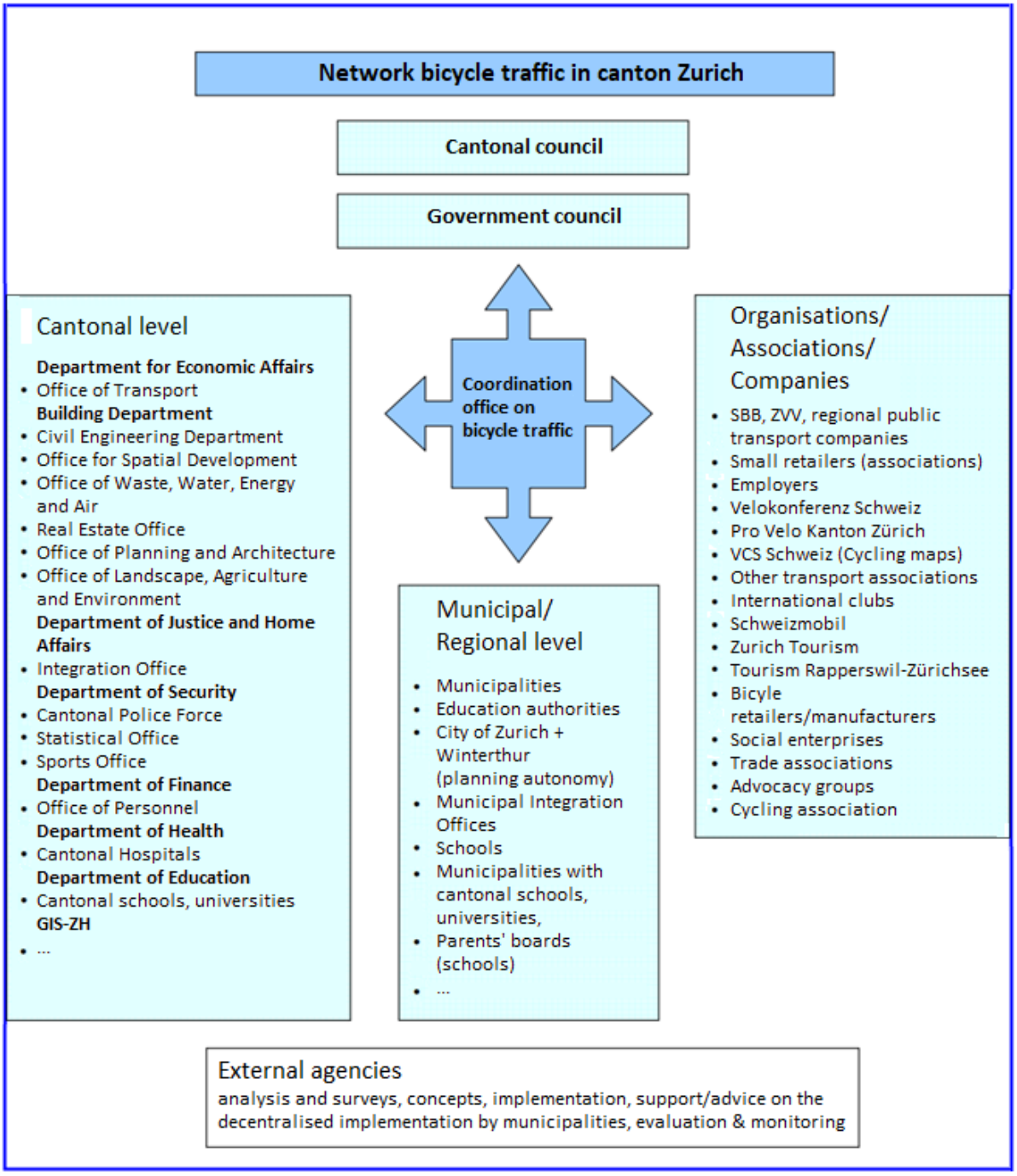


Figure 15: Actors involved in bicycle traffic in canton of Zurich (Modified from source: Lehner-Liery and Hermans, 2009, p. 19).

Although this example only refers to canton of Zurich, it is not uncommon that in other cantons many different actors are involved as well. When projects cross certain political borders, for example municipalities, projects can be even more difficult to realise (Tru-S: 10). Of course, it can be beneficial to involve a large number of actors, to increase support for the

implementation of political measures. However, collaboration with a large number of actors can cost a lot of time and resources and trust and good communication between all involved parties is vital for success (Head and Alford, 2015, p. 727). Limiting the number actors with decision-making power can reduce complexity and collaboration with a high number of actors should only be done when it is clear that the collaboration has added value (Head and Alford, 2015, p. 728).

At the moment, the needs of other modes of transport are often prioritized over bicycles (Die-G: 38; Tru-S: 25). For example, the Swiss state prescribes the construction of parking spaces for cars with new construction projects (Tru-S: 25), while participants argue that a lot of road infrastructure problems could be solved by using this space for bicycle infrastructure (Die-G: 34; Ing-CA: 40). In this way instead of supporting motorised transport, more sustainable transport modes can and should be supported (Wil-CA: 50).

Another issue is the long time span the planning of infrastructure projects takes. Often, projects are planned up 10 years in advance (Die-G: 38), however when these plans are made public, it often quite difficult to make any amendments to them (Ing-CA: 22). To what extent infrastructure projects take cycling into account varies per canton. In some cantons cycling advocacy associations are involved in the planning process, in other cantons this is not happening (Ing-CA: 12). On top of that, new road infrastructure can last a long time, around 20 years, meaning that after a infrastructure project is realised, it is likely that the first opportunity to change anything about it will be in 20 years at the earliest (Die-G: 39).

6.4.3. Regulations

Several regulations on cycling and e-cargo bikes seem to be hindering e-cargo bike usage. Because e-cargo bikes are a relative novel mode of transport Switzerland, regulation is sometimes lagging behind (Ing-CA: 82; Loe-M: 61). Some regulations are seen as appropriate, for example regarding the width of e-cargo bikes, which can be maximal 1 metre (Hui-R: 39; Jaa-D: 72; Gij-R/M: 70). Other regulations are seen as restriction e-cargo bike usage.

The limitation on weight was seen as one of the most limiting regulations. In Switzerland only a total of 200 kg is allowed to be transported by bicycle, however this includes the weight of the driver and the bike itself. This leaves very little weight, which is especially important for businesses who aim to deliver as many goods per trip as possible (Jaa-D: 47; Die-G: 63; Ada-

C: 34). This weight limit was perceived to be even more unfit, as the e-cargo bikes are often designed to transport larger loads then the 200 kg limit. In the EU one can transport even up to 380 kg with a bicycle and many e-cargo bikes models are also designed to do this (Hui-R: 37; Gij-R/M: 86).

Another hindering regulation concerns the number of passengers (Wil-CA: 40; Gij-R/M: 112; Ing-CA: 79). In Switzerland one is allowed to transport a maximum of two persons (Steinmann and Geiser, 2018), again just as with the issue of weight, there are e-cargo bike models which are designed to transport up to three to four children. Again this is also allowed in the EU and only Swiss legislation holds transporting more passengers back. Even though it might not occur often that people need to transport more than two children, it seems to make little sense to prevent this as some e-cargo bikes are specifically designed for this purpose.

Further, Swiss legislation appears to have various rules on what kind of bicycle are allowed on the road, which can make introducing new models difficult (Jaa-D: 34). When a new model is developed in the EU, it can take years before this model is allowed to be used in Switzerland (Jaa-D: 34).

6.4.4. Safety

Unsafe cycling infrastructure can deter people from cycling (Die-G: 48) or trying out e-cargo bikes (Hess and Schubert, 2019). Especially when riding with children or with heavy loads, one has to feel safe and comfortable. Some people therefore prefer transporting their children by car, as they believe that cycling is not safe enough for their children (Wil-CA: 24). Although this might be safer short-term, transporting children by car also means that they gain little experience in traffic. When at some point in life these children get a bicycle and start cycling, they have little experience with moving around in traffic, which can be dangerous (Wil-CA: 26). When someone is not comfortable with cycling, chances are low that they will choose for this mode of transport in the future. Also a lack of experience and training increases their risks in traffic (Schepers et al., 2017). In Switzerland, children receive cycling training in primary school (Die-G: 70). These programs are seen as successful (Ing-CA: 29) and can increase the likelihood of people choosing to cycle. However, as of now, many (especially adults) have received little cycling training, which implies that they also fail to understand how cyclist move in traffic. For example, car drivers could fail to judge situations with cyclist accurately as they have little cycling experience themselves (Gij-R/M: 56). Thus,

cycling experience not only improves road safety when that individual is cycling, but also when this individual uses other modes of transport and can understand cyclists better in traffic.

6.4.5. Transportation culture

In order to increase bicycle and e-cargo bike use, participants argued that cycling needs to become more embedded in Swiss transportation culture (Gij-R/M: 107; Wil-CA: 13; Die-G: 94). When it comes to transporting loads, bicycles are often not seen as the most logical mode of transport (Dir-SH: 19). More awareness on e-cargo bikes and their capabilities could change this, although this is likely to be a slow process as cultural beliefs can take decades to change (Geels, 2002). Also for businesses this can be an issue, as they also have to take into account how their employees feel about using e-cargo bikes (Jaa-D: 69; Joo-D: 52). If they prefer to use other (motorised) vehicles, a company might not be able to switch their delivery activities to e-cargo bikes.

Another issue regarding transportation culture is that when people are transporting their kids, they often use bicycle trailers. Bicycle trailers are more established in Switzerland compared to e-cargo bikes and this familiarity can results in a perception of safety (Gij-R/M: 13). However, this belief that bicycle trailers are safer than e-cargo bikes is not supported by several participants (Hui-R: 54; Jet-S: 59; Dir-SH: 4; Gij-R/M: 117). Yet, because e-cargo bikes are relatively new and unknown some individuals might prefer bicycle trailers over e-cargo bikes.

6.4.6. Costs

As mentioned, costs can be both a driving and hindering factor, depending on where an e-cargo bikes is compared to. However, with prices for the average e-cargo bike ranging between 5000-7000 Swiss Francs (Tru-S: 15; Die-G: 77; Ing-CA: 55), purchasing an e-cargo bike can be a large investment (Die-G: 84). Especially for private households who primarily wish to transport their children, a bicycle trailer, which can bought around 1000 Swiss Francs can be a cheaper option. Especially when someone already owns a regular e-bike buying an bicycle trailer to attach behind their regular e-bike can financially be a more logical option (Hui-R: 50). For businesses, the cost of integrating e-cargo bikes into their logistics systems

depends on a lot of factors and will vary per case. For example, the cost of acquiring or renting various small warehouses from which e-cargo bikes can deliver goods. However, the cost of integrating e-cargo bikes into any logistics system cannot be seen separately from the legislation regulating e-cargo bike usage. For example, the 200 kg weight restriction hinders the amount of cargo with can be transported by e-cargo bikes (Jaa-D: 47; Ada-C: 34; Die-G: 65). As some e-cargo bikes models are designed to transport heavier loads, easing this restriction would make sense (Die-G: 65). This would make e-cargo bike more attractive to be used as a delivery vehicle as they can transport larger quantities and increase their efficiency compared to other vehicles.

6.4.7. No Swiss e-cargo bike manufacturers

Because there are no Swiss e-cargo bike manufacturers, Swiss retailers need to import e-cargo bikes from countries in the EU. Often these models were designed for their respective domestic market, before developing models which could also work well in foreign markets. This might have delayed the emergence of e-cargo bike in Switzerland in the past (Gij-R/M: 86), but also has some implications today.

As of now there are few producers offering sun-protection, this might be due to the fact that in northern EU countries, were most cargo-bikes are produced, the sun might be perceived as less risky (Gij-R/M: 67). In northern countries irradiation levels are lower compared to Switzerland, meaning that in Switzerland the risk on sunburn is higher (Solargis, 2019). Another potential issue are the braking systems. Because of the hilly terrain in Switzerland, brakes wear out pretty fast (Jaa-D: 13; Gij-R/M: 55-56) and better breaking systems are believed to be necessary (Jaa-D: 107). This issue is likely to be more significant in Switzerland as steep roads simply require better breaks compared to the more flat terrain in northern Europe, where these e-cargo bikes are developed. Customers interested in e-cargo bikes can sometimes be more interested in the speed of e-cargo bikes than their braking systems (Gij-R/M: 55-56), which implies that other actors such as policy makers or retailers should push manufacturers to build better braking systems.

Another consequence of foreign manufacturers is that Swiss retailers have to pay import taxes over them. However, if retailers consequently would raise their prices, they might lose customers to cross border shopping (Gij-R/M: 79). This puts bicycle retailers in a difficult spot and can hamper their growth. This in turn could have a negative effect on the availability

and distribution of e-cargo bikes in Switzerland. The issue of shopping tourism does not apply to e-cargo bike retailers alone as many Swiss retailer are faced with a drain of purchasing power resulting from price differences between nations (Ramsey et al., 2019).

6.5. Which factors drive or hinder the rise of transport of loads with e-cargo bikes in Switzerland?

The usage of e-cargo bikes in Switzerland is influenced by many factors. It can take decades for a niche technology to move to the level of a socio-technical regimes and bring structural changes to society (Geels, 2002, 465). The first e-cargo bike models in Switzerland did not cope well with the hilly terrain (Gij-R/M: 86), however current models appear to perform better (Hui-R: 27). Technology-wise only improved braking systems and additional configurations such as a sun-screen are mentioned as improvements. This shows that over time, e-cargo bikes have become better suited for usage in Switzerland. Various factors have been identified as driving e-cargo bike usage, which are presented in Table 3. These will discussed first, before elaborating on the factors which hinder the rise of e-cargo bike in Switzerland, which are shown in Table 4.

6.5.1. Driving factors

The potential to make urban transport more sustainable causes some governments, mostly on the municipal level (Dir-SH: 39), to support e-cargo bikes. This clearly shows how landscape factors, in this case environmental concerns, puts pressure on existing transport modes and supports more sustainable alternatives, such as e-cargo bikes. Such external influences can be categorised as landscape pressures as shown in Figure 9 (Geels, 2002). This factor is likely to continue to be an important factor as environmental concerns continue to be relevant. In order to reach the goals of the Paris Agreement on Climate Change, which Switzerland committed to (The Federal Council, 2019), more sustainable transport systems are necessary (Tru-S: 17). Governments and organization are therefore likely to support sustainable transport, be it through subvention programs (Gij-R/M: 96; Dir-SH: 39), or restricting polluting transport modes (Loe-M: 61; Leonardi et al., 2012). The victory of ‘green’ political parties in Switzerland’s parliamentary elections in 2019 (Kohler, 2019) suggests that many Swiss residents value environmental sustainability.

Table 3: Factors driving e-cargo bike usage

Driving factors	Example
Environmental considerations	• E-cargo bikes are an environmentally sustainable mode of transport.
Cost[12]	• Replace motorised vehicles • Lower additional costs such as maintenance, power, taxes and insurance • Occasionally, subvention programs are available
Time efficiency	• Can avoid traffic jams • Access areas which are closed off for other transport modes • Easier to find a parking places for short stops (e.g. deliveries).
Awareness	• Social contacts with an e-cargo bike • Seeing e-cargo bikes in the neighbourhood

The other driving factors as shown in Table 3, do not originate from the socio-technical landscape, but are advantages which might make the niche innovation of e-cargo bikes superior compared to other transport modes.

Regarding costs, an e-cargo bike can be more cost-efficient compared to other transport modes. The extent to which costs are driving e-cargo bike usage is very context dependent. Various user preferences could influence how the costs of e-cargo bikes are evaluated (Joo-D: 36). When e-cargo bikes are used with the intention to replace a delivery van, e-cargo bikes could be an cheaper options for short distances. However, when someone solely wants to transport their children, bicycle trailers could be a cheaper alternative (Hui-R: 50). Various subvention programs have taken place (Dir-SH: 39; Gij-R/M: 98) and these proved to be very popular, however subvention programs can cost a lot of resources which might not be always available. Because the perceived costs of an e-cargo bike really comes down to how these

[12] Costs are both a driving and hindering factor, depending on where an e-cargo bike is compared with.

vehicles are used, informing potential users about the cost compared to other transport modes could also be an effective way of increasing e-cargo bike usage (Die-G: 61; Ing-CA: 97).

Another driving factor is time efficiency, especially in crowded urban areas e-cargo bikes can be a faster navigating through traffic (Jaa-D: 17; Ada-C: 9). For private individuals commuting to work as well as business which deliver goods, e-cargo bikes can be a way to save time (Loe-M: 36). By making use of cycling infrastructure, traffic jams can be avoided. Furthermore, finding a suitable parking space can be easier for e-cargo bikes compared to cars. Although there are little official parking spaces for e-cargo bikes (Jet-S: 52), for short stops, e-cargo bikes might find a suitable place more easily than a delivery van (Dir-SH: 3; Gij-R/M: 12). Especially for companies in the delivery sector, where time efficiency is of the essence, this can be an important difference.

Awareness of e-cargo bikes and how they can be used is another important factor driving e-cargo bike usage (Die-G: 68; Tru-S: 15). This sounds logical, as one first have to know such a vehicle exist before using it. However, this also relates to how such an e-cargo bike can be integrated into mobility patterns. Showing the potential usage purposes of e-cargo bikes can increase their uptake (Ing-CA: 97). People who purchased an e-cargo bike typically have social contacts who also use e-cargo bikes, others might have been come into contact with e-cargo bikes on holidays in Northern Europe (Gij-R/M: 15). Finally, increasing numbers of e-cargo bikes, be it through e-cargo bike sharing or an increased number of e-cargo bike owners, increases the visibility of the e-cargo bike (Tru-S: 15) and can inspire other people to use one themselves.

6.5.2. Hindering factors

Table 4: Factors hindering e-cargo bike usage

Hindering factors	Examples
Transportation infrastructure	• Bicycle infrastructure often perceived as unsafe for cyclist • Parking spaces and pedestrian refuges do not fit the dimensions of e-cargo bikes.
Political climate	• Lack of political support to improving cycling infrastructure or other project which promotes cycling • Different opinions on cycling between government bodies • Cycling advocates not always included/consulted in planning projects
Regulations	• Legislation allows to transport less weight than some e-cargo bike are designed for. • Legislation allows to transport less persons than some e-cargo bike are designed for.
Transportation culture	• Transporting loads by bicycle is not 'normal' • Employees of delivery companies might not be interested in switching to bicycles.
Safety concerns	• Bicycle infrastructure often perceived as unsafe for cyclist • Training courses for e-bikes and e-cargo bikes

Costs[13]	• More expensive than bicycle trailers • Integrating e-cargo bikes into existing logistics systems can be costly (varies per companies, e.g. investing in micro hubs or adapting IT route-planning systems)
No Swiss e-cargo bike manufacturers	• Might not always take Swiss-specific requirements into account. • Import taxes for Swiss retailers

E-cargo bikes appear to be a niche product (Tru-S: 14) and much of the hindering factors depicted in Table 5 are typical for niche innovations as described by Geels (2002). This novel transport mode competes with other transport modes which are more established in Switzerland.

When it comes to the planning of road infrastructure in Switzerland, other transport modes have been prioritised already since the mid-20th century, which makes implementation of current cycling infrastructure projects more difficult (ViaStoria and ASTRA, 2014).

Nowadays, other transport modes appear to be prioritized over cycling (Ing-CA: 24; Die-G: 38). The implementation of measures which promotes cycling and subsequently e-cargo bike usage can be hindered by a bicycle unfriendly political climate. The effect of this varies widely between regions as in some regions cycling is given more attention compared to others (Ing-CA: 24, Dir-SH: 39, Gij, 100). A vivid example of a lack of political support comes from the Canton of Zurich, were only 4 out of 26 measures out of the Cantonal cycling support programme were implemented (Fassbind, 2018). Within different governmental bodies, different opinions on cycling and e-bikes exist (Die-G: 22) and because there are many actors involved in cycling projects, it can take a long time before a project can be implemented (Die-G: 38). Furthermore, cycling advocates are not always included in planning projects (Ing-CA: 12).

[13] Costs are both a driving and hindering factor, depending on where an e-cargo bike is compared with.

Several regulations hinder the usage of e-cargo bikes, the allowed number of passengers and load (in kg) are believed to be the most prominent. Especially because e-cargo bike models are often specifically designed to transport more persons or weight than Swiss legislation allows (Hui-R: 37; Gij-R/M: 86; Wil-CA: 40; Ing-CA: 79). However, it is not uncommon for niche innovations to face regulations restricting legislation (Geels et al., 2017). In order to improve legislation on e-cargo bikes, examples from other countries can be used. In many EU countries, which is also were e-cargo bikes are manufactured, legislation seems to be better adapted to the specifications of e-cargo bikes (Die-G: 65).

Other transport modes appear to be more embedded in Swiss transportation culture (Wil-CA: 13). E-cargo bikes offer the opportunity to transport loads by bicycle however, in Swiss society today, when transporting loads the bicycle is not the first vehicle which comes to mind (Dir-SH: 19). According to Geels (2002), changes in cultural practices could take decades. Thus, it is likely that despite of the potential of e-cargo bikes to change people's mobility behaviour (Tru-S: 14), it will take time before such practice becomes more embedded or normalized within Swiss culture (Wil-CA: 13). However, as shown in the Historical overview (section 2.1.) the usage and meaning of 'the bicycle' has changed throughout time and it is possible that transportation loads by bicycle could be normalized in Swiss society in the future.

Closely related to the cultural beliefs are the safety perceptions people have regarding cycling and e-cargo bikes. Because cycling infrastructure is sometimes perceived as being unsafe (Die-G: 48; Wil-CA: 24; Hess and Schubert, 2019) some prefer to make use of other transport modes. Improvements in cycling infrastructure can increase safety perceptions, but also training courses especially for e-bikes and e-cargo bike could play a role here (Jet-S: 52).

Regarding costs, this can be both a hindering and driving factor. E-cargo bikes can be judged as costly for the average family (Die-G: 84), however one can also view it as a cost-reduction depending on where an e-cargo bike is compared with. Compared to a bicycle trailer an e-cargo bike can be judged as expensive. The initial purchasing price of 5000 to 7000 CHF (Tru-S: 15; Die-G: 77; Ing-CA: 55), is a large sum of money and can prevent people from using it. For businesses, the costs of integrating e-cargo bikes into current logistics systems need to be taken into account and will vary per case. In order to allow people or organizations with less financial resources to acquire e-cargo bikes, subvention programs or leasing could be viable options.

As e-cargo bikes are produced outside of Switzerland (Hui-R: 37), manufacturers might not always take Swiss requirements into account, this could explain why Swiss actors argue that current braking systems need improvement, as the hilly terrain in Switzerland can wear down brakes more easily (Gij-R/M: 58; Jaa-D: 13). Also Swiss retailers can have difficulties importing e-cargo bikes to Switzerland because of income taxes (Gij-R/M: 79). This could cause less bicycle retailers to sell e-cargo bikes, meaning that there would also be less bicycle retailers with the expertise to provide service and repairs for e-cargo bike users.

7. Conclusion

Current urban mobility systems are under pressure as environmental concerns, congestion and noise disturbance call for innovative and more sustainable transport modes (Banister, 2005). E-cargo bikes are a low-carbon mode of transport (Hess and Schubert, 2019) and contribute to cleaner and also less congested urban areas (Wrighton and Reiter, 2016). E-cargo bikes can transform individuals' mobility behaviour (Tru-S: 14; Riggs, 2016) and could potentially replace motorised transport on short distances, thus specifically in urban areas (Jaa-D: 16; Wrighton and Reiter, 2016; Cairns and Sloman, 2019). An e-cargo bike can efficiently transport goods or children within a range of 10 to 15 km and up to 300 kg (Beckmann et al., 2016).

In Swiss urban areas, many short-distance trips are conducted by motorised transport. As shown in Table 1, between 41 and 52% of the motorized journeys in six major Swiss cities have a distance of less than 5 km. For exactly these kind of journeys e-cargo bikes can be a viable alternative. As of now, e-cargo bikes are still a niche product in Switzerland (Tru-S: 14) and when one has to transport loads, a bicycle is typically not the mode of transport that is considered first (Dir-SH: 19). However, it is shown that the usage and cultural meaning of the bicycle has changed over time. During the early 20th century, Switzerland was a nation with lots of cyclists (ViaStoria and ASTRA, 2014) and the bicycle was viewed as the transportation vehicle for the masses. Yet, increasing popularity and affordability of cars caused bicycles numbers to decline and the bicycle became viewed as an inferior mode of transport (Oldenziel and de la Bruhèze, 2011). This changed around the 1970s, when people started questioning the dominance of motorised transport systems because of environmental concerns. From this moment on, the bicycle rose in significance again. Nowadays, cycling is viewed as part of a healthy and sustainable lifestyle (Oldenziel and de la Bruhèze, 2011). Thus, even though transporting loads by bicycle is not common today, cultural beliefs about how bicycles can and should be used is subject to change. Possibly, the e-cargo bike could 'normalize' the transport of loads by bicycle and contribute to a shift towards more sustainable transport systems in urban areas.

This research project explored which factors drive or hinder the usage of e-cargo bikes in Switzerland. Building on theory from transition literature, namely the MLP perspective of Geels (2002), the rise of e-cargo bikes and related influences from different sectors and actors in society were investigated. As a niche innovation, e-cargo bikes compete with more

established transport modes. Motorized transport is for instance much more embedded in Swiss transportation culture (Tru-S: 25; Die-G: 38; ViaStoria and ASTRA, 2014) and traffic polices, infrastructure and industries are geared towards facilitating this mode of transport. Many of the hindering factors as found in this research project are typical for niche innovations. Drawing on the expertise of bicycle retailers, manufacturers, researchers, businesses, cycling advocates and governmental employees, insights from various sectors were obtained.

Various sub-questions provided insights on the development of e-cargo bike usage in Switzerland. Furthermore, the reasons of using e-cargo bikes and limiting factors were investigated in order to give a complete answer to the main research question.

Regarding the temporal aspect of e-cargo bike usage in Switzerland, it was shown that e-cargo bikes appeared in the early 2000s in Switzerland (Ada-C: 61, Gij-R/M: 86). However, these early models did not cope well with the hilly terrain which characterizes Switzerland (Gij-R/M: 86). Improvements in the motors powering the e-cargo bikes resulted in more reliable models (Hui-R: 27). Yet, e-cargo bikes are still manufactured outside of Switzerland (Hui-R: 37) and specific requirements for the Swiss landscape might not always be accounted for by manufacturers. Today, the brakes seem to be a point of concern as the hilly terrain in Switzerland calls for better braking systems (Gij-R/M: 58; Jaa-D: 13). Still, the demand for e-cargo bikes is rising in Switzerland (Gij-R/M: 88). The more e-cargo bikes are present on the roads, the greater their visibility, and the more people who might get inspired to start using e-cargo bikes as well (Tru-S: 15). Moreover, subvention programs aimed at private households as well as businesses are popular and can cause an increase in e-cargo bike usage (Dir-SH: 39; Gij-R/M: 96). These programs are organised by governments on the municipal level and occurred sporadically throughout the 2010s.

It appears that private households typically use e-cargo bike to transport their children (Hui-R: 11; Dir-SH: 3). Another important usage purpose is doing groceries (Stawicki and Schmid, 2019). More specifically, shared e-cargo bikes appear to have potential to replace motorized vehicles, as a large part of the conducted trips would have otherwise been conducted by car (42,3%) (Stawicki and Schmid, 2019). To what extent these results can be generalized to people who own their own e-cargo bike remains unclear. However, individuals owning an e-cargo bike might have less usage barriers compared to e-cargo bike sharing, which could imply that these individuals would use their e-cargo bike even more. Overall, e-cargo bikes are often used with the goal of replacing other transport modes (Jaa-D: 17; Ada-C: 9; Dir-SH:

19) and it seems that e-cargo bikes are not frequently used as an additional transport mode. This means that e-cargo bike users do not use e-cargo bikes often to go on journeys they would not have considered before. Only very specialized models can have this effect, for example the wheelchair bike, which can transport someone in a wheelchair. With such a bike, families with a family member in a wheelchair could get inspired to go on trips and to visit places they had not considered or not had access to before (Gij-R/M: 22).

The most important drivers of e-cargo bikes usage are environmental considerations, awareness, time efficiency and costs. As Switzerland is committed to reach the goals of the Paris Agreement on Climate Change (The Federal Council, 2019), it is likely that governmental bodies will keep investigating how to make urban transport systems more sustainable and initiate programs to support e-cargo bike usage. Providing more environmentally friendly transport is also an important motivation for businesses activities (Dir-SH: 19: Loe-M: 30). For private individuals, the wish for a more sustainable lifestyle can motivate people to use e-cargo bikes (Die-G: 73). Because e-cargo bikes can be an efficient vehicle to move through congested spaces (Loe-M: 36; Jaa-D: 15), time efficiency is another driver of the uptake of e-cargo bikes in urban areas. By avoiding traffic jams private households as well as companies in the delivery sector could save valuable time. Increased awareness on e-cargo bikes and how they can be used, for example through social contacts or information materials can inspire people to starts using e-cargo bikes themselves (Tru-S: 15; Wil-CA: 13; Die-G: 61). Furthermore, the costs of e-cargo bikes can be both a driving or hindering factor as it depends on the context whether e-cargo bikes are judged as expensive or as cost-saving. Different usage purposes influence how the costs of an e-cargo bike are compared with other transport modes. If for example someone wants to replace a (second) car or a delivery van with an e-cargo bike, an e-cargo bike is a more cost-efficient option. Here, not only the purchasing prices is decisive, but also the reduced expenses on maintenance, taxes and insurance (Tru-S: 23; Gij-R/M: 11). However, if compared with a bicycle trailer, an e-cargo bike is a more expensive option, albeit more comfortable (Hui-R: 50).

Despite (comparative) costs (Die-G: 84), various other factors were identified as hindering e-cargo bike usage. More specifically, transportation infrastructure, the political climate, regulations, safety concerns, transportation culture and the fact that e-cargo bikes are produced outside of Switzerland are found to hinder e-cargo bike usage. Together these factors pose a large challenge for the rise of e-cargo bikes usage in Switzerland. It is not uncommon that niche innovations face challenges coming from diverse sectors of society

(Geels, 2002). In order to increase e-cargo bike usage, or the usage of other forms of sustainable innovation in Swiss transportations sector, a more equal support system between e-cargo bikes and other transport modes of transport necessary (Tru-S: 25). For instance, tax-financed road construction or mandatory car parking spaces for construction projects give motorised transport an advantage over e-cargo bikes. Transportation infrastructure is sometimes perceived as unsafe for cyclists and e-cargo bikes user alike (Jet-S: 65; Die-G: 48; Wil-CA: 10) and cause people to choose different transport modes. Furthermore, a bicycle friendly political climate is sometimes lacking, which inhibits the support and implementation of cycling projects (Ing-CA: 29; Die-G: 22). Several regulations, most notably the restrictions on weight and number of passengers one is allowed to transport by e-cargo bike are seen as unfit (Jaa-D: 47; Ada-C: 34; Hui-R: 40-42; Wil-CA: 40; Gij-R/M: 112; Ing-CA: 79). Especially because several e-cargo bike models are specifically designed to carry more loads or persons than Swiss legislation currently allows. In the EU, where these bikes are developed, legislation is better adapted to e-cargo bike usage (Die-G: 65). A more indirect factor hindering e-cargo bike usage is that cycling and transporting loads by bicycle needs to become more 'normalized' (Dir-SH: 19), meaning that cycling is not always strongly embedded into Swiss transportation culture (Wil-CA: 13; Die-G: 70; Gij-R/M: 107). It is believed that cycling experience from an earlier age makes individuals choosing to cycle more often (Wil-CA: 11). Finally, because e-cargo bikes are produced outside of Switzerland, Swiss retailers need to pay import taxes. These extra cost are often not passed on to the customers, out of fear for shopping tourism (Gij-R/M: 79). This puts Swiss retailers at a disadvantage compared to retailers outside of Switzerland, which might negatively influence the distribution of e-cargo bikes throughout Switzerland.

7.1. Reflection and limitations

With qualitative research subjectivity and positionality always needs to be considered. Although the qualitative data analysis was done systematically and with great care, interpreting peoples' thoughts, feelings, and experiences remains a subjective affair compared to interpretation of numbers and calculations. The results of this research project should not be considered as cold-facts but as insights into what developments are going on regarding e-cargo bike usage in Switzerland. These insights can be used to understand the role and usage of e-cargo bikes in Swiss urban transport systems better.

At first, the research project intended to focus on e-cargo bike usage just in the canton of Zurich. However, quite early during the interview stage, it became clear that this was a too small geographical scale. The initial focus on Zurich was chosen because of the federal nature of Swiss society, which can make it hard to draw conclusions on a national level. However, the interview participants mentioned various topics which do not only apply to the canton Zurich but should be considered on a national level. For example, bicycle retailers based in Zurich sell e-cargo bikes throughout Switzerland, the most important traffic regulations are dictated by the federal government and (young) delivery companies are active in multiple cities. Thus, despite the federal nature of Switzerland, actors based in canton Zurich appeared to influence and also be influenced by other regions outside of canton Zurich. Therefore, the focus was shifted to Switzerland on a national level, while keeping in mind that regional differences can occur.

Actors from a wide variety of fields could be included. This sample diversity is vital, as the goal of this research project was to explore as many different factors influencing e-cargo bike usage. However, it is likely that there are other actors which are not included, but could provide even more insights into e-cargo bike usage. Moreover, many of the interview participants have some sort of affinity with e-cargo bikes or cycling in general. Because these participants might be more positive towards cycling than others in the field of mobility, this could have influenced the results. Finding actors who might be less cycling-minded proved to be a great challenge, as these actors often stated that they were not interested in participating. These include actors from cantonal und municipal civil engineering offices, the Federal Roads Office, the Swiss Council for Accident Prevention, mobility scientists, transport consultancy agencies. Furthermore, large e-bike manufacturers also proved to be unavailable. In case actors elaborated on why they were not available, than this was mostly because they did not have the time or felt to have insufficient knowledge on the issue. This might suggest that e-cargo bikes are still quite novel and that this is not a topic on the forefront of people's minds in the mobility sector.

Another issue are the languages used in this research project, a total of three languages and one dialect[14] has been used during this research project (English, German, Dutch and Swiss-German). As the researcher is not fluent in German and Swiss-German miscommunication during the interview could have occurred. At the same time, by giving the interview participants the opportunity to speak freely in their native language, more complete and

[14] Swiss-German is considered an Alemannic dialect.

detailed answers could have been given. Further, to compensate for any language miscommunication, extra care has been taken when preparing for the German and Swiss-German interviews by practicing these interviews with German and Swiss-German speakers beforehand. As the thesis is written in English, quotes of some interview participants have been translated, which could lead to a loss of meaning. Yet, the translation has been done with the goal to maintain their original meaning best.

7.2. Future outlook

It is unclear how e-cargo bike usage in Switzerland might develop in the future. On the one hand, the demand seems to be growing (Gij-R/M: 88), on the other hand there are also other innovations in the mobility sector. For example, the bicycle courier company Notime AG, also experiments with other electric vehicles, called DXP's. Which vehicles they will be use most frequently in the future is still being evaluated (Jaa-D: 28). Moreover, other and also larger delivery companies are experimenting with e-cargo bikes, however it might take a couple of years when such pilot projects are finalised and evaluated (Joo-D: 46; Jaa-D: 60).

However, this does not imply that it is only a question of time to see if e-cargo bikes are picked by more actors in society. Several factors hindering their usage has been identified in this research project and these can have a large influence on e-cargo bike usage. For example, regulations on e-cargo bikes usage, such as the weight and number of passengers appear to be limiting e-cargo bike use (Jaa-D: 47; Ada-C: 34; Hui-R: 40-42; Wil-CA: 40; Gij-R/M: 112; Ing-CA: 79). Easing such restrictive regulation can make the difference in whether or not e-cargo bikes are evaluated as a viable vehicle for businesses or private households. Here lessons can be learned from other nations where legislation might be better adapted to e-cargo bikes (Die-G: 65).

Additionally, changes in Swiss transportation polices can also make e-cargo bikes more attractive, for example by banning cars from city centres, which already occurs in some Swiss cities (Loe-M: 61). In such cases e-cargo bikes can become a more desirable vehicle for both private households and businesses as it allow actors to still transport loads to these car-free areas.

Other factors influencing e-cargo bike usage could have a longer time span, for example making road infrastructure more safe for cyclist will benefits both cyclists and e-cargo bike users. Here urban planners do not need to reinvent the wheel, as many best-practice examples

are available (Ing-CA: 24). Improving cycling infrastructure is therefore more a question of political will (Die-G: 38). Because support for cycling varies between regions (Ing-CA: 12), it is likely that the amount of safe cycling infrastructure and consequently the amount of cyclists and e-cargo bike users will differ between Swiss regions.

The various cycling training programs, which are mostly aimed at children (Ing-CA: 29; Die-G: 70; Jet-S: 52), will increase the number of experienced cyclists in Switzerland. This could have the indirect effect that eventual barriers to use e-cargo bikes might be reduced, for instance feeling unsure how to handle such a bicycle (Jet-S: 28). Training courses on e-bikes and e-cargo bikes might reduce usage barriers even more.

Awareness of e-cargo bikes and their possibilities is likely to increase the more e-cargo bikes are on the road the more people might get inspired to starts using these vehicles as well (Tru-S: 15). Nevertheless, organisations could support this trend by providing information on how e-cargo bike could be integrated into mobility behaviour patterns, both for private households and businesses.

Future research could focus on the extent current e-cargo bike owners have changed their mobility behaviour and to what extent this is more environmentally sustainable. So far no study has quantified the extent to which e-cargo bike owners have used e-cargo bikes as an alternative for other (motorised) transport modes (Jet-S: 55). Such a quantification can be an important communication tool for policy makers as well as businesses trying to reduce emissions. Furthermore, the potential of other vehicles to make urban transport more sustainable can be explored, for example electric vehicles such as the DXP or bicycle trailers. Finally, as many large companies are experimenting with e-cargo bikes (Jaa-D: 60; Joo-D: 46) future research could, when those companies have gathered more experience, focus on reasons why they choose or not choose to use e-cargo bikes.

In order to give policy makers and researchers a better idea on the number of e-cargo bikes in Switzerland, they need to be counted separately in bicycle statistics. At the moment e-cargo bikes fall under the category e-bikes which makes it unclear how many are actually sold in Switzerland (Siegenthaler, 2017). Another related subject of investigation would be exploring how many e-cargo bikes are bought in Switzerland and how many are imported abroad. With such insights the impact of import taxes on Swiss retailers can be made more visible.

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Appendix

Appendix 1 – Interview guides

As mentioned in section 4.3. the interview guides were slightly adjusted for each interview participant. This was due to differences in time availabilities and expertise. One participant mentioned to already have conducted an interview on the topic of e-cargo bikes, which was published online, it was decided to include this interview in the research project, the link to this interview is provided below[15].

[15] This interview was conducted by Engagement Migros and can be found here: Engagement Migros. (2018). *"A cargo bicycle can make a whole family change their mobility behaviour"*. Available at: https://www.engagement-migros.ch/en/interview-de-haan [Accessed 12 Jan. 2020].

English interview guides

Interview guide Ingrid – Bicycle lobby organization in the Canton of Zurich

Intro

- Again thank you very much for your time
- Short introduction about the research
- Mention the interview is anonymous and if it is ok to record the interview
- Ask if they have any questions

General

- Could tell something about when the organization was created?
    - For which purpose? Did the purpose/mission change over time?

Infrastructure

- What kind of activities have you done with regard to bicycle infrastructure?
    - What was successful?
- Did you experience any difficulties?
- Can you tell sometimes about the different institutions involved with developing bicycle infrastructure, for example Canton and city.
- Could you tell something about how you believe bicycle infrastructure should look like?
    - Can you give ideal examples?
    - Do you think this is realized in Zurich, be it in the Canton or in the city?
- What do you think of e-cargo bikes, do they fit on current bicycle infrastructure?
- Do you see e-cargo bikes as a positive or negative development for transport infrastructure?
- Do you foresee any issues with e-cargo bikes if their numbers increase.
    - Why or why not?

Collaboration

- Have you worked or are in contact with organizations or companies that are related to e-cargo bikes?
    - If so, which one and what do you do?

Temporal

- Do you have the idea the number of e-cargo bikes rise?
- Is it a topic you are working on, or is it integrated in support for bicycling and e-bikes in general?

Policy

- Are there any regulations, policies on cargo-bikes, for example on the size, speed limit or safety?
- Who makes these policies? Bund, Canton, Gemeinde
- What do you think of these policies
    - Could they be improved? If, so how?

Members

- Can you tell me something about your members, why do they want to be a part of your organization

Subsidies

- In the past governmental bodies have subsidized e-bikes, for example in Tessin they promoted it in order to reduce car use.
- Do you know of any recent ideas of subsidizing e-bikes
- Would you think subsidies on e-cargo bikes might occur, if so on which governmental level would this be likely
    - Why?
- Do you believe governments should consider subsidies? Efficient use of recourses?
    - Why/why not?

Future

- How do you think e-cargo bikes will be used in the future more? Why or why not?
- Do you think you have a role in this?

Interview guide Jaap – Delivery company which uses bicycles and DXP's

Intro

- Again thank you very much for your time
- Short introduction about the research
- Mention the interview is anonymous and if it is ok to record the interview
- Ask if they have any questions

General

Can you tell something about the company, you started in 2015 with delivering food on regular bicycles right? And in 2015 with e-commerce in Zürich?

- What kind of customers?
- Where these e-commerce shifts done with the same e-cargo bikes that are used now?
- Why did you choose to deliver with e-cargo bikes?
    - Economical/Environmental/other reasons

Experiences

- How was this perceived by clients? Where they positive or sceptical about the use of e-cargo bikes?
- Where there instances the use of e-cargo bikes convinced clients?
- Where there instances where potential clients did not want their stuff delivered by bicycles?

Technology

- You use the Radkutsche right? Did you always use this model?
    - Why did you come to choose this manufacturer? Where these bikes more durable, economically?
- Did you consider different models? Advantages and disadvantages
- Lately, scooters, DXP and other models are also part of the vehicle fleet, can you tell something about why you choose to diversify?
- For attracting new clients or to meet the demands of existing clients.
- Would the musketeer be able to the same things as a DXP?

Policies

- What kind of regulation do you encounter, are there limitations on the usage of e-cargo bikes
- They can be maximal 1 m wide right? What about the Weight?
- To what extent does this influence this decision for which vehicle to buy
- What do you think of the current legislation in Switzerland?

Future

- How do you envision the future of the company and the delivery of e-cargo bikes? Will they always be part of the delivery fleet, or will they be replaced by other vehicles?
- Do you think that other delivery companies might also consider delivering with e-cargo bikes in the future, for example in the Netherlands and UK companies like DHL are already delivering directly.

Interview guide Diederik – Governmental body on cycling in Canton Zurich

Intro

- Again thank you very much for your time
- Short introduction about the research
- Mention the interview is anonymous and if it is ok to record the interview
- Ask if they have any questions

General

- What is the purpose/mission change of your organization?
- What has been accomplished so far?
- What remains challenging?

Infrastructure

- What kind of activities have you done with regard to bicycle infrastructure?
    - What was successful?
    - Did you experience any difficulties?
- Can you tell sometimes about the different institutions involved with developing bicycle infrastructure, for example the Canton and city.
    - How does this collaboration go?
- Could you tell something about how you believe bicycle infrastructure should look like?
    - Can you give ideal examples?
- Do you think this is realized in Zurich, be it in the Canton or in the city?
- What do you think of e-cargo bikes, do they fit on current bicycle infrastructure?
- Do you see e-cargo bikes as a positive or negative development for transport infrastructure?
- Do you foresee any issues with e-cargo bikes if their numbers increase. Why or why not?

Collaboration

- Have you worked or are in contact with organizations or companies that are related to e-cargo bikes?
- If so, which one and what do you do?

Policy

- Are there any regulations, policies on cargo-bikes, for example on the size, speed limit or safety?
- Who makes these policies? Federal government, Canton, Municipality
- What do you think of these policies
- Could they be improved? If so, how?

Subsidies

- In the past governmental bodies have subsidized e-bikes, for example in Tessin they promoted it in order to reduce car use.
- Do you know of any recent ideas of subsidizing e-bikes

- Would you think subsidies on e-cargo bikes might occur, if so on which governmental level would this be likely
    - Why?
- Do you believe governments should consider subsidies? Efficient use of recourses?
    - Why/why not?

Future

- How do you think e-cargo bikes will be used in the future more? Why or why not?
- Do you think you have a role in this?

Interview guide Jet – Scientist who conducted research on e-cargo bike sharing in Switzerland

Intro

- Again thank you very much for your time
- Short introduction about the research
- Mention the interview is anonymous and if it is ok to record the interview
- Ask if they have any questions

General

- How did you came up with this research project?
- How did you contacted your respondents?
    - What kind of people were the respondents?
- What kind of research on e-cargo bike is available in Switzerland?

Sharing

- How did you collaborate with Carvelo2go?
- Does the fact that there is only one cargo bike sharing company in Switzerland help or hinder the spread of e-cargo bikes?
    - How is this in other countries?
- Are most users early adopters of this technology?
    - Could this mean that other steps are necessary to involve more people (so beyond just the early adopters)

Interpretation of results

- To what extent can results on e-cargo bike sharing also be used for people who own an e-cargo bike themselves?
    - For example regarding cycling infrastructure
    - Other supporting or limiting factors

Future

- Do you think e-cargo bikes will be used in the future more?
    - Why or why not?
- Do you see other competing modes of transport, such as trailers?

Interview guide Dirk – Company providing a sharing platform for e-cargo bikes

Intro

- Again thank you very much for your time
- Short introduction about the research
- Mention the interview is anonymous and if it is ok to record the interview
- Ask if they have any questions

Customer feedback

- What kind of feedback does you get
    - Anything which comes to mind
- What kind of customers
    - Business, private individuals or both

User questionnaire of 2016

- The questionnaire was held when in Bern right? Did you possibly also collected information since it has expanded across Switzerland?
- Regarding to the modal shift caused by the e-cargo bikes. For example the respondents stated that 19% of the trips would previously been done by car and 20% of public transport.
  Could you elaborate more on this modal shift? Do you believe e-cargo bikes has the potential to could replace other transport modes even more?

Support

- Young companies typically needs investments and support in the early years, before the business gets profitable. Could you elaborate on how this was for you?
    - To what extent do you rely on the support from for example, Förderfonds Engagement Migros?

E-cargo bike models

- You offer multiple types of cargo-bikes, with the "Packster 60" of Riese & Müller as standard model. Was led to the selection of this model? For example, is this model the more reliable, easy to use, or economically the best choice?
- In addition to that, do you intend to keep using this model in the future, or are you also looking to new models and/or technologies?

Future

- Can you tell something about the experience of expanding to different cities? Where there any difficulties, or on the contrary, factors that made the scaling up go smoothly?
- What does you envision for the future?

Policies/subsidies

- Lastly, On the website (FAQ) you state that multiple municipalities or electricity companies might support people financially who want aim to buy a cargo-bike.
  I would love to learn more about this and get in contact with these organizations, could you name some of them? (I could so far not find organizations who offered financial support myself)

Interview guide Loes – Company which produces bicycle trailers (with and without e-support)

Intro

- Again thank you very much for your time
- Short introduction about the research
- Mention the interview is anonymous and if it is ok to record the interview
- Ask if they have any questions

General

- How did the idea for trailers emerge?
- Why?
- How did you get the idea
- Did you guys receive any support from organizations such as the government or EU?

Technology

- Development, did you build it from scratch on your own?
- Did overrun brakes for bicycles already exist, did you build it yourself, how?
- What kind of engine do you use, bosch or shimano?
- Are there things you still want to improve?

How it is used

- Can it replace car use,
    - To what extent? Limitations

Market

- What type of customers
    - Small business/private individuals
- Do you see other potential customer groups/ markets that you have not touched yet?
- What is the feedback of customers
    - Positive/Negative

Customers in CH

- I was wondering are there differences of selling to Switzerland, a non-EU country? Regulations?
- Who are your competitors
- What makes you different?
- Are there more electric powered trailers

Future

- How do you think your business and that of e-trailers and e-cargo bikes develop in the future?
- Different models
- Customers
- Different markets

Interview guide Gijsbert – Dealer of e-cargo bike models[16]

Intro

- Again thank you very much for your time
- Short introduction about the research
- Mention the interview is anonymous and if it is ok to record the interview
- Ask if they have any questions

General

- Can you tell something about how you started?
- Do you sell non-electric powered cargo bikes?
- Since when did you start selling e-cargo bikes?

Market/user preferences and maybe also culture

- Can you tell something about your customers, for example business or individuals?
- For what purpose do these customers intend to use the e-cargo bikes?
- Which models are popular by which customer
    - Do you have an idea why?
- Do you have or had models in the past that where not popular
    - Do you have an idea why?
- What kind of questions or concerns do you often get?
    - From which kinds of customers?
- Do you had different questions a few years ago
- Can you tell something about instances where customers did not decided to buy an e-cargo bike?
    - What was the reason?
- Do you know of any competitors, like shops who also focus on cargo bicycles?
- Do you have an idea to what extent other bicycle shops are selling e-cargo bikes?
- Can you tell something about you work of using e-cargo bikes for person with a disability?

Culture

- Are e-cargo bikes used as a replacement of other forms of transport, like car or public transport?
- Do you think that e-cargo bikes are becoming more known by the public?

Technology

- Can you tell something about the technology of the cargo e-bikes, for example the batteries
- How did they develop over time, price-wise/battery life
- Are there different models being developed

[16] Although the interview guide was prepared in English, this interview was conducted in Dutch, as this was the mother-language of both the interview participant and the interviewer.

Policy

- What kind of regulations/policies are there for cargo-bikes, for example on the size, speed or safety?
- Who makes these policies? Bund, Canton, Gemeinde
- What do you think of these policies
    - Could they be improved?

Future

- Do you think e-cargo bikes will be used in the future more?
    - Why or why not?

German interview guides

Interview guide Huib – bicycle shop which sells bicycles and e-cargo bikes

Intro

- Nochmals herzlichen Dank für Ihre Zeit
- Kurze Einführung über die Forschung
- das Gespräch ist anonym und frage ob es in Ordnung ist, das Gespräch aufzunehmen.
- fragen, ob sie Fragen haben

Allgemein

- Verkaufen Sie nur elektrisch betriebene Cargo-Bikes? Oder auch Cargo-bikes ohne elektrische Unterstützung?
- Seit wann sind sie angefangen mit dem Verkauf von e-Cargo-velos?

Markt-/Nutzerpräferenzen und vielleicht auch 'Kultur'

- Können Sie etwas über Ihre Kunden sagen, sind Sie zum Beispiel meistens Privatpersonen oder Unternehmen?
- Zu welchem Zweck wollen diese Kunden die E-Cargo-Bikes nutzen?
- Welche Modelle sind bei welchem Kunden beliebt?
    - Hast du eine Ahnung, warum?
- Hast du oder hattest du in der Vergangenheit Modelle, die nicht beliebt waren?
    - Hast du eine Idee, warum das so sein könnte?
- Welche Art von Fragen oder Bedenken haben Sie oft?
    - Von welchem Kundentyp?
- Hatten Sie vor ein paar Jahren andere Fragen?
- Können Sie etwas über Fälle erzählen, in denen Kunden sich nicht für ein E-Cargo-Bike entschieden haben?
    - Was war der Grund?
- Hörst du einige Erfahrungen von deinen Kunden, Was gefällt ihnen und was nicht?

Gesetze

- Gibt es Vorschriften, Richtlinien für Lastenfahrräder, z.B. über Größe, Geschwindigkeit oder Sicherheit?
- Was hältst du von diesen Richtlinien?
    - Könnten sie ihre Meinung nach, vielleicht verbessert werden?

Zukunft

- Wie werden Ihrer Meinung nach E-Cargo-Bikes in Zukunft mehr genutzt?
    - Warum oder warum nicht?

Interview guide Wilhelmina – bicycle lobby organization for entire Switzerland

Intro

- Nochmals herzlichen Dank für Ihre Zeit
- Kurze Einführung über die Forschung
- das Gespräch ist anonym und frage ob es in Ordnung ist, das Gespräch aufzunehmen.
- fragen, ob sie Fragen haben

Allgemein

- Die verein existiert seit 40 Jahren richtig? War die Unterstützung von Velos immer ein Teil der Arbeit?
- Was verstehen sie genau mit Förderung von Velos, bezüglich Infrastruktur oder Velo Unterricht zum Beispiel.
- In welcher formen hat Sie versucht, Velos zu fördern, ist das zum Beispiel meistens durch Informationen oder vielleicht auch Lobby Arbeit in der Politik?

Kultur

- Heutzutage gibt es viele verschiedene Formen von Fahrrädern, oder mit Anhängern. Glauben Sie, dass diese Verkehrsmittel eine Rolle in der Zukunft der Schweizer Mobilität spielen könnten, oder ist es mehr für eine kleine Gruppe von Fahrradbegeisterten?
    - Wieso?

Broschüre Kinder- und Warentransport per Velo

- Was ist der Grund vor die Entwicklung der Broschüre gewesen?
    - Viel fragen von Mitglieder oder war es deine eigene Idee?
- Und wie hast sie die Informationen bekommen, eigene Erfahrung oder in Gespräch/Zusammenarbeit mit andere Parteien?
- Es gibt viele verschiede Transportsysteme in die Broschüre, hast du eine Idee welche System oder form am meistens genutzt wird in der Schweiz?
    - Denkst du das sich das ändert in der Zukunft?
- Schliesslich wundere mich ich, wenn Sie irgendein Feedback auf der Broschüre bekamen?
    - Wissen Sie zum Beispiel, wem die Broschüre verwendet und was Leute davon halten.

Sicherheit

- In meine Erfahrung haben Leute unterschiedliche Ansichten darüber, was sicherer ist, indem sie Kinder hinter dir in einem Anhänger oder vorne, mit einem Cargo-Bike transportieren.
    - Was ist deine Meinung dazu?

Infrastruktur

- Glauben Sie, dass, wenn die Nutzung von Transportfahrrädern steigt, es zu Problemen mit der bestehenden Fahrradinfrastruktur kommen könnte?

Gesetzliche Grundlagen

- Am Schluss in die Broschüre gibt es ein Kapitel über die Gesetzliche Grundlagen, was findest du von die Gesetze?
    - Könnten sie ihre Meinung nach, vielleicht verbessert werden?

Zukunft

- Hast du es Idee das Lastenfahrräder mehr genutzt werden in der Zukunft
    - In welche Form, Anhänger oder e-cargo Bikes?

Interview guide Ada – small business which uses e-cargo bikes to deliver their products

Intro

- Nochmals herzlichen Dank für Ihre Zeit
- Kurze Einführung über die Forschung
- das Gespräch ist anonym und frage ob es in Ordnung ist, das Gespräch aufzunehmen.
- fragen, ob sie Fragen haben

Allgemein

- Wie ist das Idee entstanden, um mit dem Velo zu liefern?
    - Wieso Velos?
- Wie funktioniert das Ganze, haben sie verschiedene Küchen/orten wo sie die Produkte herstellen und in verschiedene Städten bringen?
- Was sind deine Erfahrungen?

Markt-/Nutzerpräferenzen und vielleicht auch 'Kultur'

- Können Sie etwas über Ihre Kunden sagen, was findest sie von es Idee mit dem Velo zu liefern, oder spielt das meistens gar kein Rolle?
    - Vor- und Nachteile
- Denkst du das es liefern mit Velos hilfreich ist Kunden zu gewinnen?
- Hatten Sie Kunden, die an der Suppe interessiert waren, aber Schwierigkeiten mit der Fahrradlieferung hatten?
- Welche Art von Fragen oder Bedenken haben Sie oft?
- Preis
- Nachhaltigkeit

Technologie

- Was für Lastenfahrräder Modelle brauchen sie
- Hast du auch andere Modelle oder Fahrzeuge überlegt? Oder vielleicht auch teilweise mit ÖV oder andere Fahrzeugen?
- Wie ist es mit kalt oder warm?

Gesetze

- Gibt es Vorschriften, Richtlinien für Lastenfahrräder, z.B. über Größe, Geschwindigkeit oder Sicherheit?
- Wer macht diese Richtlinien? Bund, Kanton, Gemeinde
- Was hältst du von diesen Richtlinien?
    - Könnten sie verbessert werden?

Zukunft

- Willst auch in der Zukunft mit Velos liefern bleiben, oder gibst es ein Punkt wo sie zum Beispiel zog ross gewachsen sind, das sie andere Fahrzeugen vielleicht muss überlegen.
- Wie werden Ihrer Meinung nach E-Cargo-Bikes in Zukunft mehr genutzt?
    - Warum oder warum nicht?

Interview guide Joop – Delivery company which experiments with e-cargo bikes

Intro

- Nochmals herzlichen Dank für Ihre Zeit
- Kurze Einführung über die Forschung
- das Gespräch ist anonym und frage ob es in Ordnung ist, das Gespräch aufzunehmen.
- fragen, ob sie Fragen haben

Allgemein

- Bin ich richtig, dass Sie mit E-Cargo-Bikes seit 2016 experimentiert hat?
- Wie ist es Idee um mit Cargo-velos zu liefern entstanden?
- Welche gründen, ökonomisch, Nachhaltigkeit
- Sind sie noch in Betrieb? Und wo? Welche Städten?

Erfahrungen

- Wie ist es Experiment gegangen/oder lauft es noch im Moment?
- Wie verhalten e-cargo-bikes sich im Vergleich zu anderen Fahrzeugen? Wie Lastwagen zum Beispiel.
    - Ökonomisch, Nachhaltigkeit
- Wenn sind e-cargo bikes effizient zu nutzen und in welche Situationen nicht?
- Was sind Vorteile von e-cargo bikes
- Was sind Nachteile
- Wie hast du das analysiert/geforscht?

Mitarbeiter

- Wie ist es ökonomisch, braucht man mehr Mitarbeiter für e-cargo bikes?
- Gibt es Leute wo gern mit ein e-cargo bike liefern oder findet man einfacher Leute für lastenwagen?

Technologie

- Welche typen oder Modellen werden benutzt? Alle dieselbe oder verschiedene für verschiedene Arten von Pakete
- Gibt es Dinge, die bei den aktuellen Bikes fehlen, sollten sie vielleicht größer, schneller, sicherer sein?

Gesetze

- Gibt es Vorschriften, Richtlinien für Lastenfahrräder, z.B. über Größe, Geschwindigkeit oder Sicherheit?
- Was hältst du von diesen Richtlinien?
    - Könnten sie ihre Meinung nach, vielleicht verbessert werden?

Zukunft

- Willst auch in der Zukunft mit Velos liefern?
    - Wieso/Wieso nicht
- Werden Ihrer Meinung nach E-Cargo-Bikes in Zukunft mehr genutzt?
    - Warum oder warum nicht?

Appendix 2 – Interview transcripts

For reasons of data protection, the interviews transcripts of this research project will not be published and has been sent separately to the supervisor.

Appendix 3 – Code System

Code System	Frequency
Code System	490
Landscape	4
raising cycling support, pressure politics	1
More urbanization	1
Future supporting landscape developments	0
car-free city centres, driving interest for e-cargo bikes	2
Socio-technical regime	7
Stabilizing factors regime (cars/public transport)	3
Bicycle shops do not offer service for e-cargo bikes (+)	4
Niche	50
Little information on e-cargo bikes in CH	3
test phase	7
possibility to customize tailor made for company	5
cargo bike niche	9
Raising awareness (+) (+) (+)	10
informing about transporting stuff with bicycles	1
e-bike how to use it	3
Professional - business - deliveries	0
Financial support	4
Coaching support	1
Network connections support	1
Environmental considerations (by start-ups CEO's)	1
Motivation of bicycling advocates (niche actors)	2
Being an example	1
Customers value sustainable transport	1
Usage purposes	1
Hindering factors	50
personnel for e-cargo bike deliveries (+)	5
disadvantages cargo bikes (+)	9
advantages cars over e-cargo bike	1
limitations e-cargo bike (+)	7
Swiss cargo bike producers	1
expensive	7
cargo bikes to long	1
Lack of implementation of cycling plans	2
Decentralized infrastructure planning	3

Long time-span of planning projects	3
Role of bicycle associations - legal	1
Unknown technology	1
Political climate (+) (+)	6
cycling vs public transport	1
Different opinions towards e-bikes/cycling	3
Supporting factors	17
financial support for cargo bikes	3
outreach for cargo-bikes	2
cargo bike companies collaborating (+)	2
Benefits e-cargo bikes	9
no driver's license	2
Can access places cars cannot	1
Costs vs cars	3
quicker compared to cars	1
advertisements on the box of bikes (+)	2
Government support cycling	1
Potential Cargo bike users	11
desire for information	1
passion for cycling	1
cargo bike operations	1
discovering markets	2
recent, cargo bikes	1
Small businesses (+)	2
Households market dynamics	1
Difficulty selling to larger organizations	1
Municipalities	1
Potential e-cargo bikes (+)	44
range e-cargo bikes	2
Integration with other transport modes (+)	7
reduce number of cars (+)	2
less space needed compared to cars	1
leasing	1
micro hubs	2
fun e-cargo bike	5
urban areas e-cargo bike no car in urban	2
interest by companies in cargo bike	1
environmental impact	3

short tours	2
congestion	3
Swiss topography	4
E-cargo bike users	14
User evaluation	2
User preferences	1
User characteristics (+) (+)	11
Geographical differences	9
Cargo bikes developed in different countries (+)	5
Import of e-cargo bikes	1
difference between cantons	3
Germany vs Switzerland	1
Subsidies	6
subsidy for disabled	1
Germany	2
Competing transport modes	39
cargo bike vs public transport	1
Cargo bikes without e-support (+)	4
cargo bikes vs other transport	15
e-cargo bikes vs DXP	7
e-cargo bike vs trailers (+) (+) (+)	10
2 wheeled vs 3-wheeled	4
kids in front	1
cargo bike vs vans	4
E-cargo bike characteristics	43
e-Cargo bike longevity	2
cargo bike models	20
motors	2
battery life	1
Breaks	10
fast e-cargo bikes	2
model for disable persons	1
cooling of goods	3
Popular cargo bike models	1
sharing	16
use sharing to try out different models	2
sharing promoting cargo bike usage	1
Swiss sharing vs other sharing	6

sharing is financially viable	1
Transportation culture	23
e-cargo bike perception	6
culture, alternative to car use	3
Culture cycling	14
afraid of cycling	3
driving e-cargo bike	1
lack of knowledge how to drive properly	1
Cycling training	12
education (+)	4
safety	19
link education and safety	1
safety label for disabled bicycles	3
unclarity how label will influence subsidy schemes	2
safety in regard to trailers	1
safety perceptions	9
safety disadvantages	1
Infrastructure	41
Infrastructure improvement	2
remove parking for cars (+)	4
infrastructure improvements	7
politics infrastructure	4
speed differences e-bikes and normal cyclist	1
need for safe infrastructure	3
more safe infrastructure	1
better infrastructure needed for e-cargo bikes	1
Infrastructure - parking	6
separate cycling from other traffic	1
cargo bike on cycling infrastructure	2
regulations	37
accountability using these bikes	1
every city own regulation on car-free	1
relation to regulations	4
Different EU regulations	2
technological improvements	3
Market	5
replacement bikes	1
option to return old e-cargo bikes	1

users who decided to buy new cargo-bikes	1
renting	2
Temporal dynamics E-cargo bikes	40
Future (+)	19
origin of cargo bikes	1

Personal declaration

I hereby declare that the submitted thesis is the result of my own, independent work. All external sources are explicitly acknowledged in the thesis.

Zurich, 30.04.2020

Felix Poelsma