Strengths and weaknesses of parcel locker concepts: a comparison between white label lockers, public transport lockers and exclusive lockers.

Public Version

Master Thesis, MSc Supply Chain Management

June 21, 2021

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Abstract

Parcel lockers have become an increasingly important alternative in last-mile delivery for parties active in the e-commerce sector. Parcel lockers can prevent issues experienced in home delivery and allow for additional sustainability and financial benefits. To further support this development, this research compares and reviews three different concepts, 1) White label locker concept, 2) Public transport locker concept, and 3) Exclusive locker concept, based on their strengths and weaknesses. Through semi-structured interviews with CEP service providers, exploiters, logistics experts and municipalities a complete overview of these three concepts is created. The main discriminating factors between the three concepts were found to be the locker location, volume efficiencies, financial considerations and regulatory approaches. This study is among the first to draw up such a comparison between the different concepts within the scientific literature.

Keywords: parcel lockers, parcel locker concepts, last mile delivery, strengths & weaknesses, e-commerce

Word count: 11894
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Chapter 1. Introduction

The E-commerce market is expected to reach a value of 392.267 billion euros in Europe in 2021. After which, it is expected to continue growing at a yearly rate of 5.16% until 2025 (Statista, 2020). The massive growth of e-commerce also means an increase in the number of parcels that need to be transported and delivered to the customer. The increase in parcels also puts a strain on the part of the supply chain responsible for the delivery, the last mile. The last mile delivery is described as the least-efficient, most expensive and polluting part of the entire supply chain (Brown & Guiffrida, 2014; Deutsch & Golany, 2018). In trying to optimize the last mile, many innovative solutions have been developed, examples of these solutions range from electric delivery vans, cargo bikes and drones to service points and parcel lockers. These solutions all have the common goal to create a more environmentally sustainable and less costly way of delivery (Ranieri et al., 2018). Due to the COVID-19 pandemic there has been an increase in demand for contactless deliveries, a boost in parcel volumes and health and safety concerns for workers has increased (Prandstetter et al., 2021; Rózycki & Kerr, 2020). As such, additional stress had been put on optimizing the last mile delivery.

One alternative to last mile delivery is the parcel lockers, they provide opportunities for contactless deliveries and reductions in cost. Additionally, they have the possibility to provide sustainable benefits. This paper will focus on publicly accessible parcel lockers, so, no parcel lockers inside office buildings and apartment buildings. These are focused on since more public information is available opposed to parcel lockers on private ground. Parcel lockers consist of multiple smaller lockers in which a parcel can be delivered for pick-up by the customer. Parcel lockers are self-serviced machines which can operate 24 hours a day, seven days a week. Customers receive an e-mail or text once their parcel is delivered, which contains a code with which they can open the locker to collect their parcel. Parcel lockers exist in many shapes and sizes each with a specific application (Faugère & Montreuil, 2020; Thi Huong & Ngoc Thiet, 2020). This research paper aims to compare three different concepts of parcel lockers; 1) white label lockers, lockers which are open to all carriers. 2) Public transport lockers, lockers which are near or incorporated with public transport infrastructure. 3) Exclusive lockers, lockers which can only be used by a single carrier. The different concepts are compared based on their perceived pros and cons. The pros and cons of each concept create decisive factors for whether or not to implement the concept.

Gevaers et al. (2009) define the last mile as “the last stretch of a B2C parcel delivery to the final consignee who has to take reception of the goods at home or at a cluster/collection point”. To visualize the impact of the last mile Zalando SE (2017) can be used as an example, a large e-commerce player, who state that 55% of their CO₂ emissions result from the transportation of parcels. Slabinc (2015) states that the cost of ‘environmental nuisance’ caused by pollution of increased traffic in European cities amounts to 100 billion Euros on a yearly basis. To further reduce the cost and polution, innovative solutions need to be developed (Gevaers et al., 2009). Solutions focused on the mode of transport for delivery are cargo bikes, electric delivery vehicles and delivery drones. These solutions provide zero-emission delivery. Other solutions
are focused on the point of delivery, for example service points and parcel lockers (Behnke, 2019; Mangiaracina et al., 2019; Slabinac, 2015). Service points are founded in shops and are able to offer customer service and are easier to deploy. Parcel lockers on the other hand present 24/7 availability, no waiting lines and opportunities for consolidation to reduce the number of delivery trips and increases first-time deliveries. Recently, shops which house the service points have critiqued the concept of service points, with long queues and small to no profit margins (Missler, 2020; Pauw, 2018; Radar, 2020). Due to these critiques, the focus in this paper lies solely on publicly accessible parcel lockers.

Within the existing literature general benefits of parcel lockers are described as a solution to solve unsuccessful home-deliveries and creation of consolidation opportunities. Van Duin et al. (2020) and Zenezini et al. (2018) add to this by stating that parcel lockers allow for optimized vehicle routing and reductions in total delivery time, they also make return options easier. Prandtstetter et al. (2021) present that CO₂ emissions could be reduced by 40% if parcels are delivered straight to a parcel locker, instead of a failed home-delivery and then delivering the parcel to a parcel locker. Iwan et al. (2016) support this by comparing parcel locker delivery to home delivery via delivery van. Annual CO₂ emissions were reduced by 95% and the total number of driven kilometres per day were reduced by 53% due to the fact that multiple deliveries points were combined to be delivered at a single location, the parcel locker. On the other hand, there also some disadvantages for parcel lockers. To place a locker, a permit is needed from local authorities, who are worried for visual defacement of their cities. So, acquiring a permit is difficult and time consuming (Iwan et al., 2016; Zenezini et al., 2018). Additionally, parcel lockers have relatively high investment cost. Which requires relatively large volumes to move through a locker to make it economically viable (Vikingson & Bengtsson, 2015; Zenezini et al., 2018). Lastly, the consumers need to be willing to use a parcel locker and thus make the final trip of the delivery process (Iwan et al., 2016). However, the consumer perspective will not be discussed in this paper as extensive research exists on this subject (IPC, 2020; Kosicki, 2020; Lemke et al., 2016; Moroz & Polkowski, 2016; Vikingson & Bengtsson, 2015; Zhou et al., 2020). This study will be approached from a CEP service provider and locker exploiter perspective, as they make the decision on which concept to deploy.

This paper aims to compare 3 different concepts of parcel lockers (white label lockers, public transport lockers, exclusive lockers) based on their perceived strengths and weaknesses. The comparison of the perceived strengths and weaknesses offers a foundation for decision makers to further develop, decide and implement (new) parcel locker concepts. Semi-structured interviews are used in which professionals are asked to review and compare their respective cases and municipalities and logistic experts are asked to compare and review the three concepts. Additionally, the identified strengths and weaknesses from the existing literature are discussed and new ones are identified. This comparison will answer the following research question; “What are the perceived strengths & weaknesses of known parcel locker concepts?”.

This study aims to fill the existing gap in the literature by comparing three different concepts of parcel lockers to present the strengths and weaknesses of each concept. To the best of my
knowledge no similar research has been performed before. Additionally, it presents added value for managers as it could serve as the basis for decision-making on about parcel collection points in general, or parcel locker concept specific. Moreover, it expands the body of literature on parcel lockers in identifying impactful factors for parcel locker concepts which could be used in future research. Within the empirical body of literature, comparisons between different innovative logistics solutions are known (Boysen et al., 2020; Iwan et al., 2016; Ranieri et al., 2018), which provides a full scope of possible alternative delivery options for the last mile. Additionally, different studies researching the configurations and deployability of parcel lockers are present within the literature (Faugère & Montreuil, 2017; Iwan et al., 2016; Lemke et al., 2016; Prandtstetter et al., 2021; Van Duin et al., 2020). These studies present impactful factors on locker placement which could impact decision making. Lastly, Thi Huong & Ngoc Thiet (2020) present an overview of different application of ‘smart lockers’ (parcel lockers) in urban areas and present the benefit and challenges to implement them in Vietnam. However, this paper merely remains at an overview of parcel locker applications and no further comparison is made.

The structure of this research paper will be as follows. Chapter 2 presents a discussion of the empirical body of literature relating to the different concepts of parcel lockers and the proposed research question. Chapter 3 presents the applied methodology used to answer the research question. Chapter 4 presents the research findings, and Chapter 5 provides a discussion of the findings. Finally, this paper will be concluded by Chapter 6 where conclusions are drawn and future research is noted.
Chapter 2. Literature review

This chapter discusses the body of empirical literature relating to the different streams of research on parcel lockers. Additionally, three parcel locker concepts are discussed and their known strengths and weaknesses are identified from the literature.

Parcel lockers are 24/7 unmanned machines which allow the customer to come and pick up and return its parcel whenever the customer desires (Boysen et al., 2020; Prandtstetter et al., 2021). Additionally, a parcel locker will attract extra customers to a shop if it is placed nearby (Zenezini et al. 2018), but this solution comes without the hassle of handling packages by personnel. Parcel lockers allow for the consolidation of parcels, as multiple parcels can be delivered at a single location compared to multiple home-deliveries (Gevaers et al., 2009). To operate the parcel locker economically viable, a large amount of volume needs to go through the parcel locker as to compensate for the high investment cost (Kosicki, 2020; Vikingson & Bengtsson, 2015). Ranieri et al. (2018) provided a review of last mile innovations, and noted the parcel locker as an innovative strategy to reduce CO2 emission, increase cost efficiency and reduce traffic in the cities. Quite a few researches focused on parcel locker locations and diffusion in different regions of the world, for example, Australia (Lachapelle et al., 2018), the Netherlands (Weltevreden, 2008), Sweden (Vakulenko et al., 2018) and Poland (Iwan et al., 2016). These studies presented important success factors for a parcel locker such as customers having to travel as little distance as possible and being able to combine the pick-up with other trips such as during travel, shopping or going to work. Other researches focused on the effects of parcel locker delivery in cities (Morganti et al., 2014) but also the results of parcel lockers on effectiveness compared to home delivery (Morganti et al., 2014a). Other researches focussed on the sustainable benefits of parcel lockers (Giuffrida et al., 2016; Prandtstetter et al., 2021), showing large potential for CO2 savings through reductions in travel distance. Lyu & Teo (2019) stated wide acceptance of the fact that lockers are capable of improving delivery efficiencies and reducing the negative impact on the environment.

2.1 Parcel locker concepts

This paragraph discusses three parcel locker concepts. These concepts are considered, to the best of my knowledge, as the main in practice active concepts in the Netherlands. In practice these concepts are applied in specific applications. These specific applications of parcel lockers will be further discussed in chapter 3.

White label locker concept

Firstly, white label logistics are used in the parcel locker market in the form of white label parcel lockers which are not owned by a specific CEP service provider. Parcu & Brennan (2020) describe a white label company as the following: “One that does not collect, sort, and transport parcels itself, but only possesses parcel lockers or service locations where parcels from different, but not necessary all, operators can be picked up by consumers”. The last part of this definition is the most significant for a white label parcel locker, as it allows for multiple CEP service providers to deliver to the same locker.
The Authority of Consumer and Market (ACM) (2020) state that companies in the market to provide white-label lockers need to collaborate with large CEP service providers in order to gain enough volume to exploit the parcel lockers. ACM (2020) and Prandtstetter et al. (2021) state that the way of working of white label lockers is seen as the most promising developments in terms of making the last-mile delivery viable. Pufahl et al. (2020) describes an ‘white-label last mile delivery platform’ in which infrastructure and transport capacity between Courier Express and Parcel (CEP) service providers are shared. In order to create more flexibly and efficiently operate the last mile. The ‘white-label platform’ requires collaboration between CEP service providers. Pufahl et al. (2020) describes white-label logistics and/or horizontal collaboration as one of the most promising solutions for increasing efficiency and decreasing cost.

**Exclusive locker concept**
Secondly, besides the parcel locker concepts based on collaboration, there is the exclusivity concept. This is described by ACM (2020) as parcel lockers in which only one CEP service provider can deliver or pick up parcels. According to a market study performed in the Netherlands by ACM (2020) the three largest CEP service providers, PostNL, DHL and UPS, all use exclusive lockers. The exclusivity presents a constraint: the customer is not able to optimally profit from delivery to parcel lockers since their nearby parcel locker may not be the one that their package is delivered to. Zenezini et al. (2018) add to this by describing that a few large retailers experience problems since they have outsourced the delivery to multiple CEP service providers. However, every CEP service provider has its own network, which forces the retailers to choose a single CEP service provider to offer the parcel locker service.

**Public transport locker concept**
Thirdly, the public transport concept combines public transport infrastructure with lockers. A public transport locker can be a white label or an exclusive label, however, from the existing practical case examples it is most likely these lockers are white label. Kosicki (2020) describes public transport nodes as possible solutions for parcel lockers, because these nodes are placed with the objective that many people are able to reach them by walking. Iwan et al. (2016), Lachapelle et al. (2018) and Oliveira et al. (2017) mention that parcel lockers near public transportation could be beneficial. However, the results from a survey among customer expectations regarding the location of a parcel locker performed by Iwan et al. (2016) contradicts this. Only 5% of the respondents wanted parcel lockers close to public transport stops, this was the least chosen option out of the total six possible options. Van Duin et al. (2020) supports this as they state that the least desired location of a parcel locker by consumers is ‘nearby shopping centres and bus/trams stops’. Despite these findings there are still practical examples of parties trying to further explore the combination of parcel lockers and public transport (Cleveron, 2020b; Evanet et al., 2021). Kosicki (2020) describes a demand from municipalities for white label lockers which are not causing defacement of the cities. This means incorporating parcel lockers in street furniture such as a bus stop, an example of this is presented by Cleveron (2020).
2.2 Strengths and weaknesses
The aforementioned concepts have their strengths and weaknesses which will be discussed in the following paragraph. These are withdrawn from the field of last mile delivery research.

White label locker concept
A strength of the white label locker concept lies is that multiple CEP service providers can make use of the parcel locker (ACM, 2020). This allows for an increase in volume and thus economic viability, as investment cost are able to be shared among multiple parties (Parcu & Brennan, 2020). Additionally, the consumers benefit as they only need to travel to one location to collect parcels from multiple CEP service providers. Rozman (2020) argued that the sharing of parcel lockers would increase network coverage which allows the customer to choose from more locations. A weakness of the white label locker concept lies in the fact that it is reliant on collaborations with other parties to achieve enough volume to make the parcel locker economically viable (ACM, 2020). ACM (2020) has described that especially for smaller organisations this can form a large obstacle.

Public transport locker concept
One of the strengths of the public transport locker concept lies in the fact that the lockers can benefit from the strategic locations of public transport nodes (Kosicki, 2020). Additionally, if the lockers can be incorporated with the current bus stops, no additional defacement of city visuals will be needed (Zenezini et al., 2018). Which might incentivize municipalities to give permission for the placement of a parcel locker. One of the weaknesses of the public transport locker concept exists in the literature on consumer perceptions for desired locations of parcel lockers. The literature shows that consumers least prefer a parcel locker near a public transport node (compared to other locations) (Iwan et al., 2016; Kosicki, 2020; Lemke et al., 2016; Van Duin et al., 2020).

Exclusive locker concept
A strength of the exclusive parcel locker concept lies in the fact that CEP service providers can design their own network, which benefits themselves. Additionally, literature has stated that this concept allows for more brand awareness and a higher distinctive capability (ACM, 2020). One of the weaknesses of the exclusive parcel locker concept lie in the fact that customers cannot optimally benefit from parcel lockers (Rozman, 2020). The customer might become dependent on a specific CEP service provider if that specific provider is the only one with a parcel locker close by. Additionally, it is stated by ACM (2020) that (in the Netherlands) if the parcel lockers were to be no longer exclusively controlled by a single CEP service provider, the density of the network would increase significantly (currently between 16% -52% increasing to 75%). Furthermore, Zurel et al. (2018) argued that creating parallel infrastructures is unlikely to be sustainable, which would be necessary in the exclusive concept.

2.3 Drivers and barriers
This paragraph identifies drivers and barriers of parcel lockers to create a complete overview from the existing literature, in addition to the strengths and weaknesses per concept. Parcel lockers have certain general drivers and barriers which are important to identify. These are
important to identify because they do not specifically belong to a single concept but parcel lockers in general. An overview of all identified drivers and barriers is presented in table 1.

Iwan et al. (2016) researched the usability and efficiency of parcel lockers in Poland. Their study presented the following drivers of parcel lockers; extra revenue for shops if a parcel locker is placed outside of it (as customers will also visit the shop), parcel lockers can become a focal point of a community, emphasizes the ambition of a city to increase sustainable development. Zenezini et al. (2018) found additional drivers in their study about drivers and barriers for ‘Collection-and-Delivery Points’. They stated that parcel lockers allow for optimization of the vehicle routing problem and a reduction of total delivery time. Besides, these operational advantages, they also mention that parcel lockers are more convenient for customers in smaller cities, because they reduce delivery time and make the return options easier.

Besides drivers there are also barriers of parcel lockers identified in the existing literature. Iwan et al. (2016) presented the following barriers; parcel lockers are not placed by public authorities and thus need to be initiated by private actions. This brings along another barrier in the form of regulation. Authorities need to give permission for the parcel locker and authorise the desired location for it. Lastly, e-commerce companies need to be willing to deliver to a parcel locker, as their service then requires customer participation to complete the final leg of the delivery. These barriers were also identified in the research of Zenezini et al. (2018), who also mentioned additional barriers. One of those barriers is the security concern (vandalism, theft) (Vikingson & Bengtsson, 2015), which stresses the need for an accessible and convenient location of the parcel lockers for customers. They also state that many city councils have regulations on perceived defacement of city centres, and ‘other barriers with local administration concerning permits for occupying public soil’.

The Authority Consumer and Market (ACM) (2020) has identified certain barriers specific for the Netherlands (the drivers are the same as aforementioned). One of the barriers is an obstacle in the form of municipalities all using different rules for authorization and permits. This make a nation wide deployment of parcel lockers more difficult. Their study also found that the parcel locker is perceived by CEP service providers as more time consuming for both customer and delivery compared to home delivery. This is contradicted by the exploiters of parcel lockers who state that parcel lockers are time saving and allow for reductions in transport movements.
Table 1
Drivers and Barriers of Parcel Lockers from the Existing Literature

<table>
<thead>
<tr>
<th>Drivers</th>
<th>Barriers</th>
</tr>
</thead>
<tbody>
<tr>
<td>- <strong>Accessibility:</strong></td>
<td>- Placement on private initiative: Parcel lockers need to be placed on private initiative as local authorities do not place them (Iwan et al., 2016)</td>
</tr>
<tr>
<td>24/7 service/access (Iwan et al., 2016; Zenezini et al., 2018; Zurel et al., 2018)</td>
<td>- Time consuming permits: Attaining permits and authorizations are time consuming (Iwan et al., 2016; Zenezini et al., 2018)</td>
</tr>
<tr>
<td>- <strong>Extra revenue:</strong></td>
<td>- Deciding on location: Choosing the right location is costly and time consuming (Iwan et al., 2016)</td>
</tr>
<tr>
<td>Extra revenue gain for shops when a parcel locker is placed nearby (Iwan et al., 2016)</td>
<td>- Willingness to use parcel lockers: Companies need to be willing to use parcel lockers since it requires the customer to be willing to travel the final leg of the delivery. (Iwan et al., 2016; Zenezini et al., 2018)</td>
</tr>
<tr>
<td>- <strong>First time delivery:</strong></td>
<td>- Losing point of contact: Resistance by retailers who do not want to lose a point of contact with their customers (Zenezini et al., 2018)</td>
</tr>
<tr>
<td>First delivery attempt always successful (Zenezini et al., 2018; Prandstetter et al., 2021; Van Duin et al., 2020)</td>
<td>- Investment cost: High investment/activation cost 40,000 – 50,000 per parcel locker in 2014 (Zurel et al., 2018; Zenezini et al., 2018)</td>
</tr>
<tr>
<td>- <strong>Sustainability:</strong></td>
<td>- Accessibility / safety: Security concerns (vandalism &amp; theft) (Zenezini et al., 2018)</td>
</tr>
<tr>
<td>Reduction in daily driven kilometres of 53% (Iwan et al., 2016)</td>
<td>Need for an accessible and convenient location due to security concerns (Vikingsson &amp; Bengtsson, 2015)</td>
</tr>
<tr>
<td>CO₂ reductions can be realized (Iwan et al., 2016; Prandstetter et al., 2021)</td>
<td></td>
</tr>
<tr>
<td>- <strong>Time and cost savings CEP service providers:</strong></td>
<td>-</td>
</tr>
<tr>
<td>Allow for optimization of vehicle routing problems (Zenezini et al., 2018)</td>
<td></td>
</tr>
<tr>
<td>Allow for reductions in total delivery time for CEP service providers (Zenezini et al., 2018)</td>
<td></td>
</tr>
<tr>
<td>Large cost reductions possible for CEP service providers when using parcel lockers in a dense network (Iwan et al., 2016; Van Duin et al., 2019)</td>
<td></td>
</tr>
<tr>
<td>- <strong>COVID-19:</strong></td>
<td>-</td>
</tr>
<tr>
<td>Contactless nature of the lockers, which has become more important since COVID-19 (Prandstetter et al., 2021)</td>
<td></td>
</tr>
<tr>
<td>- <strong>Respond to peak demand</strong></td>
<td>-</td>
</tr>
<tr>
<td>Parcel lockers could solve the problem of high demand and lack of drivers/shippers during peak seasons (Huong et al., 2020)</td>
<td></td>
</tr>
</tbody>
</table>
Chapter 3. Methodology

This section will present the main methodology used in this research paper. Firstly, in the research design the overlapping research method is explained. Secondly, the data collection part will be more elaborated on. Lastly, the cases, which will be the main subjects in the interviews, are elaborated on, the interview protocol is described, and the interviewees and their added value will be introduced.

3.1 Research design

As presented in the literature review, three concepts of parcel lockers were presented. The academical literature surrounding these concepts is very limited. The specific characteristics and strength and weaknesses per concept are not identified. Due to this, the exploratory approach has been chosen for this study. An exploratory approach helps researchers when there is no existing model and the concepts of interest need to be better understood and measured (Forza, 2016). To further explore the concepts of interest, interviews are used. DeMarrais & Lapan (2004) defines interviews as ‘a process in which researcher and participants engage in a conversation focused on question related to research study’. The use of a semi-structured interview is supported by (Merriam, 2009), who states this is very common structure of interviews for a qualitative study. It allows for more open-ended questions to let the participants speak from their own perspective, which is of interest in qualitative research (Merriam, 2009). The interviews are conducted with exploiters of the parcel locker concepts, logistics experts and municipalities. Different cases per parcel locker concept will be reviewed in the interviews, to identify the perceived strengths and weaknesses and verify the few identified strengths and weaknesses of the concepts from the literature. Collecting different perspectives on the locker concepts and testing and identifying strengths and weaknesses will contribute to answering the main research question.

3.2 Data collection

Data used in this exploratory study will primarily be collected from 8 semi-structured interviews. Using multiple viewpoints through interviews provide both triangulation and enhancement in validity (Åhlström & Karlsson, 2016). Additionally, asking multiple people the same question enhances the reliability of the data (Åhlström & Karlsson, 2016).

The interviewees were selected based on the belief that they are best informed on the subject and context at hand. The interviewees are divided into different groups, these are as follows: exploiters of a parcel locker concept, logistics experts and municipalities. If an interviewee may turn out to be not as informed as needed be, additional interviewees are used. The interviewees are contacted via the researchers own network. The exploiters of parcel locker concepts are chosen due to the possible interesting insights in their decision-making processes they can present. The logistics experts are chosen to present an unbiased opinion, since the exploiters of lockers will have a more subjective opinion about a certain concept. Lastly, the municipalities will be interviewed to provide a perspective on deciding factors from a governmental viewpoint, which will present different priorities compared to the exploiters and experts.
3.3 The cases
The four cases are used as practical applications of the three concepts identified in chapter 2 (see figure 1). By discussing, comparing and testing the cases with the interviewees, the interviews will provide generalizable statements about the concepts which will help to answer the main research question.

Figure 1

*Locker Concepts with the Associated Practical Applications Cases*

**White-label locker concept - De Buren**
De Buren is a company constructing a network of white-label lockers in the Netherlands and Belgium (Buren, 2021). De Buren started expanding their locker network in 2011, since then they have built a network of over 250 lockers in the Benelux. In the Netherlands they have over 100 parcel lockers, which makes them the largest white-label locker network in the Netherlands. In collaboration with DHL in 2014, which increased volume in the Netherlands, and Bpost in 2016 in Belgium they have been able to expand quickly. In collaboration with a subsidiary of Bpost, Cubee, more and more lockers are placed (Hoven, 2017).

**Public transport locker concept - Cleveron**
Cleveron is an Estonian company who is “the innovation leader in creating robotics-based parcel terminals and developing last mile click and collect pickup solutions for retail and logistics sectors” (Cleveron, 2020a). Cleveron is currently active in Europe, North and South America (Tännavsuu, 2019). As a response to the COVID-19 pandemic and thereby the increase in parcels, they have designed the Cleveron 361. This is a parcel locker which is incorporated into a bus stop. The lockers have not been implemented yet but were received with a lot of enthusiasm from the Estonian population. The locker is designed to be placed near villages to make these villages more connected and with a total investment of 20 million euros this could be realized (Cleveron, 2020b; Liive, 2020).

**Public transport locker concept - Evanet**
Evanet is a start-up in the Netherlands who have collaborated with the province of South-Holland to place three parcel lockers near a bus stop (Evanet et al., 2021). Evanet is interesting to use as a case as it is a start-up with a very small-scale deployment in collaboration with a municipality. Multiple carriers can deliver to their lockers, so this forms a white label concept.
in the core, but in the execution, it identifies as a public transport locker. Their pilot to place parcel lockers near a bus stop can be further developed to in the future implement a ‘Nano Hub’. Which provides more services additional to the bus stop and parcel locker.

**Exclusive parcel locker concept - PostNL**

PostNL is the market leader in the Netherlands in the post and parcel market (ACM, 2020; Van Duin et al., 2020). They are also described as very conservative in terms of collaboration (ACM, 2020). Hence, they employ the exclusive parcel locker concept. Currently they have 122 parcel lockers throughout the Netherlands (PostNL, 2020). Since they are the market leader, certain strengths and weaknesses could be different compared to other cases.

### 3.4 Interview protocol

The interview protocol is shown in Appendix A. This protocol will be used as a checklist to make sure every subject of interest is touched upon and if no important information is forgotten.

### 3.5 Interview approach

Every interview will start with a general introduction about the aim and background of the research. Thereafter, the interviewee is asked for permission to record the interview. Before starting with more specific questions, general questions about the company/organisation and the interviewee will be asked. After the general introduction, the interviewee will be questioned on the specific application of lockers applied by his or her company. The constructed interview protocol will be used as a structured checklist, to make sure all subjects are discussed (Åhlström & Karlsson, 2016). At the end of every interview, the interviewee will be asked to reflect shortly on all concepts and compare practical cases. Additionally, they will be asked if all subjects of importance are touched upon in their perception.

In table 2, the first column presents different groups in which interviewees are placed. Group A consists of interviewees who all work for a company which exploits one of the aforementioned cases. A2 (DHL) is added as they collaborate with De Buren in the Netherlands and have a large parcel locker network in Germany (DHL, 2021). Group B involves experts in the field of parcel lockers, logistics or last mile innovations. The experts are interviewed as they are expected to have a different perspective on the matter and provide more objective answers as they are not directly involved with an application. Group C is formed by a representative of a municipality. The answers of the municipality can provide a different perspective, as the municipalities are the ones who provide permits for the placement of parcel lockers (ACM, 2020; Zenezini et al., 2018). Table 2 shows an overview of the interviewees and their position, their company and the specific category.
Table 2
Overview of Interviewees

<table>
<thead>
<tr>
<th>Group</th>
<th>Interviewee</th>
<th>Profession</th>
<th>Company</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
<td>Jean-Luc Otten</td>
<td>Business Development Manager</td>
<td>Pakket-en Brief Automaat</td>
<td>Exploiter</td>
</tr>
<tr>
<td>A2</td>
<td>Rene Korving</td>
<td>B2C Program Manager</td>
<td>DHL Express Europe</td>
<td>Exploiter</td>
</tr>
<tr>
<td>A3</td>
<td>Marge Taivere</td>
<td>Senior Regional Manager Western Europe and South America</td>
<td>Cleveron Ltd</td>
<td>Exploiter</td>
</tr>
<tr>
<td>A4</td>
<td>Robin Dragstra</td>
<td>CEO</td>
<td>De Buren</td>
<td>Exploiter</td>
</tr>
<tr>
<td>A5</td>
<td>Laurens Tuinhout</td>
<td>Founder/CEO</td>
<td>Evanet</td>
<td>Exploiter</td>
</tr>
<tr>
<td>B1</td>
<td>Ronald Veldman</td>
<td>Expert</td>
<td>Large E-commerce player</td>
<td>Expert</td>
</tr>
<tr>
<td>B2</td>
<td>Wolter Ploos van Amstel</td>
<td>Professor in City Logistics Amsterdam University of Applied Sciences</td>
<td></td>
<td>Expert</td>
</tr>
<tr>
<td>C1</td>
<td>Sjouke van der Vlugt</td>
<td>Senior policy officer Urban Development</td>
<td>Municipality of Groningen</td>
<td>Municipality</td>
</tr>
</tbody>
</table>

3.6 Data processing
After each interview, the recordings will be used to transcribe the interviews word by word. After which, the three step coding scheme suggested by Strauss and Corbin (1990) will be followed. Voss et al. (2016) describe the three steps, with the first one being open coding. This step is described as an analytical process in which concepts are identified and developed. The second step is axial coding, which is described as putting data together in new ways, with the goal to regroup and link categories in new ways. The last step is called selective coding in which categories are related to other categories. Voss et al. (2016) state reliability improves when presenting data collection procedures in such a way that it can be repeated with the same results.

As a starting point for a deductive approach, using the existing literature an initial coding tree is constructed (Appendix C). The initial coding tree was based on literature reviewed in chapter two. The literature articles have been collected through a thorough search with electronic databases such as Google Scholar, Smartcat and Business Source Premier. A number of different keywords were included; ‘white label concept’, ‘exclusive locker concept’, ‘public transport lockers’, ‘parcel lockers’, ‘dedicated lockers’, ‘open network’, ‘last mile delivery’ and ‘smart lockers’. Additionally, a snowballing technique was used to identify other relevant sources from reference lists of found literature. Lastly, the search was limited to English and Dutch research papers. Table 3 shows the final coding tree as constructed after the interviews, resulting in fourteen dimensions.
### Table 3

**Final Coding Tree**

<table>
<thead>
<tr>
<th>2nd order codes</th>
<th>Dimension</th>
<th>2nd order codes</th>
<th>Dimension</th>
</tr>
</thead>
<tbody>
<tr>
<td>Limited fill rate</td>
<td>Volume</td>
<td>Sustainable cities</td>
<td>CO2 emission</td>
</tr>
<tr>
<td>High fill rate</td>
<td></td>
<td></td>
<td>Sustainability</td>
</tr>
<tr>
<td>Fill rate essential in cost calculations</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Capacity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Milk Run</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peak demand</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Integration between systems</td>
<td>Technology</td>
<td>B2B market</td>
<td></td>
</tr>
<tr>
<td>Locker space reservations</td>
<td></td>
<td>B2C market</td>
<td></td>
</tr>
<tr>
<td>Information clarity</td>
<td></td>
<td>Market position</td>
<td></td>
</tr>
<tr>
<td>Collaborative investments</td>
<td></td>
<td>Webshops</td>
<td></td>
</tr>
<tr>
<td>Completed software expandable</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Software design</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>API protocol scalable</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Checkout ranking</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rural areas</td>
<td>Location</td>
<td>Vandalism</td>
<td></td>
</tr>
<tr>
<td>Liveability</td>
<td></td>
<td>Safety concerns</td>
<td></td>
</tr>
<tr>
<td>Accessibility</td>
<td></td>
<td>Safety concerns</td>
<td></td>
</tr>
<tr>
<td>Demanding location owners</td>
<td></td>
<td>Fraud and theft protection</td>
<td></td>
</tr>
<tr>
<td>Inside or outside lockers</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strategic location</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Traffic</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maintained and easily accessible</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Busstops and locker ugly</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Busstops end of trip</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Successful in other countries</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Public transport hub</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Who pays for lockers in busstops</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Agreements</td>
<td>Collaboration</td>
<td>Accessibility since COVID</td>
<td></td>
</tr>
<tr>
<td>Need for collaboration</td>
<td></td>
<td>COVID change to outside lockers</td>
<td></td>
</tr>
<tr>
<td>Platforms</td>
<td></td>
<td>COVID hides delivery problems</td>
<td></td>
</tr>
<tr>
<td>Exclusive network</td>
<td></td>
<td>COVID reduced public transport</td>
<td></td>
</tr>
<tr>
<td>Integration</td>
<td></td>
<td>COVID-19</td>
<td></td>
</tr>
<tr>
<td>Role of network</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pricing</td>
<td>Financial</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Capital intensive investments</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Business case</td>
<td></td>
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</tbody>
</table>
Chapter 4. Findings

This chapter will present the findings from the semi-structured interviews. These will be linked together in order to recognize and explain similarities, differences and expectancies. This chapter is based around explaining and elaborating the results of the interviews. In this chapter the most interesting findings will be highlighted and further explained in detail. Information about dimensions which are not mentioned in this chapter can be found in appendix D in the final coding tree.

4.1 Volume

A white label exploiter stated the following benefit of the white label concept: “If you have more parties involved then you have more volume in a locker and the profitability is also higher because you always have full lockers”. This was a returning statement among the interviewees, who argued a high fill rate was needed to ensure a high efficiency but also to make the locker economically viable. The fill rate plays an essential part in this as one exploiter of white label lockers stated ‘At least a 70% fill rate is needed for a locker to be economically viable’. This was supported by others that the fill rate of a locker is an essential factor in their cost calculations. A public transport exploiter stated that networking is essential in attracting volume for the lockers. As he argued that with no network there is no volume and with no volume there is no network. So, connecting as many different parties to their network is essential for their future as a locker exploiter. The interviews revealed a key decision factor that carriers use to decide whether to deploy an exclusive locker concept or a white label locker concept. One of these factors is the market position of a carrier. When a carrier is market leader, it will do everything to protect this position. This means that cooperating with competitors is not an option. Also, they do not need to cooperate to generate more volume as they have enough volume by themselves but also making it harder for their competitors to generate enough volume. This makes the exclusive concept is a good option for a market leader. However, if a party is the number two or three in a market, then cooperating in order to generate more volume is a great advantage. Thus, making the white label concept more desirable. A good example of this was presented in the following statement: “DHL is a good example; in the Netherlands they are the challenger and in Germany they keep everything exclusive”. As DHL is the market leader in Germany and using an exclusive network and in the Netherlands, they are the second largest party in the market and using mostly a white label locker network.

Furthermore, the larger exclusive locker exploiters such as PostNL and Amazon were described by an expert as having enough volume to fill all of their own lockers. They have a capacity which is capable of handling their own volume but there is no room left for volume of other carriers. This was supported by an exclusive locker exploiter (also the market leader), who argued that the scale of lockers is simply not large enough to be able to share their capacity. On the contrary, another exclusive locker exploiter stated that when experiencing low fill rates in the lockers, white label becomes increasingly more interesting. Currently they have decently filled lockers, and it is imaginable that if other carriers were to also fill their lockers with parcels. That the capacity would quickly not be enough anymore. Therefore, they mentioned that if white label lockers were to have enough capacity for all carriers, it would be a good
A white label exploiter continued on this by noting that there are currently no more than 250 lockers in the Netherlands. With those 250 lockers there will never be enough capacity for all carriers. This could provide an explanation as to why the exclusive locker exploiters stated that they have no problem achieving a decent fill rate, since there are simply only a few lockers.

The exclusive exploiters were most sceptical about locker capacity when discussing the white label concept. The following statement expresses this concern for a more internationally focused carrier: “We depart later as our colleagues who are more in domestic transport and then the possibility exists for these locations, that whoever comes last then has bad luck. And so, there is no more room. As a result, the customer has to wait longer for his or her package. Which is no option for us”. Additionally, the exclusive exploiter described the white label concept as too dependent on others to fill the remaining space in the lockers which forms a liability. The exclusive locker exploiter also added that the choice to create an exclusive network was a well thought out decision. The main reason being that they have the control over how they want to design their network. Especially, since they have many manned pick-up points and a dense home delivery network, the locker network will mainly serve as a complementary service.

4.2 Technology

Exclusive locker exploiters pointed out that before they even consider using the white label concept there needs to be a guarantee that information sharing and system integration between carrier and locker exploiter is seamless. This is essential as they want to deliver high quality to their customers, which involves updating the customer on every move of their parcel and the expected pickup date/time. Additionally, it was stated that for example DHL is using capacity management to allow customers to choose which locker they want. The system then reserves a locker in that specific location. This additional service requires even more integration. PostNL added to this by stating that the IT-systems need to be able to communicate with each other and defaults must be set in case of errors or delays in the process. When using white label there needs to be a collaborative environment in which the software is developed, but also collaborative investments to achieve the development. This argument was supported by a white label exploiter who stated ‘We have invested millions in to the software, as we started developing software which supports an open character from day one’. Additionally, it was stated by multiple interviewees that once the software supporting a white label network was completed, it was very easily expandable and scalable.

On the other hand, the exclusive locker concept for the software development was described as less complex, because developing software for a single dedicated partner is easier. The difficulties of integrating multiple systems are not relevant in this concept. So, it can be concluded that software for the exclusive concept is easier to design due to a lower complexity. However, it can also be argued that even though the white label software is more complex to design, once completed it will provide a higher functionality for a locker network. Therefore, a trade-off appears, creating less complex software for lower investment cost for a single
dedicated partner but with less functionality for a locker network. Or designing a more complex software with higher investment cost but with higher functionality.

4.3 Location

For the rural areas it became clear that for lockers, whether it is an exclusive or white label locker, the interviewees were quite pessimistic about it. A white label exploiter stated that they only place lockers when it is commercially or economically profitable. However, to increase the liveability of a town or city a municipality could collaborate with the exploiter to make the locker exploitable, as described by white label exploiter. A representative of a municipality stated that their municipality currently does not yet support such collaborations, but they want to start with that in the near future. The municipality could then be looking to support local retailers or enhance the existing infrastructure. The representative added that a parcel locker enhances the liveability in two ways, the first one being a reduction in city traffic and the other one being an increase in the comfort for residents.

The public transport concept was described as a promising concept for rural areas. The interviewees were all enthusiastic about combining parcel lockers at public transport locations in rural areas. As these public transport locations would receive regular traffic and if it were to be combined with other amenities it could be a successful concept. One expert pointed out that this is successful in Scandinavian countries and in Poland. The public transport locker concept considers all forms of public transport. However, the interviews stated that pilots have shown parcel pick up at train stations to be undesired by customers, but bus stops were argued to be promising. One of the main reasons for this is that bus stops are regulated to be close to homes which places lockers within walking distance of customers. Also, considering customer satisfaction when picking up a parcel. An expert argued that when you have to pick up a large parcel in the middle of your travel, it will be an inconvenience. However, if the pick-up is possible at a location at the end of your travel such as a bus stop, it will not matter as you will almost be home. Another reason for placing lockers in bus stops, is that the bus stops are already being maintained and in locations which are easily accessible (for customer and delivery van). In the interviews an expert expressed that when the lockers in bus stops were to be combined with other facilities, the added value would be high. With other facilities combined, the bus stop would form a public transport hub which was positively responded to the interviewees. However, it was stated in the interviews that the funding is still a deciding factor. Discussions between the municipalities and the interested locker parties resulted in a standstill, as both sides believed the other party should invest in the bus stop lockers.

The interviews presented many different influential factors in deciding where to locate lockers. For the public transport concept, the location is the starting point. A public transport locker exploiter stated that their pilots have shown the potential of lockers in bus stops and the prospected savings, such as reducing daily driven kilometres and CO2 emissions. However, an expert stated that the success of the public transport concept depends on how densely the lockers are placed and determining how many lockers are needed in a certain area is very difficult. He added that when the lockers are not densely placed in an area, the concept would not succeed. Lastly, the representative of a municipality stated that they try to increase the
quality of life of their residents by placing parcel lockers. Having that extra comfort of a nearby locker to pick up your parcels with the goal to increase liveability. However, it was stated that they still had to experience whether residents actually experience an increase in comfort due to lockers, which was not confirmed yet.

An exclusive locker exploiter stated that a trend is seen in demands from location owners. Meaning that when a locker exploiter wants to place a locker in a certain location, for example a supermarket, the supermarket owner will have demands about whether it is an exclusive or white label locker. The exclusive locker exploiter stated that more store owners are demanding white label lockers. The white label lockers offer a central point for pickup and returning of parcels from multiple carriers. He expected this trend to continue and to be experienced more and more. A white label exploiter added to this, that white label lockers are less likely to face being charged with rent by private property owners. The reason for this is because the locker allows delivery from multiple parties, the locker drives traffic to the store which prevents rent being charged. He continued by stating that large carriers such as PostNL or DHL were often charged with high rents by location owners, due to the fact that they are such large companies which are believed to have deep pockets. However, this was not confirmed or denied by any of the larger companies.

4.4 Collaboration
The white label concept relies on collaboration as a core basic. The interviews presented benefits and also downsides to collaboration. The downsides also formed one of the reasons as to why the choice for the exclusive concept was made by exclusive locker exploiters. The benefits of collaboration are shared cost, as to not being solely responsible for large investments. This makes it more viable an accessible to place more lockers. The placement of lockers is a capital-intensive investment, as a location can cost between 15,000 to 20,000 euros. If more parties make use of this locker, the cost can be shared over multiple parties. Or when one party places the locker, it can charge the other parties for each use of the locker, which reduces the impact of the investment. This presents a large downside for the exclusive concept. Any investment in lockers would be solely for the exclusive exploiter, which puts extra pressure on achieving a minimum daily input rate for a locker to create a positive business case. Another benefit of the high degree of collaboration in the white label locker concept was described as the willingness to share infrastructure. By sharing the infrastructure there is no need for all parties to invest in their own infrastructure, thus saving on cost. Additionally, the collaboration reduces the need for all carriers to use their own vehicles and drive to their own locations. Therefore, reducing traffic movement, the amount of delivery vans and CO2 emissions. Additionally, it was argued when multiple exclusive locker exploiters all build their own network, the infrastructure will be very expensive with little added value. For all three concepts a minimum daily user rate and fill rate is required to be able to create a positive business case for a locker, which for the white label concept was estimated to be above 70%.

The representative of a municipality, stated that the reduction of traffic movements, number of delivery vans in the cities and CO2 emissions are among the benefits municipalities are after. Therefore, they only want the white label locker concept in the future in their cities. However,
the representative also stated that the described benefits of parcel lockers such as less delivery vans, less CO2 emissions and increased customer satisfaction were not undisputed. They are in a ‘exploratory phase’ in which they possibly also allow exclusive lockers to be placed in order to collect more data on the effects of parcel lockers quickly. With the help of more data and more experience with parcel lockers they are looking to form a strategy for the coming years. This strategy will form a starting point for developing an overall policy on parcel lockers in their municipality for the coming years. During the development of the policy, the desire is to enter a transition phase. In which a collaboration with all parties who have placed lockers is started, in order to transform all lockers into white label lockers. However, this was opposed by an expert, who stated that the starting phase is most important, as this phase requires the most capital-intensive investments. Therefore, if a party has more invested in lockers than other parties and is reeking the benefits from it, it will not want to throw all that away in order to make the lockers white label. The expert added that the municipalities need to be involved from the beginning because white label won’t succeed otherwise. Additionally, a public transport locker exploiter described added complexity due to a high degree of discretionary power. Meaning that every municipality can decide on their own rules, regulations and policies for parcel lockers, which hinders a quicker and wider deployment of lockers overall. The exclusive exploiters supported the choice for their concept with the downsides of the collaboration required in the white label concept. They expressed concerns about non existing agreements about what happens in case a parcel remains too long in a locker or who has priority in terms of reserving space in a locker. These uncertainties led to them building their own network, as they decided the risks of collaboration was higher than the rewards. Additionally, both experts agreed on the fact that exclusive locker exploiters still all believe that they have the best strategy and the best technology to achieve a monopoly position. This monopoly position can be achieved through collaborations with municipalities, to establish themselves as the only ones allowed to place lockers within that municipality. However, it is dependent per municipality whether or not this is accepted.

4.5 Sustainability

Sustainability is a very actual and important subject in which a parcel locker could provide a partial solution for problems in the last mile. However, ambiguity exist between different parties in the locker market. White label and public transport exploiters described the parcel locker as saving significant amounts of CO2 emission as long as most customers performed pick up by foot or bike. On the other hand, the exclusive locker exploiters do not support these statements as they claim only very small savings are realised by using parcel lockers. One of the explanations for the different statements is caused by their respective perspectives. The exclusive locker exploiter looks at parcel locker combined with home delivery. As they also perform home delivery and take parcels destined for the parcel lockers in their normal delivery runs. The only savings achieved then are less stops, so less overall time consuming. On the other hand, the public transport exploiter and the white label exploiter do not compare it to home delivery. So, when purely looked at consolidating parcels to deliver to parcel lockers it will save CO2 emissions as less delivery vans and trips need to be made when comparing it to home delivery. Another explanation could be due to the fact that a white label locker allows for parcel delivery to a single locker from multiple carriers. This provides a central pick-up
point for customers, who then only have to travel to one locker for multiple parcels. The exclusive locker concept does not allow for a combination of parcels from multiple carriers, which requires the customer to travel more thus possibly emitting more CO2. The white label locker also reduces the opportunity of the customer becoming carrier dependent. Meaning that a customer is only able to order parcels from web shops if a certain carrier is linked to that web shop.

Additionally, the representative of the municipality argued that we need to be careful not to pass the CO2 burden to the customers, because the savings are lost if the customer picks up the parcel by car. However, a white label exploiter contradicted this statement by stating the following: “The picture that is often painted is that someone jumps in the car to drive to a parcel locker. This is a picture that we don't recognize”. The reason the representative of the municipality is cautious and the white label exploiter doesn’t recognize ‘this picture’ could be due to differences in the level of experience and information. The representative of the municipality stated that they need to see and experience whether or not the customer uses its car to just pick up a parcel. While on the other hand the white label exploiter has data available through its own locker network.

4.6 Branding
Exclusive concept exploiters and experts have stated that branding has proven to be a decisive factor for companies exploiting the exclusive concept. Having the brand name largely placed on a locker in the public eye presents a lot of advertising value, sometimes even more than the value of the parcel delivery to a locker itself. On the other hand, a white label exploiter described the possibility of changing the exterior as an extra flexibility of the locker to better fit in with the location, which could possibly help attaining a permit. This flexibility is not possible for an exclusive locker as they have standard brandings.
Chapter 5. Discussion

This chapter couples the main findings to the existing literature. The goal is to be able to explain ambiguities, check for contradictions or similar statements. Through comparing existing literature with the main findings of this study, a complete and critical overview will be formed about the main findings of this study.

5.1 Location

This study presents a trend in demanding location owners. Meaning that for example supermarket owners only want a specific locker concept at their store. It was argued that the white label concept is most desired as it creates a central pickup point for customers to return or collect their parcels for multiple carriers. The example of Lidl, a German supermarket chain, only wanting white label lockers in their stores was presented. It was also argued that this trend is expected to keep growing as demand for parcel lockers in general increases. The existing literature agrees upon placing parcel lockers in and around supermarkets, gas station and transportation hubs (Gevaers et al., 2009; Iwan et al., 2016; Kosicki, 2020; Lachapelle et al., 2018; Lagorio & Pinto, 2020; Mangiaracina et al., 2019; Oliveira et al., 2017). However, no literature exists on demanding location owners who only preferred a single concept.

Additionally, this study presented the public transport concept to be especially interesting for bus stops. The bus stops are regulated by the municipalities and placed at predetermined and regulated locations, which are easily accessible and already maintained. The bus stops are regulated to be close to customer homes and are usually at the end of the trip. Therefore, when parcels are picked up, the customer has only a little inconvenience from the pick up as the customer is already close to home. This is supported by Rohmer & Gendron (2020) who stated that lockers at public transport stations are easily accessible and can function as collection and consolidation points. Rohmer & Gendron (2020) also mentioned that lockers in bus stops encourage an improved use of publicly funded infrastructure. Lastly, they stated that, despite its potential, it has not yet been addressed in the scientific literature. Zurel et al. (2018) merely presents practical examples of pilots of public transport lockers in Sweden and Norway.

5.2 Volume

This study presented ambiguity between the interviewees about whether or not the exclusive locker concept is suitable for the current volume. An expert stated that the larger exclusive locker exploiters such as PostNL and Amazon have enough volume to fill all their own lockers. Their lockers network capacity is only capable of handling their own volume, but is not able to process additional capacity of other carriers. This was supported by an exclusive locker exploiter (the market leader), who stated that the scale of lockers is simply not large enough to be able to share their capacity. However, another exclusive locker exploiter stated that white label becomes increasingly more interesting when low fill rates are experienced. Subsequently, ACM (2020) stated that parcel delivery consolidated in white label lockers, which have a high fill rate, have a better rentability compared to exclusive parcel lockers. Additionally, according to Kin et al. (2020) even though many exclusive lockers are currently active, white label lockers offer more comfort to customers. Collaboration, as performed in the white label concept, also
creates higher efficiency due to higher combined volumes and thus a higher fill rate (Bovaird, 2014; Fjeldstad et al., 2012; Park et al., 2016). The opposing views between the respondents and the literature, could be caused by the number of parcel lockers currently in the Netherlands compared to the number of parcel lockers in other countries. Currently in the Netherlands there are an estimated 200 parcel lockers (Zuil, 2021), compared to other countries such as Germany, 4500 lockers, and Finland, 1000 lockers (Setien, 2020; Zuil, 2021). To put that into perspective, in the Netherlands there are 11 lockers per million citizens, in Germany there are 54 per million citizens and in Finland there are 181 lockers per million citizens. This large difference could explain why Dutch exclusive locker exploiters experience enough volume to fill all the lockers themselves. Thus, when there are only a few lockers, they will be filled rather quick. However, once the demand for delivery to parcel lockers increases and more lockers are placed, this dynamic will change.

5.3 Financial
This study presented a difference in the financial situation between the white label concept and the exclusive concept. The white label concept was described to be especially beneficial for cost sharing between the involved parties. These costs involve, among others, the investment cost for lockers and the cost for the software development. While for the exclusive locker concept, these costs are financed by a single party. Additionally, when there are multiple exclusive locker networks next to each other, a very expensive infrastructure of lockers is created with little added value. Taniguchi et al. (2020) supports this by stating that too many lockers can lead to additional capital and operating costs. Rohmer & Gendron (2020) add to this by stating that depending on the level of collaboration, parties have two options. The first one being to charge others for the use of separate lockers without a fixed contract. The second option is to share the costs and accessibility rights for the locker stations supported by a long-term partnership agreement. Lastly, Taniguchi et al. (2020) stated that in order to maximize the potential of parcel locker networks to improve efficiency in the last mile, it is essential that white-label networks are created in which lockers are shared by multiple carriers. This further supports the findings of this study, which show white label as an option to share cost and increase efficiency. This is not possible when using exclusive lockers.

5.4 Sustainability
The white label and public transport locker exploiters argued that a significant saving in CO2 emissions could be achieved through the use of parcel lockers. While on the other hand, exclusive locker exploiters did not support those statements of significant CO2 emission savings. The exclusive locker exploiter looks at parcel locker combined with home delivery. As they also perform home delivery and take parcels destined for the parcel lockers in their normal delivery runs. The only savings achieved then are less stops, and more time efficient. On the other hand, the public transport exploiter and the white label exploiter do not compare it to home delivery. So, when purely looking at consolidating parcels to deliver to parcel lockers it will save CO2 emissions as less delivery vans and trips are needed compared to home delivery (Prandtstetter et al., 2021). Since, the percentage of home delivery compared to locker delivery is still very high (respectively 82% and 1% of all deliveries (ACM, 2020)), the reduction in stops does not have a significant effect on reducing CO2 emissions.
Another explanation can be found in the fact that a white label locker allows for parcel delivery to a single locker from multiple carriers. This provides a central pick-up point for customers, who then only have to travel to one locker for multiple parcels (Pufahl et al., 2020). The exclusive locker concept does not allow for a combination of parcels from multiple carriers, thus requires the customer to travel more thereby causing more CO2 emissions (Lachapelle et al., 2018; Prandtstetter et al., 2021). The white label locker also reduces the opportunity of the customer becoming carrier dependent: a customer is only able to order parcels from web shops if a certain carrier is linked to that web shop. A final possible explanation could be that the exclusive locker exploiter takes into account the possibility of the customer picking up its parcel by car. Existing literature has shown that when a customer picks up the parcel by car, the CO2 savings could disappear (Prandtstetter et al., 2021). Giuffrida et al. (2016) determined in their study that if a customer does not need to travel by car more than 0.94 km to a locker, the convenience of the parcel locker compared to home delivery remains. This emphasizes the importance of precise placement of lockers to avoid placing the CO2 emission burden at the customer.

5.5 Municipalities

This study presented the vision of municipalities on the different locker concepts. It was presented that the white label concept and the public transport concept are most preferred and will be demanded in the future. The representative described a transition phase which allows all concepts at first and in the end transitions into all white label lockers. This was opposed by an expert who stated that this would create a lot of potential resistance from exclusive locker exploiters due to high starting investment cost but also due to weakening the first-mover advantage (Parcu & Brennan, 2020). It has to be mentioned that due to high discretionary powers in the Netherlands, this could be completely different in other municipalities. Zurel et al. (2018) studied parcel lockers in general and how they are applied in five European countries. They state that in those five different countries no specific legislation for parcel lockers was present possibly due to the infancy of the parcel locker market, this is supported by Lagorio & Pinto (2020). Rozman (2020) however found that EU countries have a different regulatory approach and the larger share of countries has not yet developed any regulations. This could explain why there is also still no clear legislation in the Netherlands. Rozman (2020) states that ‘from a broader policymaking and regulatory perspective, sharing of parcel lockers generates a positive social outcome, e.g., increased network coverage and positive environmental and urban logistics effects’. Thus, further supporting and emphasizing the desire and benefits of white label lockers in the future by municipalities as shown in this study.

5.6 Dimensions

The fourteen dimensions used to code the transcripts of the interviews, served as the structure for elaborating the findings. The coding tree started on the initial coding tree which was formed by examining existing literature and identifying returning factors of influence for locker concepts and drivers and barriers of parcel lockers. The coding process presented more 1st and 2nd order codes which did not fit with the dimensions of the initial coding tree.
Therefore, the initial eight dimensions were extended with six more dimensions (technology, collaboration, market, government & municipalities, safety, permits, growth of parcel lockers and COVID-19).

When comparing the dimensions from the constructed coding tree to dimensions used in existing literature, certain similarities and differences can be found. Lagorio & Pinto (2020) used six very similar dimensions in their case study to determine what the best locations for parcel lockers are and what factors are influencing them. They used the following six dimensions; availability, accessibility, security, environmental impact, costs, methods of use and regulations. They stated that due to a small number of papers in the literature, they added real case studies to their analysis. Additionally, the paper of Yuen et al. (2019) studied the determinants of customers’ intention to use parcel lockers. This was examined through a survey exploring whether perceived value and transaction costs mediate the effects of convenience, privacy, security and reliability. These dimensions are more focused on the customer perspective to use a locker, which this paper is not. Still, these factors can be taken into account by locker exploiters and can provide benefits or downsides for the different concepts. The different dimensions do have a high degree of overlap with the dimensions used in this paper. For example, security can be compared to the dimension of safety, convenience can be associated with accessibility and lastly, reliability can be associated with technology.

The dimensions used in this paper which do not receive specific attention within the existing literature are ‘the growth of number of parcel lockers’ and ‘COVID-19’. The first dimension is a very general dimension, which was used because very specific statements were made about what was needed to support the parcel locker growth. However, the 2nd order codes used in the dimension are very specific and are researched in different research streams within parcel locker research. Lastly, the dimension COVID-19 is created as a very recent development with little existing scientific literature, to the best of my knowledge only Prandtstetter et al. (2021) mentioned an increase in demand for parcel lockers due to the ‘contactless nature’. Additionally, Faugère et al. (2020) stressed the need for companies to increase their last-mile delivery capabilities and to handle the massive shift to online channels. Due to the lack of existing literature on COVID-19 compared with parcel lockers, this dimension was added to the coding tree.

The generalizability of this study is limited due to the characteristics of the interviewees. Seven out of the eight interviewees were Dutch with knowledge mainly focused on the Dutch last mile, this limits generalizability. Additionally, the practical examples of the public transport concept are still all in a pilot phase, this could impact the generalizability as these pilots are there to test certain setups. Since, no final version of the concept has been implemented, the generalizability of the statements from the public transport locker exploiter are limited. Lastly, the representative of the municipality presented the view of a single municipality. However, due to the high degree of discretionary power in the Netherlands, this view could be completely different in other municipalities which limits the generalizability of the statements of the representative.
Chapter 6. Conclusion

Due to the growth of E-commerce over the last few years, the last-mile has received a higher pressure to be more sustainable and cost efficient. Multiple alternatives for last-mile delivery exist, one of which was the focus point of this study, the parcel locker. This research compared and reviewed three different concepts, 1) White label locker concept, 2) Public transport locker concept, and 3) Exclusive locker concept, based on their strengths and weaknesses. To the best of my knowledge, no similar research has been previously performed. Therefore, this study fills the gap in the literature by answering the following research question: “What are the perceived strengths & weaknesses of known parcel locker concepts?”.

Semi-structured interviews were used to gather data to answer the research question. Professionals were asked to elaborate on their locker concept of expertise. The logistics experts and the representative of a municipality were asked to reflect on the three concepts and compare them. The professionals offered insights on decision making factors. The logistics experts provided an objective opinion on the different concepts, and the representative of a municipality offered information on decision making factors important for municipalities. The transcripts of the interviews were first open coded, then axially coded and finally selectively coded. The three layers of coding (open, axial and selective coding), yielded a coding tree with fourteen different dimensions.

This study has shown that a trend can be recognized amongst location owners in terms of which locker concepts they will allow on their location. The white label concept was most favoured as it allows to have a central pick-up location for parcels from multiple carriers, also preventing unnecessary trips. Additionally, it became clear that lockers combined with bus stops are very promising. Due to their strategic location, easy accessibility and convenience for customers the bus stop lockers could provide usefulness in the near future. However, since the bus stops are owned by the government, the debate about who is funding the lockers is preventing further practical deployment. Furthermore, this study showed that the current number of lockers in the Netherlands represents a capacity which is not enough to cover the volume of all carriers. The exclusive exploiters argued to have enough volume to fill their own lockers, but did state that when low fill rates are experienced the white label concept becomes increasingly more interesting. This was supported by the existing literature which described the white label concept to have a better rentability, higher efficiency and offer more comfort to customers. The literature also presented an explanation as to why there is only little capacity available in the Netherlands, as the number of lockers is significantly lower compared to other countries such as Germany and Finland.

Additionally, it became clear that white label exploiters look at the consolidation of parcels and delivering these to a parcel locker, which reduces the number of transport movements, driven kilometres and CO2 emissions. On the other hand, the exclusive locker exploiters also consider home delivery in their argument. When parcels destined for parcel lockers and home delivery are combined in a single delivery run, it will only reduce the number of stops and time. However, no CO2 emissions are reduced in that perspective. Another explanation for the
differences was found in the fact that a white label locker allows for the consolidation of parcels from multiple carriers, thus allowing the customer to travel once to a central point to collect all of the parcels. Subsequently, this is not possible with an exclusive locker: when a customer has ordered multiple parcels delivered to multiple lockers, it has to travel more and is not saving on CO2 emissions. Lastly, this study presented a policy gap due to the lack of experience of municipalities with lockers. To gain experience quicker the municipalities want to enter a transition phase in which firstly, all locker concepts are allowed. Later, they will be transition to white label lockers. As the white label concept has the clear preference of the municipalities. However, it has to be noted that within the Netherlands the degree of discretionary power is high which could cause large differences between municipalities in regulatory approaches towards lockers.

This study contributes to both theory and practice. From a theoretical perspective, it enriches the literature by providing a comparison between the three concepts and their respective strengths and weaknesses. Another contribution of this study is that it combines multiple perspectives of the field of parcel lockers, namely, the exploiters, the logistics experts, the municipalities and the existing literature. This provides a multi-perspective view on the different concepts and their strengths and weaknesses. From a managerial perspective, this study on the one hand provides guidance for locker exploiters and policymakers when choosing a locker concept. On the other hand, it presents a comprehensive overview of all factors influencing the economical and sustainable profitability of a locker, which can be utilized to better comprehend the locker landscape. Moreover, the interviews presented interesting findings, which were outside of the scope of this research but could serve as future research. Possible future research could further explore the benefits of parcel lockers for the B2B market, with the main goal of reducing the number of service vans in the cities. Another possible direction for future research could focus on the transition phase municipalities think to employ. This study showed that municipalities first want to allow all concepts and gradually move to a white label concept in the future. It would be interesting to see the possible effects of such a transition phase. Lastly, researching the trend of demanding location owners who have a preference for a specific concept. No existing research was found on this subject and it would be interesting to see the effects this has on the non-desirable concepts or exploiters of such concepts.
References


Appendices

Appendix A. Interview Protocol

Dank u dat u aan deze studie wilt deelnemen. Deze studie is gericht op het vergelijken van verschillende pakketkluis concepten. Het doel van het onderzoek is om een vergelijking te kunnen maken tussen deze verschillende concepten met hun sterke en zwakke punten. Uw antwoorden zullen dienen als input voor deze vergelijking op basis van uw kennis en expertise. Uw antwoorden zullen worden gecombineerd met antwoorden van andere interviews om een compleet en veelzijdig beeld te vormen van de verschillende concepten.

Nog belangrijk:
- Uw antwoorden zullen alleen worden gebruikt in de kader van dit onderzoek en zullen niet voor andere doeleinden worden gebruikt.
- Heb ik uw toestemming om dit interview op te nemen?
- Wilt u graag anoniem blijven?

Interview met DHL, PostNL, Cleveron & Evanet:
Afhankelijk van de geïnterviewde, bevragen over het specifieke concept waarin diegene is gespecialiseerd als diegene dat is, met de volgende vragen:

- Q1: Hoe is het concept vormgegeven/ingericht? (+/- 15 minuten)
- Q2: Wat zijn de voor- en nadelen van uw concept? (+/- 15 minuten)
- Q3: Wat zijn de bepalende factoren geweest om dit concept te gebruiken? (+/- 10 minuten)
- Q4: Hoe verhoudt dit concept zich tot andere concepten? (+/- 10 minuten)

White label:
- Volume needed (V)
- Accessibility (V)
- Collaboration (N)

Public transport:
- Location (V)
- Defacement (V)
- Consumer location (N)

Exclusive locker:
- Network design (V)
- Competition (V)
- Branding (V)
Q5: Wat is het toekomstperspectief voor dit concept? (+/- 5 minuten)

5 minuten speling in totaal

Checklist: Accessibility, costs, collaboration, competitors, location, safety, sustainability

Interview met experts & gemeenten:
Beginnen met een korte inleiding over het onderzoek daarna:
White label locker concept (+/- 15 minuten):

Q1. Bent u bekend met het White label pakket kluis concept? Zo ja, wat vindt u van het concept?
   - Voordelen:
     - Volume → Meerdere pakketvervoerders op 1 kluis
       o Hoger volume → eerder rendabel
     - Accessibility → Centraal punt voor klanten
   - Nadelen:
     • Collaboration → Samenwerkingen tussen partijen essentieel (volume, rendabel)
       o Lastige markt-toetreding voor nieuwe partijen

Checklist: Accessibility, costs, collaboration, competitors, location, safety, sustainability

Q2. Is er nog iets onbesproken gebleven over dit concept wat wel van belang is?

Public transport lockers: (+/- 15 minuten)

Q3. Bent u bekend met het public transport locker concept? Zo ja, wat vindt u van het concept?
   - Voordelen:
     • Location → Profiteert van strategische gelegen bestaande locaties
     • Defacement → Geen schade aan het straataanzicht
   - Nadelen:
     • Consumer location → Minder gewenste locatie door consument

Checklist: Accessibility, costs, collaboration, competitors, location, safety, sustainability

Q4. Is er nog iets onbesproken gebleven over dit concept wat wel van belang is?

Exclusive parcel locker concept (+/- 15 minuten):

Q5. Bent u bekend met het exclusieve parcel locker concept? Zo ja, wat vindt u van het concept?
   - Voordelen:
• Network Design → Eigen netwerk van pakketvervoerder
• Competition → Concurrentie wordt niet geholpen
• Branding → Grotere naamsbekendheid en onderscheidend vermogen

- Nadelen:
  • Accessibility → De consument heeft geen centraal ophaalpunt
  • Dependability → Consument wordt vervoerder afhankelijk

**Checklist:** Accessibility, costs, collaboration, competitors, location, safety, sustainability

Q6. *Is er nog iets onbesproken gebleven over dit concept wat wel van belang is?*

**Vergelijkingen (+/- 12 minuten):**

Q7. Welk concept heeft de meeste voorkeur volgens u? Kunt u dit toelichten?

Q8. Welk concept heeft uw minste voorkeur? Kunt u dit toelichten? (Hierna doorvragen op het middelste concept)

Q9. Als u de casussen vergelijkt, wat springt dan in het oog? (wat is echt een belangrijk ding)

Vragen of de geïnterviewde een kopie van het getranscribeerde interview wil ontvangen en of deze vrijuit gebruikt mag worden binnen dit onderzoeksverslag.

Bedanken voor het vrijmaken van tijd voor dit interview.
Appendix B: Initial Coding Tree

Table B1

Initial Coding Tree

<table>
<thead>
<tr>
<th>1st order code</th>
<th>2nd order code</th>
<th>Dimension</th>
</tr>
</thead>
<tbody>
<tr>
<td>Permits time consuming</td>
<td>Permits</td>
<td></td>
</tr>
<tr>
<td>Vandalism &amp; theft</td>
<td>Safety</td>
<td>Location</td>
</tr>
<tr>
<td>Negative customer perspective</td>
<td>Public transport</td>
<td></td>
</tr>
<tr>
<td>Strategic locations</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No visual defacement of city</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Achieving enough volume</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reliant on collaborations</td>
<td>Collaboration</td>
<td>Volume</td>
</tr>
<tr>
<td>Multiple providers use locker</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peak demand</td>
<td>Demand</td>
<td></td>
</tr>
<tr>
<td>Willingness of customers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Customer negatively affected</td>
<td>Impact on customers</td>
<td>Customer</td>
</tr>
<tr>
<td>Losing point of contact</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dependent on one carrier</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Customer central point</td>
<td></td>
<td></td>
</tr>
<tr>
<td>24/7 access</td>
<td>Access to lockers</td>
<td>Accessibility</td>
</tr>
<tr>
<td>Accessible and convenient location</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brand awareness</td>
<td>Branding &amp; exposure</td>
<td>Branding</td>
</tr>
<tr>
<td>Distinctive capability</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Investment cost</td>
<td></td>
<td>Financial factors</td>
</tr>
<tr>
<td>Location choice cost and time consuming</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Extra revenue for shops</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cost reductions in dense network</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Contactless nature</td>
<td>COVID-19</td>
<td></td>
</tr>
<tr>
<td>CO2 reduction</td>
<td></td>
<td>Environmental factors</td>
</tr>
<tr>
<td>100% first time delivery</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total delivery time</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Daily driven kilometres</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Optimization of vehicle routing problems</td>
<td></td>
<td>Optimization</td>
</tr>
<tr>
<td>Design own network</td>
<td></td>
<td>Design</td>
</tr>
<tr>
<td>Preventing dense network</td>
<td>Dense network</td>
<td></td>
</tr>
<tr>
<td>Placement on private initiative</td>
<td>Private initiative</td>
<td></td>
</tr>
</tbody>
</table>
Appendix C: Final Coding Tree

The final coding tree is removed from the public version of this thesis, due to confidentiality reasons.