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alBOX: White Label Parcel Lockers as Sustainable Solution for Last Mile Delivery

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1 ABSTRACT

Online commerce is an expanding and therefore challenging market. Due to its complexity, innovative solutions are required to guarantee a resource-saving supply quality with flexible goods and services in urban and rural areas. The challenges lie in developing an economically, ecologically and socially sustainable receiving and shipping system that offers the possibility of directly involving the local economy and strengthening locations overall. In particular, overcoming the last-mile in parcel delivery by courier express parcel services (CEP services) is associated with numerous problems.

Based on these logistical-organisational problems and challenges, vendor-independent ("white-label") parcel lockers were developed within the alBOX research project framework. Therefore, a pilot operation of white-label parcel systems in two target areas with different settlement structures (rural community of Kaumberg in Lower Austria and Vienna's 5th district Margareten) was implemented for twelve months. The implementation of the white-label parcel lockers system was accompanied by conducting a mixed methods research which uses quantitative data (e.g. average package sizes, frequency of orders, usage times etc.) as well as qualitative data (e.g. user experience, operability etc.) to test, analyse and evaluate this innovative service.

In this paper, the project's results are linked to delivery and distribution logistics' challenges to explain white-label parcel lockers' contribution to ensure a nationwide, innovative and demand-oriented (local) supply structure for spatially scalable and flexible flows of goods, information and services. For this purpose, supply-related, social, economic, and ecologically and environmentally relevant objectives were considered. The focus is on the results that describe the delivery situation from the recipients' perspective and their usage behaviour. It is discussed to what extent the parcel lockers as the first delivery address influence the delivery situation in the target areas of the pilot operation.

Keywords: white label, parcel lockers, last mile, CEP, distribution logistics

2 CURRENT SITUATION

Parcel lockers with permanent access are currently offered mostly by those CEP service providers with a corresponding market share in the respective segment. This development can lead to monopolies, especially in rural regions, with all the associated disadvantages. The parcel lockers of the two strongest providers, Post AG and Amazon, are managed exclusively as a closed system. So they are not accessible to other retailers and CEP delivery companies. In terms of cream-skimming, competition will primarily arise where there is particularly high demand. This will possibly (see LTE or 5G network) lead to spatial disparities. Local trade and the use of parcel lockers for municipal purposes (secure deposit of objects/documents between private individuals or public institutions) will be excluded from this service. It is comparatively more difficult to supply the local population with goods and services in rural and sparsely populated regions. The range of products in local stationary retail is mostly reduced to the essentials. Partly online retailing compensate for disparities in the supply quality of communities with retail and specialised shops between urban and rural areas (Gumz et al. 2020). Furthermore, an increase in online trade puts pressure on regional traders in

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peripheral areas. Platforms for the joint marketing of products or the bundled provision of products and services can sustainably strengthen retail and direct marketing in rural areas (Mensing 2016).

In order to capture the current developments in the delivery industry, especially concerning parcel lockers in Vienna and Lower Austria, a spatial analysis by Gregory Consultings (2019) and a survey by Logistic 2030 are combined in Figure 1. Thus, the development of the number of parcel locker locations per provider in Vienna and Lower Austria is summarised for the period March 2019 to October 2020. Furthermore, the figure shows the proportions of open and closed systems in the respective periods. From March to October 2019, the delivery service DHL closed all of its 28 parcel stations.

By October 2019, Variocube, a new provider, comes along. A1 triples, and Renz almost doubles its number of locations. In 2020, on the other hand, only Interspar will reduce its number of locations, while Myflexbox and Amazon will become new providers. Outstanding is that, despite the new start of Amazon, it takes immediate third place among the providers with the most locations in Vienna and Lower Austria. Renz, A1 and Variocube doubled their number of locations in this period. Post AG can also show an increase of 32%.

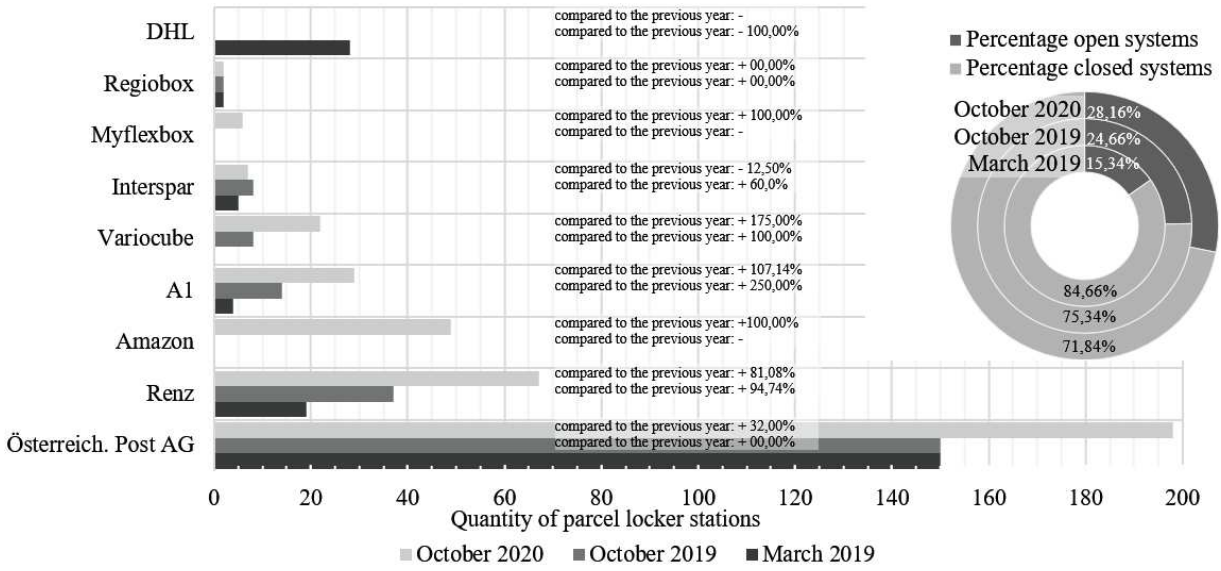

Fig. 1: Development of the number of parcel locker stations in Vienna and Lower Austria in the period of March 2019 until October 2020, Source: own calculation, Data: (Wirtschaftskammer Wien 2020 and Gregori Consulting 2019)

Overcoming the last mile in the delivery logistics of CEP companies is associated with numerous economic and ecological challenges. The traffic induced by parcel delivery increases, especially when the first delivery attempt at the recipients fails. If additional journeys have to be made by CEP providers and recipients to pick-up the parcel from a parcel shop in the vicinity, more time-, travel- and CO2-costs are generated.

To this end, Prandtstetter et al. (2021) calculate simulations using models conducted as part of the alBOX research project. Depending on the parameters "rate of successful first deliveries", "rate of recipients using parcel lockers", "rate of collecting parcels exclusively" and the selected region in combination with the corresponding modal split, distances travelled, and CO2 emissions of delivery traffic are determined for each scenario. A comparison of the results shows that parcel lockers can significantly help to reduce CO2 and achieve distance savings if their location can be easily integrated into the delivery process.

2.1 Comparison of existing forms of parcel lockers

Various systems exist for the delivery of parcels when recipients are absent. Those pick-up points for parcels are structurally bound to a location and have a particular spatial catchment area. They handle the delivery process of parcels without direct contact between the delivering company and the recipient. In a summary of national and international reception and dispatch systems, a distinction can be made between time-bound pick-up points and time-independent locker systems.

Time-bound pick-up points differentiate between directly at the residence or work located ones and those that are public and staffed. Pick-up points for parcels can be provided by partner shops of the CEP services or operated by the particular CEP services. The principle of the CEP partner shop is linked to existing

infrastructures and is based on the time-efficient drop-off and pick-up of parcels. The integration of this process into the recipient's daily consumption routine is essential.

Building-integrated, time-independent parcel locker systems at the place of residence are a new dimension of shipment consolidation. The delivery of parcels is completely decoupled from the presence of the recipient and staff. Recipients and CEP services can access and process parcel shipments 24 hours a day. Public parcel locker systems can be provided by one CEP service or be operated by several CEP services.

2.2 Development of the mail order business in Austria

According to a European survey on ICT use, the proportion of people using online shopping increased enormously between 2003 and 2019 (Figure 2). Between 2003 and 2015, the target group of 25 to 34 year-olds made the most use of online shopping. However, from 2015 onwards, 16 to 24 year-olds are equally represented, as are people in the 35 to 44 age group. The year 2016 is remarkable because a decline in online shopping is noticeable in all age groups, except for the 25 to 34 year-olds and 65 to 74 year-olds (Statistik Austria 2019).

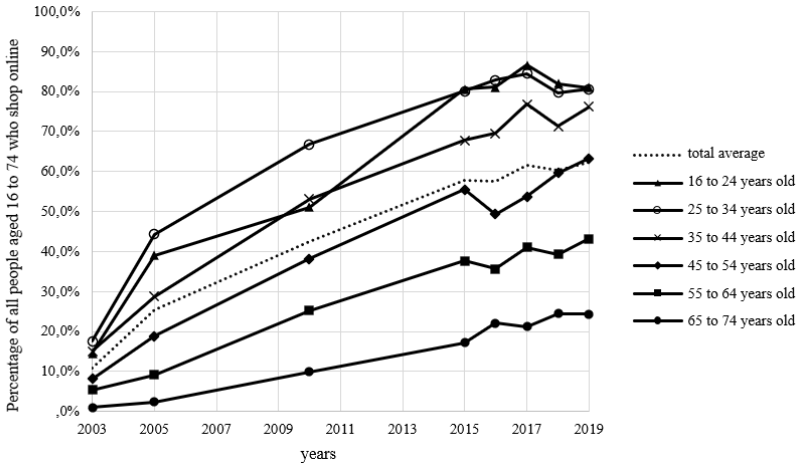

Fig. 2: Development of the proportion of people who shop online per age group; Data: (Statistik Austria 2019), own computation

The proportion of companies in Austria that are exclusively active in online retailing, and thus belong to the ÖNACE category Mail-order and Internet Retailing G4791, is continuously increasing. Figure 3 shows this increase and the percentage change in the number of companies compared to the previous year. After a substantial increase in companies in this sector of +36.33% between 2008 and 2009, the growth rates of percentage change per year are in the range of around 6-11% (Statistik Austria 2017).

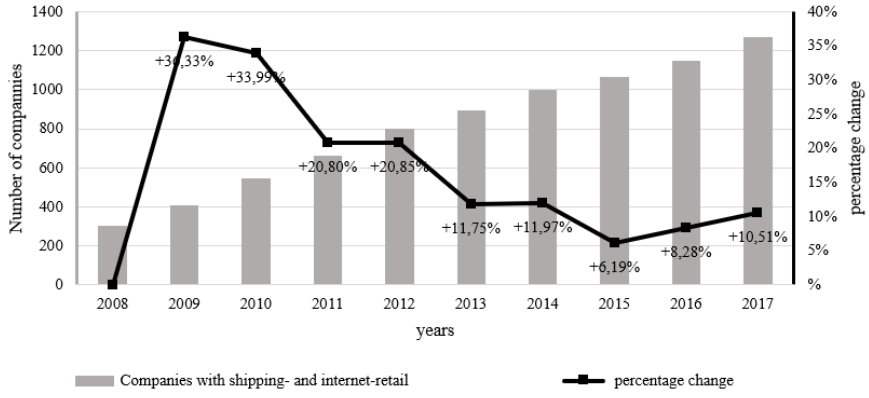

Fig. 3: Development of the number of companies belonging to the ÖNACE category G4791 - mail-order and internet retail trade; Data: (Statistik Austria 2017), own computation

3 WHITE-LABEL PARCEL LOCKERS

In the course of the alBOX research project, vendor-independent ("white-label") parcel lockers were developed as receiving and shipping systems for parcels and objects. Subsequently, the white-label parcel lockers were implemented as pilot operation in the two different target areas (rural community of Kaumberg in Lower Austria and Vienna's 5th district Margareten). In addition, the project investigates which further innovative services of white-label parcel lockers can lead to more overall municipal added values. In order

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for different groups of stakeholders to use the white-label parcel lockers, the interests of the recipients, operators, companies, municipal decision-makers, and logistics service providers are taken into account during the whole development process. For example, companies in the catchment area can offer their products and services via the white-label parcel lockers outside of their business hours with the help of the deposit function. The high degree of flexibility and independence between shipper and recipient in a delivery procedure via the white-label parcel lockers enables more efficient route bundling. Moreover, the white-label parcel lockers counteract the disparities in the delivery speed and efficiency of goods that occur in rural areas compared to urban centres.

The white-label parcel lockers currently have dimensions between 460 x 130 x 650 cm and 460 x 730 x 650 cm. They are weatherproof and designed to be tamper-proof. In Kaumberg the white-label parcel lockers are located outdoors, whereas at the location in 5th district of Vienna they are installed in the stairwell of a residential building. Further, in contrast to Kaumberg, only a closed user group can use the white-label parcel lockers at the location in Vienna. The white-label parcel lockers run autonomously and can be operated by the recipients and CEP services themselves. So no additional staff is needed to handle the delivery process.

In the context of the pilot operation, only the identified core services are offered. That includes the vendor-independent receipt of parcels and the deposit of items between private individuals or companies. For this purpose, each customer receives a personal parcel locker number after registering online. In the course of an order process, the address of the parcel locker location and the personal parcel locker number is entered. After successful (parcel) delivery, customers receive a five-digit pick-up code per e-mail. This code is entered directly on the touchscreen monitor of the parcel locker installation to open the parcel locker. After the parcel has been removed, the compartment is closed again and is ready for the following delivery process. A transfer order is created via the customer's account on the provider's website to deposit items for other people. With this code, the compartment can be locked and opened again within a specific time.

3.1 Pilot operation rural community of Kaumberg, Lower Austria

Kaumberg, one of 12 municipalities located in the Triestingtal valley in Lower Austria, has a cadastral area of 4,303.7 ha, with a share of forest land of 63.52%. The municipality is served by the Hainfeld Road B 18, which runs from the Vienna Basin via Günselsdorf and Leobersdorf (connection to A2) to Traisen (Mostviertel) and connects the Triesting Valley with its municipalities Berndorf, Pottenstein, Weissenbach an der Triesting, Altenmarkt an der Triesting, Kaumberg, Hainfeld, Rohrbach an der Gölsen, Rainfeld and St. Veit an der Gölsen. By public transport, Kaumberg can be reached by train in combination with the Postbus or the taxi business Trixi. When looking at the population development, an increase of approx. 73% to 1,011 inhabitants in 2017 can be recorded since 1991. Of these, 623 inhabitants are in the 15-60 age group (Amt der NÖ Landesregierung 2019). The white-label parcel lockers are installed in the market square area at the address Markt 13, 2572 Kaumberg.

3.2 Pilot operation Vienna's 5th district Margareten

Margareten is the fifth district of Vienna and is located southwest within the Vienna Gürtel. It is densely built-up and very well connected to the high-level transport network by public transport, e.g. underground line 4. The district boundaries cover an area of 201.1 ha, of which 129.3 ha are subject to building land use. 8.8 ha are used as parklands, and 63 ha are used for transport. The population increased to 55,405 inhabitants between 2009 and 2019, which means an increase of 5.9% within the last ten years. Of these, approximately 27,000 residents of the municipality of Margareten have a migration background in 2019. The social infrastructure within the district is cosmopolitan and has a wide range of medical care as well as educational institutions (Stadt Wien 2020). The white-label parcel lockers were installed at the address Grohgasse 5-7, 1050 Wien Margareten. The location is about 350m walking distance from the underground station Pilgramgasse (U4).

4 METHODOLOGY

The objective is the comprehensive, integrative and experimental piloting of vendor-independent locker systems that can be sustainably integrated into the cityscape. For this purpose, various methods will be used to interview different stakeholders about the delivery situation on the last mile and the role of the white-label parcel lockers presented in the project. It will be determined how and which ecological, economic and social

effects white-label parcel lockers can achieve on a long-term level. The observation period of the entire pilot operation is 12 months from 01.07.2019 to 30.06.2020.

4.1 Evaluation of the quantitative user data to detect the actual use of the white-label parcel lockers

For the examination of the actual usage, the main focus is on evaluating the quantitative usage data that is continuously collected by the software. Further, the customers provided personal data during registration for the creation of a customer account.

The datasheet was reviewed to identify outliers, test or spam accounts to exclude them from the evaluation. Data records were declared as outliers if parcels were deposited for less than ten minutes or longer than two weeks. The affected records are congruent with the expected assumptions and knowledge about periods in which testing was conducted, or system malfunctions occurred.

Overall, 31% of the registered clients used the white-label lockers in the catchment area of Vienna Margareten and 69% in the catchment area of Kaumberg Lower Austria. The persons participating in the pilot project were predominantly male with a share of 62% and part of the age groups covering the ranges 21 to 40 years. Of all registered clients from the catchment area of the white-label parcel lockers at the pilot location Kaumberg, 93% of the persons directly reside in the cadastral municipality of Kaumberg. In contrast, at the pilot location in Vienna Margareten, the parcel boxes are only accessible to delivery staff, residents of Grohgasse 5-7, 1050 Vienna, and to employees of the nearby Storebox Holding GmbH.

4.2 Qualitative survey of the usage behaviour and experiences of the participating users

Within the framework of the qualitative surveys, information on user experiences and user behaviour could be generated. For this purpose, a workshop was conducted among so-called heavy users (above-average number of parcel deliveries) on 29.10.2019 in Kaumberg. Only male users participated, who were between 26 and 40 years old. The majority stated that they have an irregular or flexible daily schedule. For this reason, the white-label parcel lockers are willingly accepted, as they are independent of the opening hours of the postal partners. However, during the workshop, experience reports were also shared that the service has already been tried out by older generations together with the workshop participants.

From May to June 2020, a six-week online survey was conducted among registered participants. A total of 34 people out of 65 contacted persons participated, resulting in a response rate of 52.3%. Of these, 2/3 stated that they use the white-label parcel lockers at the pilot location in Kaumberg Lower Austria, and 1/3 use the white-label parcel lockers in Vienna Margareten. A similar proportion is also found among the actual, registered users. In July 2020, 69% of the users resided in the catchment area of Kaumberg, and 31% of the users resided in the catchment area of Vienna Margareten. Of these, 50% were between 24 and 34 years old. The gender ratio among the participants is balanced at 50%. Furthermore, 90% of the participants are employed and just over half state that they have a regular daily routine on weekdays. The household size of the participating clients is predominantly composed of 2 people over the age of 18.

In the course of the implementation of the white-label parcel lockers, a service hotline was set up. The hotline can be called to communicate support messages, wishes and suggestions. After a large number of open questions had already been answered during the workshop, only a few messages were received via the alBOX service hotline.

4.3 Qualitative interviews with other stakeholder groups

To assess the relevance and potential of white-label parcel lockers, several interviews with other stakeholders were conducted. For example, experts from the fields of municipal development and logistics, e-commerce, entrepreneurs in the catchment areas of the white-label parcel lockers and drivers of the CEP providers who already used parcel lockers, administrative functionaries of Lower Austrian municipalities from different spatial typologies (Statistik Austria 2016) were interviewed. The interviews were executed by telephone and in person.

5 RESULTS

The implementation of the white-label parcel lockers is about testing a new technology, initially in the area of parcel delivery. The service was tested primarily by people in the age groups 24 to 44, of whom 62% of the registered participants are male. However, the gender ratio is balanced in the course of the survey of

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usability and user experiences. Even though only a small percentage of registered customers are over 64 years old, reports from the workshops show that people from the 64+ generation use the white-label parcel lockers. In the further development of the white-label parcel lockers and additional services, the idea of an inclusive service design should definitely be pushed in order to create added value for as many stakeholder groups as possible so that no social groups are excluded.

The workshop's results in Kaumberg in October 2019 differ slightly from the online survey in May/June 2020. However, it should be noted that the online survey surveyed a significantly larger group of people and not only heavy users from Kaumberg as in the workshop in October 2019. As a result, the trends in the data are comparable but significantly more differentiated. Furthermore, the workshop in October 2019 in Kaumberg did not record the detours or time spent collecting parcels from the WLP, in contrast to the much more comprehensive online survey from May/June 2020. With the possibility of receiving products via the white-label parcel lockers, customers' usage behaviour, time, and distance efforts changed.

5.1 General situation of distribution logistics in the target areas of the pilot operations

In October 2019, 75% of the surveyed heavy users stated that the parcels would be deposited in a parcel shop in the case of an unsuccessful delivery attempt. However, in the survey in May/June 2020, 29% of the participants from the catchment area of Kaumberg stated that this option is not desired or not satisfactory. In the workshop in October 2019 in Kaumberg, all participants said that without the option of having parcels delivered via the white-label parcel lockers, problems frequently arise on a scale of 1 to 4 (always - frequently - rarely - never) due to absence during delivery by the CEP service.

In the case of an unsuccessful first delivery attempt, various options for depositing parcels are possible. When asked about the frequency of delivery problems, only 3% of the survey participants stated that problems never occur. In contrast, 53% described regular delivery problems (6% almost always and 47% frequently) when the recipient is absent. In the case of an unsuccessful first delivery attempt, the parcel is usually collected in the immediate vicinity of the delivery address by about one-third of the participants, but 67% have to make a trip to a pick-up shop or a post office. In the online survey from May/June 2020, it was asked which locations are not desirable to deposit parcels from the recipients' point of view.

It should be noted that all respondents selected at least one inappropriate deposit location (Figure 4). In order to categorise the reasons why the stated deposit locations are undesirable, the qualitative statements were summarised in the course of a qualitative content analysis and thus divided into the respective superordinate categories (Mayring 2015). The superordinate categories are composed of the previously queried deposit locations and were then supplemented with subcategories, which were defined inductively based on the qualitative statements (Döring et al. 2016).

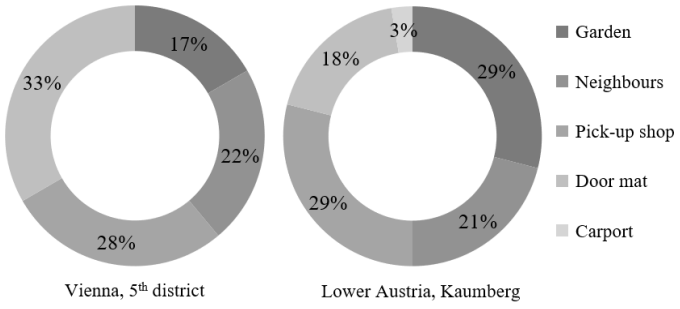

Fig. 4: Locations that are inappropriate for a parcel deposit from the participants' point of view (online survey May/June 2020)

Figure 5 should therefore be read so that the size of the rectangles in the graph represents the shares of the categories in the total number of justifications. It should be noted that each participant gave at least one reason. This shows which reasons occurred most frequently in relation to the others in connection with the superordinate category.

For example, a total of 33.3% of the statements referred to the fact that leaving the parcel in a parcel pick-up shop is undesirable. In this context, the necessary detours are a point of criticism for more than half of the participants, and for around 29% the limited opening hours are a reason why deliveries via a parcel pick-up shop are not desired. In the two categories "garden" and "door mat" the place of deposit was declared inappropriate in both cases due to the risk of theft. Furthermore, it was pointed out several times that dogs

could carry away or destroy the parcels. Leaving parcels with the neighbours is inappropriate for the customers because they do not know them, or the possible pick-up time is very uncertain. Some described that the additional effort for the neighbours and for themselves is too great to accept the parcels.

Overall, the survey of the current distribution situation shows that it must be classified as problematic. The situation of the current range of options for depositing parcels is not satisfactory and can not be seen as a solution, but rather the lesser of two evils.

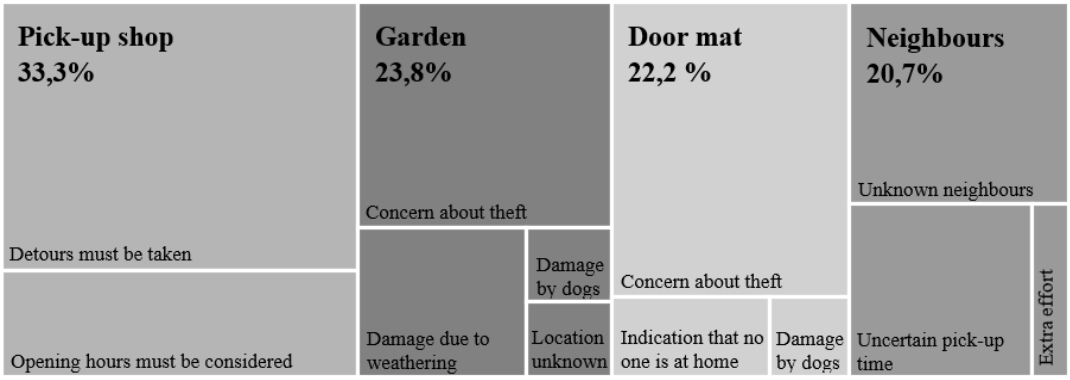

Fig. 5: Reasons for the undesirable deposit locations (online survey May/June 2020)

5.2 Analysis of delivery times at the target areas

The analysis of delivery and pick-up times is based on the quantitative usage data, which is permanently and automatically recorded by the white-label parcel locker system. Figure 6 clearly shows that the delivery of parcels by the CEP service takes place in very different periods than the collection of parcels from the white-label parcel lockers by the recipients. In Kaumberg, most deliveries are made between 08:00 and 10:00 in the morning and in Vienna between 11:00 and 13:00. The collection of the parcels by the customers, on the other hand, takes place in the afternoon or predominantly in the period between 17:00 and 20:00. Especially at the pilot location in Kaumberg, the parcels are also regularly collected until 22:00. A further evaluation shows that the distribution of delivery and collection regarding the days of the week is almost equally distributed at both pilot locations on weekdays and Saturdays. Only on Sundays and public holidays are there hardly any deliveries or collections.

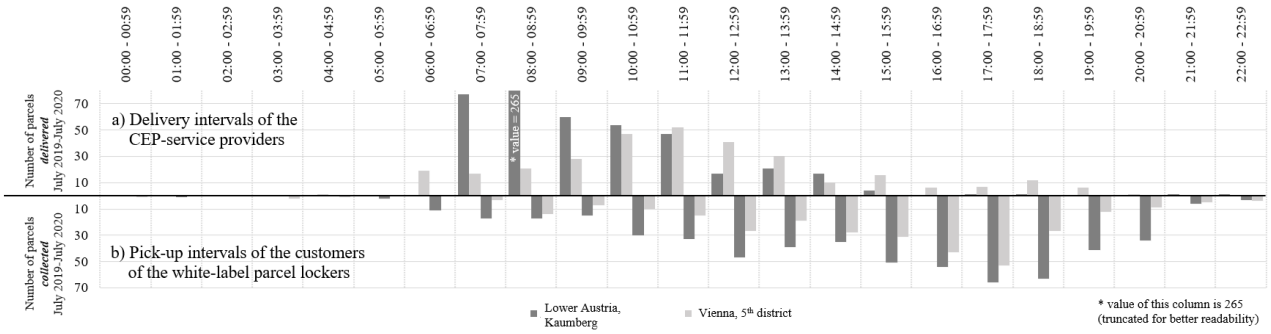

Fig. 6: Comparison of delivery (a) and pick-up (b) intervals at the pilot locations in the period July 2019 to July 2020

5.3 Analysis of the required detours to handle the delivery process at the target areas

The delivery situation without white-label parcel lockers leads to detours up to 15km, especially at the pilot location in Kaumberg. There the detours are covered by almost three-quarters of the people by car to pick up the parcel from a parcel shop. Furthermore, the pick-up is strongly restricted by the given opening hours, which causes a significant delay in receiving the parcel. In the catchment area of the pilot location in Vienna Margareten, the detours in kilometres are less decisive, but rather the additional time required for the recipients when a parcel has to be collected from a parcel shop.

Especially the results of the online survey from May/June 2020 shows that the distance to the nearest parcel shop from the respondents' homes is an important distinguishing feature of the catchment areas. In the area of Vienna Margareten, 55% of the respondents stated that the nearest parcel shop was within 500m of their place of residence and that they did not have to make a detour of more than 5km. Whereas in Kaumberg, the

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nearest parcel shop is 1 to 5 km away from the recipients' homes for 57%, and 14% have to travel more than 10 km to reach the parcel shop.

When considering the detours that are required to pick up a parcel from the parcel shop, this amounts to an average of 7 minutes in Kaumberg. On the other hand, in Vienna, the average detours take 17 minutes and over 90% of the people walk and none of the survey participants goes by car.

With the option of delivering a parcel via white-label parcel lockers, the diversions in minutes to pick up a parcel is reduced at both pilot locations. In Kaumberg, the average detour is reduced to about three minutes and in Vienna to less than one minute, as the parcel wall is located in the respondents' homes.

Furthermore, the information on the forms of mobility predominantly chosen for collection in the Vienna catchment area changes to a lower proportion of walking and the omission of public transport. As a result, the car is increasingly used. This may be because no extra detours have to be made, but the white-label parcel locker is on the way to work, for example, and no other walk is required. For the catchment area of Kaumberg, it is true that at the loss of mobility by car, parcels are picked up on foot about 10% more often. At the same time, the total time spent is reduced significantly.

5.4 Parcel volume during pilot operation

In contrast to the number of registered persons, only about 56% used the white-label parcel lockers as a delivery option. At the location in Vienna, 17 active users can be recorded, who had an average of 18 parcels per person delivered via the WLP from July 2019 to July 2020. This means an average value of 4.7 parcels delivered per month for the most active user and an overall average of 1.4 parcels per month per active user at the WLP location in Vienna Margareten.

At the pilot location in Kaumberg, Lower Austria, a total of 25 people used the parcel wall as a delivery option at least once in the period from July 2019 to July 2020. With 22.8 parcels per active customer, a higher average value was achieved than at the pilot location in Vienna. The maximum value of 88 parcels delivered for this registered person means that an average of 6.7 parcels per month were delivered via the white-label parcel lockers from July 2019-July 2020. Overall, an average of 1.7 parcels per month per registered person is achieved at the Kaumberg Lower Austria site in the period July 2019 to July 2020 inclusive. It must be emphasised that the median for both pilot locations is 15 parcels per active customer within the period of one year, if the outliers with over 60 parcels per year are eliminated.

The chronological analysis of the delivered parcels per month from July 2019 to July 2020 shows the highest delivery rates in October, November and December 2019 (Figure 7). At this point, it should be noted that since November 2019, the number of registered customers has remained almost constant at approximately 70 people. A further increase in the number of parcels delivered via the white-label parcel lockers occurred at both pilot sites in March and April 2020. This period was particularly affected by the Covid-19 pandemic and the associated restrictions on local trade due to the Austrian federal government's lockdown measures. The strong increase in delivery amounts in September 2019 at the Vienna location is due to the equal increase in newly registered customers in this month.

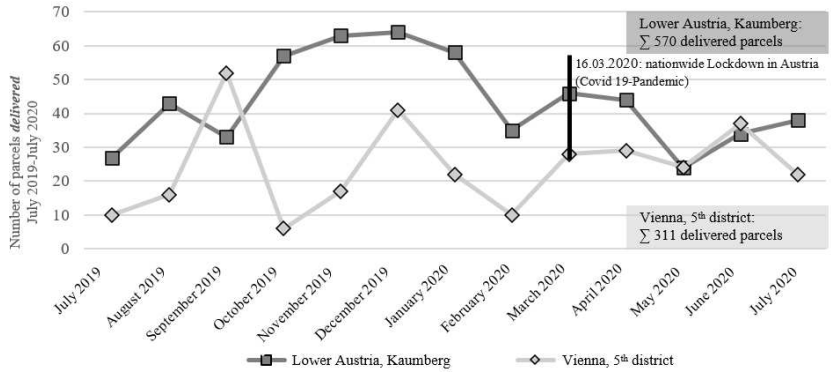

Fig. 7: Number of delivered parcels per month via the white-label parcel lockers in the perios July 2019-July 2020

5.5 Usage and ordering behaviour of participants in the target areas

In order to evaluate the usage and ordering behaviour, various situations were assessed by the customers on a scale from "strongly disagree" to "strongly agree". Almost 80% of the participants from the Kaumberg

catchment area stated, both at the workshop in October 2019 and in the online survey in May/June 2020, that the white-label parcel lockers have no negative influence on the local suppliers and small shops/service providers in the municipality. All participants can reduce the time and distance spent compared to the delivery situation without white-label parcel lockers. For the Vienna location, the result is similar, but significantly more people (almost 40%) stated that substituting local shopping due to the white-label parcel-lockers is not out of the question. The possibility of making deliveries via the white-label parcel lockers prompts most of the participants to order more items online. The range of product groups ordered online is also expanding to include product categories that tend to be more expensive, such as computers and car accessories as well as electronic items. The Sankey diagram in Figure 8 shows how delivery frequencies per category have changed, indicating that in most cases the change per person tends towards a more frequent delivery number per unit of time.

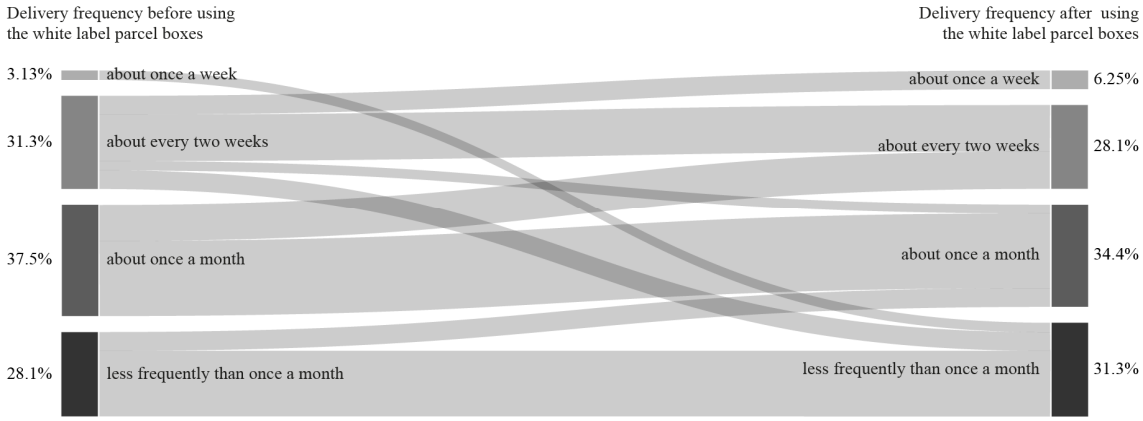

Fig. 8: Frequency of deliveries by CEP services before and after the possibility to receive orders via the white-label parcel lockers (online survey May/June 2020)

5.6 SWOT-Analysis of the white-label parcel lockers

In order to assess the strengths, weaknesses, opportunities and threats of the WLP, interviews with people from different stakeholder groups were conducted in addition to the surveys and workshops related to the pilot operation. The resulting findings are summarised in a SWOT analysis (Figure 9). SWOT refers to the fields of action Strengths - Weaknesses- Opportunities - Threats. (Krogerus et al. 2017).

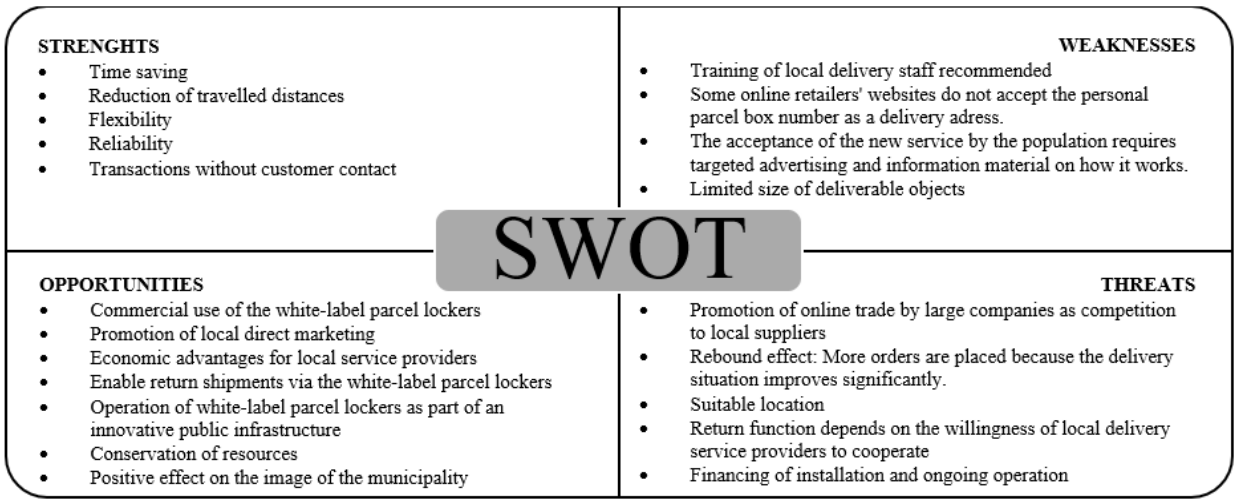

Fig. 9: SWOT analysis of the white-label parcel lockers

For example, more than half of the CEP drivers surveyed, see the use of parcel lockers as a very positive alternative to traditional door/mailbox delivery. Mainly due to the possibility leaving parcels at any time and thus process them faster. Especially for entrepreneurs, the handling of transactions without customer contact and at any time represents a very high added value. By using the WLP as a delivery option, hardly any negative effects can be identified by the customers surveyed.

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The interviews with functionaries of the municipal administration and experts of the economy and regional development refer to the economic situation, business landscape, and spatial structure of the municipality. Further, the effects on residents, the environment, traffic and local businesses are discussed. Based on the interviews it is critically pointed out that white-label parcel lockers have to be used carefully so that they do not represent additional competition to the local retail trade. Regarding to the achievable economic added value in the supply chain, it is noted that this requires intensive cooperation with the companies in the catchment areas. In addition, the price/performance ratio must be acceptable to the entrepreneurs. If these factors are met, an increase in the competitiveness of local businesses compared to online business is possible. Finding a suitable location involves a risk and should consider the local scene and cityscape. An opportunity for long-term independent operation is seen primarily in operating the white-label parcel lockers as part of the municipalities' public infrastructure. However, this would require financial support from the municipalities, especially in the course of installation.

Further it is essential for the implementation that the system is easily manageable and easy to use for all groups of people. Customer service must be permanently available to prevent frustration in case of problems. The development of a service for the last mile between the white-label parcel lockers and the residence for people with limited mobility would be desirable. Standards and regulations are necessary for a uniformly functioning system. Finally, the success of the system depends on the commitment of the municipal administration and the active cooperation with local stakeholders.

6 CONCLUSIONS

The pilot operation in the target areas of Kaumberg Lower Austria and Vienna Margareten lasted twelve months from July 2019 to July 2020. In this period the core services delivery of parcels, deposit of parcels C2C and deposit of parcels B2C could be tested free of charge by participants from the catchment areas. A total of 74 people registered during the pilot operation, of which 17 persons were identified as active users at the Vienna Margareten location and 25 at the Kaumberg Lower Austria location. The total number of successfully delivered parcels during this period was 881. Several surveys show that the greatest advantage of white-label parcel lockers is seen in the independence of parcel delivery. Therefore, the delivery reliability and efficiency can be significantly increased. At the same time, a reduction in energy consumption, savings in time and travel costs as well as a reduction in traffic-induced CO2 emissions can be achieved at both pilot locations by shortening the transport routes.

7 FUTURE WORK

The sustainable success of white-label parcel lockers depends on a variety of factors. Identifying these factors and linking them to existing data could enable optimal location decisions using machine learning or AI (artificial intelligence). It is already clear from alBox that location plays a key role in the economic and environmental savings potential. An analysis of alternative forms of financing (keyword PPP) could show a way to enable innovative logistics infrastructure, especially in rural areas. Possible commercial potentials need to be surveyed in order to investigate the economic viability of different locations.

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