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Estimating e-consumers' attitude towards Parcel Locker usage

Ionut Alexandru Mitrea
Department of Management and Production Engineering
Politecnico di Torino
Turin, Italy
alex_mitrea@libero.it

Giovanni Zenezini
Department of Management and Production Engineering
Politecnico di Torino
Turin, Italy
giovanni.zenezini@polito.it

Alberto De Marco
Department of Management and Production Engineering
Politecnico di Torino
Turin, Italy
alberto.demarco@polito.it

Filippo Maria Ottaviani
Department of Management and Production Engineering
Politecnico di Torino
Turin, Italy
filippomariaottaviani@gmail.com

Tiziana Delmastro
Urban Mobility and Logistic Systems
Links Foundation
Turin, Italy
tiziana.delmastro@linksfoundation.com

Cristiana Botta
Urban Mobility and Logistic Systems
Links Foundation
Turin, Italy
cristiana.botta@linksfoundation.com

***Abstract*— The widespread diffusion of the online channel in the retail marketplace is impacting modern society considerably in recent years. Given the growing demand, Business to Consumer (B2C) e-commerce entails a much higher complexity of the delivery process due to significant fragmentation of parcel shipments in the last mile, especially in urban areas, where traffic and congestion problems are arising together with environmental issues. All these aspects rise interest not only from companies – which strive to maintain a high target service level for their customers - but also for public administrations, that aim to foresee the implications of this phenomenon. In this context, the purpose of the study is to investigate the potential of an alternative solution to the traditional home delivery, namely the self-collection delivery service through automated parcel lockers. The research study is based on data gathered from an online survey submitted to a sample of residents living in the metropolitan city of Turin, Italy. The potential of parcel lockers to capture the actual demand will be assessed to determine the feasibility of the delivery solution under consideration.**

Keywords—Parcel Locker, E-freight, Online Consumers, Survey, City Logistics

I. INTRODUCTION

Nowadays, B2C e-commerce plays a crucial role in the profitability of most of the worldwide companies, in both mature and emergent markets. During 2019, B2C e-commerce in Italy has reached a turnover of 31.6 billion euros, with the biggest increase ever, compared to the previous year (+15%). As in the past, consumers buy online more products than services (products accounted for 18.1 billion euros) [1], [2]. Moreover, the first quarter of 2020 has registered a boom in e-commerce sales due to the COVID19 outbreak and the lockdown measures implemented all over Italy: during the third week of March the online consumer goods sales increased by 142.3% compared to the same week in 2019 [3]. In addition, the emergency has pushed many small retailers toward e-commerce. B2C e-commerce entails, however, higher complexity of logistic activities in the supply chain. As the most complicated segment of the logistic chain, last-mile delivery seems to account for about 30 percent of total transport costs (up to 50 in some cases) [4]. Thus, companies are striving to find alternatives to the traditional home delivery able to deal with the modern fast-changing business environment, which is characterized not only by growing volumes of delivered and returned parcels, but also by an increase in customer expectations and more intense market competition. In this direction, the most popular solution is the Collection-and-Delivery point (CDP), which provides consumers with a self-collection delivery service. When it comes to self-collection services, a clear distinction needs to be made between two options: attended (pick-up points) and unattended (parcel lockers).

In this context, the aim of this study is to define the consumers' adoption behaviour towards self-collection of parcels through an automated locker box to estimate its potential as a delivery solution. Hence, the most important variables that affect the decision to adopt this new self-collection delivery solution are investigated, highlighting the differences in perception among non-users and potential users. To this end, a regression analysis based on data collected via a survey is proposed.

This study is part of a wider project that aims to get an optimal positioning solution of locker boxes in the metropolitan city of Turin by investigating first the consumers' attitude towards e-shopping and then exploring their willingness to adopt the parcel locker as a delivery solution.

The paper is structured as follows: Section 2 draws attention on existing literature on the topic. Section 3 describes the methodology implemented to collect and analyse data, Section 4 presents the main results and Section 5 closes the paper discussing the main conclusions and limitations of this study.

II. LITERATURE REVIEW

Reference [5], [6], [7] highlighted that only a few studies focused on analysing the innovative solutions able to mitigate the last mile delivery problem from the customer's perspective. In particular, there is scarce literature that contributes to explain the customer's viewpoint regarding self-collection delivery via parcel lockers. CDP solutions were first studied by [8], that highlighted that attended solutions called service points ("shop-in-shop" model) were the dominant form of CDPs, thus it investigated the socio-economic characteristics and habits of service point users. In 2014, [9] pointed out the fast-spreading of alternative parcel delivery services such as the parcel locker in European metropolitan areas. Similarly, [10] highlighted the growing

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importance of parcel locker solutions for city logistics, drawing attention on users' preferences through a pilot survey in Poland.

In the last few years, more papers dealing with the study of automated parcel stations were published. However, most of them focus on city logistics, highlighting the impact of this innovative delivery solution from the logistic service provider perspective [11], [12], [13].

Hence, this study aims to contribute to the scarce existing literature about the topic, by providing insights on the uptake of parcel lockers in Italy from the customer's viewpoint.

III. METHODOLOGY

A. Online survey and data analysis

In order to collect the data, we conducted an online survey. First, we submitted the survey to a panel of 20 people for validity checks and feedbacks on the clarity of the questions. Then, we disseminated the final questionnaire to potential respondents across different channels. In particular, the survey was submitted through the mailing lists provided by the partners of the project, namely a university with 30'000 students and 2'000 employees (Politecnico di Torino), a research center with 150 employees (LINKS Foundation) and the Piedmont regional government. Moreover, the survey was disseminated through Facebook groups related to the city of Turin. The survey was left open for about 1 month (from 16/01/2020 to 21/02/2020) and we accepted only one answer per respondent.

The questionnaire was divided into three main sections: the first one investigated the socio-economic characteristics of respondents and their habits, the second one focused on consumers' attitude towards e-commerce, while the last one explored the potential of parcel lockers as a last-mile delivery solution. However, section two of the questionnaire is out of the scope of this paper.

We received a total of 1446 responses. We carried out an accurate data cleaning process on this preliminary set of responses, aimed at discarding incomplete or inconsistent responses. Moreover, to ensure geographical consistency of the answers, only respondents currently living in the metropolitan city of Turin were considered. After the data cleaning process, we arrived at 1140 usable responses. Among respondents, 1053 declared to be online consumers. Hence, we focused on them to investigate the potential of parcel locker.

To analyse the survey data, both descriptive and inference statistics were used. As concerns inference statistics, we implemented a logistic regression model to calculate the influence of different socio-economic characteristics on the willingness to adopt the parcel locker. Since the dependent variable is dichotomous (Yes/No), the use of logistic regression is appropriate. It calculates the probability p of the occurrence of an event (parcel locker adoption) for any type of predicting variable in the model, by applying the logarithm of the odds ratio in a logit function.

B. Description of the sample

Among the 1053 respondents involved in the study, 692 are females (65.7%) while 361 are males (34.3%). They are aged between 18 and 76, with a median age of 44. A remarkable share of respondents is well educated: over 60 percent holds at least a Bachelor's degree. Most of the respondents are employed (70.94 %) or students (23.46 %), while only 2.75 percent are unemployed, and 2.85 percent retired. Lastly, almost 50 percent of employed respondents earns more than 1500 euros per month.

IV. RESULTS

This section covers the results from descriptive and inference statistics across four topics, namely:

- Willingness by online consumers to adopt the parcel locker;
- Evaluation of specific features of the parcel locker;
- Socio-demographic characteristics of parcel locker adopters;
- Location preferences.

A. Willingness by online consumers to adopt the parcel locker

In this study, we investigated consumers' past experiences on collecting parcels from parcel lockers and their willingness to use them in the future (Table 1).

TABLE I. E-CONSUMERS' ATTITUDE TOWARDS THE PARCEL LOCKER

	N (Total = 1053)	% of total
I have already used it	268	25.4
I would like to use it again	257	24.4
I would not like to use it again	11	1.0
I have never used it	785	74.6
I would like to use it	731	69.4
I would not like to use it	54	5.1

On the one side we can notice that, among those who already collected a parcel through an automated box, 257 out of 268 (96%) would be willing to do it again. This remarks the very high customer satisfaction related to this delivery service, with only 4 percent of consumers regretting their choice. On the other side, we must underline the great potential of parcel lockers among those who have not tried it yet. They represent most of the sample according to Table 1 and these results should be encouraging for stakeholders investigating locker potential. To conclude, the share of potential adopters of parcel lockers equals 93.8 percent of the sample, while only a few non-adopters will not be willing to use this delivery solution under any circumstance.

B. Evaluation of specific features of the parcel locker

In order to better understand what specific features drive the adoption of an automated locker box solution, we asked respondents to rate some selected factors through a Likert scale from 1 to 5 (1 = "Not important", 5 = "Very important"). First, we asked opinions about five general characteristics of the last mile delivery services, namely: A1) the aversion to carrying the parcel from the delivery point to home, B1) the possibility to choose the exact time when to collect the parcel, C1) having a social interaction in collecting the parcel, D1) the price of the delivery service, E1) the sustainable impact of the delivery solution.

Then, we asked respondents their opinion about the following four specific factors of the parcel locker, namely: A2) privacy in collecting the parcel, B2) parcel collection 24h/24h, C2) safety risk, D2) technological barrier.

We analysed the data by comparing the median values of the responses across the two groups of potential adopters and non-adopters.
The results are displayed in Fig. 1, Fig. 2, Fig. 3 and Fig. 4, that show the minimum, the maximum, the sample median, and the first and third quartile of the distribution of responses.

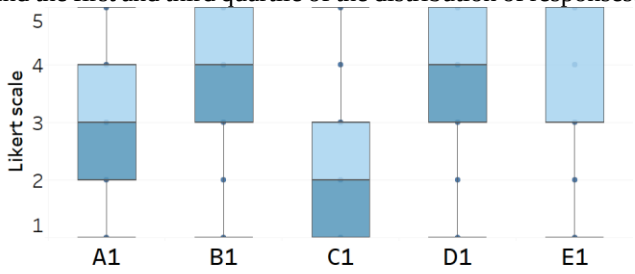


Fig. 1. Features of delivery services - potential adopters

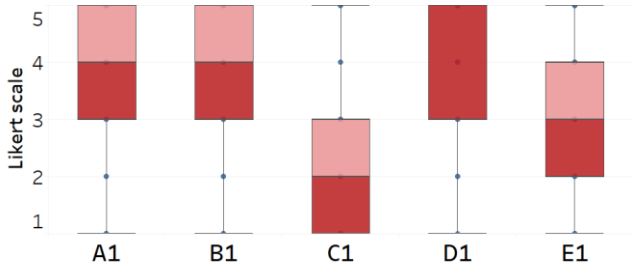


Fig. 2. Features of delivery services – non-adopters

By comparing results from Fig. 1 and Fig. 2, it looks clear that only two factors seem to be decisive when explaining the different attitude towards parcel locker solutions between the two groups of online consumers, namely A1 (i.e. carrying the parcel home) and E1 (i.e. the sustainability aspect of the delivery service).
Those not willing to use the parcel locker are more concerned about carrying the parcel on their own (median is equal to 4, Fig. 2). On the other hand, as expected, people with a positive attitude toward automated boxes are more willing to carry the parcel (Fig. 1). Furthermore, an evident difference results in the assessment of the delivery service sustainability. As discussed in many articles, the parcel locker is an environmentally friendly solution for several reasons. It allows to reduce the freight transport trip km in comparison with attended delivery, lowering consistently social externalities such as traffic congestion, greenhouse emissions, noise and energy consumption [10], [13], [14]. In this case, potential adopters seem to weigh much more this aspect in the choice of the delivery solution than non-adopters. Among the former ones, 78 percent ranked it with a score of 3 or above; while among the latter ones only 67.7 percent did the same. These findings are in line with [1], that highlighted for example that nowadays young Italian consumers value much more the sustainable aspects when purchasing online.
The remaining three features of the service do not seem to discriminate the two groups. Among these features, the social interaction in collecting the parcel seems to be the least important aspect for both groups. As expected, the price of the service is important for all consumers. In addition, the possibility to choose the exact time when to collect the parcel is valued in the same manner by the two categories of e-consumers.
As above-mentioned, we also asked respondents their opinion about four specific factors of the parcel locker (Fig. 3 and 4).

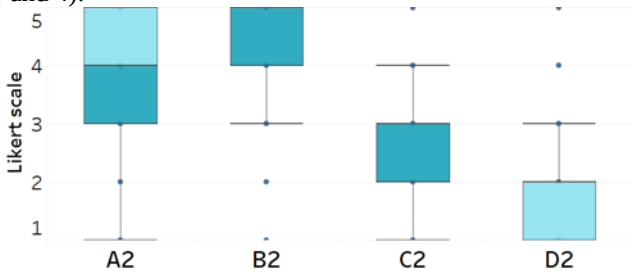


Fig. 3. Specific parcel locker features - potential adopters

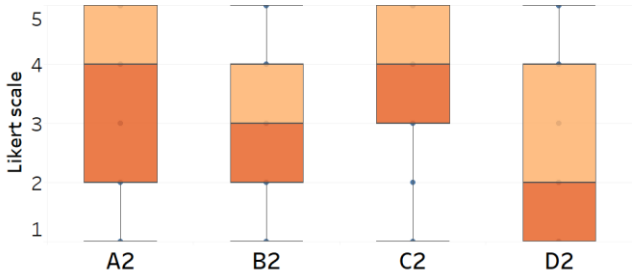


Fig. 4. Specific parcel locker features – non-adopters

First of all, we can notice that the opinions of non-adopters are more dispersed and, among the four features, only the median related to privacy (A2) in collecting the parcel is the same between the two groups. This aspect seems to be quite important for online consumers. It refers to the consumer's preference not to make others aware of his/her online purchasing activity. It is in general about not interacting with people when collecting the parcel, in order to keep confidentiality.
The different opinions about the other three features seem to better explain what aspects matter most for the two categories of respondents. The possibility to collect the parcels around the clock (B2), even during the night, is one of the biggest motives of differentiation of automated lockers from all the other delivery services. Not surprisingly, potential adopters value this opportunity much more. The median value of the answer for this feature is equal to 5, and respondents rated it almost only with scores equal to 4 and 5 on the five-level Likert scale. On the contrary, it turns out that for non-adopters this opportunity is less relevant, maybe simply because their daily routine does not prevent them from collecting the parcels during the day, during the usual opening hours of the shops. The median is equal to 3, thus at least fifty percent of non-adopters value this feature 3 or less. To what concerns the safety risk (C2), it might be highlighted as one of the drawbacks of locker boxes. They are installed on the streets and this fact might prevent people from adopting this solution because they are concerned about the risk of theft while collecting the parcel, especially if it contains high-value items. As confirmation, we can see that the safety risk is quite relevant for non-adopters. The median is equal to 4 and about

50 percent scored it with a 5 on the Likert scale (Fig. 4). On the other side, most of the potential adopters ranked this aspect between 2 and 3 (Fig. 3), and very few respondents gave it a score equal to 5. This comparison is symptomatic of extremely different attitudes by consumers. A possible reason why some people do not trust this solution is that they are not aware that parcel lockers are provided with cameras to reduce considerably the risk of theft or acts of vandalism.

To conclude, the technological barrier refers to the utilization of the locker box. Parcel Lockers are automated machines that require the customer to interact with a touch screen to enter an alpha-numeric code or to scan a QR code received by e-mail. This procedure requires consumers to be comfortable with this kind of technology. However, the potential users of locker boxes are online consumers, who are used to Internet and e-shopping, and thus it should not represent a relevant obstacle for them. As we can notice from the comparison between Fig. 3 and Fig. 4, parcel locker potential adopters do not perceive technological innovation as a barrier (D2). It is indicative that the median is equal to 1, meaning that at least 50 percent of them gave to this factor a score equal to 1. On the contrary, non-adopters are more concerned about the technological requirements of the solution under consideration.

C. Socio-demographic characteristics of parcel locker adopters

In order to determine the socio-demographic characteristics of potential parcel locker users, we performed a logistic regression since the output is dichotomous (0 = "I would not be willing to adopt or use again the parcel locker", 1 = "I would be willing to use the parcel locker as delivery solution"). We balanced the sample disproportion between males and females applying relative weights before running the logistic regression.

SPSS software has been used for the analysis, implementing the Enter method. The category variables are Gender, Age, Education level, Tenants, Job, Income, Means of Transport Used, Hours online and Hours away from home. For the category variables encoded in dummy variables, the reference categories are: 18-30 (Age), Secondary school (Education), Live alone (Tenants), Student (Job), No income (Income), Less than 1 hour (Hours online).

Concerning the goodness of fit of the model, the Nagelkerke's R-squared resulted equal to 0.127 and the model passed the Hosmer-Lemeshow's test with a significance of 0.858 (Table 2).

By testing variables on a 95% confidence level, the outcome of the analysis draws attention on two variables. The most significant variable seems to be "Over 66" (Age), which is negatively correlated with the intention to adopt parcel locker as a delivery solution. This means that the older group of respondents point out a significantly different attitude towards parcel lockers when compared with the youngest (reference category is 18-30). Similarly, the other two categories (31-50 and 51-65) are less inclined to this delivery solution than the youngest ones, but not in a significant manner. These results are in line with expectations since older people are generally less receptive to trying new technologies. Moreover, they are consistent with findings from [12], [15], [16], that stated that automated locker boxes are preferred by younger people. Besides, [16] defined the most likely age range of parcel locker users (25-34), which is very close to the output of our analysis (18-30). The other significant variable is "4 people" (Tenants). It seems that online consumers who live with 4 people have a significantly negative attitude towards parcel locker adoption if compared to those living alone (reference category). This interesting outcome may be a consequence of the different risk of failed delivery faced by the two categories of customers. An online consumer living alone probably is more inclined to adopt parcel locker because (if she works or goes to university) during the day there is nobody at home, thus her situation and daily routines are not in line with home delivery. On the contrary, the scenario is different for a worker/student living with many people (specifically 4 people): it is likely that even if the one who placed the order is not at home, someone living with her might be able to receive the parcel and avoid the failed delivery. This fact presumably lowers the intention to adopt self-collection delivery services such as the parcel locker, because consumers can exploit the convenience of home delivery solution. If we extend the confidence level to 90%, other two variables acquire statistical significance. The first one is related to the means of transport used. It seems that using car-sharing for daily trips has a negative effect on consumers' intention to use automated locker boxes. This is in line with expectations because, more likely, individuals paying for a car-sharing are not willing to stop and collect their parcel on the street, since this would increase the cost of the mobility on-demand service. The other significant variable seems to be related to the hours spent online. Spending 10 or more hours online has a significant negative impact on the willingness to adopt a parcel locker solution. This might be due to a specific lifestyle of consumers in this category. For example, consider a scenario where people work from home and spend several hours online, they would prefer the home delivery, more convenient and in line with their lifestyle. Furthermore, it is important to mention that all the other variables are not statistically significant on the output; this fact is interesting. According to the analysis, gender does not affect the intention towards this delivery solution and this is in line with other two recent articles on the same topic [15], [17]. Similarly, education seems not to be relevant, which is someway unexpected since individuals with higher education could possess more knowledge about parcel locker functioning and the positive implications on the environment and society. However, the findings are in line with [14]. To what concerns the income, it is interesting to mention the non-significant effect on customers' intention to use the parcel locker, which differs from the results of other articles [8], [12], [14].

TABLE II. SOCIO-ECONOMIC CHARACTERISTICS OF PARCEL LOCKER USERS

Significant variables	Parcel locker adoption
	Odds ratio
Age over 66	.026*
4 Tenants	.368*
Car-sharing	.328#
More than 10 hours online	.223#
Constant	14.739*
Regression analysis	Logistic regression
Dependent variable	1 = Potential adopter 0 = Non-adopter

Number of cases	1053
Adjusted R^2	0.127

#p < 0.10, *p < 0.05, **p < 0.01, ***p < 0.001

D. Location preferences

This section draws attention to parcel locker location preferences, investigating opinions from potential adopters of this innovative delivery service (Table 3).

TABLE III. LOCATION PREFERENCES FOR PARCEL LOCKERS

	N (Total = 988)	% of the total
Close to home	791	80.1
Close to the workplace	381	38.6
In front of a supermarket	366	37.0
At a gas station	56	5.7
In a parking area	38	3.8
In a shopping centre	219	22.2
In a university campus	164	16.6
Other	19	1.9

To what concerns the preferred location for a parcel locker, there is no doubt that consumers would like to have it available close to home (80.1%). This result is very much in line with findings from the research study conducted by [16] on a sample of respondents in Poland. It pointed out that 79 percent out of the total of 2933 respondents declared their preference for a parcel locker located close to home.

The second most preferred location for a locker is close to the workplace. Reference [18] pointed out that most online purchases are delivered at home or work (78%) because this does not require personal travel by consumers to collect the parcel. The outcome seems to emphasize that the majority of consumers would be willing to adopt the parcel locker and exploit the benefits of this innovative solution. However, they would prefer not to change their routine.

Nevertheless, a good share of respondents is considering also to integrate the parcel collection in their daily routine, for example while performing another activity, such as doing grocery. The favourite locations are close to a supermarket and in a shopping centre. In a similar study carried out in Belo Horizonte (Brazil), respondents stated their location preference without being provided with the choices "Close to home" and "Close to the workplace". They ranked the supermarket and the shopping centre as their favourite locations by far, hence the results are very much in line [19]. Finally, consumers do not seem enthusiastic about parcel lockers located in a parking area (3.8%) or at a gas station (5.7%). This might be due to their concern related to safety risk when collecting the parcel.

To complete the analysis related to parcel locker location preferences, we asked respondents to state how many minutes they would be willing to deviate from usual daily trips (e.g. home-workplace or home-university) to collect a parcel in a locker box (Fig.5).

We can notice from Fig. 5 that only 6.0 percent of potential adopters are not willing to deviate at all, which means that they would like to have the parcel locker right in front of their home place or workplace, and not do any additional effort. On the other side, the majority of e-consumers (38.2%) are available to deviate between 5 to 10 minutes to collect their parcel.

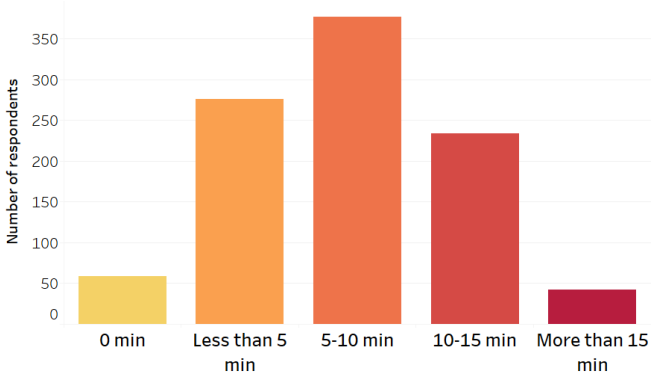


Fig. 5. Maximum deviation (in minutes) to collect a parcel in a locker box

V. CONCLUSION AND DISCUSSION

The steep growth of e-commerce in recent years has led to a remarkable increase of home deliveries, which is widely acknowledged as one of the main problems of city logistics to what concerns urban mobility and sustainability. Consequently, this accelerated the interest of public administrations to implement city logistics measures. Despite the cultural and social differences between residents in different cities, parcel volumes and sustainability concerns are developing consistently throughout Europe. With this research, we studied the significant socio-economic and behavioural variables that affect the decision to adopt the parcel locker as a delivery solution, providing insights related to current utilization of this innovative delivery solution in the metropolitan city of Turin.

According to the outcome of the analysis, among online consumers, the parcel locker user has age below 66 and she does not live with many people (4 people). She does not use car-sharing and she usually spends online less than 10 hours per day. The online consumer mainly adopts the parcel locker because she appreciates above all the possibility to collect the parcel around the clock. Moreover, she considers sustainability as a really important feature of a delivery service. She does not perceive interacting with an automated solution as a technological barrier and she does not consider that the safety risk related to this solution is significant. As concerns the location preferences, most potential users prefer to have the parcel locker close to home, close to the workplace or alternatively in front of a supermarket, in order to integrate the parcel collection in the daily routine. Most of consumers are willing to deviate from the daily trip to collect the parcel, between 5 to 10 minutes.

To conclude, this study makes several contributions. From the theoretical viewpoint, the paper enriches the scarce existing literature about the uptake of parcel locker, especially in Italy. The findings provide a better understanding of consumers' attitude towards this innovative delivery solution and the socio-economic characteristics of potential adopters. To what concerns the practical implications, this study provides relevant insights for both public administration and logistic service providers. It highlights the tremendous potential of this delivery service

among consumers (988 potential adopters out of the 1053 online consumers that replied to our survey). If lockers were implemented effectively in terms of number and optimal positioning, there would be meaningful positive implications. Public administration and transport policymakers would reduce the negative social externalities associated with home delivery, while logistic service providers would be able to cut down their operating costs by consolidating shipments and avoiding failed deliveries.

Despite the contribution of this research study, there is a limitation related to the nature of the sample. The age distribution within the sample is not representative of the population, especially to what concerns the share of respondents in the age over 66. Nevertheless, the small share of old people in the sample seems to be a common problem because they represent a category much more difficult to involve in the survey, especially when the survey is conducted online [5]. This limitation offers opportunity for further research in the field.

Moreover, future research could also integrate the results of this exploratory study, that focuses on behavioural intention (consumers' attitudes towards parcel locker), by investigating the relationship between behavioural intention and actual behavior in the adoption of the parcel locker. In fact, actual behaviour is sometimes affected by factors not directly under the control of the individual, which implies she will not act even if she would like to [5]. In the case of parcel locker, this means that a consumer might have a strong intention to adopt the parcel locker, however, this might not be translated in actual adoption of the service because not conveniently accessible, for instance.

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