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## Usability of the parcel lockers from the customer perspective – the research in Polish Cities

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### Abstract

The growth of B2C e-commerce market results in the increase of importance of last mile deliveries in the city area. Due to e-commerce's generic specificity, functioning of the deliveries in e-commerce on B2C market is based on home deliveries. Due to influence on the growing demand for deliveries, which consequently could have the impact on traffic and congestion problem as well as city environment, it is important to look for the alternative measures, which will help to reduce this negative impact. In recent years a very interesting and popular solution became parcel lockers as the efficient last mile delivery system. This paper is focused on the assessment of usability of this measure based on the example of InPost company system.

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### 1. Introduction

Development and the growing importance of e-commerce offer new opportunities to integrate and improve supply chains (Kot, Starostka-Patyk, Krzywda 2009). On the other hand, however, they pose new challenges in terms of supply chain management, due to the specificity of delivery (Visser, Nemoto, Brown 2014). One of the

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biggest problems with the organization of the supply of goods to customers in e-commerce is that there is a significant fragmentation of the orders, resulting from the fact that individual customers usually buy small amounts of products. Additionally, their expectations regarding fast realization of the orders have an influence on competitive market of transport services, which is forced to respond dynamically to the emerging demand for transport. Due to that fact and in order to satisfy the customer, delivering companies provide their services regardless of the degree of use of loading spaces of vehicles. On the other hand, at this point it is worth to highlight the problem of inadequate fleet of transport companies, which is not adapted to the needs of e-commerce, particularly in the context of the size of the vehicles in relation to the volume of deliveries. Therefore, one of the most important categories of good practices in current urban freight transport systems become solutions to rationalize the last mile delivery, through the use of (Allen, Thorne, Browne 2007):

- reception boxes, permanently fixed to a wall outside the customer's home, to which access is possible using a key or an electronic code; customer can be alerted of the delivery by mobile phone or email; used mostly for parcels, but can be used for foods if the boxes are temperature controlled;
- delivery boxes, owned by the retailer or delivery company; filled with the goods at the distribution depot, and then temporarily attached to the home via a locking device fixed on the wall in a secure place at the customer's home; empty boxes or boxes containing returned goods are then collected by the delivery company either as a separate collection round or as part of the next delivery;
- controlled access systems, provide the delivery driver with a means of gaining access to a locked area to leave the goods in; a key may be sealed inside a unit, which is mounted in a location where delivery staff can access it; the driver enters an access code into the sealed unit to release the key and open the nominated delivery location to leave the goods;
- collection points, based on the use of locations other than customers' homes to which goods are delivered (the nearest Post Office, convenience store or a petrol station; often have long opening hours. Goods are delivered by the retailer or their carrier to the collection point and the customer is informed that their order is ready for collection. Customers may arrange with the collection point for the goods to be delivered to their home. Collection points result in fewer delivery locations and improved drop density.
- locker-banks are groups of reception box units (lockers), which are similar to collection points although they are not sited at each customers premise but sited in apartment blocks, work places, car parks, railway stations etc. Customers are not usually assigned to their own locker to optimize usage (lockers have electronic locks with a variable opening code, and can be used for different customers on different days). They may be dedicated to one delivery company or used by many. Customers may be notified by message about when their delivery has arrived, the box number and location, and the code to open the box. Locker-banks require the customer to make the final leg of the journey. However, locker-banks are located to make the deviation in customers' journeys as short as possible.

Important and popular solution become locker-banks, as they favor the reduction of traffic and improve the use of cargo compartment by consolidating deliveries and making them more independent from the available time slots. Example of this kind of measure is well-known in Poland parcel lockers system, implemented by InPost company.

Parcel lockers are a very interesting and efficient measure. According to the results of the analysis presented above, this kind of delivery system is well assessed by users. Moreover, this solution has very high potential and it could be utilized not only in B2C e-commerce market as this is an interesting example of reverse logistics services outsourcing. Nevertheless, implementation and efficient utilization of parcel lockers require the support of local residents, courier/delivery companies and the owners of places where parcel lockers are located. Additionally, local authorities must be involved in the stage of implementation with regard to the permission and the selection of sites. It is directly connected with major role of local authorities in the development of sustainable city logistics as it may help to achieve better results regarding the usability of this measure. Nowadays more than 3000 InPost parcel lockers are utilized in 20 countries all over the world (Bilik 2014). In Germany similar system has been implemented by Deutsche Post in cooperation with DHL (*Deutsche...* 2016).

## 2. Analysis of the usability of the parcel lockers from the customer perspective – objectives and methodology

Pursuant to the Environmental Protection Act, sustainable development is defined as "social and economic growth involving a process of integrating political, economic and social activities in such way so as to preserve the natural balance and sustainability of fundamental natural processes, in order to guarantee the possibilities to meet basic needs of individual societies or citizens in both contemporary and future generations" (Act... 2001). That means that the current needs of city dwellers should not be met at the future population's expense. One of the areas addressed by sustainable development policies is ecology and impact of business activity on the natural environment. The special issue is the emissions aspect. In this context, the study was expected to provide answers to several fundamental questions. Firstly, to what extent does the present location of the parcel lockers have "a negative environmental impact"? Secondly, what can be improved in the parcel locker location so as to mitigate "the negative environmental impact"? Finally, what is parcel locker users' environmental awareness like?

The InPost company has been following the sustainable development trend through, among other things, its action called „ECOmission” (InPost... 2016). In their operations, InPost "search for new solutions that enhance eco-friendly activities". The study in question may be used as a starting point for working out new, "eco-friendly" activities connected with parcel locker location.

The purpose of the study was to evaluate parcel locker services in Poland. The analysis in particular aimed to find out to what extent the location of parcel lockers in the given cities fits into the strategy of sustainable development and also InPost's strategy entitled „ECOmission”. This study was conducted under the Polish-Norwegian project called GRASS (Green and Sustainable Transport Systems in Cities) by researchers from Maritime University of Szczecin in cooperation with InPost – a postal services company. The survey addressed the parcel locker users registered in InPost's database. InPost sent out e-mails to their customers asking them to fill in anonymous online surveys (Evaluation... 2016). The survey included 23 open-ended and closed-ended questions. This paper covers the surveys completed in February 2015. Estimates regarding the whole population were made using confidence intervals for the structure function, assuming the confidence coefficient of 0.95:

$$P\left(\frac{m}{n} - u_{\alpha} * \sqrt{\frac{\frac{m}{n}(1-\frac{m}{n})}{n}} < p < \frac{m}{n} + u_{\alpha} * \sqrt{\frac{\frac{m}{n}(1-\frac{m}{n})}{n}}\right) \cong 1 - \alpha \quad (1)$$

where:

- n – sample size;
- m – number of elements distinguished in the sample;
- $u_{\alpha}$  – distribution function value of normal distribution, for confidence coefficient  $1-\alpha$ ;  $1-\alpha=0.95$  was assumed, resulting in  $u_{\alpha} = 1.96$  (Zeliaś, Pawełek, Wanat 2002).

For average grades (questions 11,12,15), the confidence interval for a large sample with the assumed confidence coefficient  $1-\alpha$  0.95 was estimated:

$$P\left(\bar{X} - u_{\alpha} \frac{S}{\sqrt{n}} < \mu < \bar{X} + u_{\alpha} \frac{S}{\sqrt{n}}\right) = 1 - \alpha \quad (2)$$

$$S = \sqrt{\frac{1}{n} \sum_{i=1}^n (x'_i - \bar{X})^2 f_i} \quad (3)$$

$$\bar{X} = \frac{1}{n} \sum_{i=1}^n x'_i f_i \quad (4)$$

where:

- $n$  – number of surveyed respondents;
- $\bar{X}$  – the mean of the sample for the frequency distribution
- $S$  – standard deviation of the sample for the frequency distribution ;
- $u_\alpha$  – distribution function value of normal distribution, for confidence coefficient  $1-\alpha$  ( $1-\alpha=0.95$  was assumed, resulting in  $u_\alpha = 1.96$ );
- $x'_i$  – grade value;
- $f_i$  – number of respondents who awarded grade  $x_i$ .

### 3. Analysis of the usability of the parcel lockers from the customer perspective – the results

#### 3.1. Respondents group

In the period in question, completed surveys were returned by 2933 persons. 45% of them were women, and 55% were men. The respondents' age is presented in Table 1.

Table 1. Age of parcel locker users.

Age range	Number of respondents	% of respondents
below 18 years	69	2.35
18-24	420	14.32
25-34	1209	41.22
35-44	776	26.46
above 44	459	15.65
Total	2933	100.00

The most numerous group was made up by people who may be assumed to be young and occupationally active. It is possible to state with probability of 95% that between 39.44% and 43% of all the parcel locker users fall within the age range from 25 to 35. The "25-34" generation uses the internet on a daily basis and for them there are no mental or technological barriers with regard to online shopping. The study shows a correlation between using parcel lockers and using IT. Almost 88% of the respondents learned about parcel lockers when they were using the internet for various purposes (online shopping, online advertisements, social media, other online activities).

The survey participants came from all the voivodeships, but the largest group was made up by residents of Mazowieckie Voivodeship (Tab. 2).

Table 2. Structure of respondents as per voivodeship.

Voivodeship	City with the greatest number of completed surveys per voivodeships			
	Number of respondents	City	Number of respondents	% of surveys in the voivodeship
mazowieckie	587	Warszawa	399	<b>67.97</b>
śląskie	455	Katowice	53	11.65
małopolskie	298	Kraków	125	41.95
wielkopolskie	248	Lublin	61	24.6
dolnośląskie	239	Wrocław	125	52.3
pomorskie	216	Gdańsk	97	44.91
łódzkie	188	Łódź	103	<b>54.79</b>

zachodniopomorskie	138	Szczecin	83	<b>60.14</b>
kujawsko-pomorskie	118	Bydgoszcz	45	38.14
podkarpackie	107	Rzeszów	34	31.78
lubelskie	104	Lublin	61	<b>58.65</b>
warmińsko-mazurskie	58	Olsztyn	19	32.76
lubuskie	52	Zielona Góra	13	25
świętokrzyskie	45	Kielce	22	48.89
podlaskie	43	Białystok	21	48.84
opolskie	37	Opole	14	37.84

Within the individual voivodeships, most respondents were inhabitants of Warsaw (67.97% of the surveys were returned from Warsaw), Szczecin (60.4%), Lublin (58.65%) and Łódź (54.79%).

### 3.2. General evaluation of parcel locker services compared to other services

Based on the research study it can be stated with probability of 95% that parcel locker users are satisfied with the service. The average grade given by the whole population falls between 8.7 and 8.9 in the scale ranging from 1 to 10, where 10 is the maximum grade. Also, with probability of 95%, between 33.8% and 37.3% parcel locker users would grant the maximum grade to parcel lockers (Fig. 1).

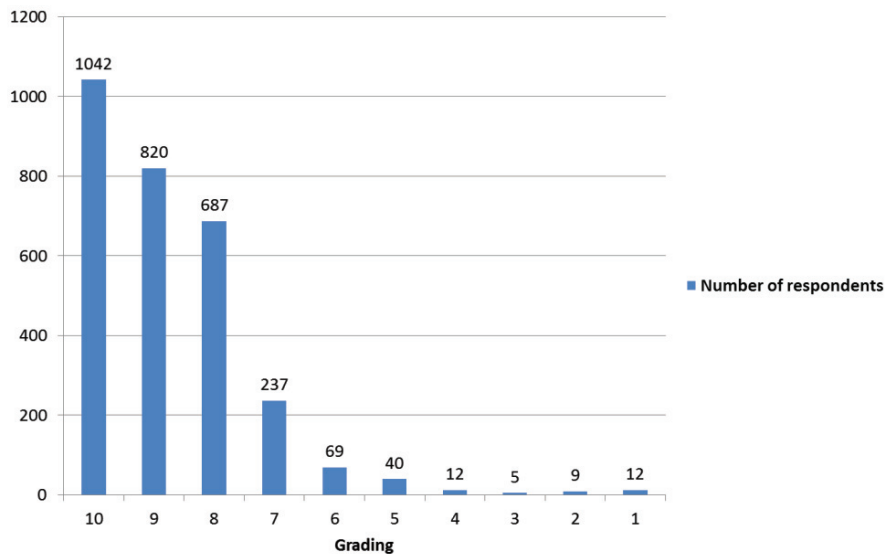


Fig. 1. General evaluation of parcel locker service (10= very good; 1= very bad).

The parcel locker users definitely prefer this service to the competitive solutions (Fig. 2). Nearly 89% of the respondents declared that the parcel locker service is better than the Polish Post.

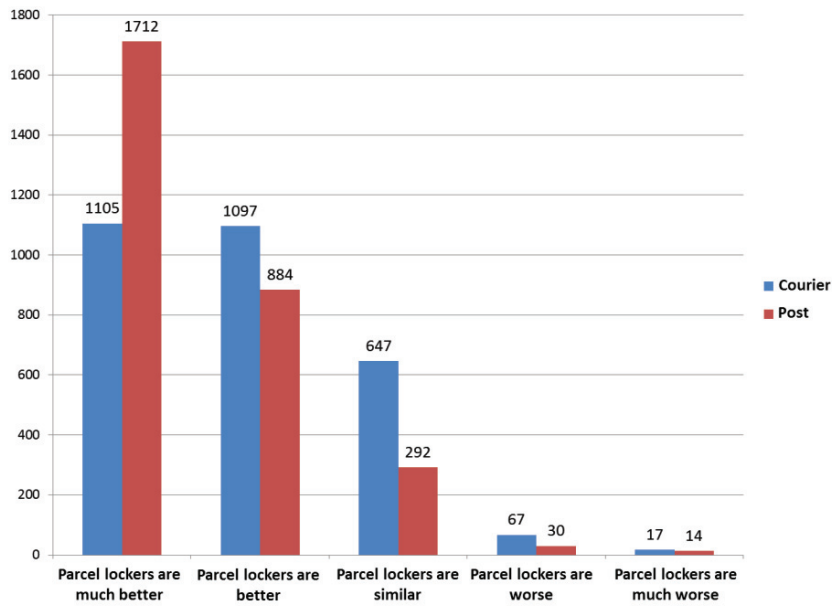


Fig. 2. Comparing the parcel locker service to other service providers.

Other courier companies are slightly more competitive. However, even they have lost to the parcel lockers. Over 75% of the respondents found the service rendered by InPost better or much better than courier service.

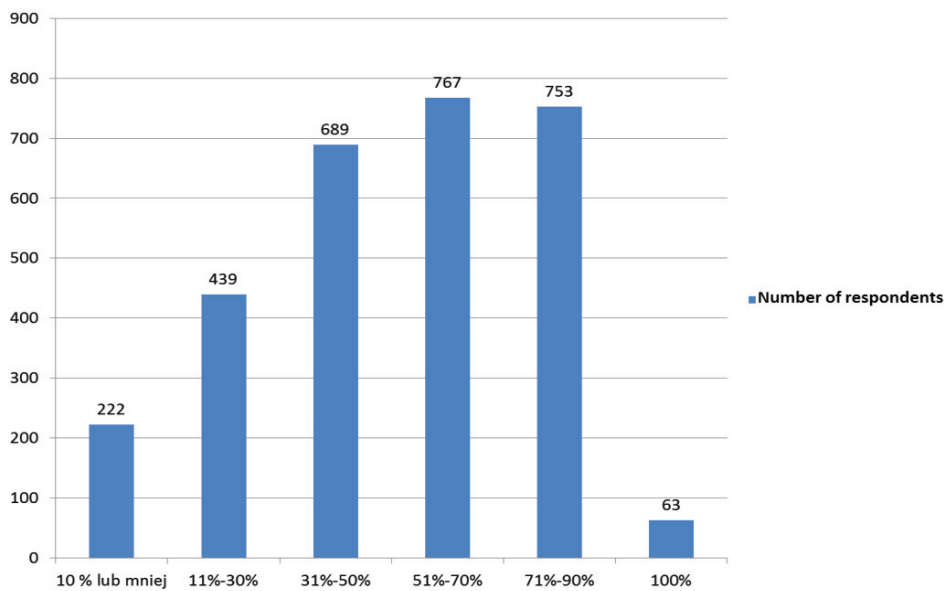


Fig. 3. Share of orders delivered via parcel lockers in total orders.

InPost's customers' satisfaction with the service translates into choosing parcel lockers when there is a need to pick up/ dispatch a parcel (Fig. 3), and also into probability of recommending the service to others (Fig. 4). Pearson

correlation coefficient amounted to 0.71 for the correlation between the service evaluation and choosing the service, and 0.83 for the correlation between the parcel locker service evaluation and probability of recommending it to others (Zeliaś, Pawelek, Wanat 2002).

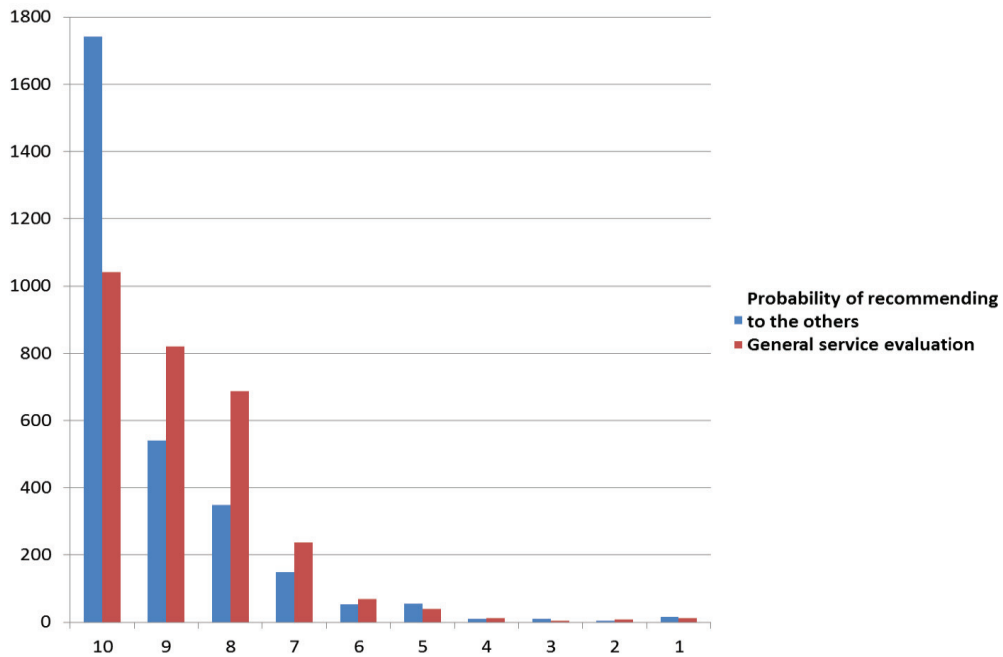


Fig. 4. Parcel locker service evaluation and probability of recommending it to others.

However, it must be stressed that the respondents use the parcel locker service relatively seldom. The largest group are the persons who picked up or dispatched a parcel only several times in a year. Assuming the probability of 95%, the group comprises from 52.17 to 55.78% of all persons using the parcel lockers. Moreover, the survey was addressed to InPost customers only. The research study carried out in 2012 under the C-Liege project, in which Szczecin inhabitants were surveyed with regard to courier services and parcel lockers, showed that 54% of courier service users had not even once collected a parcel from a parcel locker.

In view of InPost customers' satisfaction with the service, it may be assumed that any measures taken to improve the parcel locker use frequency should also translate into attracting new individual customers. The reason for the low frequency of using parcel lockers may also be the fact that some suppliers (e.g. online stores) do not offer the parcel locker service (Fig. 5).

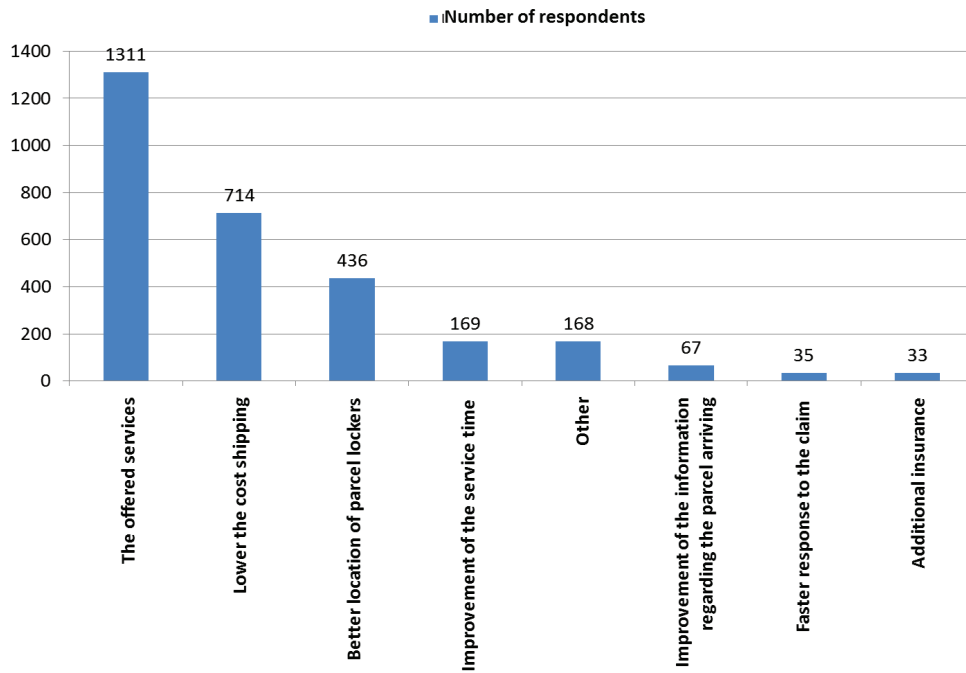


Fig. 5. Criteria for more frequent use of parcel lockers.

In this context, an interesting situation was created by the responses to the question whether a customer decides not to shop at an online store if it does not provide the possibility to collect the parcel from a parcel locker (Fig. 6).

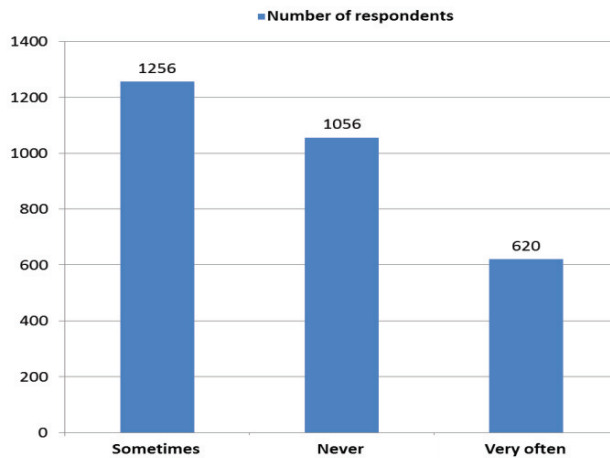


Fig. 6. Decision not to shop at an online store that does not offer a parcel locker service.

Over 40% of the respondents make their purchases at online stores that do not offer the parcel locker service, if they cannot buy the things in any shop that makes it possible to collect the purchased items from a parcel locker.



However, only slightly fewer respondents do not pay any attention to this aspect. Therefore, to make the use of parcel locker services more frequent, it would be necessary to look at other parameters.

For the respondents, the most important criterion in selecting the service provider (Fig. 7) is the service price (79.29%), and then the time needed to complete the service (69.7%) and 24/7 access to the service (66.48%).

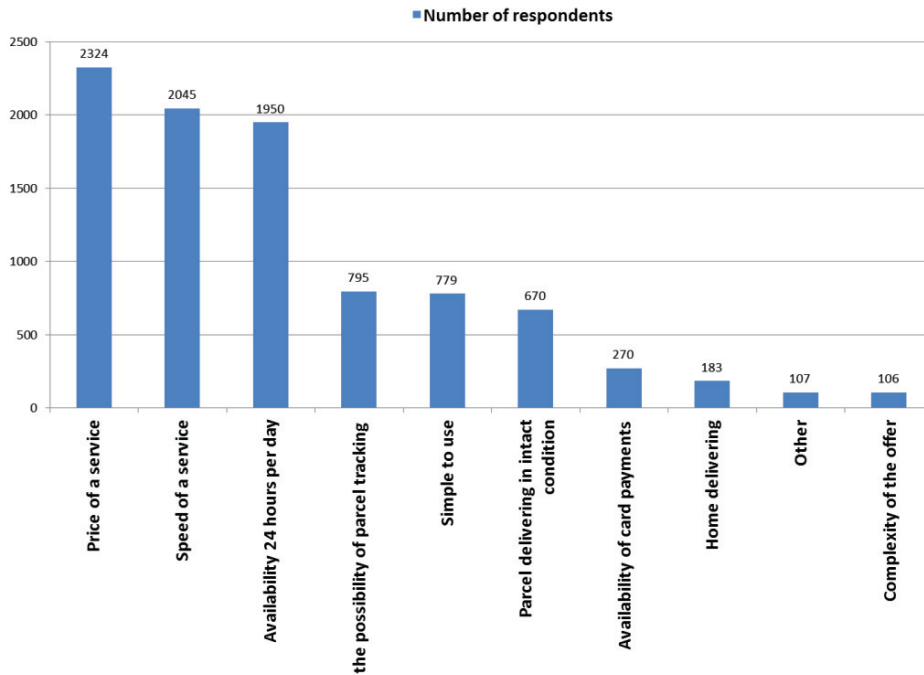


Fig. 7. Criteria for choosing parcel locker service.

InPost's service offer attracts individual customers mainly because of the possibility to collect parcels at any time (Fig. 8).

The third most important factor in this context is a convenient location. Since all parcel lockers may be used on a 24/7 basis, to make InPost offer more attractive it might be reasonable to look for improvements in the parcel lockers deployment. In this context, it is worthwhile to compare the analysed data with the aforementioned 2012 research study results (Fig. 9).

Only 8% of Szczecin inhabitants using courier services (including parcel lockers) indicated the 24/7 access as a criterion in choosing courier services. For more of them (12%) it was more important to have the ordered goods delivered to their homes. Therefore, the parcel locker location should be attractive enough to "beat" the need to pick up the parcel oneself (Fig. 9).

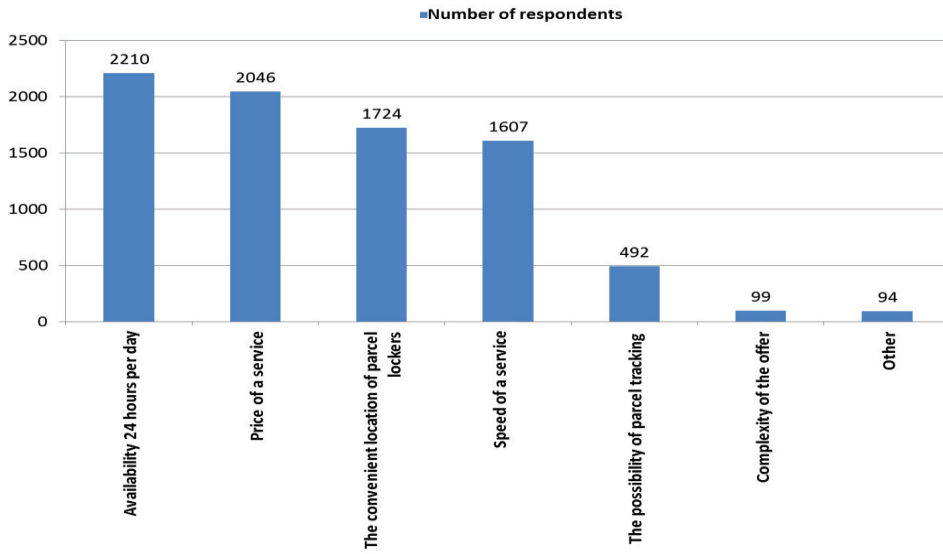


Fig. 8. Criteria for choosing parcel locker service.

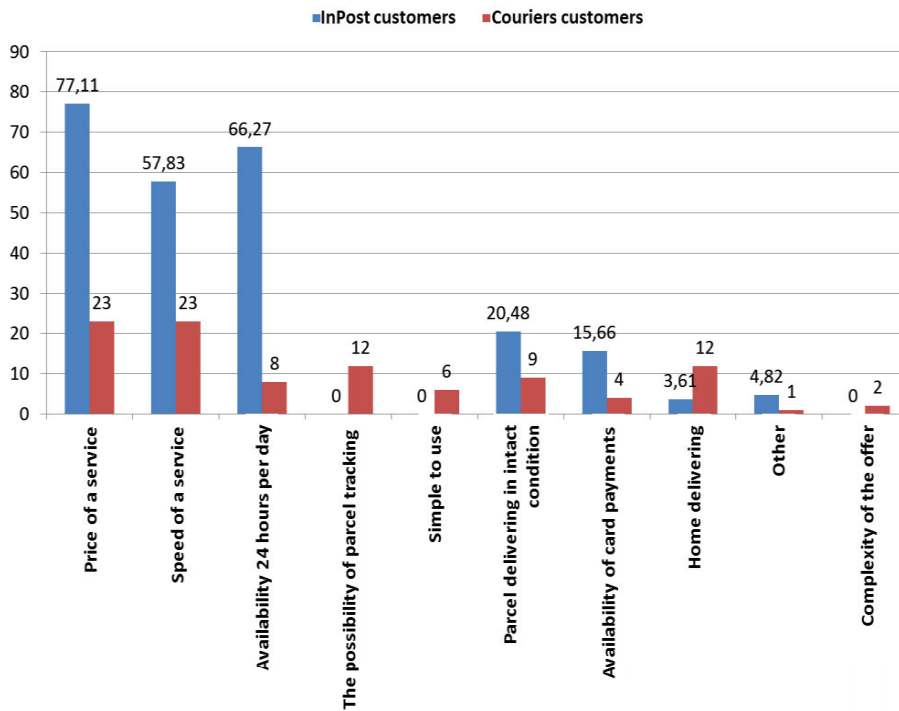


Fig. 9. Comparing the criteria for choosing services by Szczecin-based parcel locker users (2015 study) and Szczecin-based courier service users (2012 study).

### 3.3. Evaluation of parcel locker locations

The respondents were asked about the parcel locker locations. Almost 40% of the respondents consider the location of parcel lockers as very good. The mean grade for parcel locker location is 8.25. However, nearly 15% of the surveyed persons were willing to use parcel lockers more often if their locations improved (Fig. 10).

The respondents favour the parcel lockers found in the vicinity of their homes (2319 responses, i.e. as many as 79% out of the total of 2933). The next in rank are the parcel lockers located on the respondents' way from work and in places where it is possible to park the car. The least attractive parcel locker locations for persons intending to pick up a parcel are: in the vicinity of a shopping centre and tram/ bus stops. These results correspond to the way of reaching the parcel lockers: the most frequent way to reach a parcel locker was by car (1501 responses) and on foot (1055 responses). Moreover, it was found that 1370 respondents did not need to detour to pick up a parcel from the parcel locker, and 1346 respondents had to cover an extra distance between 1 and 5 kilometres. This constitutes 92.6% of the total number of the respondents.

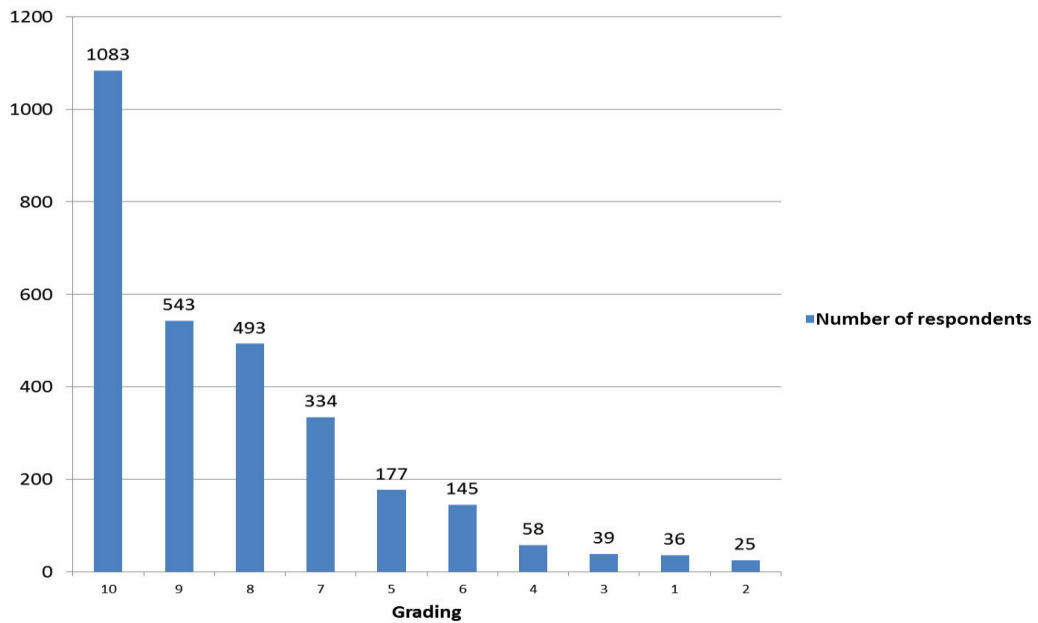


Fig. 10. Evaluation of parcel lockers location (10= very good; 1= very bad).

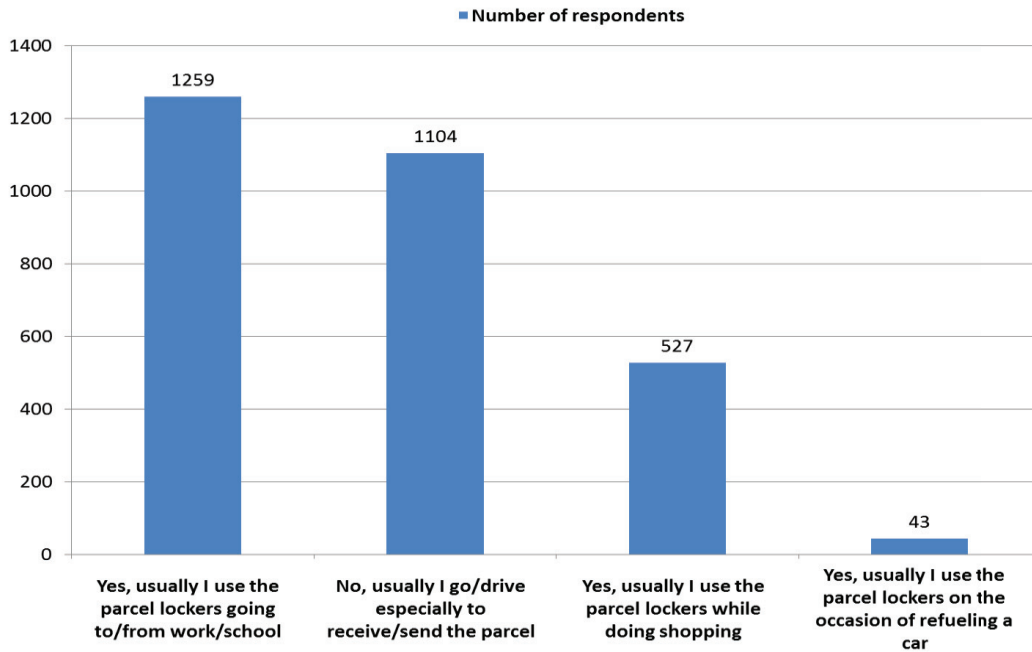


Fig. 11. Picking up a parcel "while running other errands".

To assess the parcel lockers location, it is also interesting to analyse the replies to the question whether the people go to that location only to pick up the parcel, or whether they use the parcel lockers while running other errands (Fig. 11).

Comparing the responses presented at Figure 11 with other questions it may be assumed that the most numerous group of users are those who reach the parcel lockers by car on the way to or from work. The second group includes the persons who go to the parcel locker location only to pick up the parcel. These will use the locations that can be reached easily on foot. If we assume that both petrol stations and shopping centres have parking spaces, considering that nearly 51% of the respondents indicate a possibility to park a car as one of the location choosing criteria, one may wonder why they don't use other services (e.g. doing the shopping or refuelling the car) alongside collecting the parcel. As shown at Figure 12, more than 29% of the respondents never combined picking up a parcel with the above mentioned activities.

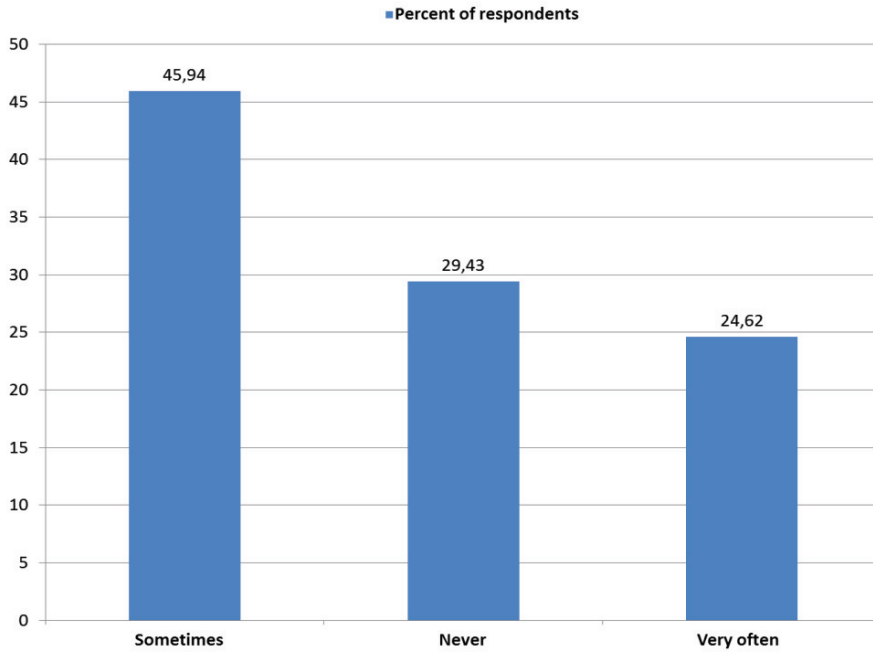


Fig. 12. "Running other errands" alongside using a parcel locker.

Assuming that respondents go to work or school 5-6 times a week, they do their shopping on a less frequent basis, and refuel their cars even more seldom, the reasons for "car parking" on the way home only to collect a parcel should be related to the frequency of the above mentioned activities. However, what stops the parcel locker users from doing their shopping or refuelling their car when they have stopped to collect a parcel from a parcel locker on their way home? It should be noted that the respondents from the cities with the highest response rates (Warsaw – 67.97%, Szczecin – 60.14%, and Lublin – 58.65%) most often use the parcel lockers located in the vicinity of shopping centres (Fig. 13).

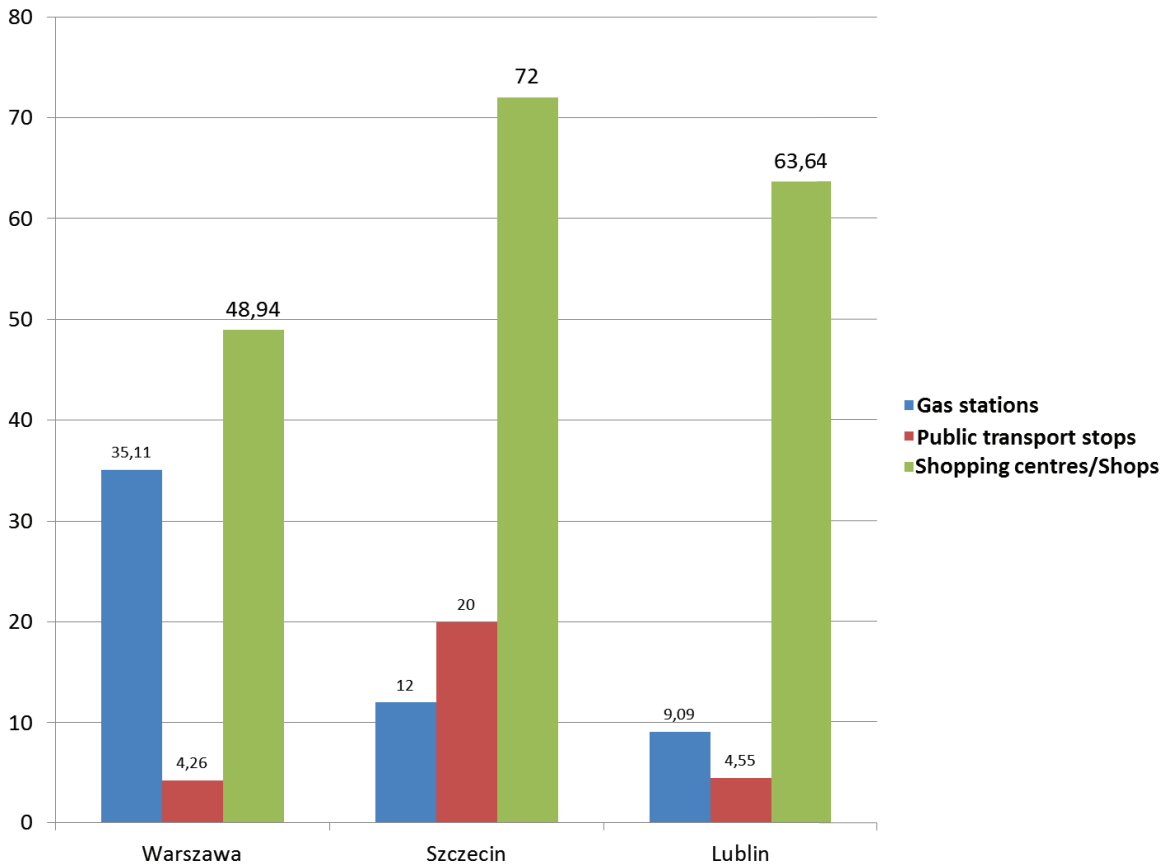


Fig. 13. Percentage of parcel lockers located in the vicinity of a city's logistic entities.

Parcel locker users could be encouraged to make eco-friendly choices by applying incentive systems similar to those employed by petrol stations located close to shopping centres, i.e. doing shopping at a store is rewarded with a discount for refuelling. Similarly, a person collecting a parcel from a parcel locker could receive a discount for refuelling or extending the time of free-of-charge parking at the shopping centre car park. This solution may be consistent with InPost's "ECOmission" strategy.

In the context of sustainable development, interesting findings were made with regard to proposing better parcel locker locations (Fig. 14).

The survey participants were asked to provide a short description of a place where they would like their parcel locker to be located. Over 22% of the parcel locker users living in Warsaw and Szczecin indicated they should be close to tram/bus stops, while in Warsaw preferred locations were predominantly tube stations. These results suggest that locating parcel lockers in the vicinity of tram or bus stops should be considered.

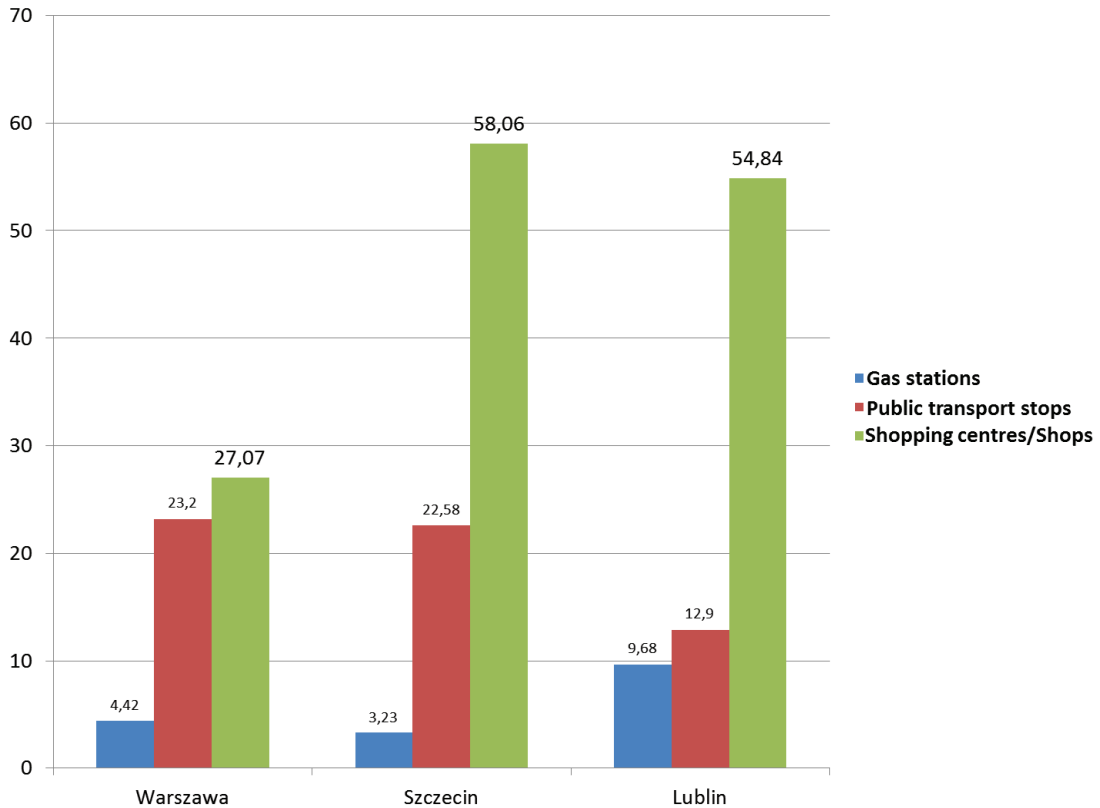


Fig. 14. The best locations for parcel lockers.

#### 4. Conclusions

Summing up, it is legitimate to state that parcel locker service is trusted by InPost's individual customers. Parcel locker users show an eco-friendly attitude by collecting their parcels "on the way to/from work". They also propose parcel locker locations in the vicinity of public transport stops and stations. In view of the 6th place taken by this option in the list of criteria for choosing parcel locker location, it would be interesting to know whether following the users' recommendation by InPost would result in a decrease in car use.

It seems that in the next few years the popularity of the parcel lockers will increase. Moreover, this idea could be utilized not only on B2C e-commerce market. Interesting challenge for this kind of delivering system are shop deliveries. This kind of solution was proposed under CityLog project (*CityLog...* 2016). CityLog BentoBox is an innovative concept consists for the carrier in delivering out of hours of shopping with available packages to the recipients in a smart package system. This system was tested in Berlin and in Lyon (*CityLog...* 2016).

The utilization of parcel lockers becomes an interesting alternative taking to the account the environmental impact of delivering system. According to the results of analysis made by researchers from the AGH University of Science and Technology in Krakow realized in October 2013, the courier servicing InPost parcel lockers is able to deliver 600 parcels in just one day, with travel distance of about 70 km in comparison to respectively 60 parcels and 150 km in traditional delivery system. It results with CO<sub>2</sub> emission 1516 tons per year in comparison to 32500 tons

in traditional courier service (*InPost...* 2015). Similar results were achieved in analysis on influence of parcel lockers on environment in the city area, realized by the Department of Logistics and Transport Systems at the Maritime University of Szczecin as the part of C-LIEGE project (Lückenkötter *et al.* 2013). Due to that analysis, parcel lockers are consistent with sustainable development assumptions.

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## References

- Kot S., Starostka-Patyk M., Krzywda D. (2009). *Zarządzanie łańcuchami dostaw*, Wydawnictwo Wydziału Zarządzania Politechniki Częstochowskiej, Częstochowa.
- Allen J., Thorne G., Browne M. (2007). *BESTUFS Good Practice Guide on Urban Freight Transport*, www.bestufs.net, accessed on 10.01.2016.
- Act of 27 April 2001 Environmental Protection Law*. Part II Art. 3 para. 50.
- InPost website*, <http://www.inpost.pl/ekoinpost2.html>, accessed on 13.01.2016.
- Evaluation of parcel locker service*, <http://grassproject.eu/ankieta/>, accessed on 13.01.2016.
- Zeliaś A., Pawelek B., Wanat S. (2002). *Metody statystyczne. Zadania i sprawdziany*, PWE, Warszawa.
- Visser J., Nemoto T., Brown M. (2014). *Home Delivery and the Impacts on Urban Freight Transport: A Review*, Procedia – Social and Behavioral Sciences, Volume 125, Elsevier.
- Bilik J. (2014). *Parcel machines - green solution for green cities*, Presentation at 1st International Conference Green Logistics for Greener Cities, Szczecin.
- Deutsche Post DHL Group*, [standorte.dhl.de/packstationen\\_paketboxen](http://standorte.dhl.de/packstationen_paketboxen), accessed on 10.01.2016.
- CityLog Project Web-site*, [www.city-log.eu](http://www.city-log.eu), accessed on 10.01.2016.
- InPost parcel lockers: survey report (2015)*, [http://log4.pl/aktualnosci-2609-Paczkomaty\\_InPost\\_\\_\\_ekspertyza\\_AGH.html](http://log4.pl/aktualnosci-2609-Paczkomaty_InPost___ekspertyza_AGH.html), accessed on 10.01.2016.
- Lückenkötter J. *et al.* (2013). C-LIEGE Final Evaluation. Deliverable 6.3, [www.c-liege.eu](http://www.c-liege.eu), accessed on 10.01.2016.