

# Research of the potential opportunities of crowdshipping: the case study of Ukraine and the Czech Republic

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**Abstract.** Urbanization and the growth of e-commerce are the main factors behind the growth of last-mile delivery volumes. Crowdshipping using the public transport system is one of the relatively new scenarios for the organization of such delivery. This solution has good potential to meet consumer demands for fast delivery while simultaneously minimizing the negative externalities of urban freight transportation, which is the basis of the sustainability of the urban freight transport system. An important condition for understanding the development of crowdshipping using the public transport system and the formation of certain practical recommendations for the effective functioning of such delivery is the study of the opinion of potential users and crowdshippers. Analysis of available literary sources allows us to assert that the potential of crowdshipping delivery depends on specific urban planning conditions and characteristics of the population. Studying the opinions of respondents from Ukraine and the Czech Republic will allow us to gain new knowledge about the attitude of residents of cities that differ in size and characteristics of the public transport system to the possibilities of crowdshipping.

## 1 Introduction

The high population density in cities combined with the growth of e-commerce poses new challenges to sustainability principles: on the one side, online shopping reduces the need for people to move around physically, but on the other side, it increases freight traffic and, consequently, the likelihood of congestion, accidents, and increased air and noise pollution [1, 2]. Finding a balance between fulfilling consumer demands for fast delivery and the negative externalities of urban freight transport is the basis for the sustainability of the urban freight transport system [3].

Increasing the sustainability of urban freight transport can be achieved by using crowd logistics (a combination of shared economy and logistics) [4-5]. Although passenger and freight transport share the same infrastructure, these systems are often considered as separate systems, especially in cities, which wastes resources. Integration of passenger and freight transport, considering passenger and freight flows not separately but in a complex, will help to significantly improve the situation in the field of last-mile delivery [6].

Crowdsources delivery or crowdshipping is a part of crowd logistics. It is the delivery of goods by non-professional couriers who make movements to satisfy their needs and are ready to deliver the goods along the way. Crowdshipping using public transport has more advantages compared to crowd-delivery by private transport because car owners are more likely to make detours from their main route and may have parking problems [7]. Accordingly, crowdshipping based on

private cars may increase the negative impact on the environment [8, 9]. On the contrary, crowdshipping using public transport can reduce air emissions by 17%, and delivery costs for the carrier can be reduced by up to 29% per parcel, especially for cities with an extensive route network [10].

Confirming the significant potential prospects of crowdshipping, it is worth saying that this delivery system, despite certain attempts at its practical implementation, is still at the stage of development. An important condition for the effectiveness of crowdshipping is the spatial and temporal matching between personal travel and freight movement [11]. That is, the starting and ending places of the crowdshipper's trip and the sending and destination of the parcel must coincide, minimizing deviations from the route. The crowdshipper's travel time must also be synchronized with the time windows of the supplier and recipient of the parcel.

Another important factor is the population's attitude to crowdshipping delivery: the possibility of receiving ordered goods using crowdshipping and the possibility of being a crowdshipper. There are some studies conducted on this topic. These results allow a positive assessment of the prospects of crowdshipping [4, 12, 13].

There are still not many studies on the possibilities of crowdshipping using the public transport system. Studies in Rome seem to have been among the first [14]. Based on the results of surveys of subway users, the authors modelled the change in the probability of delivery using public transport depending on the change in the location of the parcel lockers and the amount of payment for delivery. The probability of crowdshipping is highest in

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the case of higher payment for delivery and the location of the parcel locker within the metro station (86.4%). The location of parcel lockers influences slightly more than reward: 54.8% compared to 46%. The crowdshipper's age is taken into account separately.

In the paper [15], based on the results of survey in Copenhagen (Denmark), the authors assessed the influence of such factors as the amount of monetary compensation, additional time spent on delivery, size, weight and number of parcels on the probability of crowdshipping delivery using the public transport system. Also, increasing the popularity of crowdshipping delivery using public transport can be achieved by forming the habit of crowdshippers to do such delivery. An increase in the probability of forming such a habit is possible thanks to the positive emotions that crowdshippers receive from the delivery [16].

Despite the availability of certain studies of the potential of crowdshipping delivery and the availability of successful cases of the implementation of such a service, it is worth remembering that copying even the most successful solutions for one city will most likely fail for another city [17].

## 2 Characteristics of research samples

The purpose of our research is to compare the attitude of residents of two cities: Lviv (Ukraine) and Pardubice (Czech Republic), which differ in size, population density, and characteristics of the public transport system, to crowdshipping delivery. Understanding these features will make it possible to formulate recommendations that are better for achieving the goals of sustainable development of the city taking into account its characteristics.

The survey (for the purpose of data collection) was conducted using the online platform Google-form. Conducting a survey using an online platform may have disadvantages related to the representativeness of different population groups [18]. But this method of surveying is appropriate for our research. As stated in [19], crowdshipping platforms depend on the Internet and the use of mobile applications, then it is important to get answers from people who know how to use such services.

The survey resulted in 229 unique responses: 144 from Ukrainian respondents and 85 from Czech respondents (data collection is still ongoing). The socioeconomic characteristics of the sample are presented in the frequency Table 1.

A general analysis of the attitude of respondents from Ukraine and the Czech Republic to crowdshipping indicates generally positive prospects for crowdshipping. Only 5.7% of Ukrainian respondents have a negative attitude to the possibility of receiving ordered goods through the crowdshipping service; among Czech respondents such answers are 4.7%. A significant proportion of respondents (35.8% and 56.5%, respectively) couldn't answer this question, which can be explained by insufficient understanding of crowdshipping and lack of experience in its practical use both in Ukraine and in the Czech Republic. In general, only 2% of Czech and 6.6% of Ukrainian respondents have experience of such delivery.

**Table 1.** Socio-economics characteristics of respondents

Indicator, %	Ukraine	Czech
Distribution by age:		
- age under 18	9,8	4,7
- age 18 - 29	76,2	48,2
- age 30 and over	14	47,1
Distribution by gender:		
- male	53	65
- female	47	35
Distribution by professional status:		
- student with a scholarship	30,1	
- student without a scholarship	17,5	
- working student with a scholarship	7	72,2
- working student without a scholarship	14	
- full-time employee	25,9	22,2
- other	5,5	5,5
Distribution by personal average monthly income <sup>1</sup> :		
- diapason I	45,5	22,4
- diapason II	16,8	17,6
- diapason III	6,9	22,4
- diapason VI	11,2	22,4
- no respond	19,6	15,3
Distribution by family status:		
- unmarried	67,2	40
- married, no children	10,5	41,2
- married, children under 18	11,9	11,8
- other	10,4	7,1

<sup>1</sup>The ranges of average monthly income differ for Ukraine and the Czech Republic:

- diapason I: up to UAH 10,000 or EUR 250 (Ukraine) and up to CZK 15,000 or EUR 600 (Czech Republic);
- diapason II: 10,001 - 20,000 UAH or 251 - 500 EUR (Ukraine) and 15,001 - 25,000 CZK or 600 - 1000 EUR (Czech Republic);
- diapason III: 20 001 - 30 000 UAH or 500 - 750 EUR (Ukraine) and 25 001 - 35 000 CZK or 1000 - 1400 EUR (Czech Republic);
- diapason VI: more than UAH 30,000 or more than EUR 750 (Ukraine) and more than CZK 35,000 or more than EUR 1400 (Czech Republic).

Official bank exchange rate: 1 EUR = 24,1 CZK = 40,4 UAH

## 3 Attitudes towards crowdshipping: comparison of Ukraine and the Czech Republic

The willingness of respondents to make crowdshipping delivery while travelling by public transport is also high: only 16% of Ukrainian respondents and 17% of Czech respondents chose the "never" option. Another 29% and 61% respectively are never ready to make such delivery for free. Details of the possible frequency of such services are presented in Table 2.

The most noticeable difference between Ukrainian and Czech respondents is regarding their willingness to make crowdshipping delivery for free and their willingness to make regular delivery for bonuses.

The question of adequate compensation for delivery is also essential. On the one hand, the high cost of crowdshipping services can encourage trips made specifically for delivery. Because of this, the main essence

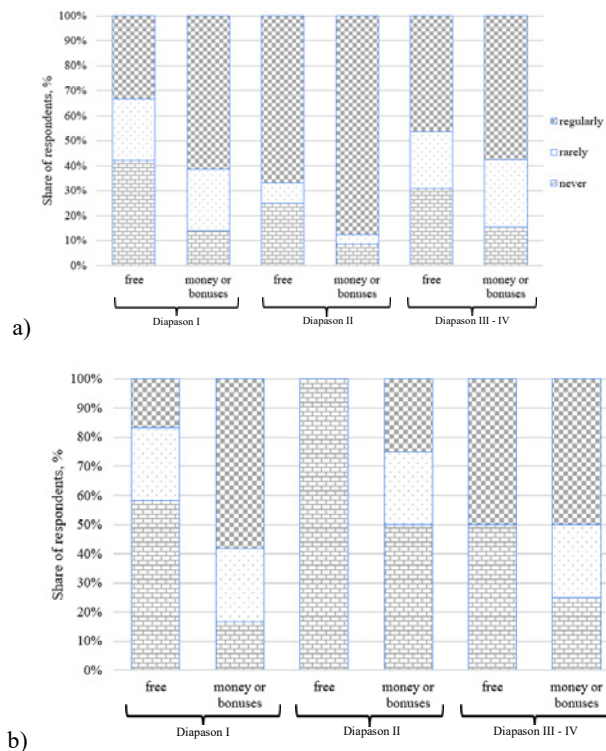
of crowdshipping (to reduce the number of trips) is losing. On the other hand, too little compensation value may reduce the number of crowdshippers or the quality of services. Among Ukrainian respondents, 36.5% consider an adequate reward of up to UAH 40, another 50% are ready to transport parcels for reward from 41 to 70 UAH. Czech respondents consider the delivery reward from 40 to 59 CZK (37%) or from 60 to 79 CZK (31.3%) to be adequate. The minimum price of delivering a parcel weighing up to 5 kg around the city for the postal operator Ukrposhta is 42 UAH (approximately 1 EUR) to the post office and 72 UAH (1.8 EUR) by courier home, the minimum price of a similar delivery by the operator Česká pošta is 109 CZK (4.5 EUR) to the branch and 129 CZK (5.4 EUR) by courier home.

**Table 2.** Readiness for crowdshipping delivery

	Ukraine		Czech	
	regularly	rarely	regularly	rarely
Free	34,9	19,8	22,2	16,7
For a monetary reward	61,3	22,6	55,6	27,8
For certain bonuses	57,5	23,6	33,3	33,3

Regularly – readiness to deliver at least once a week  
 Rarely – readiness to deliver a maximum of several times a month

Among the socio-economic characteristics, the average monthly income has the greatest influence on the willingness to perform crowdshipping delivery (Fig. 1).



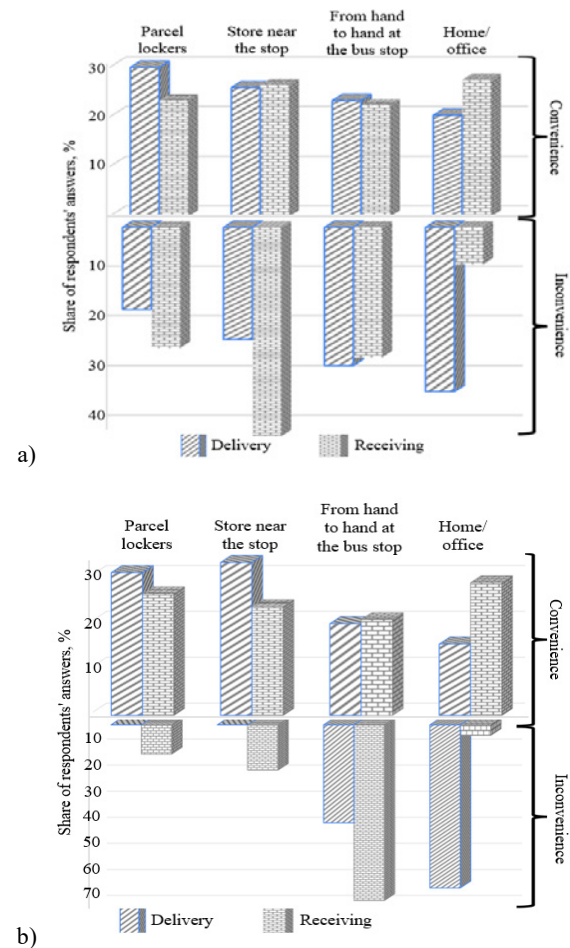
**Fig. 1.** Change in willingness to make crowdshipping delivery depending on the level of average monthly income: a) Ukraine; b) the Czech Republic

*Ukraine:* the largest share of respondents who are ready to regularly make crowdshipping delivery for a fee

has an average monthly income within the II diapasón (within the average salary in Ukraine). Respondents with the lowest income level are the least willing to deliver free of charge.

*Czech:* Czech respondents generally express a lower level of willingness to crowdshipping delivery when commute by public transport. The largest number of positive answers to this question among respondents with an average monthly income within the I diapasón.

Also, the respondents evaluated the convenience of the following delivery options: a parcel locker at a public transport stop; kiosk/store/gas station near the stop; giving or receiving a parcel in person at the stop; delivery/receipt of parcel at home/office (Fig. 2).



**Fig. 2.** Attitude to the methods of cargo transfer between the crowdshipper and the recipient: a) Ukraine; b) the Czech Republic

*Ukraine:* Potential crowdshippers consider the most convenient option to deliver a parcel to a parcel locker at a public transport stop, and the least convenient option is to deliver it to a home or office. Recipients of crowdshipping delivery consider delivery to their home or office the most convenient option, and personal receipt from a crowdshipper courier at a stop is the least convenient.

*Czech:* for Czech respondents, the most convenient way of delivery is delivery to a store near the stop or parcel lockers at the stop, and the most convenient way to receive a parcel is home or office. The least convenient way for potential crowdshippers is home or

office delivery, and for package recipients - personal receipt from a crowdshipper courier at a bus stop.

The personal transfer of the parcel involves the coincidence of the time windows of delivery and receipt

of the parcel. The results of a comparison of the time parameters of crowdshipping delivery from the point of view of the crowdshipper and the recipient are presented in Table 3.

**Table 3.** Time parameters of crowdshipping delivery using public transport

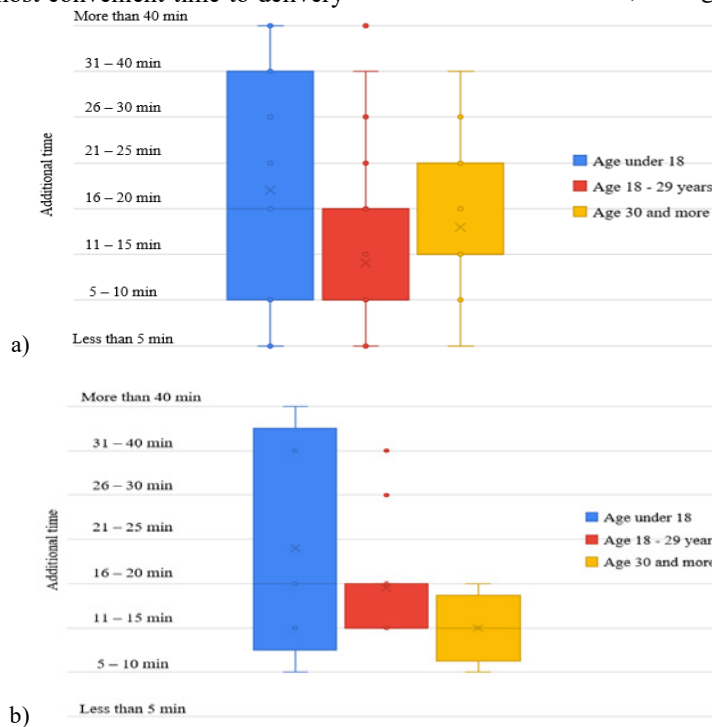
Time	Ukraine			Czech		
	Receiving, %	Delivery, %	Difference, %	Receiving, %	Delivery, %	Difference, %
05 <sup>00</sup> – 09 <sup>00</sup>	2,56	10,20	7,64	5,15	24	18,85
09 <sup>00</sup> – 12 <sup>00</sup>	12,31	13,61	1,3	13,97	12	-1,97
12 <sup>00</sup> – 15 <sup>00</sup>	12,82	17,69	4,87	10,29	16	5,71
15 <sup>00</sup> – 18 <sup>00</sup>	12,31	18,37	6,06	22,79	24	1,21
18 <sup>00</sup> – 21 <sup>00</sup>	31,28	17,69	-13,59	26,47	4	-22,47
21 <sup>00</sup> – 05 <sup>00</sup>	2,05	2,04	-0,01	2,94	0,8	-2,14
Does not matter	26,67	20,41	-6,26	18,38	19,2	0,82

*Ukraine:* The most convenient time of day to receive orders is between 18:00 and 21:00 hours: 31.3% of respondents are satisfied with this time. For another 26.7%, the time does not matter or can change. Regarding the convenient delivery time for crowdshippers, the maximum number of responses was approximately evenly distributed between the three periods from 12:00 to 21:00 – 18% in each period. Time is not important for another 20.4% of respondents. The largest difference between the preferred time for delivering and receiving orders is for the morning period from 05:00 to 09:00 hours: three times as many respondents are ready to deliver in the morning as to receive. The largest reverse difference is for the evening period from 18:00 to 21:00: 13.6% fewer respondents are ready to deliver cargo during this period than to receive it.

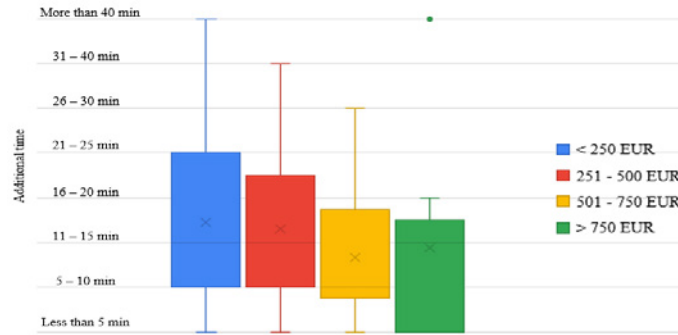
*Czech:* the most convenient time of day for receiving orders is from 15:00 to 18:00 and from 18:00 to 21:00: 26.5% and 22.8% of respondents are satisfied with this time, respectively. The most convenient time to delivery

is the morning period from 5:00 to 9:00 and the daytime period from 15:00 to 18:00 (24% of respondents each). The biggest difference between the preferred time of day to fulfill and receive orders is in the morning period from 5:00 to 9:00: 18.8% of respondents are more willing to deliver in the morning than to receive. The biggest negative difference is in the evening period from 18:00 to 21:00 - only 4% of respondents are ready to deliver the parcel during this period.

63% of Ukrainian respondents and 70,6% of Czech respondents are ready to spend no more than 15 minutes in addition to their usual travel time to make a crowdshipping delivery (take the package for delivery and give it to the recipient): 16.7% of Ukrainian respondents and 5,9% of Czech respondents are not ready to spend more than 5 minutes, another 31.5% and 47% respectively - from 5 to 10 minutes. This parameter is influenced by the respondent's age (Fig. 3) and, for Ukrainian conditions, average monthly income (Fig. 4).



**Fig. 3.** Box plot of the additional delivery time depending on the age of the crowdshipper: a) Ukraine; b) the Czech Republic



**Fig. 4.** Box plot of the additional delivery time depending on the income level of the crowdshipper in Ukraine

The maximum variation in the possible values of additional time spent on delivery is observed among respondents under the age of 18. Ukrainian respondents aged 18 to 29 and Czech respondents over 30 are the least willing to spend time. The higher the income of the Ukrainian respondent, the less inclined he is to increase the usual length of his trip. Among the Czech respondents, no connection was found between the average monthly income and the amount of additional time spent.

#### 4 Barriers to crowdshipping

In order to identify the main factors that are barriers to the respondent's assessment of their readiness to make crowdshipping delivery, the questionnaire contains 21 of statements that respondents evaluated according to the degree to which the statement corresponds to their opinion. According to the results of the correlation analysis of the answers, the statements can be divided into 6 main groups:

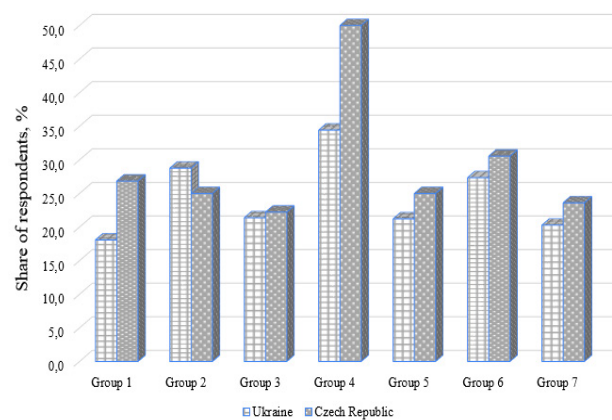
- 1) Group 1: concerns about the confidentiality of personal data (I am concerned about the security of personal data; I do not want to provide my phone number or other personal information; I do not want the sender/recipient of the parcel to track my movement; I do not want to insure the risk of non-delivery/loss/theft of the parcel using my bank card; I am uncomfortable communicating with strangers; I am uncomfortable with the sender/recipient of the parcel assessing the quality of my services);
- 2) Group 2: concerns about the cargo (I am afraid that I may inadvertently deliver dangerous or prohibited items; I am afraid that I may lose/damage the parcel);
- 3) Group 3: concerns about the process of transporting the cargo (I may have difficulty boarding or disembarking a vehicle or travelling in a vehicle due to the presence of the parcel; I may disturb other passengers in public transport if the package is too large);
- 4) Group 4: concerns about the process of transferring the cargo to the recipient (I do not want to make a second delivery in the absence of the customer; I do not want to deliver to another location in the absence of the customer at the previously agreed location);
- 5) Group 5: concerns related to technical difficulties (I don't know how to use crowdshipping platforms or

applications; I will be worried about not being able to open the parcel locker or face other technical problems); 6) Group 6: time-related concerns (I will worry that I might be late for work/study because of the parcel delivery; I am afraid that I will not be able to make the delivery on time);

The intraclass correlation coefficient of the answers in each of the groups varies from 0.6 for the 6th group to 0.88 for the 4th group (answers of Ukrainian respondents) and from 0.62 for the 2th group to 0.85 for the 6th group (answers of Czech respondents).

Group 7 includes statements that cannot be combined with any of the groups: I think that the amount of payment for delivery will be insufficient for me; I am not familiar enough with this method of parcel delivery; I do not support this method of delivery; I don't have enough time.

In general, the significance of certain groups of barriers to crowdshipping delivery is comparable for Ukrainian and Czech respondents (Fig. 5). The main factors that are a warning for all potential crowdshippers are the factors of the fourth group. The second most important factors for Ukrainian respondents are the factors of the second group, and for Czech respondents - time-related concerns.



**Fig. 5.** The share of respondents for whom a certain group of factors is the most significant as a barrier to crowdshipping delivery

The top three statements for which the most respondents answered that these factors are the biggest concern when making a decision to perform crowdshipping delivery coincide in both groups of respondents:

- I am not familiar enough with this method of parcel delivery;
- I do not want to make a second delivery in the absence of the customer;
- I do not want to deliver to another location in the absence of the customer at the previously agreed location.

All respondents least agree with the statement "I do not support this method of delivery". Ukrainian respondents are also not concerned about such cautions as "I am uncomfortable with the sender/recipient of the parcel assessing the quality of my services" and "I am uncomfortable communicating with strangers". Instead, the Czech respondents most often noted as not a barrier for them to perform crowdshipping, "I am afraid that I may inadvertently deliver dangerous or prohibited items" and "I am concerned about the security of personal data".

The biggest difference between Ukrainian and Czech respondents is in the assessment of the following statements:

- I am afraid that I may inadvertently deliver dangerous or prohibited items (concerns Ukrainian respondents much more);
- I don't have enough time (concerns Ukrainian respondents much more);
- I may have difficulty boarding or disembarking a vehicle due to the presence of the parcel (concerns Czech respondents much more);
- I am afraid that I may lose/damage the parcel (concerns Ukrainian respondents much more).

## 5 Conclusions

Crowdshipping is a relatively new initiative that has good prospects for increasing the sustainability of last-mile delivery. The purpose of the conducted research is to study the attitude of people to the possibility of receiving ordered goods through the crowdshipping service and the implementation of crowdshipping delivery during a trip by public transport. The survey was conducted among residents of Lviv (Ukraine) and Pardubice (Czech Republic). Surveys are still ongoing, but based on the processing of 229 questionnaires, certain preliminary conclusions can be drawn.

In general, the respondents have a positive attitude to receiving parcels using the crowdshipping service. Only 5.7% of Ukrainian and 4.7% of Czech respondents have a negative attitude to such an opportunity. However, a significant share of both Ukrainian and Czech respondents are not sufficiently familiar with this method of delivery, which is one of the obstacles to the spread of crowdshipping.

The share of respondents who, under any conditions, are not ready to perform crowdshipping delivery is comparable in both groups of respondents (16% and 17%, respectively). 55.6% of Czech and 61.3% of Ukrainian respondents are ready to regularly perform crowdshipping delivery for a certain monetary reward. Ukrainian respondents also have a positive attitude to receiving rewards in the form of certain bonuses or certificates (57.5%), only 33.3% of Czech respondents

do so. Willingness to perform crowdshipping delivery depends on the average monthly income. The majority of respondents are ready to transport parcels for a reward lower than the cost of delivery by the main postal operators of Ukraine and the Czech Republic.

Both Ukrainian and Czech potential crowdshippers consider delivery to a parcel locker at a public transport stop the most convenient way, and home or office address delivery the least convenient. Recipients, on the contrary, consider address delivery the most convenient way. Regarding the least convenient way of receiving a parcel, opinions are divided: for Czech crowdshippers, it is personal collection from a courier-crowdshipper at a bus stop, and for Ukrainians - receiving a parcel at a store near the bus stop.

Delivery time windows, which are convenient for performers and recipients, also differ somewhat. The biggest difference between the desired period of the day for carrying out and receiving orders is for the morning period from 5:00 to 9:00 hours and for the evening period from 18:00 to 21:00. 63% of Ukrainian respondents and 70.6% of Czech respondents are ready to spend no more than 15 minutes in addition to their usual travel time to make a crowdshipping delivery.

Respondents were also asked to rate 21 potential crowdshipping caveats in terms of their relevance. As a result, the factors that are most negatively perceived by people when making a decision to do crowdshipping delivery during trips in public transport were determined.

The obtained results may be of interest both to last-mile service providers and to city management bodies that make decisions regarding the sustainable development of the city transport system.

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