

MODERN METHODS OF PRODUCT DELIVERY – ACCEPTANCE OF INNOVATIONS AMONG KEP INDUSTRY CUSTOMERS

Agnieszka KAWECKA^{1*}, Danguolė IGNATAVIČIŪTĖ²

¹ Krakow University of Economics; kaweckaa@uek.krakow.pl, ORCID: 0000-0003-2562-3784

² Vilnius Kolegija (Higher Education Institution); d.ignataviciute@ekf.viko.lt, ORCID: 0000-0003-1081-887X

* Correspondence author

Purpose: The primary aim of this investigation is to scrutinize the level of acceptance of novel parcel delivery methods, inclusive of parcel machines, drones, autonomous cars, and delivery robots, within the specific socio-economic context of Poland. This inquiry is specifically directed toward individuals actively involved in online retail transactions and the utilization of online food ordering applications.

Design/methodology/approach: A survey was conducted among people actively using online stores regarding modern methods of delivery of purchased products, 140 respondents were surveyed in two main age groups: young consumers up to 35 years of age and a group of older consumers over 35 years of age.

Findings: The pivotal findings from the surveys underscore that the reluctance to embrace new delivery solutions primarily affects respondents aged 35 and above. Additionally, this demographic highlighted numerous inconveniences and concerns associated with the delivery process. A proper communication scheme is advisable for that group to embrace the innovations.

Research limitations/implications: A conspicuous imperative arises for the extension of research endeavors to encompass the entirety of the Polish population. Heretofore, the conducted research has predominantly focused on diverse nations, encompassing various European countries. Presented in the paper analysis, conducted on a selectively chosen cohort expressly for this investigation, thereby underscores the inapplicability of its findings to the broader societal milieu.

Practical implications: The conducted research holds the potential to influence the breadth and preparedness of consumers for the introduction of innovative methods in product delivery. A comprehensive comprehension of concerns and limitations stands to facilitate the formulation of pertinent information campaigns tailored to address these aspects effectively.

Originality/value: Until now, there has been limited research in Poland regarding the acceptance of modern methods in product delivery.

Keywords: consumer acceptance, technological innovation acceptance, parcel machine, delivery robots.

Category of the paper: research paper.

1. Introduction

The Courier, Express, and Parcel industries are undergoing continuous development, marked by not only escalating volumes and market expansion but also technological advancements. A growing interest is observed in the extensive adoption of automation and robotization within the realm of parcel delivery. Mechanization, automation, and robotization are manifesting not only in the transportation of parcels but also in their accurate identification (utilizing barcodes, multi-dimensional QR codes, or RFID) and sorting processes employing automated systems in parcel sorting centers of courier companies or post offices. In recent years, systems facilitating the automatic delivery of parcels through the use of parcel machines have been developed.

Companies serving the courier industry are testing or already using robots to deliver orders to customers. They do this mainly to automate the final part of the delivery process or reduce last-mile costs. It may also result from the desire to stand out from the competition. Companies showing interest in delivery robots include Amazon, Postmates, FedEx, and Starship Technologies. Drones are a special case of testing and very preliminary use. Amazon plans to equip courier cars with drones that would deliver parcels by taking off from the courier's car. Thanks to this, it could reduce the number of kilometers to be covered during the last mile stage. After delivering the order, the drone would return to the car (Tarkowska, Bolisęga, 2020). The drone could carry a parcel weighing up to 2.5 kilograms over a distance of 16 kilometers (Remiszewska, Czubaszek, 2021).

The objective of this paper is to investigate the degree of acceptance for innovative parcel delivery methods, encompassing parcel machines, drones, autonomous cars, and delivery robots, within the context of Poland. This examination is targeted at individuals actively engaged in online shopping and utilizing online food ordering applications. Specifically, the research seeks to gain insights into consumer opinions regarding the perceived advantages, disadvantages, and challenges associated with these emerging delivery modalities.

2. Consumer attitude towards modern forms of delivery

Consumers'/end-users attitudes towards forms of delivery are important to consider while introducing to the market new solutions in last-mile logistics. Their acceptance is crucial in innovation development.

The shift in acceptance of contemporary solutions has become evident in the post-COVID-19 era, particularly in recommendations advocating reduced interpersonal contact and the maintenance of physical distance. This extends to the domain of contactless parcel

deliveries. Studies by Pani et al. (2020), Yuen et al. (2022), and Buldeo Rai et al. (2022) have highlighted that the unique circumstances of the pandemic have significantly impacted consumers' perceptions. It has increased their awareness of the associated risks with traditional parcel deliveries involving direct contact with couriers. This elevated awareness has further reinforced attitudes toward prioritizing health and safety, consequently fostering an increased acceptance of deliveries in an impersonal format.

Extensive scholarly investigations have scrutinized contemporary delivery methodologies, with a notable emphasis on the meticulous examination of parcel lockers. Numerous studies have investigated models of operating those solutions by Orenstein et al. (2019) usability by Lemke et al. (2016), costs and location by van Duin et al. (2020) consumers intentions were analyzed by Yuen et al. (2019). Sustainability and environmental issues concerning last-mile were raised by Liu et al. (2017), and Ramirez-Villamil et al. (2022), that topic was mentioned in most of the previously mentioned above.

Autonomous delivery systems like robots and cars are challenging issues in city logistics Bachofner et al. (2022), accessibility in cities was studied by Plank et al. (2022), acceptance was investigated by Romanjuk (2020), Yuen et al. (2022), acceptance in public space by Rasouli and Tsotsos (2020). The literature review revealed a small share of research on the acceptance of innovative solutions in the field of last-mile logistics, especially in different age groups.

3. Research method and respondents characteristics

This research, conducted in September 2023, employed a survey methodology to assess the attitudes and preferences of e-commerce users towards delivery robots and parcel machines. The questionnaire titled "Acceptance of innovative forms of goods delivery among e-shop users" was distributed to respondents through online platforms. The deliberate selection of participants yielded two distinct age groups: 70 individuals aged 18-35 and 70 individuals aged above 35. All participants were identified as active users of online retail platforms or food ordering applications, having utilized courier services for the delivery of purchased goods or parcel machines. The characteristics of the respondents are presented in table 1.

The questionnaire, comprising 20 inquiries of varied nature, focused on exploring diverse facets of respondents' perspectives. In the subsequent analysis presented herein, emphasis is placed on four specific questions of the acceptance of delivery robots, drones, autonomous cars, and parcel machines, elucidation of associated advantages and disadvantages/obstacles of these delivery modalities.

Table 1.
Characteristics of the respondents

Category	Description of the characteristics	Number of indications	Percentage
Gendre	Woman	89	63.6%
	Man	50	35.7%
	Other	1	0.7%
Age	18-25	40	28.6%
	26-35	30	21.4%
	35-50	42	30.0%
	51-69	25	17.9%
	70 and more	3	2.1%
Dwelling-place	Village	29	20.7%
	City up to 200 thousand residents thirty	35	25.0%
	City with over 200,000 inhabitants residents	76	54.3%

Source: Own study.

The majority of women participated in the study, the share of men was approximately 36%. Respondents were stratified based on their age, and subsequent analyses were conducted concerning two distinct age cohorts: individuals aged up to 35 years and those surpassing this age threshold. Delving into the specifics of the age distribution, the preeminent demographic comprised respondents within the 35 to 50 years age bracket, constituting 30% of the participant pool. Following closely, individuals aged between 18 and 25 years represented a substantial proportion, amounting to nearly 29%. An effort was made to ensure respondent diversity, as evidenced by the inclusion of participants aged over 70, albeit constituting a modest 2% of the overall population surveyed.

The purchasing behaviors of the deliberately selected respondents, identified as patrons of online retail establishments and food delivery applications, are delineated in Table 2. The utilization patterns of courier services and parcel machines by the respondents are also expounded upon. The dataset is stratified into two distinct cohorts, namely those below 35 years of age and those aged 35 years and above.

Table 2.
Characteristics of the respondents

Category	Description of the characteristics	Number of total indications	Percentage	Number of indications in the group under 35 years	Percentage share in the group up to 35 years old	Number of indications in the group over 35 years of age	Percentage share in the group over 35 years old
Online shopping	E-shops and e-commerce platforms	140	100.0%	70	100.0%	70	100.0%
	Food ordering applications	85	60.7%	47	67.1%	38	54.3%
Delivery options	Courier services	105	75.0%	54	77.1%	51	72.9%
	Parcel machines	116	82.8%	69	98.6%	47	67.1%

Source: Own study.

The table presents a comprehensive overview of respondents' characteristics categorized by age, particularly emphasizing their engagement with online shopping and delivery options. The data reveals that, in the group where every respondent is involved in online shopping, the younger group is more engaged in food delivery via applications. Analyzing the used delivery options, courier services are less popular than parcel machines. In the younger group, only one respondent did not use them. In the older group, courier services were more popular than parcel machines.

The specific selection of the group was necessitated by the imperative to investigate individuals engaged in online shopping to assess their acceptance of innovative solutions in the realm of parcel delivery, encompassing food services. One of the primary research objectives was to ascertain the willingness of respondents to utilize parcel machines, drones, autonomous cars, and delivery robots. In particular, the study sought to address the following inquiries:

1. Does the older research group exhibit significant differences in acceptance of parcel lockers, drones, autonomous cars, and delivery robots compared to the younger research group?
2. What advantages do respondents observe in employing delivery services through innovative forms of goods delivery?
3. What disadvantages and impediments do respondents identify in the proposed delivery methods?
4. Do respondents harbor the belief that delivery robots, drones, or autonomous cars can potentially supplant traditional couriers in the future?

The answers to these research questions were sought in the analysis of data obtained from respondents and the use of statistical inference.

4. Respondents' attitudes towards modern methods of goods delivery

The initial analytical inquiry pertained to the respondents' willingness to embrace specified modes of delivery. On a nominal scale, their task was to indicate to what extent they accepted the above-mentioned delivery solutions. The results divided into two age groups are presented in Fig. 1. The data presented in the figure shows responses regarding the acceptance of parcel machines, drones, delivery robots, and autonomous cars. Respondents could indicate the following answers: strong rejection, partial rejection, neutral or undecided, partial acceptance, and strong acceptance.

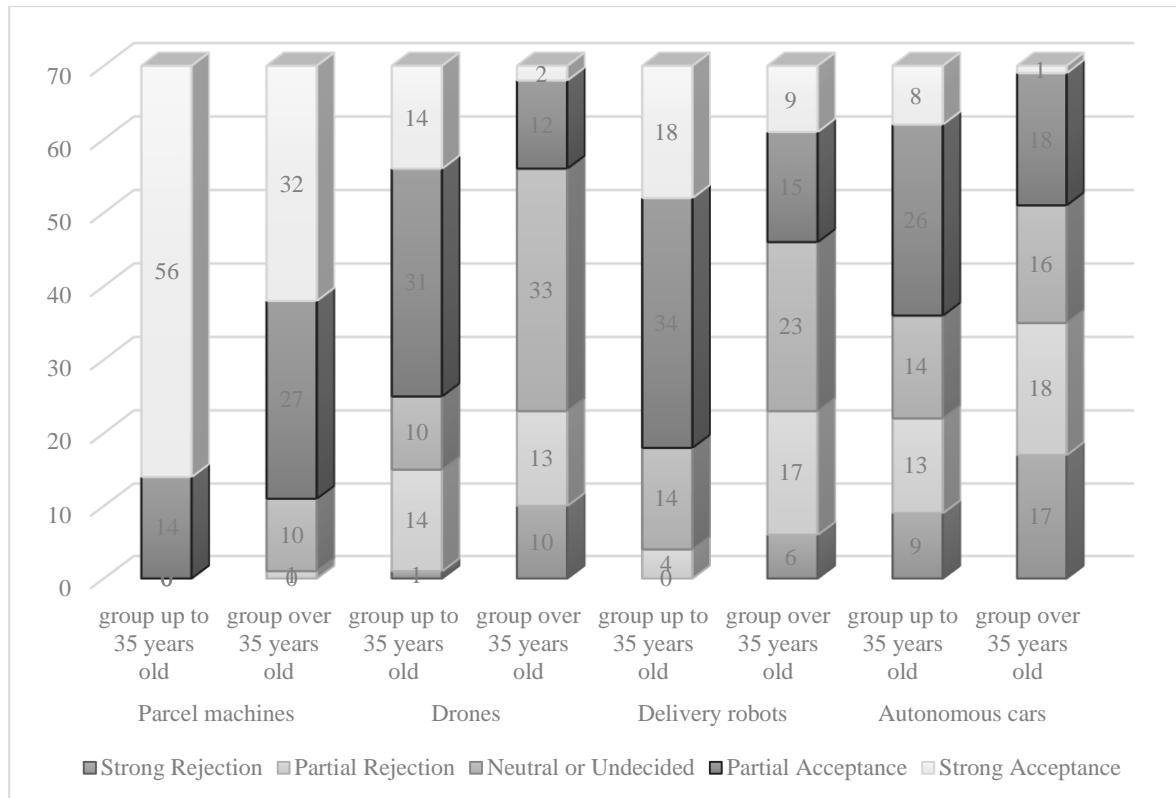


Figure 1. Innovative forms of goods delivery acceptance.

Source: Own study.

Parcel lockers, a well-known solution, were predominantly accepted by the majority of respondents, with only one person in the older group rejecting the possibility of goods delivery through this means. On the other hand, drones proved to be a less acceptable solution, with 45 individuals in the younger group and 14 individuals in the older group supporting this delivery form. Delivery robots garnered acceptance from the majority of younger individuals, while in the older group, 24 individuals expressed a willingness to use this service. Autonomous cars had 34 supporters in the younger group, with only 19 individuals in the older group accepting this solution.

To investigate whether the rejection and acceptance is independent of age, Table 3 was prepared, wherein the sums of strong rejections and partial rejection indications were combined, as well as strong agreement and partial agreement, χ^2 test value was analyzed. The results constituted an analysis of independence, testing the hypothesis regarding the relationship between the age of respondents and their response to the rejection of delivery methods. A test value less than 0.05 indicated that the answer was independent of age. The statistical analysis revealed that the rejection of the solutions was dependent on age. Acceptance was independent of age.

Table 3.

Rejection and acceptance numbers concerning services through innovative forms of goods delivery in age groups

Age category	Parcel lockers	Drones	Delivery robots	Autonomous cars	χ^2 test value
Rejection numbers					
Group up to 35	0	15	4	24	0.086
Group over 35	1	23	23	35	
Acceptance numbers					
Group up to 35	70	45	52	34	0,021
Group over 35	59	14	24	19	

Source: Own study.

An important element of the study was the respondents' indication of the benefits they noticed from the use of modern forms of delivery. Multiple choice semi-open questions with a proposed cafeteria of answers and the option to add respondents' responses. The results are shown in Fig. 2.

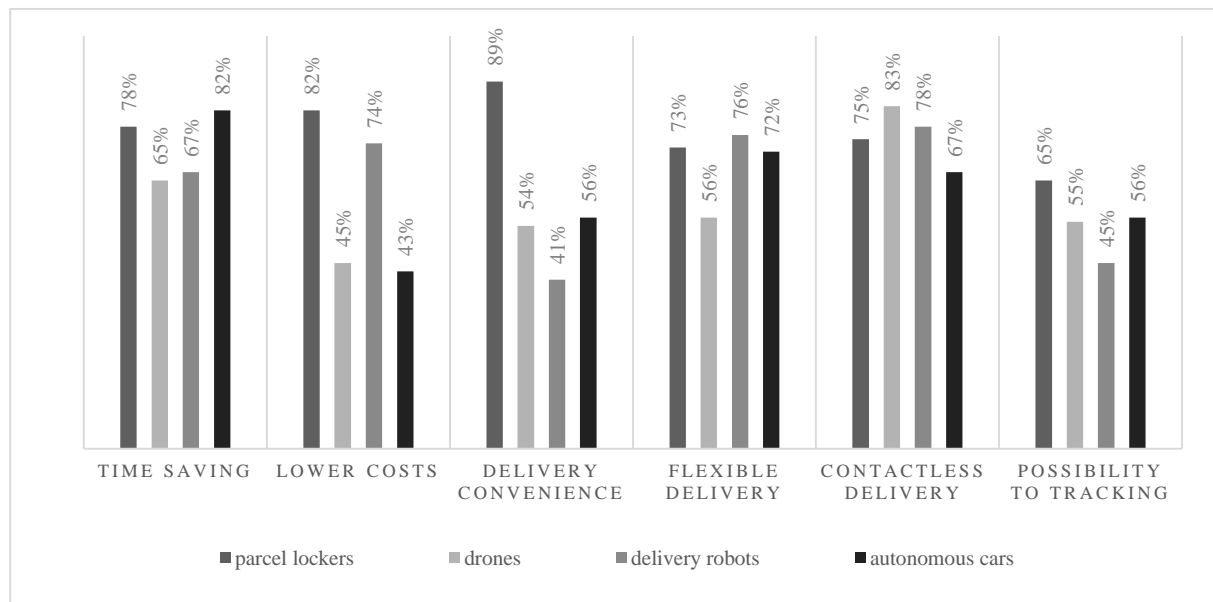


Figure 2. Advantages identified by participants in the utilization of modern delivery methods.

Source: Own study.

Time-saving was indicated as merit most frequently for autonomous cars (82% of respondents) and parcel machines (78%). Drones and delivery robots got 65% and 67% respectively. Lower costs of delivery were indicated in parcel machines and delivery robots methods. The flexibility of delivery was indicated by 76% of respondents in robot delivery very close results also parcel locker (73%) and autonomous cars (72%). Contactless delivery (no need for interaction with other person) was prized in the result of drones (83% of respondents indicated that answer). The possibility of tracking was indicated less frequently concerning other answers but still was indicated as an advantage by 65% of analyzed persons in the opinion about parcel machines. The high percentage of responses indicates that respondents notice many benefits resulting from the use of modern delivery methods.

The next part of the study was the identification of disadvantages and impediments of novelty delivery solutions, data was collected in two age groups separately, and are presented in table 4.

Research results have revealed that the most commonly indicated disadvantage was the problem of accessibility for all locations, even in cities. This issue concerned both younger and older groups of respondents. Other noticeable inconveniences included unreliability, problems with another application necessary for operation, as well as safety concerns, and dangers to animals. There is a significant difference between the number of disadvantages indicated by younger and older respondents is statistically confirmed.

Table 4.

Disadvantages and impediments of goods delivery innovative methods indicated by respondents in different age groups

Disadvantages and impediments	Group up to 35 years old	Group over 35 years old	All participants
Unable to reach all locations	35	56	91
Unreliability, possible failures	21	52	73
The need to install the application on the smartphone	20	42	62
Safety hazards on roads and sidewalks	18	39	57
Danger to domestic and wild animals	19	28	47
Longer delivery time	12	34	46
Limiting jobs	9	33	42
Sum of indications	134	284	418
χ^2 test value	0,009226		

Source: Own study.

5. Findings and discussion

The research results indicated a much higher percentage of young people interested in and accepting modern delivery solutions. The most important results of the surveys are the demonstration that the lack of acceptance of new delivery solutions applies mainly to respondents over 35 years of age., this group also pointed out many inconveniences and concerns related to the correct delivery process.

In research on the acceptance of technological innovation Technology Acceptance Model delivered by Davis, (1989) is useful. In that model external variables are categories in perceived usefulness and perceived ease of use, those two categories influence behavioral intention partly through attitude. Behavioral intention translates into actual system use. The results obtained and analysis allowed us to indicate important variables that might improve acceptance and influence attributes, behavioral intention, and actual system use. According to the Technology Acceptance Model (TAM) perceived usefulness and perceived ease of use based on analysis, presented on figure 3, were indicated.

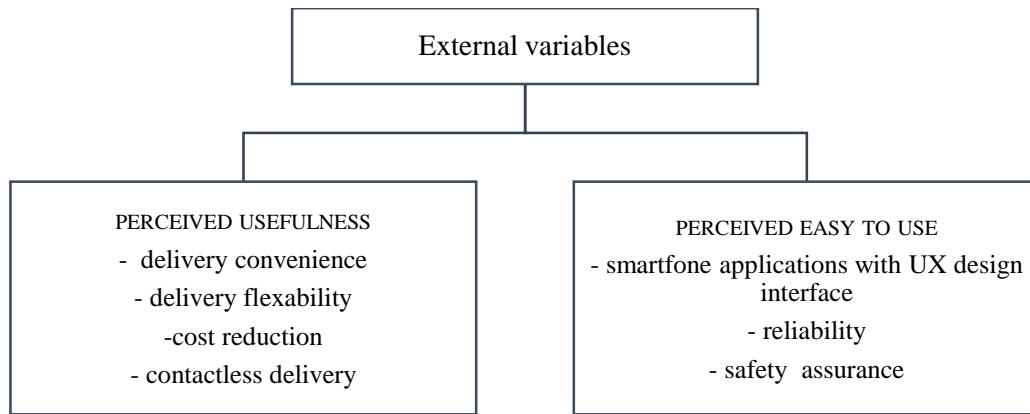


Figure 3. TAM external variables demonstrated through research.

Source: Own study.

Concerning identified variables and results of the study the older group of users should be the one to which, information campaigns and pessimistic messages should be addressed. Since the research indicates certain inconveniences related to modern forms of delivery, mainly the doubts and beliefs related to them should be refined and clarified to attitudes and behavior change.

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References

1. Abrams, A.M.H., Dautzenberg, P.S.C., Jakobowsky, C., Ladwig, S., Rosenthal-von der Pütten, A.M. (2021). *A Theoretical and Empirical Reflection on Technology Acceptance Models for Autonomous Delivery Robots*. Proceedings of the 2021 ACM/IEEE International Conference on Human-Robot Interaction (HRI '21). Association for Computing Machinery, New York, NY, USA, 272-280. <https://doi.org/10.1145/3434073.3444662>.
2. Bachofner, M., Lemardelé, C., Estrada, M., Pagès, L. (2022). City logistics: Challenges and opportunities for technology providers. *Journal of Urban Mobility*, Vol. 2, <https://doi.org/10.1016/j.urbmob.2022.100020>.

3. Buldeo Rai, H., Touami, S., Dablanc, L. (2022). Autonomous e-commerce delivery in ordinary and exceptional circumstances. The French case. *Research in Transportation Business & Management*, Vol. 45, Part A, <https://doi.org/10.1016/j.rtbm.2021.100774>.
4. Davis, F.D., Bagozzi, R.P., Warshaw, P.R. (1989). User Acceptance of Computer Technology: A Comparison of Two Theoretical Models. *Management Science*, Vol. 35, No. 8, pp. 982-1003, <https://doi.org/10.1287/mnsc.35.8.982>
5. Lemke, J., Iwan, S., Korczak, J. (2016). Usability of the parcel lockers from the customer perspective – the research in Polish Cities. *Transportation Research Procedia*, 16, pp. 272-287.
6. Liu, Ch., Wang, Q., Susilo, Y.O. (2019). Assessing the impacts of collection-delivery points to individual's activity-travel patterns: A greener last mile alternative? *Transportation Research Part E: Logistics and Transportation Review*, Vol. 121, pp. 84-99, <https://doi.org/10.1016/j.tre.2017.08.007>.
7. Orenstein, I., Raviv, T., Sadan, E. (2019). Flexible parcel delivery to automated parcel lockers: models, solution methods and analysis. *EURO Journal on Transportation and Logistics*, Vol. 8, Iss. 5, pp. 683-711, <https://doi.org/10.1007/s13676-019-00144-7>.
8. Pani, A., Mishra, S., Golias, M., Figliozzi, M. (2020). Evaluating public acceptance of autonomous delivery robots during COVID-19 pandemic. *Transportation Research Part D: Transport and Environment*, Vol. 89, <https://doi.org/10.1016/j.trd.2020.102600>
9. Plank, M., Lemardelé, C., Assmann, T., Zug, S. (2022). Ready for robots? Assessment of autonomous delivery robot operative accessibility in German cities. *Journal of Urban Mobility*, Vol. 2, <https://doi.org/10.1016/j.urbmob.2022.100036>.
10. Ramirez-Villamil, A., Jaegler, A., Montoya-Torres, J.R. (2022). Sustainable local pickup and delivery: The case of Paris. *Research in Transportation Business & Management*, Vol. 45, Part A, <https://doi.org/10.1016/j.rtbm.2021.100692>
11. Rasouli, A., Tsotsos, J.K. (2020). Autonomous Vehicles That Interact With Pedestrians: A Survey of Theory and Practice. *IEEE Transactions on Intelligent Transportation Systems*, vol. 21, no. 3, pp. 900-918, doi: 10.1109/TITS.2019.2901817.
12. Remiszewska, A., Czubaszek, M. (2021). Wykorzystanie dronów w logistyce w Polsce – szanse i ograniczenia. *Akademia Zarządzania*, 5(2), pp. 140-154.
13. Romanjuk, M. (2020). *Delivery robots serving last mile B2C: an evaluation of Tallinn residents' incentives behind the usage of delivery robots in 2020 on the basis of starship technologies example*. Tallin: TALTECH School of Business and Governance.
14. Tarkowska, E., Bolisęga, P. (2020). Drony – nowa era usług kurierskich. *Journal of Translogistics*, Vol. 6, no. 1, pp. 79-88.
15. van Duin, J.H.R., Wiegmans, B.W., van Arend, B., van Amstel, Y. (2020). From home delivery to parcel lockers: a case study in Amsterdam. *Transportation Research Procedia*, vol. 46, pp. 37-44.

16. Yuen, K.F., Koh, L.Y., Bin Anwar, M.H.D., Wang, X. (2022). *Acceptance of autonomous delivery robots in urban cities*. *Cities*, Vol. 131, <https://doi.org/10.1016/j.cities.2022.104056>.
17. Yuen, K.F., Wang, X., Mac, F., Wong, Y.D. (2019). The determinants of customers' intention to use smart lockers for last-mile deliveries. *Journal of Retailing and Consumer Services*, vol. 49, pp. 316-326.