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26th Euro Working Group on Transportation Meeting (EWGT 2024)

End-consumer preferences for e-purchase delivery location

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Abstract

The e-commerce growth trend has great potential to influence both the nature and the dimension of the challenges policymakers will face in the near future. In this sense, the purchasing habits of the end consumer have undergone a significant change with the development of the emerging information and communication technologies that impact on the purchase behaviour and the way of receiving the item bought. The goal of the paper is thus to analyse cutting-edge last mile delivery alternatives while looking at the characteristics that determine the preferred alternative for receiving e-purchases. The identified new alternatives besides traditional mail are: crowdshipping, delivery to the car trunk, delivery by autonomous delivery robots, unattended parcel locker, attended pick up point and click-and-collect service. The paper presents the methodology for designing and delivering, as well as the findings of a survey carried out for investigating users' behaviour, after reviewing the key attributes and levels that influence end consumers in choosing how to receive their e-purchases.

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Keywords: last mile; end consumer; e-delivery alternative; e-delivery attribute; stated preference survey; city logistics.

1. Introduction

As the world continues to grow and develop, the sustainable urbanisation depends on the successful management and planning of transport systems in cities (UN, 2019). While local administrations are becoming more interested in freight mobility, cities have only recently been pressured to address the effects of urban freight movements on the sustainability and liveability of their communities. Furthermore, the United Nations has published Agenda 2030 and set 17 Sustainable Development Goals (SDG), which emphasise the direction of sustainability in urban development (Ruiz-Mallén and Heras, 2020). The SDG11 focuses on cities (*make cities and human settlements inclusive, safe, resilient, and sustainable*). In this regard, the European Commission has supported recommendations for creating plans for sustainable urban transportation and has pushed the idea of sustainable urban mobility (Lyons et al., 2024).

Referring to freight mobility, the ENCLOSE (Energy Efficiency in City Logistics Services for small and mid-sized European historic towns; Ambrosino et al., 2015) research project established recommendations for the creation and execution of sustainable urban logistics plans, utilising the SUMP methodology (Sustainable Urban Mobility Plans; SUMP, 2019).

On the other hand, with the growth of e-commerce, it has become necessary over time to look into the switching from physical stores to online platforms (Campisi et al., 2023; Meister et al., 2023). In 2020, there was an approximate 31.8% increase in online purchases (e-purchases) between the first and second quarters. Furthermore, compared to 2019, in some specific periods (e.g., black Friday), sales of physical store purchases decreased by 52.1%, while sales of online shopping increased by 21.6% (Wang et al., 2021). After 2020, end consumers worldwide started to prefer e-purchasing over physical store purchases. For example, the percentage of end consumers making purchases online for the main product categories is growing by 15% to 30% during Covid19 (McKinsey, 2020). The percentage of internet users in European countries who have made online purchases is rising annually, according to the European E-Commerce Report (Lone et al., 2023). Additionally, the growth rates of business-to-consumer (B2C) e-commerce are higher in Europe than in the rest of the world.

Therefore, urban logistics has received a great deal of attention worldwide due to the various challenges posed by the increase in freight flows in cities (Grondys, 2019), which are fuelled by ongoing changes such as the expansion of e-commerce, smaller, sprawled and more frequent deliveries (Cauwelier et al., 2023). Last mile delivery contributes around 25% of urban congestion and accounts for an average of 53% of overall delivery costs. Furthermore, empirical research has demonstrated that the average load factor of the cars employed in the last mile delivery process is between 30 and 40%, with over 20% of the vehicles running empty (Muriel et al., 2022). Besides, the failure delivery attempts continue to be a significant issue (Nogueira et al., 2024), resulting in extra cost for logistics providers, inconvenience for end customers, and a rise in the number of vehicles on the urban road (which has the potential to cause externalities such as congestion, pollution emissions, accidents, etc.). These challenges push urban transport planners and researchers to develop solutions for mitigating the negative impacts of freight transport with the aim to build more sustainable and liveable cities (Alverhed et al., 2024; Gao and Zhu, 2022). In particular, the telematics is offering new opportunities to manage and control freight flow deriving from purchases done on line (Comi et al., 2024; Comi and Hriekova, 2024).

In this context, the paper focuses on the user's behaviour in accepting/choosing the different ways to receive the e-purchases. In fact, the choice of how to receive the e-purchase impacts on the flows for delivering to the end consumers by trucks which are not always optimised. Besides, in relation to the receiving choice (e.g., unattended parcel locker), further trips by end consumers can derive, e.g., they have to go to take the e-purchase (Comi, 2021).

The rest of the paper is organised as follows. Section 2 summarises the background where the research is developed. Section 3 consists of a methodology with a strong focus on the stated preference survey, broken down into two subsections and summarises the results of the survey. Finally, in Section 4 the conclusions and the further development are drawn.

2. The background

The current literature on transport flow prediction related to e-purchase deliveries mainly refers to delivery tours from the perspective of transport operators (Anand et al., 2015). Transport demand models, which include e-commerce purchases, do not consider explicitly that end consumers can decide how to receive the purchase in different places such as Points of Interest (PoI), outside of their homes. However, the decision of end consumers about the locations to receive e-purchases has a great importance given that it impacts on the production of truck flows for delivering and possible extra private trips for taking the bought products can derive, which not always are undertaken by environment-friendly means of transport.

Since online shopping eliminates the need for separate motorised trips to physical stores, it may appear to be better for the environment overall. Conversely, adverse consequences also appear such as the decoupling of deliveries generated by single e-purchase that can make under-utilisation of the assets or failed/repeated trips (Maltese et al., 2021). These circumstances push stakeholders to investigate and provide new solutions in terms of environmental effects, business innovation, and efficiency. For this reason, the paper focusses on the end consumers' preferences for the location of the e-purchase delivery.

Pointing out specifically the logistics aspects, which largely affect the subsequent transport decisions, there is a classification of last mile delivery alternatives. The investigated alternatives can be characterised by three criteria: attendance (attended and unattended; BESTUFS, 2007; van Duin et al., 2016), automation (autonomous and non-autonomous), and level of innovation (none and experimental). “Attended” delivery or door-step delivery (i.e., where the end customer has to be available to accept delivery) is still the most common type of e-delivery method. “Unattended” deliveries are based on the concept that the presence of customers should not be necessary when making a delivery. The “automation” characteristic can be divided into two main categories: “autonomous”, where the human presence is not required in transport or at receiving stage and “non-autonomous” which typically involves humans in delivering service. The “level of innovation” criteria characteristic enables us to gauge expresses the level degree of implementation familiarity with alternatives. “None” refers to options already created and used regularly in last mile delivery by end consumers, while “experimental” denotes them experimental options at the pilot or prototype stage. The identified new alternatives besides traditional mail (TR) are: crowdshipping (CW), delivery to the car trunk (TT), delivery by autonomous delivery robots (ADR), unattended parcel locker (PL), attended pick up point and click-and-collect service (PP). Figure 1 presents the alternatives according to the above classification, excluded traditional mail.

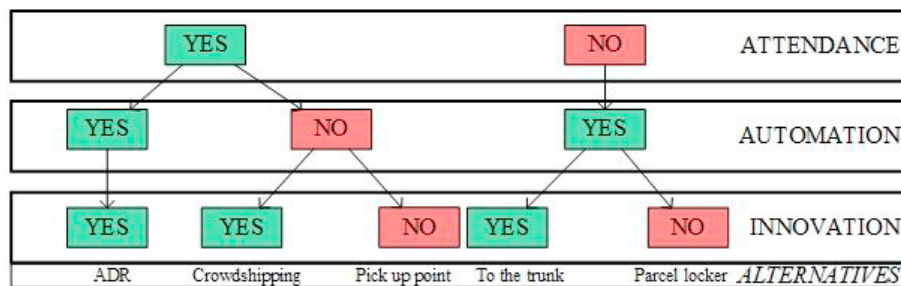


Fig. 1. Classification of alternatives.

According to these identified receiving alternatives, the literature can be classified in studies that investigate the *factors* that can guide the choice and studies that propose and apply *assessment or forecasting methodologies*.

The different studies that investigated the relevant attributes that influence the end consumers' choice identified such ones: destination location, delivery time and price, time windows in which receive the e-parcel, security level of data shared, track and tracing service, payment, flexibility and sustainability. For what concerns *destination location*, the research points out the following places (Morganti et al., 2014; Rai et al., 2020; Risberg, 2023): home or work (end consumers manually input the appropriate address - home, workplace, or point where they spend much time – PoI); not home, by walking (end consumers have to choose the appropriate address between the given. It can be a place close to the end-consumer PoI, and he/she can reach it by walking); not home, using the car (they have to choose the appropriate address between the given. It can be a place far from the end-consumer PoI, and he/she has to use the car). Some studies investigated the *delivery time* as the time spent between the initiation of purchase and the delivery of the item (Janjevic and Winkenbach, 2020; Kedia et al., 2017; Merkert et al., 2022; Risberg, 2023): 1-2 days, 3-5 days, more than 6 days. While others pointed out the *delivery price* (Maltese et al., 2021; Marcucci et al., 2024; Merkert et al., 2022; Risberg, 2023) which is strictly related to the products price. Another relevant factor that influence the end consumer's choice is the *time window* (Janjevic and Winkenbach, 2020; Maltese et al., 2021; Merkert et al., 2022; Risberg, 2023), such as the specific timeframe during which the end consumer would like to receive the e-purchase, i.e., the end consumer has the possibility of choosing the convenient time window to receive the e-purchase. The *security level* of the private data shared can influence the investigated choice (Janjevic and Winkenbach, 2020; Kedia et al., 2017; Merkert et al., 2022). Besides, the possibility to have the full knowledge of *delivery status* become significant (Belcore et al., 2024). In particular, some users would like to receive info only for main stages (for example, sent, at hub, on its way, etc.), however a significant share of users prefer to obtain info in real time (delivery position at each moment). The expectation if the item will be delivered *damaged* or not is also significant as well as the *payment* (Janjevic and Winkenbach, 2020) is required before or after receipt of the e-purchase. Finally, the *flexibility* (Rai et al., 2020), i.e., the possibility of adjusting the characteristics of delivery after the order is completed,

including while the shipment is on the way (e.g., nothing can be changed after order) or the perceived level of *sustainability* of the delivery (Janjevic and Winkenbach, 2020; Risberg, 2023), which represents the level of negative impact of externalities including noise, and other ecology related factors by vehicles.

Referring to the methodologies for the assessment of the choice, one of the approaches that researchers use to analyse the stakeholders preferences and behaviour is the stated preference (SP) experiment. The survey uses statements made by interviewees about their preferences in hypothetical scenarios. SP methods have been largely in the transport field, and relevant studies refer also to the way of receiving the e-purchases. However, the majority of the them investigated the choice between the traditional and one of the new one above recalled. Examples are those used to investigate the choice of crowdshipping (Castiglione et al., 2022; Cebeci et al., 2023; Merkert et al., 2022; Wicaksono et al., 2022) or pick up point (Masteguim and Cunha, 2022; Morganti et al., 2014; Rai et al., 2020) or parcel locker (Di Gangi et al., 2023; Dong et al., 2023; Tsai and Tiwasing, 2021). This paper focusses on the decision in which end consumers compare the different options available all together.

E-commerce, especially e-grocery, research has taken off in recent years (Belcore et al., 2024; Marcucci et al., 2024). End-consumer preferences on the basis of delivery attributes in e-purchasing do not seem to have been sufficiently researched. In particular, SP surveys have been used to estimate end-consumer decisions. As a result, the most important driver is the product price for the Norwegian grocery market. In the line with the paper, the grocery market in Shanghai (China) was analysed, where the key attributes are product price, service cost and product range (Gatta et al., 2021). On the same wavelength, (Maltese et al., 2021) analyse attributes such as product cost, transport service cost, lead time, time window and product range Italy.

Nonetheless, despite its importance for both end consumers and retailers and its diffusion, such a brief literature review allows the authors to recognise some challenges. Firstly, generally papers focus on investigating the preference between online and in-store shopping. Secondly, studies based on SP surveys point out mainly the choice between two alternatives, i.e., traditional and the new one (e.g., home delivery by traditional mail vs click-and-collect or delivery to the trunk or delivery by autonomous delivery robots). Thirdly, it is worth investigating more attributes than before. For example, the attribute payment timeframe does not seem to be investigated enough (Janjevic and Winkenbach, 2020).

3. Methodology and obtained results

According to the above three objectives, the SP survey have been designed and delivered. Besides, in order to evaluate the importance of the ten literature factors impacting the choice of how to receive the e-purchase, a short survey was carried out.

3.1. Data collection and survey design

In this research, a SP survey is used, since no innovative alternatives have been applied in European countries yet, so there are no Revealed Preference (RP) data available. Data on stated preference choices are very helpful when addressing innovations and potential changes in preferences.

Respondents were asked to select one option from each set based on their preferences once a predetermined number of sets of choices have been created. This experimental technique enables the authors to capture the decision to use alternatives.

The SP survey considers the following six labelled alternatives: traditional mail (TR), crowdshipping (CW), delivery to the trunk (TT), autonomous delivery robots (ADR), attended pick up points (PP, including click and collect service – CC) and unattended parcel locker (PL). The total number of attributes used is 10 with 2-3 level, then the possible choice scenarios are 5,184.

In line with other SP studies (Maltese et al., 2021; Marcucci et al., 2024), a two-wave efficient experimental design has been adopted to acquire data. In more detail, an efficient design was applied in the first wave, where 310 responses were performed divided into two blocks. The resulting coefficient estimates were used as input for developing a d-optimal efficient design with four blocks using the software Ngene 1.4. Blocks allow to reduce number of scenarios for single respondent.

The well-known alternative, such as traditional mail, has the characteristics that have been used as a basis for others. As most alternatives are emerging and hypothetical, traditional one has been selected as “reference” option. Besides, to avoid boring effects, the number of queries has been limited and the final version of the questionnaire is not longer than 15 minutes.

3.2. Sample and results

The 15-minutes questionnaire was carried out in some European countries, with a focus on Italy, to explore preferences for last mile delivery options. Respondents were asked about their socioeconomics characteristics, e-shopping habits and to choose among the different delivery alternatives. A tree-part questionnaire administered between May and June 2024. The survey was available in English and Italian. The first part of the questionnaire consisted of socioeconomic questions. The second part consisted of nine choice tasks in a stated choice experiment. Respondents were asked to imagine the buying online an item of 25 euros and size 40 (W) x 25 (L) x 15 (H) cm. The third part is a section to acquire knowledge about the habits of the respondents in the e-purchasing.

The survey was administered both via e-mail and face-to-face. Information was thus gathered from 106 individuals interviewed. The first part of the survey allows the authors to investigate socioeconomic characteristics of the respondents and connections between these characteristics with decisions. The demographic questions are used to identify possible latent response categories and investigate the difference in preferences among countries. The first part consists of three closed-ended questions (gender, age, level of education) and four open-ended questions (demographic information). The preliminary results represent that the 86% of the respondents are living in Italy. Almost half of the respondents are around 24-35 years old (38 %). The Figure 2 shows a sample distribution for the others age groups by gender.

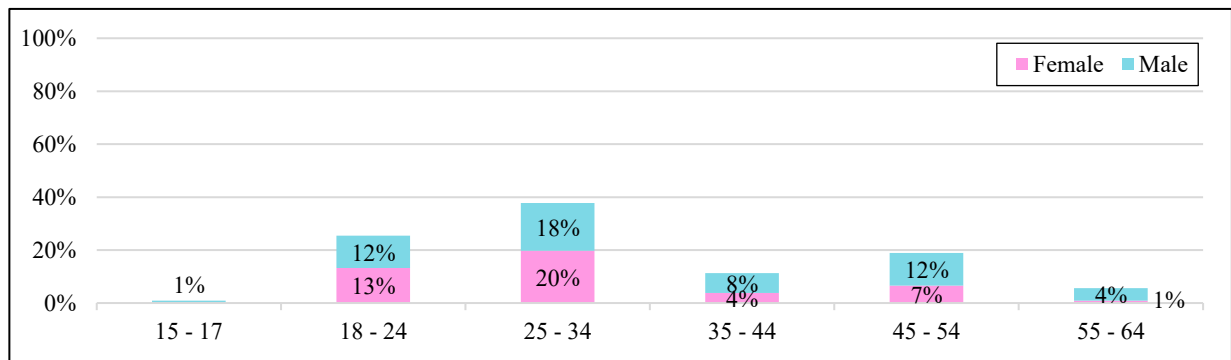


Fig. 2. Information about respondents

In terms of employment status and educational level, 36% of the respondents are full-time office workers with Master's degree or higher level of education. 40% are students (bachelor, master, PhD student). Respondents who work in an office are twice as likely as those who work at home.

The distribution of commuting journeys mode is shown in Figure 3. Young people choose public transport (PT) and the car. With increasing age, the respondents prefer to travel by car. The preferred distance for receiving the purchase is close to Point of Interest (46%) and by making an additional stop on the respondent's usual journey (33%). 6% deliberately travel to get the e-purchase. End consumers make the additional journey to receive the e-purchase. Others (15%) are always in favour of home delivery without having to make extra trips.

The five freight types analysed are: clothes and footwear, electronic devices, beauty and health products, books, furniture. Respondents were asked about their usual online purchases within these categories. The options varied between always, sometimes and rarely/never. The total number of votes for the categories is 530 (106 respondents and 5 freight types). The tree most popular categories of items bought online are electronic devices, books, clothes and footwear. Furniture, beauty and health products are the least popular categories. Furniture is usually delivered by traditional mail due to its size and price of purchase. The end consumers need consultation/advise from a professional

(e.g., pharmacist) when buying beauty and health products. This category is purchased online when the end consumer systematically takes the same product.

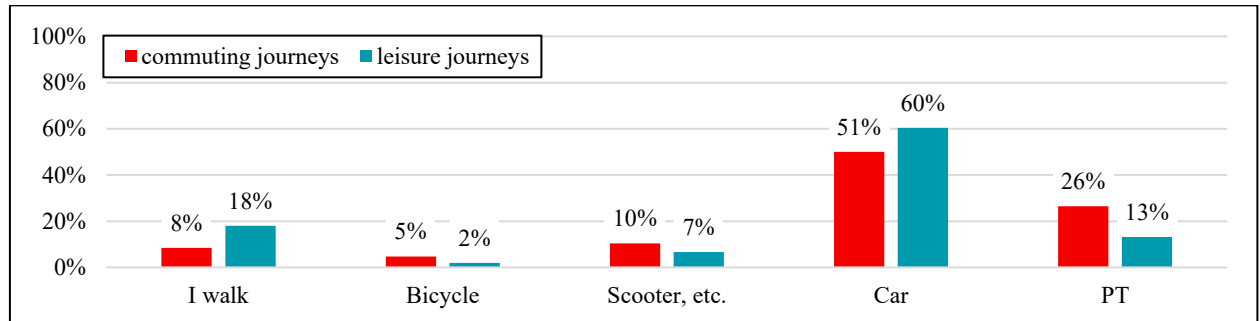


Fig. 3. Preferences of mode

It is worth to noting that the preferred period for holding the e-purchase (in the cases of PP and PL) is 1-6 days. For 40 % of the respondents, 1-2 days is enough to receive the parcel. Only 10% need more than 7 days to receive the e-item. The respondent's decisions in scenarios are 954 votes. The well-known alternatives were chosen in scenarios and ranged such as traditional mail (32.5%), unattended parcel locker (23.4%) and attended pick up point (17.0%). The preliminary results show us the high interest to the hypothetical alternatives such as crowdshipping (10.6%), delivery to the trunk (6,3%) and by autonomous delivery robots (10.2%). Figure 4 shows that male respondents prefer crowdshipping between innovative alternatives. And females would like to use autonomous delivery robots such as last mile delivery.

The existing alternatives ("none" innovation) which is unattended is a parcel locker. The innovative alternative is delivery to the car trunk (TT). Some of the respondents unexpected this option because it is just at the emerging stage, and it is difficult to imagine how it works in real life.

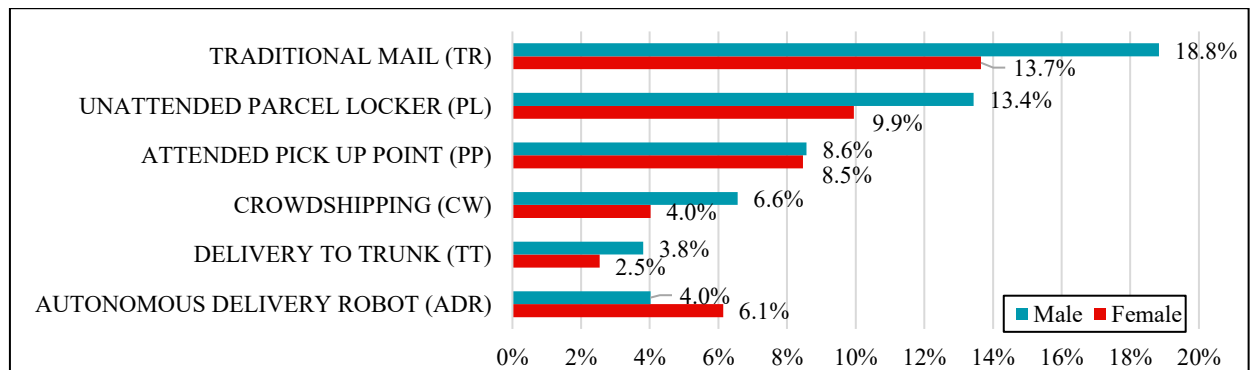


Fig. 4. End consumers preferences by gender

However, the survey also asked about the dissatisfaction of end consumers. 40% said that the main reason was the delay in delivery. According to their choices, respondents prefer TR but are open to new alternatives, especially to CW. Another significant reason is difficulty in tracking the purchase. 30% of respondents who chose this reason prefer PL and between hypothetical alternatives are ready to receive purchases delivered by ADR. Dissatisfaction such as damage of the item during the delivery process has 18% of choices. It is interesting to note that respondents preferred the ADR alternative based on the stated preference part of the questionnaire. Only 12% are satisfied and have low votes for hypothetical innovative alternatives.

4. Conclusions

E-commerce is gaining popularity worldwide. This causes some negative impacts, such as increasing number of vehicles used in last mile delivery in the cities. The urban freight transport causes numerous issues such as congestions, externalities, etc. These challenges push researchers and stakeholders develop solutions for last mile delivery. Nowadays, these solutions are focused on the improving sustainability and liveability in the cities. On the other hand, the strategies generated the numerous alternatives for the last mile delivery and end consumers have the options how to receive e-purchases.

The end consumers' preferences depend on attributes that characterised the alternatives such as destination location, delivery time, delivery price, time window, security level, track and trace service, undamaged level, payment timeframe, flexibility and sustainability.

The paper provides a novel methodological approach to investigating end-consumers preferences for e-purchase delivery location. The SP survey was conducted for investigating the hypothetical alternatives. The designing of the questionnaire based on the alternatives, attributes and their levels.

The preliminary results derive the preference between alternatives. The survey allows us to collect some significant data to investigate the preferences and analyse the main barriers. One of the main limitations of the research is the large participation of respondents live in Italy in the sample. Also, few respondents are beyond the European Union countries. Nevertheless, the analysis of end-consumers' preferences based on full sample (106 responds).

As said, sequence of statistics was presented based on data collected mainly in Italy. The development of discrete choice models able to reproduce the end consumers' choices is under development. Besides, the sample needs to be enlarged in order to improve the representativeness of the built sample, and further analysis is required in order to:

- specify and calibrate models able to reproduce the choice of the sample,
- investigate the influence of socioeconomic attributes on the choice,
- model the choice set generation within the delivery location model in order to point out the fully knowledge of the presented alternatives,
- apply the developed discrete choice models to a real case study in order to assess the effects that each receipt way can produce on city sustainability and livability.

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