Urban Freight Transport and Emerging Information and Communication Technologies: Analysing End-Consumers Decision in Receiving E-purchases

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Abstract. This paper aimed to address the need for a comprehensive review of the attributes affecting end-consumers decision behaviour to fill the gaps by deepening the knowledge on socio-economic analysis. On the other hand, the evolution of emerging information and communication technologies are strongly impacting on end-consumers' decision behaviour and in particular the choice of receiving e-purchases. The goods reach the cities to satisfy end-consumers' needs. It is relevant for any city logistics scenario assessment to have a clear understanding of the attributes that guide the shopping behaviour process.

Keywords: Customer Decision Behaviour · Last Mile Delivery · Changes · City Logistics · e-ICT · E-purchase

1 Introduction

The necessity to investigate the shifting from in physical store to online has occurred over time because e-commerce is growing [1, 2]. Online purchasing increased approximately by 31.8% from the first quarter to second quarter in 2020. In addition, during specific periods (i.e., Black Friday) online shopping sales increased by 21.6%, while in store shopping sales decreased by 52.1% compared to 2019 [3]. End consumers around the world revealed a trend toward choosing online shopping from in store after 2020. For instance, there is a 15–30% growth in end consumers who purchase online for most categories of goods [4]. According to the European e-commerce report [5] the percentage of Internet users who bought goods or services online is increasing every year in European countries (37 countries: EU-27 and 10 neighbouring digital economies). Furthermore, Europe shows higher growth rates in business-to-consumer (B2C) e-commerce. This concept is becoming significant in urban freight transport. But in B2C, there is a challenge, such as a delivery failure [6–8] and more small and frequent parcels [9, 10]. These cause more freight movements in the cities and thus more negative impact, in economic, social, and environmental terms.

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Nowadays, end consumers have more options for last mile delivery alternatives than ever before. They would like to have personalised delivery. Their decisions affect the delivery operations and, subsequently, influence the sustainability of city [11–15]. The increase in online enquiries means that delivery services, particularly last mile delivery, have to be optimised, taking into account the improved network design for urban delivery points and also the need for contactless delivery [2]. In order to improve and optimise e-commerce and delivery related services, it is necessary to analyse and define the attributes that influence the end-consumer's decision behaviour in terms of last mile delivery. Through a careful literature review, this paper has identified a number of attributes influencing last mile delivery in e-commerce on a B2C concept. In general, the main existing and emerging alternatives for end consumers to receive their purchases are quite identified. However, it is a need to identify attributes that influence e-commerce trends and last mile delivery trends.

On the other hand, emerging information and communication technologies (e-ICT) are the cutting edge of the mess all over the world. It makes processes easier, optimises the operations, reduces the number of errors and has many positive aspects. The use of technologies has not yet reached widespread use in city logistics, and they can contribute significantly in improving e-delivery operations.

This paper evaluates recent studies on end-consumers decision behaviour and seeks to answer two main research questions:

1. What are the most commonly used attributes in the literature that affect end-consumers' decision behaviour and the choice in receiving e-purchases?
2. How do the attributes related to socio-economic analysis, e-ICTs affect the changes of end-consumers' decision behaviour and the choice to receive e-purchases?

For this purpose, looking at the current literature (see Sect. 2), the majority of the research focused on a single way of receiving e-purchases investigating the performances and assessing the choice of using it with respect the traditional one. Therefore, the need a further effort in such a topic germinates. Thus, an overview of the attributes affecting end-consumer purchase decision behaviour has been established. Subsequently, given that e-ICTs are providing new opportunities and are pushing toward new shopping patterns with significant changes in urban freight transport and logistics with substantial impact on the number of vehicles achieved and traffic impact produced, how shopping decision dimensions of end consumers can change is investigated. The results of the analysis will be adhered to identify the policies and measures that can be used to improve the level of sustainability in urban areas. The results can provide a reliable assessment for planners or decision makers to understand the key attributes contributing changing end-consumers purchase decision behaviour to identify the lever on which the influence is to reach the target volume of sustainability as defined by Agenda 2030. The results obtained from this overview can also be a guideline for operators, policy makers and researchers to improve the efficiency of the delivery service in relation to end-consumer's willingness to buy and the offered e-ICT opportunities.

The paper is organised as follows. The Sect. 2 introduces the literature review on papers with purchase decision in terms of last mile delivery on and investigates the state of the art. Although Sect. 3 recognises the last mile delivery alternatives in terms of end consumers and explores attributes for each one. Section 4 discusses survey analysis for

implementing the knowledge in a real case study. Conclusions and further development are presented in Sect. 5.

2 Literature Review

The literature review allows us to understand the most current and novelty topic, which can guide researcher discussions. It is for investigating modern and innovative approaches, observing the impact over many years, and discovering if gaps exist in the study of a given research field.

This section reviews papers on the way to receive e-purchases from the perspective of end consumers. The main papers are from 2018 to 2024, in English (see Table 1). The papers mainly focus on the analysis of end consumer preferences toward choosing the last mile delivery channel and the acceptance of new last mile delivery alternatives.

According to the data in Table 1, the literature review aimed at categorising the specific papers reviewed according to the following criteria:

- the papers that presented hypothetical implementation of last mile delivery alternative (designing, column *D*). In the list, they are represented designing pick up locker (*PL*), autonomous delivery robots (*ADR*) and crowdshipping service (*CW*);
- the papers that proposed ex- or post-ante assessment (column *A*);
- the papers that used modelling frameworks to compare different alternatives with the use of attributes with different levels (column *M*);
- the papers that represented implementation of survey or interviews in a real case study in a city or country (column *RC*) in order to investigate end-consumer preferences and choices;
- the papers that focused on main actors such as end consumer (column *ec*) or other (column *other*).

It is interesting to note that papers that represented modelling (*M*) are usually based on real case studies through surveys. The focus of the literature was on end consumers, but some papers also included other stakeholders such as retailers or municipalities.

Furthermore, PL, ADR and CW are the most popular instead of others in each category. Delivery to the trunk (TT) has a lot of issues in terms of safety and security, so there are fewer papers among other alternatives. It is important to note that click and collect service (CC) has been more interesting than the attended pick up point (PP) alternative. Thus, traditional mail (TR) occurs only compared with others. In more detail, insights and characteristics of existing and hypothetical alternatives are discussed in Sect. 3.

Then, the literature review shows us the need for research into some topics that have not yet been researched or are less researched. About 30% of the reviewed papers compared alternatives to investigate preferences. Furthermore, the main recognised source of information is a small number of papers that included all the alternatives. In addition, delivery to the trunk is an innovative alternative that has only recently appeared and is beginning to be piloted to become more popular.

Table 1. The literature review of papers analysed choice behaviour in receiving e-purchases.

#	Reference	Year	Alternative	Segmentation criteria						
				D	A		M	RC	Actors	
					ex-	post-			ec	other
1	Gatta et al. [16]	2018	CW[1]		x		x	x		
2	Punel et al. [17]	2018	CW		x	x	x	x		
3	Tiwapat et al.[18]	2018	TR[2], PP[3]		x				x	x
4	Vakulenko et al. [19]	2018	PL[4]		x			x	x	
5	Wang et al. [20]	2018	PL	x			x	x	x	
6	Buldeo Rai et al. [21]	2019	TT[5], PP, CC[6], PL			x	x	x	x	
7	Le and Ukkusuri [22]	2019	TT, CW		x			x		
8	Yuen et al. [23]	2019	PL			x	x	x	x	
9	Bjerkan et al. [24]	2020	TT, PP					x	x	
10	Chung et al. [25]	2020	ADR[7]		x					
11	Jaller et al. [26]	2020	ADR				x	x	x	
12	Kapser and Abdelrahman [27]	2020	CC			x	x	x	x	
13	Milioti et al. [28]	2020	ADR			x	x	x	x	
14	Pugliese et al. [29]	2020	ADR	x	x		x			
15	Simoni et al. [30]	2020	CW	x	x		x			
16	Taniguchi et al. [31]	2020	CW, PL		x					
17	van Duin et al. [32]	2020	PL	x		x	x	x		
18	Boysen et al. [33]	2021	PL				x	x	x	
19	Cai et al. [34]	2021	CW, TT, ADR, PL		x	x			x	x
20	Chen et al. [35]	2021	CC, PL, ADR			x	x	x	x	
21	Gatta et al. [36]	2021	ADR	x			x			
22	Maltese et al. [37]	2021	CC			x	x	x	x	

(*continued*)

Table 1. (*continued*)

#	Reference	Year	Alternative	Segmentation criteria						
				D	A		M	RC	Actors	
					ex-	post-			ec	other
23	Marcucci et al. [38]	2021	TT, CC			x	x	x	x	
24	Schaefer and Figliozzi [39]	2021	CC			x		x		
25	Tang et al. [40]	2021	PL			x		x	x	
26	Tsai and Tiwasing [41]	2021	PL		x		x	x	x	
27	Wieland [42]	2021	PL		x		x	x	x	
28	Edrisi and Ganjipour [43]	2022	CC		x		x	x	x	
29	Giglio and Maio [44]	2022	ADR				x	x	x	
30	Merkert et al. [45]	2022	CW			x	x	x	x	
31	Polydoropoulou et al. [46]	2022	TT, ADR			x	x	x	x	
32	Risberg [47]	2022	TR, CC		x				x	x
33	Cebeci et al. [48]	2023	CW			x	x	x	x	
34	Dong et al. [49]	2023	PL	x		x		x		
35	Garg et al. [50]	2023	ADR		x					
36	Koh et al. [51]	2023	ADR				x	x	x	
37	Mohri et al.[52]	2023	CW		x					
38	Ranjbari et al. [53]	2023	PL		x					
39	Wang et al. [54]	2023	TT, PL, PP, CC				x	x	x	
40	Alverhed et al. [55]	2024	ADR		x	x				
Results										
			CW	1	7	4	5	5		
			TR		2					
			PP		1	1	1	3		
			PL	3	6	7	9	12		

(*continued*)

Table 1. (*continued*)

#	Reference	Year	Alternative	Segmentation criteria						
				D	A		M	RC	Actors	
					ex-	post-			ec	other
			TT		1	4	3	6		
			CC		2	6	6	7		
			ADR	2	5	6	7	6		

CW[1] *– crowdshipping; TR*[2] *– traditional mail; PP*[3] *– attended pick up point; PL*[4] *– pick up locker; TT*[5] *– delivery to trunk; CC*[6] *– click & collect ADR;*[7] *– autonomous delivery robots*

3 The Alternatives for Receiving E-purchases

The following section introduces last mile delivery alternatives. The literature review allows us to identify attended and unattended alternatives as well as if the end consumers need to undertake a further activity (e.g., a further trip or stop along his/her usual commuter travel) by her/himself for obtaining the e-purchase (self-pick up *vs* not self-pick up). Besides, in the choice of the way of receiving the e-purchases, the end consumers can only decide the location putting the preferable addresses or/and the mode (e.g., crowdshipping and ADR). Such a possible classification is plotted in Fig. 1.

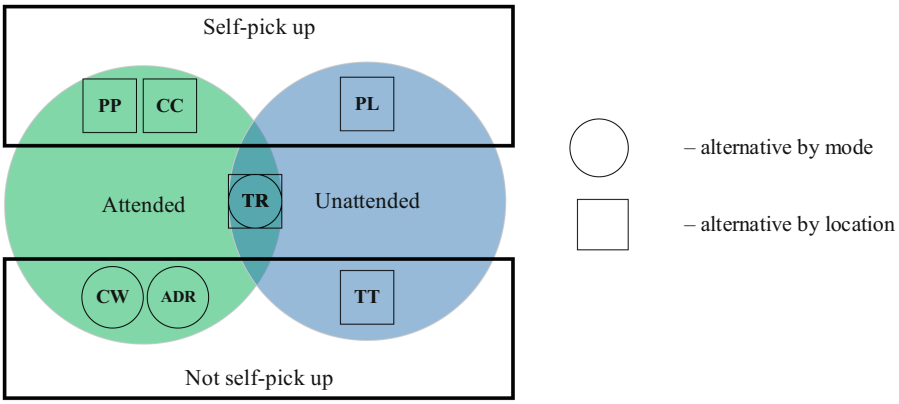

Fig. 1. Last mile delivery alternatives on the end consumer side.

3.1 Traditional Mail

It is a well-known concept that can be either attended or unattended. The alternative for delivering e-parcels to end consumers represents a company that provides last mile delivery services. The process is under the control from the sender's point to the end

consumer. The couriers and drivers are professionals and are responsible for the safety and security of the e-parcel. Usually, this alternative is more expensive and could provide auxiliary services such as delivery within a few hours, track and trace service, notifications, changeable address and time window.

Thus, traditional mail for end consumers is an alternative represents both in location and mode. The attributes were investigated including payment, lead time, time window and delivery price. Additional attributes are environmental impact, safety and security and reliability.

3.2 Delivery to the Trunk

The alternative delivery to the trunk has a location criterion. It is unattended by the end consumer. Access to the car trunk could be shared with the provider. Through a mobile application, it is possible to know the accurate location and time window for delivery. This is a novel alternative and nowadays carriers combine traditional mode and delivery to the trunk.

The attributes for delivery to the trunk are delivery time, time window and delivery price. Also, additional attributes such as safety and security make sense. When it comes to sharing access to one's own car, it is not just a matter of security for the e-parcel, but also for the belongings in the car.

3.3 Autonomous Delivery Robots (ADR)

The paper uses the term ADR for aerial delivery drones, sidewalk robots and droids (all existing autonomous delivery robots). The common characteristic for them now is attended delivery by end consumers. The ADR replaces the courier in last mile delivery service. They have a limited capacity, limited speed and restrictions. Today, it is a hypothetical alternative, although some real experiments are ongoing.

ADR has the following attributes: delivery time, time window and delivery price. Additional attributes are following environmental impact, safety and security, reliability and auxiliary services such as track and trace, notifications, changeable address and time window.

3.4 Crowdshipping

One of the ways to achieve a more sustainable city is a concept of collaboration. In addition, cities have a crowded flow of people with a concentration at Points of Interest (PoI). Crowdshipping is a service that includes drivers or non-professional couriers responding to the end consumer requests and can share the underused or unused capacity of their vehicles or themselves. Crowdshipping represents a mode for last mile delivery. It is an attended alternative by the end consumer. The website platform or mobile application that attracts freelance driver-partners. The attributes for crowdshipping are delivery time, time window and delivery price.

The challenge is the security of the information and the safety of the purchase. The respondent is someone who agreed to become a courier per the request. Thus, additional attributes are safety and security, also environmental impact and reliability. Auxiliary services such as track and trace, changeability and update notification are recognised.

3.5 Attended Pick Up Point

Self-pick up is an alternative represented by a location. The pick-up point is an attended alternative. It usually takes place in shops, cafes or at the post office. Pick up point has opening hours and is usually closed on weekends. It is a place that the end consumer can choose in a convenient area. The concept is a network that covers the city with high density. The attributes for this alternative are payment method, location, delivery time, time window and delivery price. Additional attributes include environmental impact, safety and security, reliability, and auxiliary services such as track and trace, notifications, changeable location and time window.

3.6 Click & Collect

The sub-alternative of the attended pick up point is a click & collect (i.e., "click & pick", "Research online, buy offline", "Buy online, pick up in store" or "Buy online, return offline" in the case of returns). The concept from the end consumer side is to buy online. Thus, this alternative was also emphasised because it involves restocking from the retailer's point of view. End consumers receive the e-purchase by self-picking up in the appropriate shop. The difference between an attended pick up point and "click & collect" is that the second has a shop network. It means like "booking" the item to ensure the availability and price of the e-purchase. The attributes are the same as for the attended pick up point.

3.7 Pick Up Locker

A well-known location alternative is a pick-up locker (i.e., automated parcel station). It is a storage medium used to facilitate the transfer of orders placed online for collection at a physical retail location. The locker can only be opened with the appropriate parcel locker key. The "boxes" form the networks of private companies. It is autonomous and available 24 h a day.

The unattended alternative has attributes such as location of delivery, delivery time, delivery price, and excluded time window. Pick up locker has additional attributes such as environmental impact, safety and security, reliability, and auxiliary services such as track and trace, notifications, changeable location and time window.

4 Survey Analysis

Section 3 has shown modern and innovative alternatives for last mile delivery. In addition, end consumers have leverage on delivery alternatives through their preferences. Thus, one important step is providing a socio-economic analysis of the study area to recognise the preferences according to end-consumer characteristics. Crocco et al. [56] findings show that socio-economic factors, consumer attitudes, and shopping mode characteristics influence the end-consumers' purchase decision behaviour.

The literature review allows us to investigate the main socio-economic characteristics that are helpful for visualising preferences in last mile delivery services. The research

by Comi and Nuzzolo [57] demonstrates that demographic and socio-economic changes can be a major factor in determining transport costs and related environmental impact.

The important characteristics of the respondent are age, income, family dimension and lifestyle, which influence preferences in last mile delivery. For example, young people are more familiarised with emerging technologies and are open to using them. In addition, they buy online more than others [58]. However students purchase less than other types of employees (about 1 purchase per week) [59]. In fact, empirical studies have indicated that males, the more highly educated, and people in the higher-income groups are more likely to buy online than females, the less well-educated, and lower-income groups [60, 61]. Srinivasan and Bhat [62] focused on overall shopping trip generation and report that females, people on high incomes, older people and households with children tend to engage in shopping more often than males, people on low incomes, younger people and households without children. According to employment status, Comi and Nuzzolo [58] showed that housewives undertake more trips than those in other types of employment, while young people travel less than older people.

Therefore, the survey allows us to analyse the socio-economic characteristics of end consumers. Then, it is possible to split them into different groups according to demographic affiliation, socio-economic status, some habits (such as purchase frequency) and familiarity with new technologies, etc.

Based on such literature findings, a survey was carried out in Italy in the first months of 2023. For the actual data collection, an online questionnaire was launched with 310 respondents. The survey consisted of a first part aiming to obtain socio-economic data and personal habits in shopping on line. Therefore, the stated preference part was proposed in order to reveal the possible choice behaviour in hypothetical scenarios.

4.1 Socio-Economic and Demographic Analysis

For the socio-economic analysis, answers were chosen such as: gender, age, current employment status, demographic affiliation, members of the family unit and level of education. In addition, preferences of transport mode were considered.

The respondents were almost equally divided by *gender*. Women make up 45% and men 55%. Most of the respondents said they were between 18 and 34 years of age (68%). Based on the existing survey experience, it is important to analyse the *current employment status* of end consumers. Thus, students represent 37% of respondents and full-time employees are 38%. End consumers in these categories are dependent on schedules and time windows. Predictably, the main attribute for full-time employees is a time window of delivery such as lunchtime or after working hours.

The *demographic affiliation* is as follows: 35% live in southern Italy, mainly in cities located in Calabria and Puglia, 50% live in central Italy, mainly in Rome and, finally, the remaining part (15%) live in regions of northern Italy. It will be used to analyse the existing last mile delivery system and the preferences of end consumers based on affiliation.

Looking more closely at *the members of the family unit*, it can be seen that 50% of answered families are made up of four members, while around 75% of people say that they belong to families in which at least two members are adults.

Regarding *the educational level* of the respondents, only 4% currently qualify higher than a master's degree, a qualification held by 38% of the respondents. Of the rest, 33% have a three-year degree (Bachelor's degree) and 26% have not yet completed high school.

Turning now to the travel habits of the respondents, it should be noted that around 80% of people have only a B driving licence, which allows them to drive all cars and certain types of motorbikes. When analysing end-consumers travel habits, 72% of respondents use their own car as a *preferred mode of transport*, followed by walking (preferred by 12% of respondents), public transport (7%) and motorcycle (5%).

4.2 Statistical-Descriptive Analysis: End-Consumers Decision Behaviour

In this section, 25 questions explore online purchasing behaviour for durable goods. It provides an overview on the data collected and allow to identify drivers of shopping behaviours. In particular, it examines the frequency of e-purchases, the delivery channel chosen and the preferred time window for the receipt of e-purchases. Answers to questions about the motivation for buying online and the most important attributes, when choosing the last mile delivery channel help to analyse end-consumers' preferences in more detail.

This section also analyses purchases made in the week before the survey. It provides real-time information on the behaviour and preferences of respondents' decisions about last mile delivery. The types of products purchased online, and the level of resilience was examined. These data help identify current trends and evaluate the effectiveness of last mile delivery strategies.

The result obtained was an assessment of the *frequency of e-purchasing* durable products. Durable goods include electronics, stationery, clothing and footwear, and household products such as crockery and vases. Products in the category 'durable goods with at least weekly replacement' are excluded, for example, tinned food. In terms of frequency of purchase, there is an almost even distribution of respondents who purchase on average several times a week (31%), once a week (23%) and less than once a week, but at least once a month (35%).

Each respondent is also asked to indicate the main *categories of products* they buy online. According to this, 84% of those questioned said that they mainly go online to buy clothes or shoes. This is followed by electronic goods, which are among the main items purchased online by 56% of the respondents, and the last category with a significant percentage of preference (44%) is household products.

Motivation to buy online rather than in a physical store. 44% of people buy online because it is more convenient. This is justified by the fact that it is apparently possible to buy online 24 h a day, unlike in a store. Other reasons include greater economic convenience (cited by 24% of the sample), a wider range of products (18%) and time savings (13%).

Last mile delivery *alternatives* such as home delivery (or workplace), pick up locker, pick up point and others were analysed. Respondents preferred home delivery (57%). The most used alternative to home delivery so far is delivery to a locker point (e.g., pick up locker at the railway station; 35%).

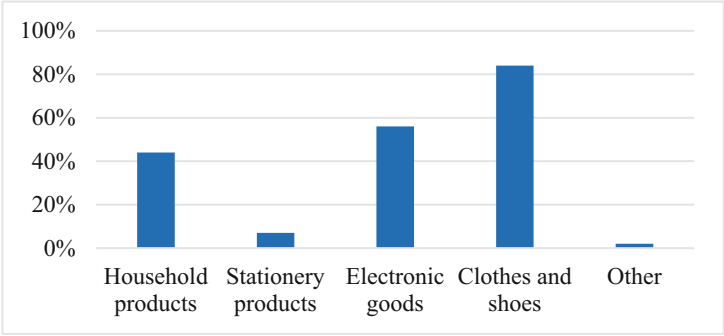

Fig. 2. Main categories of products to purchase.

The preferred *time window* is also one of the questions, too. The most convenient time window is between 14.00 and 16.00 when many workers have their lunch break and students return home (41%). Another time window is between 18.00 and 20.00, the time when the working day ends for most people, especially full-time employees.

Respondents were asked to identify the most *important attributes* that influence their purchase decision of the last mile delivery channel. Almost all respondents mentioned delivery time and price. Other attributes considered important by around 40% of respondents are delivery flexibility, i.e., the ability to choose a specific delivery day or time window or to receive the e-purchase at a pick-up point or locker. In addition, the security of the e-parcel is an important attribute for end consumers (traceability, confirmation signatures, or insurance).

The additional question aimed at understanding the maximum price a person is *willing to pay* to receive a parcel with standard dimensions, for example, 36 × 23 × 12 cm. 46% of the respondents are prepared to pay more than 5 euros, but no more than 10% of the price of the e-purchase. The other half say that they are not prepared to pay more than 5 euros, regardless of the price of the purchase.

Within the questionnaire, the sample is asked to select the main reasons for dissatisfaction arising from the choice of the last mile delivery channel. *Resilience* was analysed through this question. 84% of the sample cites late delivery as the main reason for dissatisfaction. The other main reason for dissatisfaction is difficulty in tracking (cited by 62%), while damage, loss of product and other reasons are only cited by a minority of the sample.

4.3 Previous Week's End-Consumers Decision Behaviour

As mentioned above, part of the questionnaire is dedicated to collecting information on the previous week's purchasing behaviour. Consequently, only 25% of respondents had not made any online purchases in the seven days before completing the questionnaire. On a more detailed level, 54% had made only one purchase and 21% had two or more.

As reported (Sect. 4.2), this is also reflected in the specific case of the last seven days, i.e. the *main type of product* purchased online in the last week is clothing and footwear, followed by electronic goods and household products.

Referring to the last order placed online, 42% of the sample said they had used an express *last mile delivery service*, such as Amazon Prime, which guarantees delivery within 2 days. 32% say they have used delivery to a pick-up locker, such as Amazon Locker. A residual share was recorded for other delivery channels. In addition, the preferred distance to receive e-purchases by self-pick up is closest to the home or workplace.

Particular attention is also paid to returns, as the majority of people (72%) declare the *returns policy* to be very influential on the choice of an online purchase. 85% of the sample report having made at least one return in their lifetime. If we look more closely at the last six months, we see that the percentage of people who have made a return in this period falls to 48%, a sign that the frequency of returns is not excessive. Around 70% of the respondents would prefer a home collection service rather than delivery to a specific physical location when making a return. The main barriers to returning e-purchases are waiting times for refunds or replacements (53%), the complexity of the returns process (26%) and the additional cost of returns (8%).

A cross-analysis between the age of the respondents and the preference for *last mile delivery channel* shows that as the age of the respondents decreases, the percentage of respondents in each age group who prefer to receive the e-purchases in a pick-up locker rather than at home increases. For example, 67% of respondents aged between 14 and 17 choose a pick-up locker as their last mile delivery alternative, whereas the percentage is very different for respondents aged 45 and over, with an average of 14%. Obviously, the opposite behaviour is found among respondents who prefer delivery to their home. This solution is most often chosen by over-65s (79%) and least often by the under-17s (33%). The graph below shows that there is a clear difference in choice between the under-34s, with an average of 44%, and the over-34s, with an average of 72%.

In terms of delivery *time window* preference, similar behaviours are found regardless of current employment status. What was said earlier (Sect. 4.1) for the sample in general applies specifically to students, employees, and retirees, with peaks of preference declared between 14.00 and 16.00 and between 18.00 and 20.00 (see below, Fig. 2).

The survey also showed how the motivation to buy online versus in-store is linked to current employment status. 62% of students say their main reason for shopping online is to save time and avoid travelling, while the majority of employees (77%) say that their main reason is to save time and money. Retired respondents who shop online say they do so mainly to save money and avoid travelling (73%) (Fig. 3).

Based on existing and hypothetical last mile delivery alternatives and done socio-economic analysis, the stated preference survey is most appropriate for investigating end-consumer preferences.

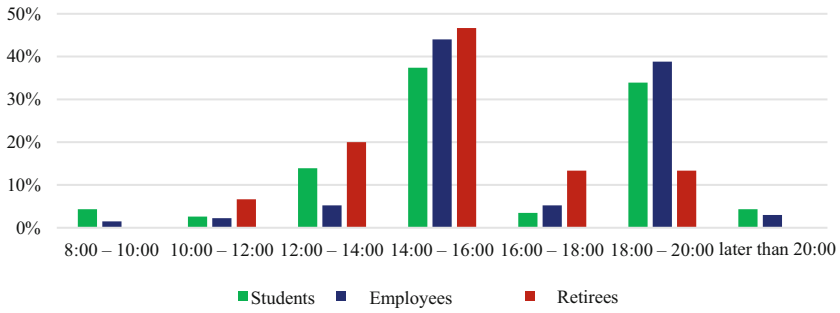

Fig. 3. Preferred delivery window in relation to current employment status.

5 Conclusions and Further Development

Nowadays, end consumers have more alternatives for receiving e-purchases than in the past. The paper provides a review of the literature on last mile delivery services and presents the results of a survey carried out in Italy. It provides valuable knowledge, useful for supporting both private and public sectors to reshape and optimise their last mile delivery services.

The growth of e-commerce and the business-to-consumer concept is having a strong impact on the changing behaviour of end consumers. It encourages service providers and researchers to identify emerging alternatives and key attributes of end-consumer preferences. Thus, the last mile delivery should be reshaped for optimising, including the existing and new services.

The literature review allowed us to emphasise existing alternatives such as traditional mail, attended pick up point and click and collect service, pick up locker, and modern alternatives such as delivery to the trunk, using autonomous delivery robots and crowd-shipping. In addition, the most commonly used attributes were investigated according to the literature affecting end-consumers' choice of receiving e-purchases. The main attributes are delivery time and price. Attributes such as payment method, lead time, time window and delivery price were investigated. Additional attributes are environmental impact, safety and security and reliability. Auxiliary services can also be track and trace service, notifications, changeable location and time window. The attributes were discussed in more detail in Sect. 3.

The attributes were investigated that related to socio-economic analysis and emerging information and communication technologies and affect the changes in end-consumers behaviour; and choice in receiving e-purchases. One of them is the preferred time window in terms of current employment status. The most convenient time window is between 14.00 and 16.00 when many employees have their lunch break and students return home (41% of the students' respondents preferred this time window). Another time window is between 18.00 and 20.00, the time when the working day ends for most people, especially full-time employees. The motivation to buy online is also linked to the current employment status. 62% of students say their main reason for shopping online is to save time and avoid travel, while the majority of employees (77%) say that their main reason is

to save time and money. Retired people who shop online say their main reason for doing so is to save money and avoid travelling (73%). A more detailed response is discussed in Sect. 4.

As mentioned above, end consumers are decision makers and their requests influence directly on existing and future last mile delivery alternatives. This is because the further step might be a stated preference survey, with the aim of investigating end-consumers preferences for last mile delivery alternatives. This paper has discussed the attributes, but the levels also need to be emphasised, which one the input for the design of the stated preference survey.

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